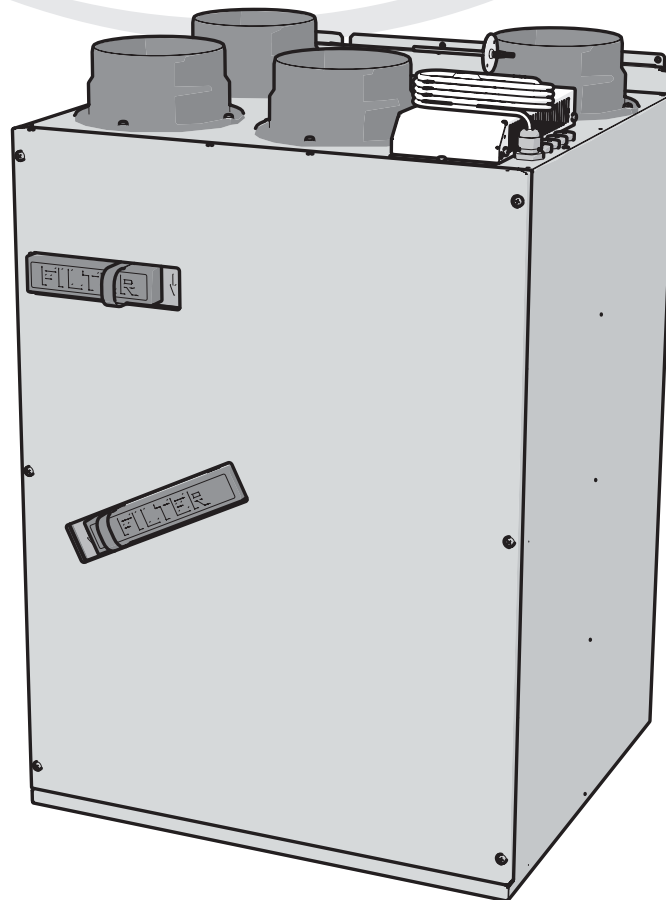


AHU WITH HEAT RECOVERY

# Smarty 4X V



User's and service technical manual

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Symbols



Warning – pay attention

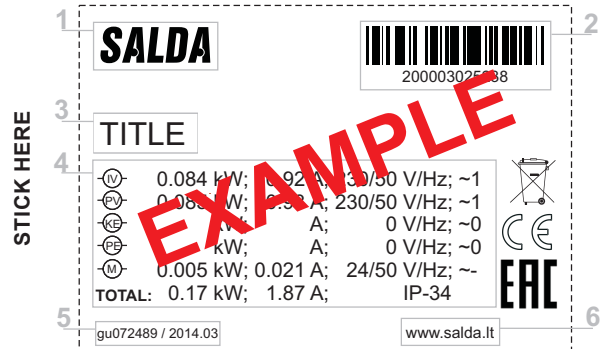


Additional information

Marking

Stick the auxiliary label on the unit (on an easily accessible place) or on the dashed place of a technical manual in order to keep the important information about the unit.

- 1 – Logo
- 2 – Internal usage code
- 3 – Brand name
- 4 – Technical data
- 5 – Units number
- 6 – Web address



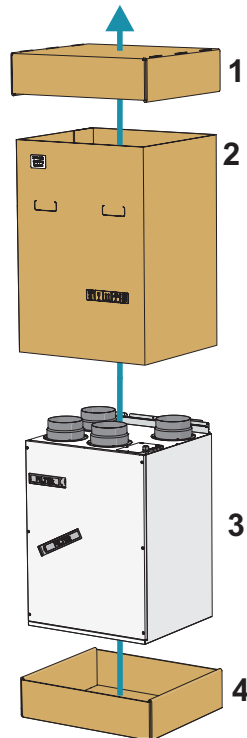
Transportation and storage

- All units are packed in the factory to withstand regular conditions of transportation.
- Upon unpacking, check the unit for any damages caused during transportation. It is forbidden to install damaged units!!!
- The package is only for protection purpose!
- While unloading and storing the units, use suitable lifting equipment to avoid damages and injuries. Do not lift units by holding on power supply cables, connection boxes, air extract or exhaust flanges. Avoid hits and shock overloads. Before installation units must be stored in a dry room with the relative air humidity not exceeding 70% (at +20 °C) and with the average ambient temperature ranging between +5 °C and +30 °C. The place of storage must be protected against dirt and water.
- The units must be transported to the storage or installation site using forklifts.
- The storage is not recommended for a period longer than one year. In case of storage longer than one year, before the installation it is necessary to verify whether the bearings of fans and motor rotate easily (turn the impeller by hand) and if the electric circuit insulation is not damaged or the moisture is accumulated.



Preparation for transportation

## Unpacking



## Standard package of components

Standard package (without optional accessories) includes:

1. Key - 1 pc.
2. Sealing tape FIX-PV 6x20
3. Suspension bracket - 1 pc.
4. Condensate outlet pipe G3/8 - 1 pc.

## Safety precautions

- Do not use the unit for purposes other than its' intended.
- Do not disassemble or modify the unit in any way which may lead to mechanical failure or injury.
- Use special clothing and be careful while performing maintenance and repair jobs – the unit's and its components' edges may be sharp and cutting.
- Do not wear loose clothing that could be entangled in to operating unit.
- Do not place fingers or other foreign objects through inlet or exhaust guards or into connected duct. If a foreign object enters the unit, immediately disconnect power source. Before removing object, make sure that any mechanical motion has stopped, the heater has cooled down and the restart is not possible.
- Do not connect to any other power source than indicated on the model label.
- Do not place or operate unit on unsteady surfaces and mounting frames.
- Mount the unit firmly to ensure safe operating.
- Never use this unit in any explosive or aggressive elements containing environment.
- Do not use the unit if external connections are broken or damaged. If there are any defects, stop operating the unit and replace the damaged parts immediately. That can be performed only by qualified electrician.
- Do not use water or another liquid to clean electrical parts or connections.
- If you notice water on electrical parts or connections, stop operating the unit.

## Description

Smarty 4X V are residential air handling unit with a high efficiency (up to 90 %) counter flow heat exchanger. The unit provides ventilation in the home and takes the heat from the exhausted air. AHU complies with ErP 2018 and Passivhaus requirements. The unit is operated by a separate remote control panel or through separate MB-Gateway by PC. Remote control panel and MB-Gateway are optional and not included in standard package. Control functions depend on selected control board type: MiniMCB or MiniMCB basic. Smarty 4X V operates within the limits of the airflow diagrams and is suitable for indoor operation only. Required ambient temperatures must be from +5 °C to +40 °C. For the cold climate zones (air temperatures below -5 °C), integrated or optional pre-heater is required.

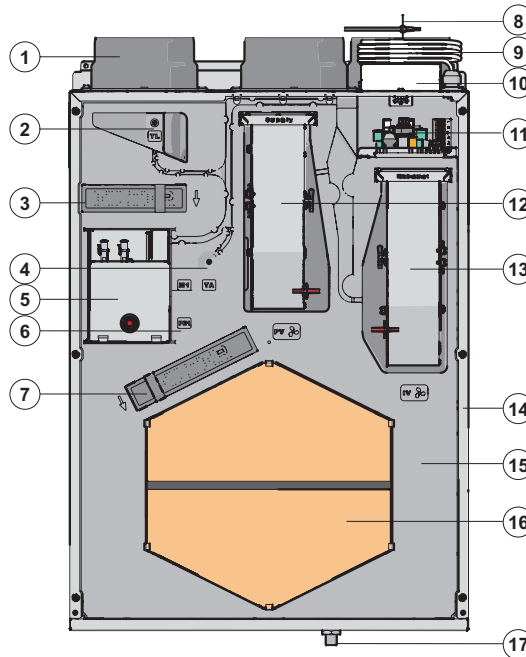
Smarty 4X V are available in three versions:

Product name	Control board	Type	Heat recovery	Temperature control	Bypass damper	Pressure sensor (filter pollution monitoring)	Integrated pre-heater	Optional heating elements	
								*- only pre-heater or heater	
								Duct based Air Pre-Heater	Duct based Air Heater
Smarty 4X V 1.1	Mini MCB	Premium	+	+	+	+	+	-	+
Smarty 4X V 1.2	Mini MCB Basic	Advanced	+	+	+	-	-	+*	



Not suitable for swimming pools, saunas and other similar facilities.

Components



- |  |                             |
|--|-----------------------------|
| 1. Flange 4 pcs.   | 12. Supply air fan (PV)*    |
| 2. Outdoor air temperature sensor (TL)                       | 13. Exhaust air fan (IV)*   |
| 3. Outdoor air filter (G4/(F7 - optional)) and the EPP cover | 14. Galvanized steel casing |
| 4. Extract air sensor (TA)*                                  | 15. EPP casing              |
| 5. Bypass damper (M1)*                                       | 16. Heat exchanger          |
| 6. Preheater (PE1)*  | 17. Condensate tube plugs   |
| 7. Extract air filter (G4) and the EPP cover*                |                             |
| 8. Supply air sensor   |                             |
| 9. CE7/7 power supply cable - 3 m.                           |                             |
| 10. Switching Power Supply                                   |                             |
| 11. Control board.   |                             |

\* Depends on unit type.

Operating conditions

- Unit is designed to operate only indoors.
- It is forbidden to use the unit in potentially explosive environment.
- Unit is designed to supply/extract only clean air (free of chemical compounds causing metal corrosion, of substances aggressive to zinc, plastic and rubber, and of particles of solid, adhesive and fibred materials).

Outdoor	- temperature min./max.	[°C]	-5/ +40* -11 / +40** -30 / +40***
	- humidity	[%]	90

Extract	- temperature min./max.*	[°C]	+15 / +40
	- humidity	[%]	60

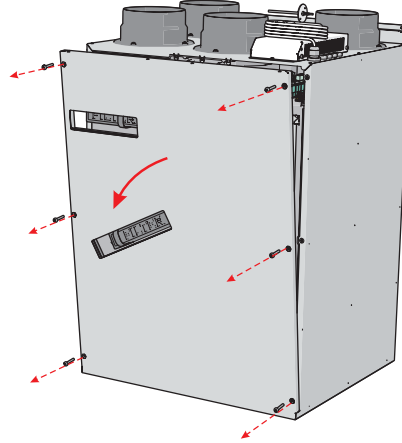
\* - Outdoor air temperature without preheater (Salda Antifrost off)  
 \*\* - with integrated preheater (Smarty 4XV 1.1) or Smarty 4XV 1.2 (Salda Antifrost on)  
 \*\*\* - with optional preheater on duct  
 Salda Antifrost uses dis-balancing of the air flow and it may cause negative pressure in premises.

## Maintenance

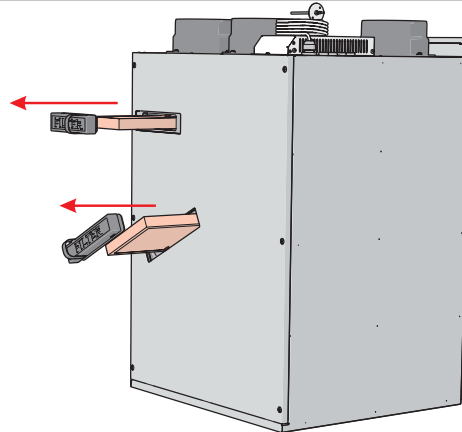


Unplug unit from mains before opening the door (disconnect the power plug from the outlet or if there is a two-pole automatic circuit breaker installed – disconnect it as well. It is necessary to ensure that it won't be turned on by third parties) and wait until the full stop of the fans (for about 2 min.).

## Cover opening



## Filters maintenance



**Removing Smarty 4X V filters:** opening filter cover (pulling the strap), retractable filter. Uses G4 / (F7 - optional) filters. Dirty filters increase air resistance, airflow into the room.



**Changing filters, filters reload timer control.** Description of remote control panel functions is provided in the remote control panel technical documentation or on the website [www.salda.it](http://www.salda.it).  
**Allowed to operate the unit without filters!**



**It is advisable to change the filters every 3 - for 4 months, or according to their testimony timer remote control.**

## Fans maintenance

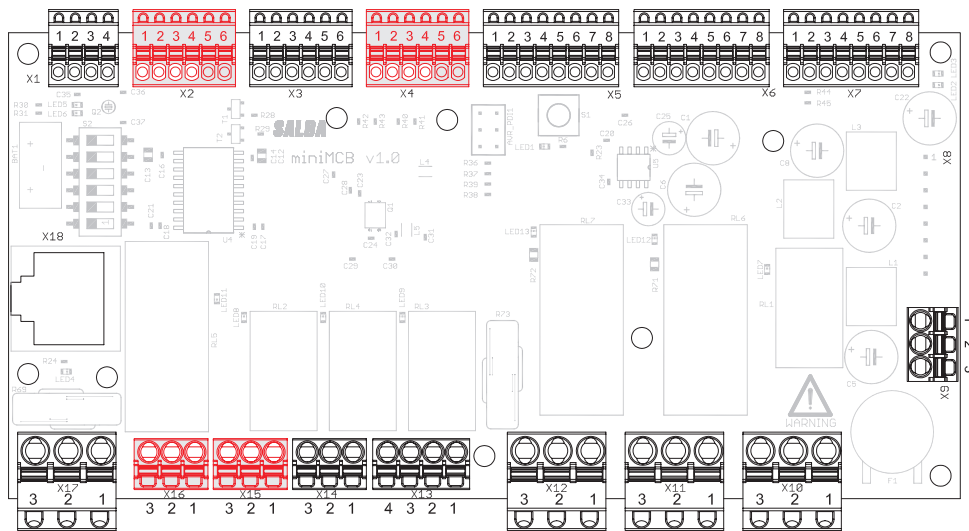
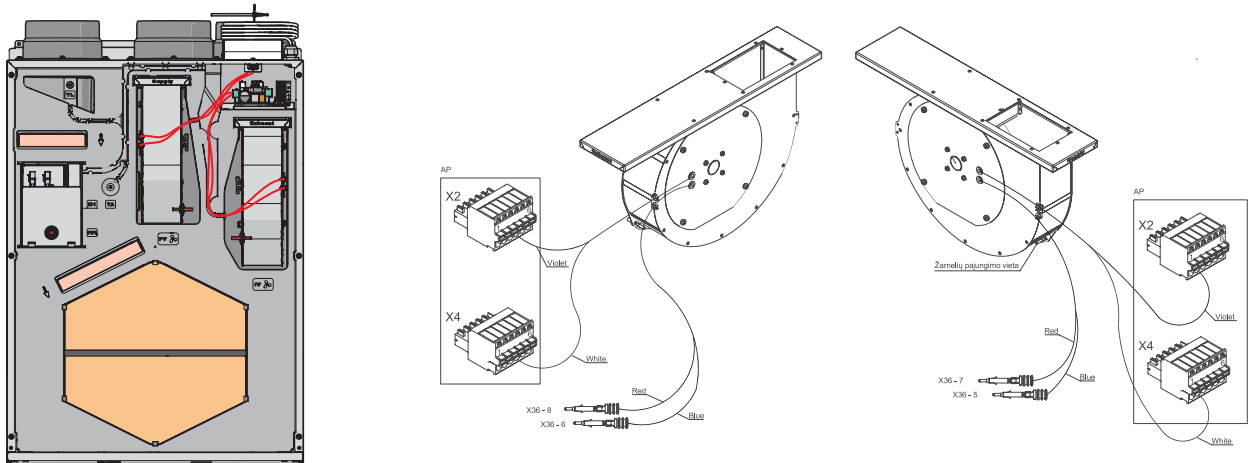
- Maintenance should be performed only by experienced and trained staff.
- The fan should be inspected and cleaned at least once a year.
- Be sure the fan is disconnected from power source before performing any maintenance or repair.
- Observe staff safety regulations during maintenance and repair.
- The motor is of heavy duty ball bearing construction. The motor is completely sealed and requires no lubrication. Supplied air fan from X2, X4. Extract air fan from X2, X4.
- Detach fan from the unit.
- Impeller should be specially checked for built-up material or dirt which may cause an imbalance. Excessive imbalance can lead to accelerated wear on motor bearings and vibration.
- Clean impeller and inside housing with mild detergent, water and damp, soft cloth.
- Do not use high pressure cleaner, abrasives, sharp instruments or caustic solvents that may scratch or damage housing and impeller.
- Do not plunge the motor into any fluid while cleaning impeller.
- Make sure, that impeller's balance weights are not moved.
- Make sure the impeller is not hindered.
- Mount the fan back into the unit. Connect the fan to power supply source.

- If after maintenance the fan does not start or stop itself, contact the producer. Malfunction of the fan can be identified according to the pressure in the system (when pressure switches are connected). When there is a fault in fans' motor, any separate notice is shown on the control panel.

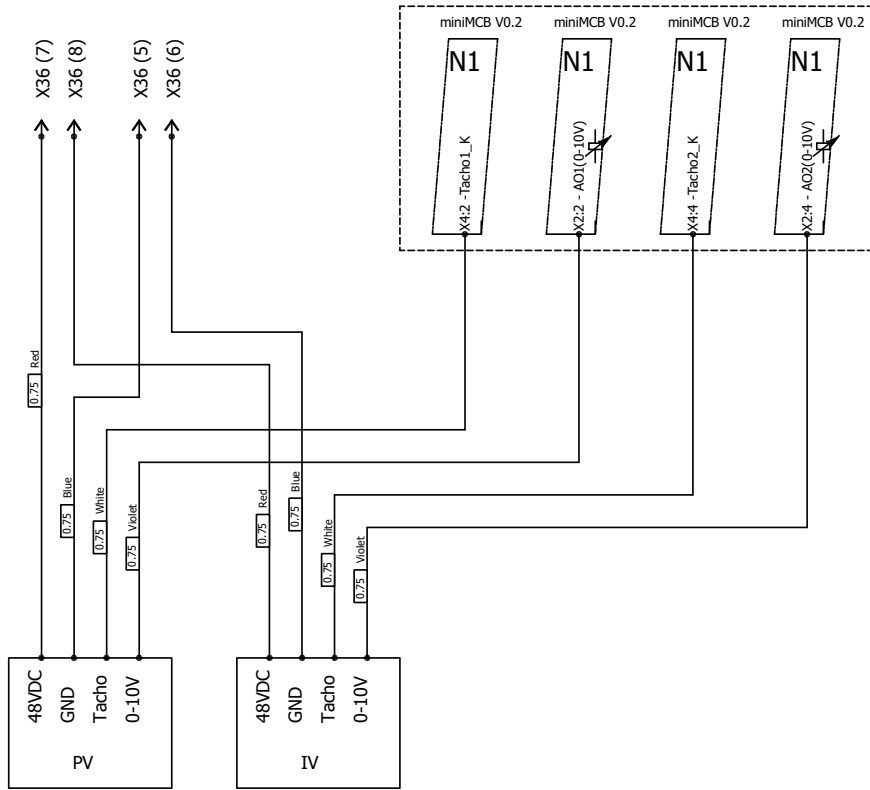


**Be sure the unit is disconnected from power source before performing any maintenance or repair.**

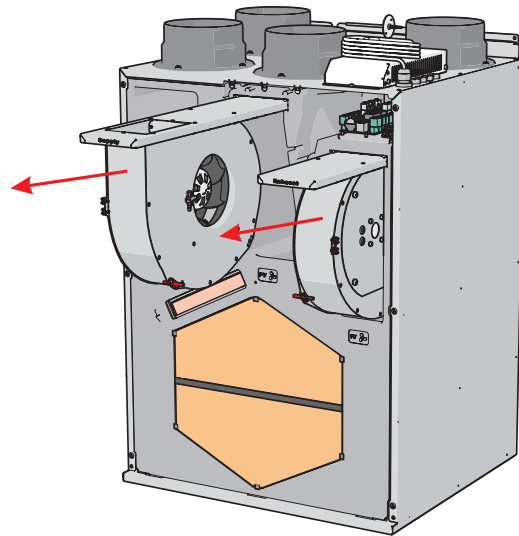
Unplug fan control connector from the control board. Connectors are the same for the both fans – X2, X4. Disconnect fan power supply by pulling X36 connector out from the power source (see el. scheme below). Unscrew one screw from protection plate of the power source and disconnecting connector X36.





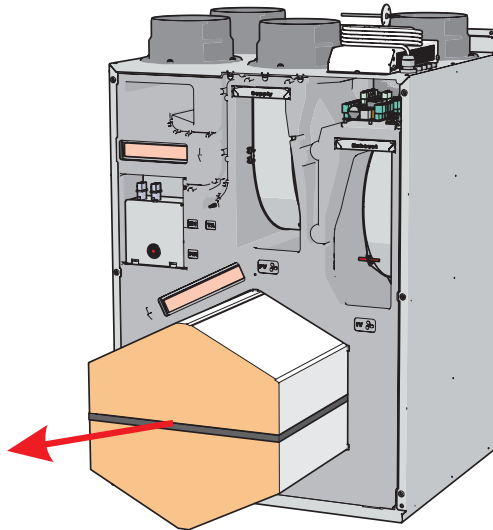


BK	BN	GY	WH	BU	RD	GN/YE
Black	Brown	Grey	White	Blue	Red	Green/Yellow



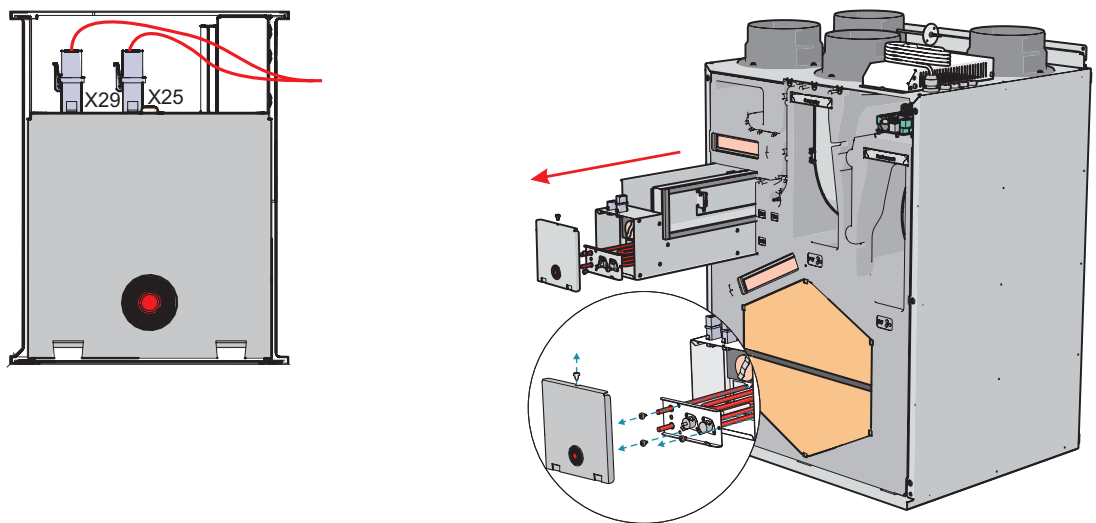
### Heat exchanger maintenance

- Proceed to maintenance and repair after any rotation in the fan stopped.
- Clean the heat exchanger once a year.
- Firstly take out heat exchanger cassette carefully. Submerge it into a bath and wash with warm soapy water (do not use soda). Then rinse it with weak hot water stream (too strong stream can fold the plates). Place back the heat exchanger only when it is completely dry.



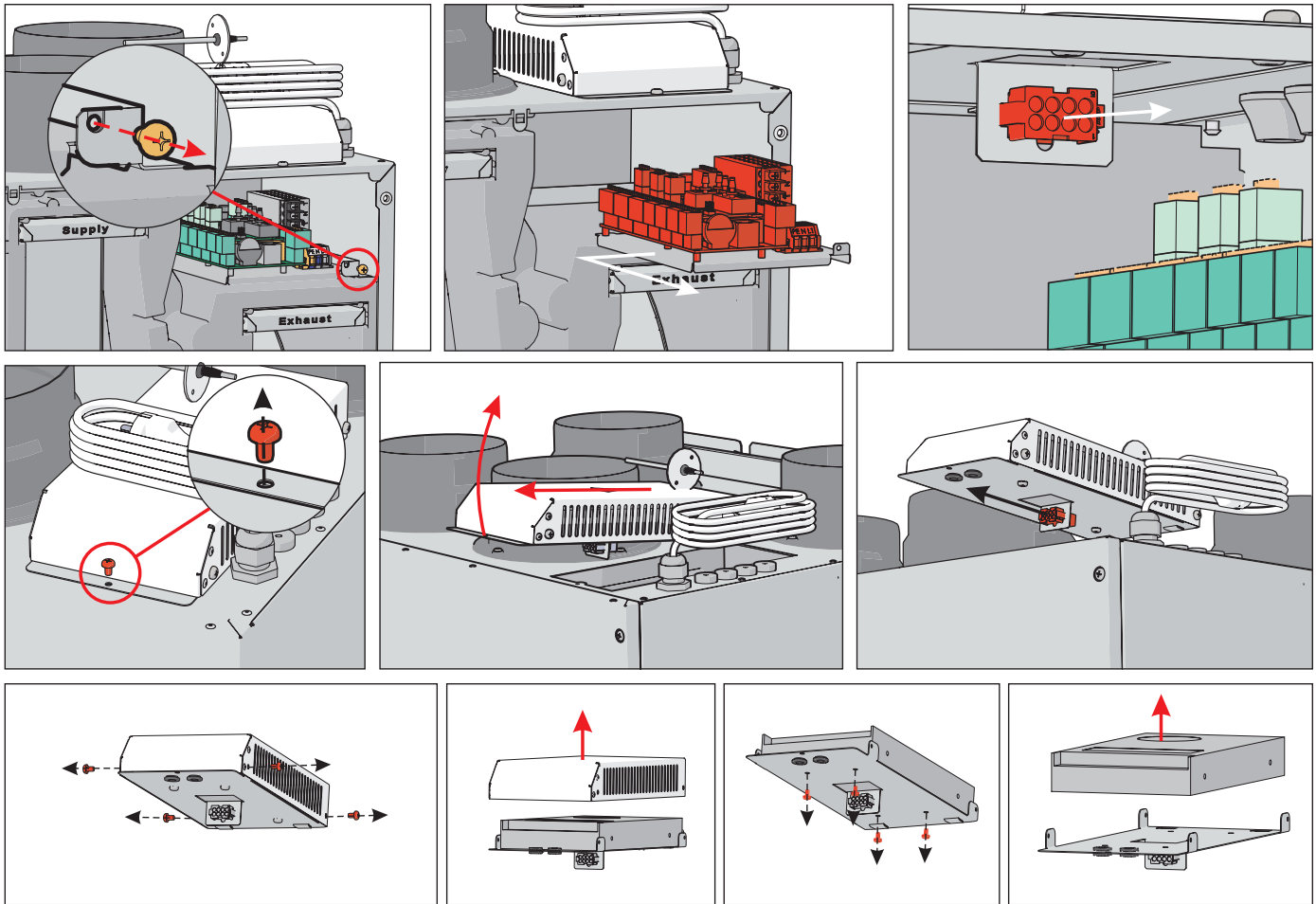
### Bypass Dampers and Pre-Heater maintenance

Bypass damper and pre-heater are mounted on one block. The pre-heater shall be disconnected by removing X29 connector. The bypass damper shall be disconnected by removing X25 .



**Control board and Switching Power Supply maintenance**

- Unscrew the front bolt securing the control board holder to the unit casing.
- Withdraw the automation through the front part.
- Disconnect the connectors from the control board.
- The connectors are marked according to connection location. Thus during automation reassembly please observe the marking of the connection location of connectors and controller. If the marking on the controller terminals is not visible follow the PCB information provided in this passport (see miniMCB description: Fig. 2 and Fig. 3):



**Recommendations for Installation of Unit Functional Blocks**

- All the metering, control and execution units shall be mounted in freely accessible locations for maintenance, repairs or replacement.
- Prior to handover to the user, the pre-commissioning activities shall be performed to ensure proper operation of the automatic control system of the air handling unit. Power plug socket shall be installed at a distance to ensure unstrained power cable of the unit. Standard length of the unit power cable shall be: ~2.5 m long from the unit casing.

Prior to connecting the unit to the mains, the door shall be closed.

The installed plug socket shall be of at least the same nominal current as the unit nominal current, which is indicated in the unit rating plate.

**Unit shall be connected to the mains through the current leakage relay (30 mA).**



**After complete dismantling of the unit control automation and its reinstallation, when connecting the automation connectors, it is necessary to check if the connector conductors are not damaged or otherwise broken.**

- Install the control panel at the designed location.
- Connect the connection cable supplied with the remote control panel kit between the control panel and the HVAC unit. It is recommended to install the remote control board separately from the power cables.

NOTE: If the cable is used together with other power cables, the remote control panel cable shall be shielded with grounded shielding armour.

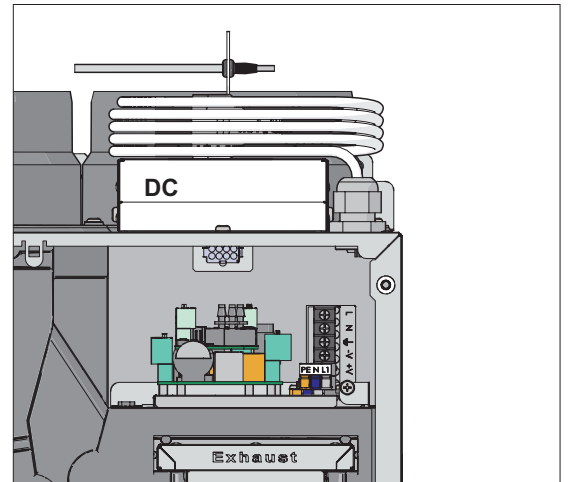
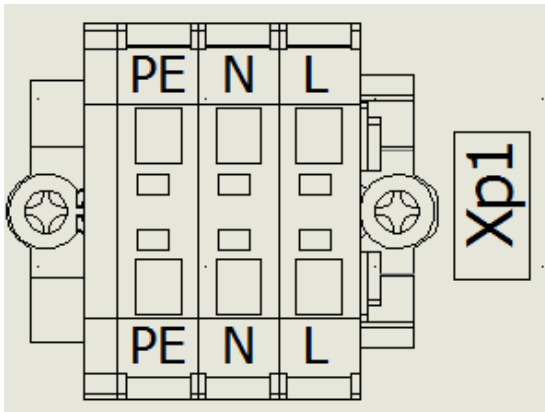
NOTE: the remote control panel shall be connected and/or disconnected only after disconnecting power supply to HVAC unit.

**Wiring Diagram**

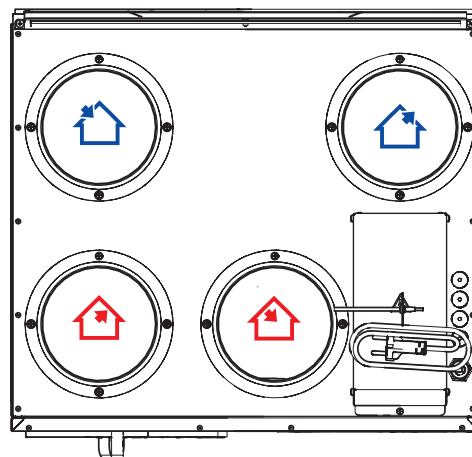
Electrical equipment connection to the control board terminals. Control board connectors shall be of the following cross sectional area.

Control board	0,5 mm <sup>2</sup>	1,5 mm <sup>2</sup>	2,5 mm <sup>2</sup>
miniMCB	X1, X2, X3, X4, X5, X6, X7	X9, X13, X14, X15, X16	X10, X11, X12, X17
miniEX1	X19, X20, X21, X23	-	-
Power supply	-	-	Xp1

Automation E zone, connector Xp1 general power connection to the unit ~1/230 VAC.  
 The 48 V direct current (DC) power source is intended to use only for power supply of Smarty 4XV fans.



**Air flow**



Exhaust air

Supply air

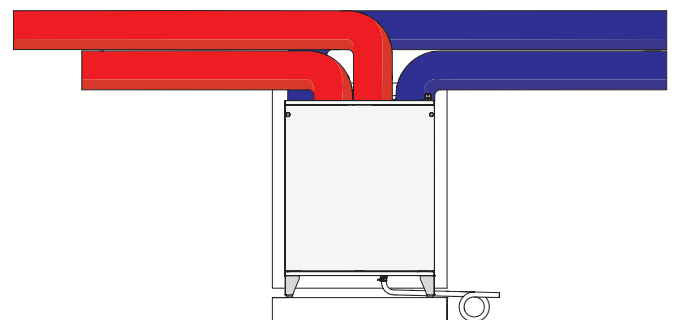
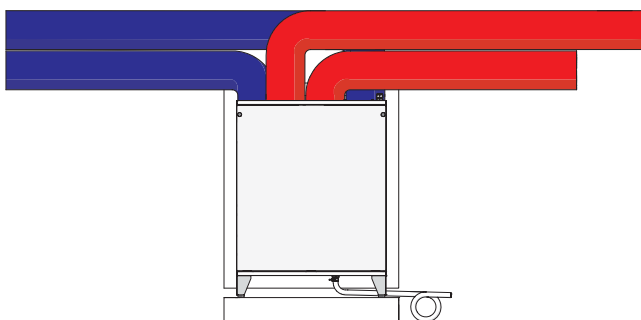
Outdoor air

air Extract

**Smarty 4X V connection possibilities**

Right side connection

Left side connection



**Technical data**

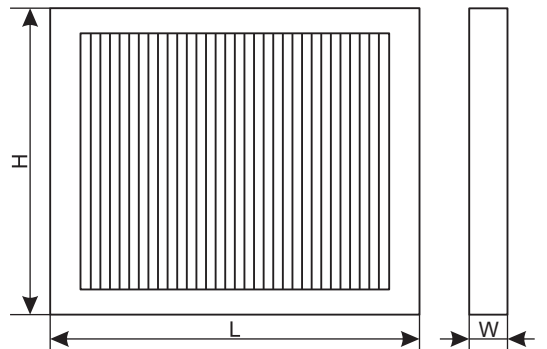
Smarty		4X V 1.1		4X V 1.2	
Exhaust air fan	phase/voltage	[50 Hz/VAC]	~1/230		
	power/current	[kW/A]	0,21/0,92		
	speed	[min <sup>-1</sup> ]	4400		
	control input	[VDC]	0-10		
	protection class		IP54		
Supply air fan	phase/voltage	[50 Hz/VAC]	~1/230		
	power/current	[kW/A]	0,21/0,92		
	speed	[min <sup>-1</sup> ]	4400		
	control input	[VDC]	0-10		
	protection class		IP54		
Total power consumption	power/current	[kW/A]	1,2/5,2	-	
Automatic control integrated			1,62/7,09	0,42/1,89	
Thermal efficiency			90 %*		
Insulation of walls		[mm]	30		
Netto weight		[kg]	39		
Pre-heater	power/current	[kW/A]	+		

According to EN 13141-7 standard.

Smarty 4X V	LWA visas, dB(A)	LWA, dB(A)								
		63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	5 kHz	
Supply	62	47	53	58	56	54	51	46	41	
Exhaust	54	44	45	50	47	45	43	38	35	
Surrounding	51	30	35	48	46	40	35	27	24	
Measured at		flow/pressure	[m <sup>3</sup> /h / Pa]	406/50						

**Filter**

Smarty 4X V			
Exhaust air filter	class	G4	
	width	L [mm]	475
	height	H [mm]	180
	depth	W [mm]	25
	model	MPL	
Supply air filter	class	G4/(F7 - optional)	
	width	L [mm]	475
	height	H [mm]	134
	depth	W [mm]	25
	model	MPL	

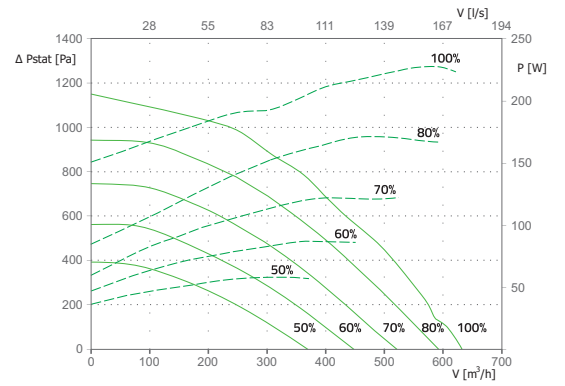


NOTE. Subject to technical modification

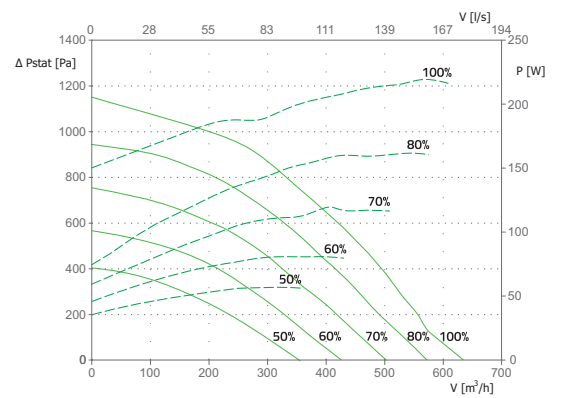
Air flow Diagrams

— Operational limits  
 - - Power consumption

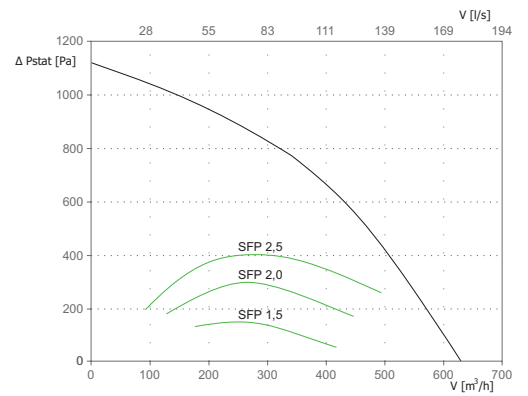
Supply air



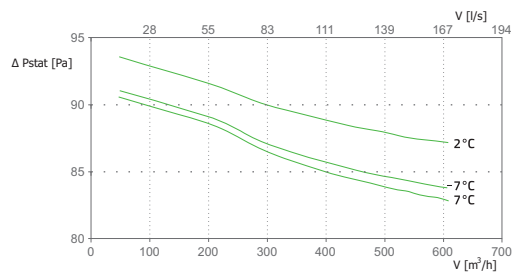
Exhaust air



Specific fan power (SFP)



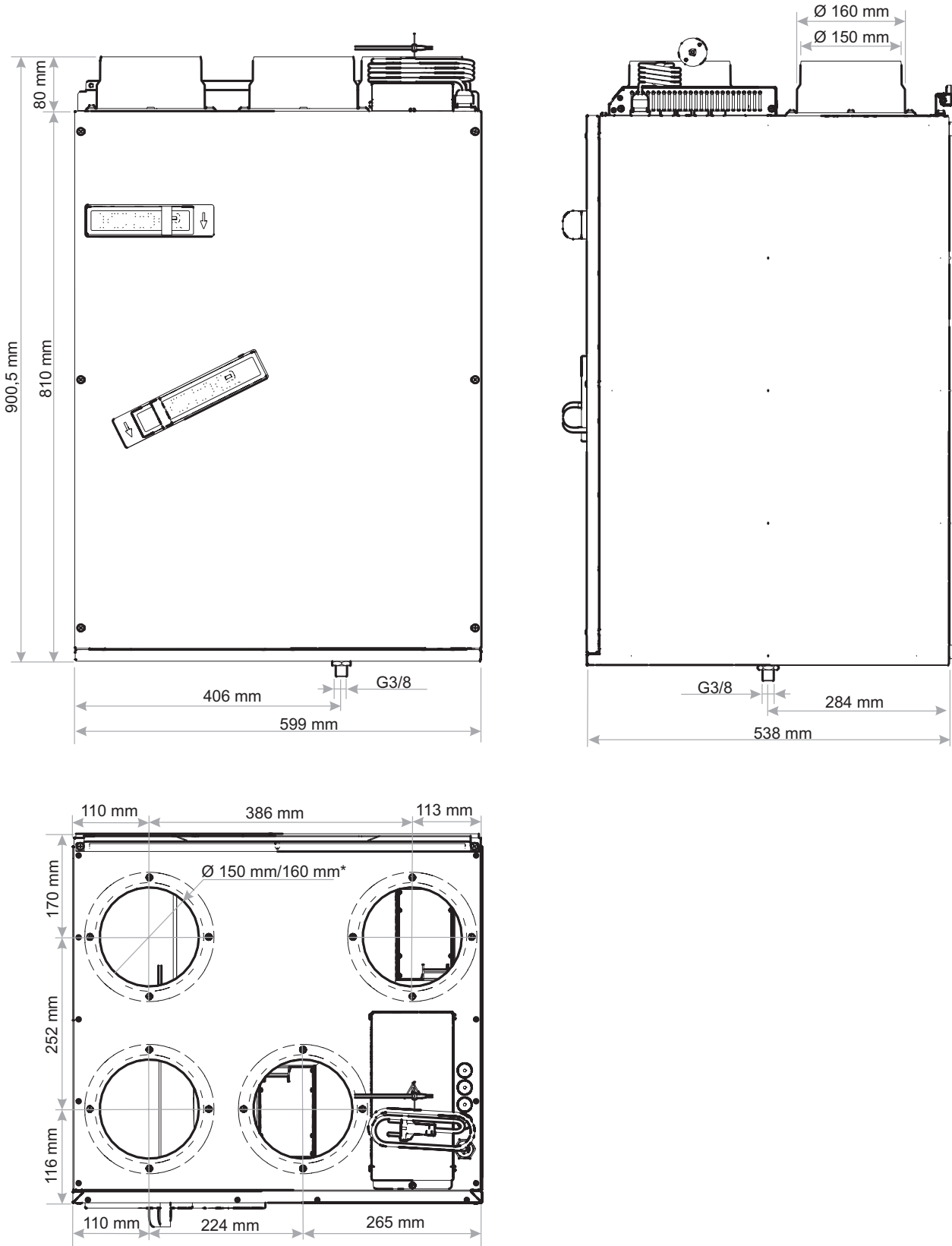
Temperature efficiency



Temperature efficiency (balanced mass flow):

Extract air	20 °C / 39 % RH	20 °C / 60 % RH	20 °C / 39 % RH
Outdoor air	7 °C / 80 % RH	2 °C / 80 % RH	-7 °C / 80 % RH
Standart	EN 13141-7		

Smarty 4X V dimensions

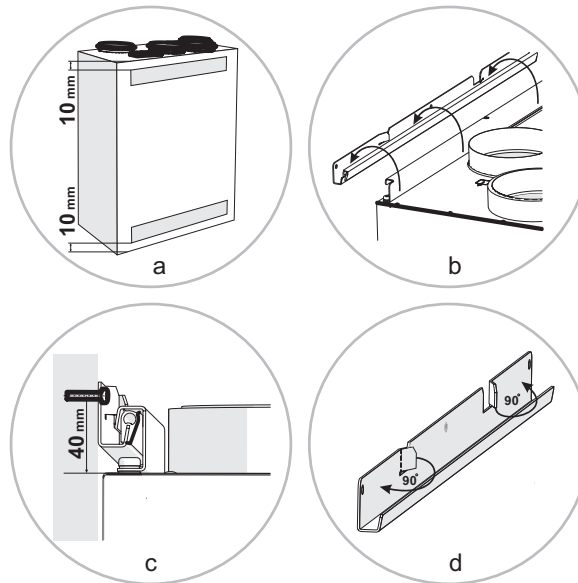


\* Possibility to insert coupling of corresponding diameter

## Mounting

- Installation should only be performed by qualified and trained staff.
- When connecting air ducts, consider the notices indicated on the casing of the unit.
- Before connecting to the air duct system, the connection openings of ventilation unit should be closed.
- When connecting the ducts, you should pay attention to the air flow direction indicated on the device housing.
- Do not connect the bends close to connection flanges of the unit. The minimum distance of the straight air duct between the unit and the first branch of the air duct in the supply air duct must be  $1xD$ , in air exhaust duct  $3xD$ , where  $D$  is diameter of the air duct.
- It is recommended to use the accessories-holders. This will reduce vibration transmitted by the unit to the air duct system and environment.
- Enough space must be left for opening of the maintenance door and filter covers.
- If the installed ventilation unit is adherent to the wall, it may transmit noise vibrations to the premises. Though the level of noise caused by the fans is admissible, it is recommended to mount the unit at the distance of 400 mm from the nearest wall. If it is not possible, the mounting of the unit is recommended on the wall of the room where the level of noise is not important.
- Ducts are connected to the unit in such way that they could be easily disassembled and the heater could be removed from the unit when performing service or repair works.

## Mounting on wall

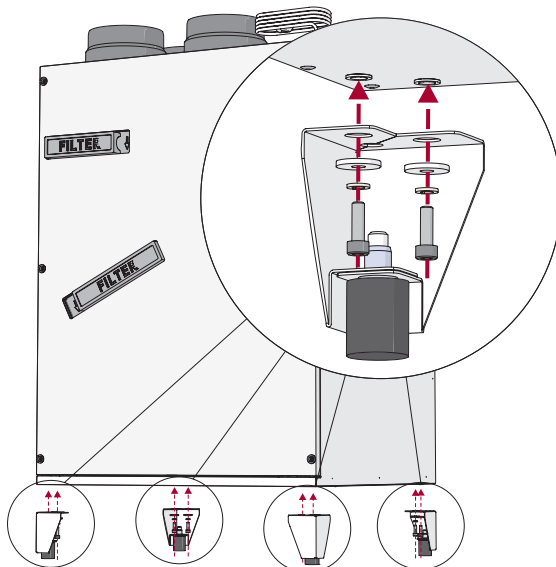


### Unit mounting on wall:

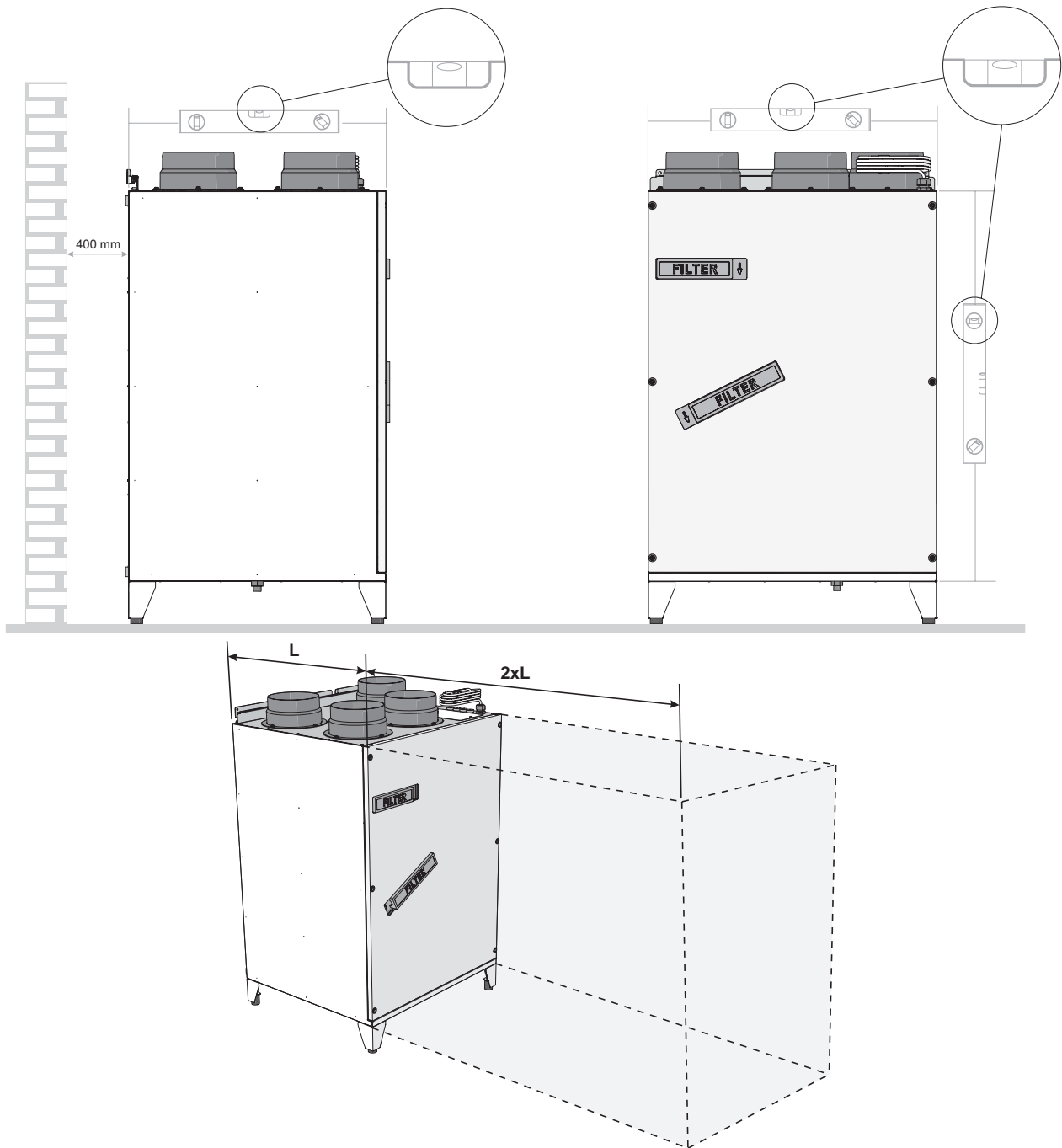
- To reduce the vibration stick the insulating tape on the unit's casing side which touches the wall before mounting the unit on the wall.
- The unit has to be mounted on the mounting brackets.
- AHU mounting drawing.
- After the unit is mounted two wall bracket tabs has to be folded to  $90^\circ$  angle by pliers to avoid the accident fall of the unit.

## Mounting on Legs

Legs are optional and not included in standard package.







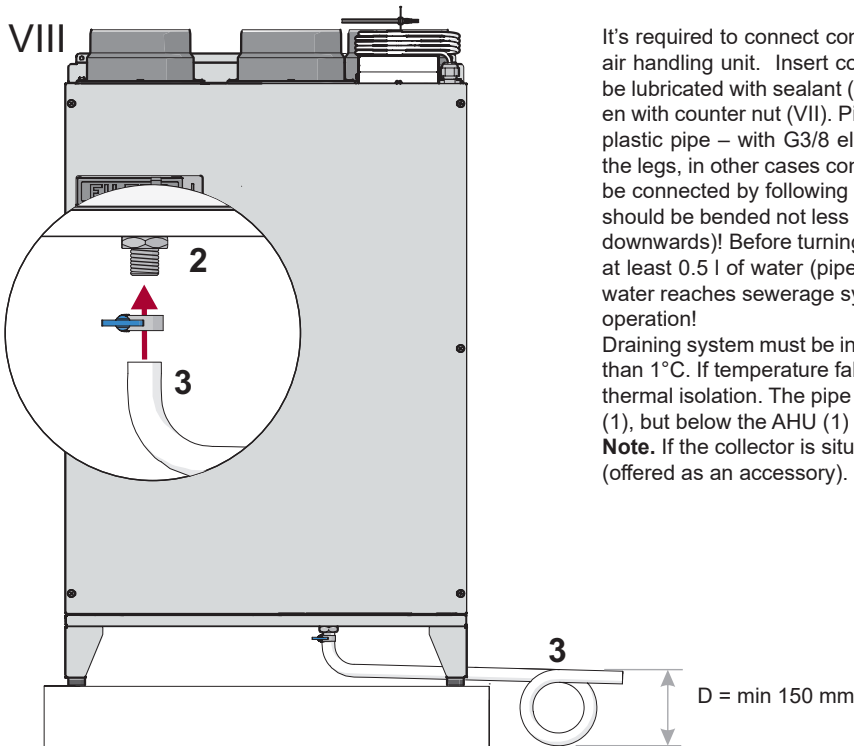
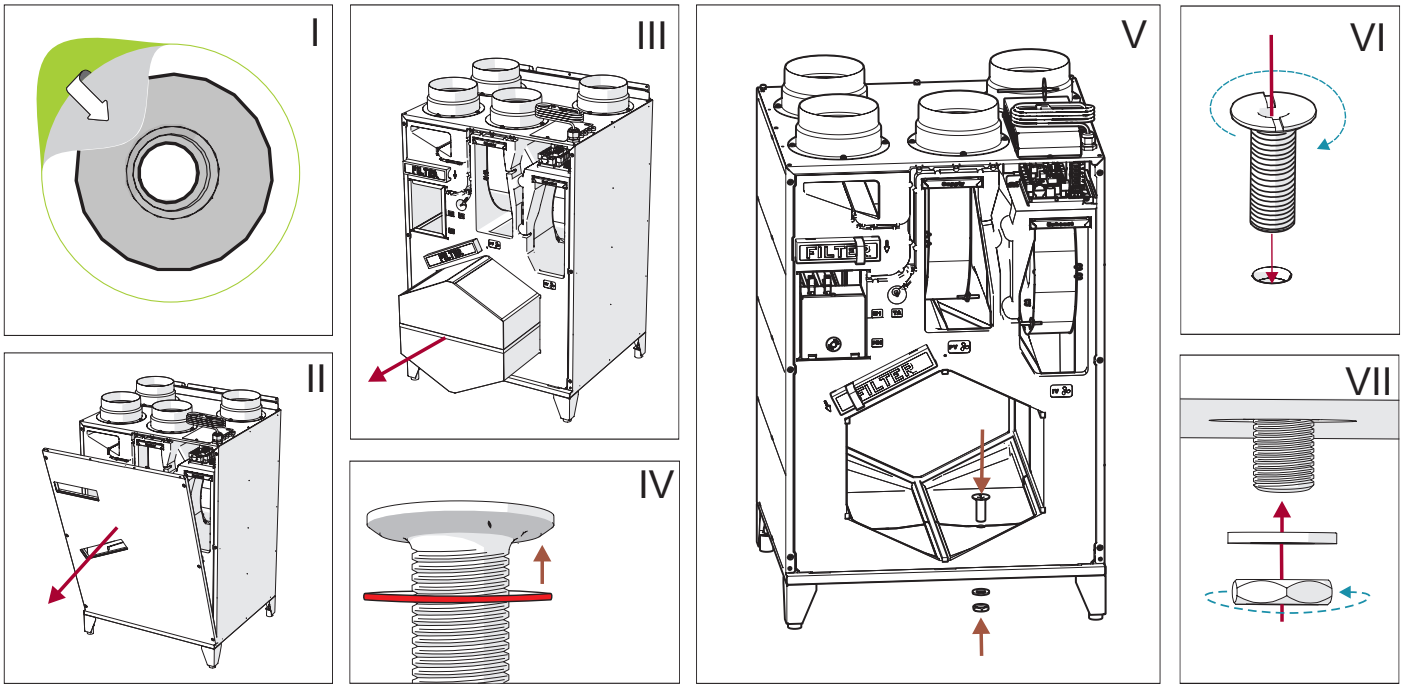
### Connection of the unit to electric network

- Supply voltage to the unit must be connected by a qualified specialist following the manufacturer's instructions and effective safety instructions.
- The unit's power network voltage must correspond to electrotechnical parameters of the unit indicated in the technical decal.
- The unit's voltage, power and other technical parameters are provided in the unit's technical decal (on the unit casing). The unit must be connected to the voltage plug socket of the grounded power network in compliance with the effective requirements.
- The unit must be earthed according to the rules on installing electrical equipment.
- It is prohibited to use extension wires (cables) and power network plug socket distribution devices.
- Prior to carrying out any ventilation unit installation and connection activities (until its hand-over to the customer), the unit must be disconnected from the power network.
- After installation of the ventilation unit, the power network plug socket must be accessible at any time and disconnection from the power network is performed through the two-pole circuit breaker (by disconnecting phase pole and neutral).
- The unit must be thoroughly checked against damages (execution, control, measurement nodes) during transportation before it is connected to the power network.
- The power cable can be replaced only by a qualified specialist upon the evaluation of the rated power and current.



The manufacturer does not assume any liability for personal injuries and property damage due to non-conformance with the provided instructions.

Drainage



It's required to connect condensate drainage system after hanging or placement of air handling unit. Insert condensate draining into AHU. Condensate draining must be lubricated with sealant (I-VII). Then place plastic washer on the bottom and tighten with counter nut (VII). Pipe (3) (metal pipe should be connected with G3/8 elbow, plastic pipe – with G3/8 elbow or rubber hose – with strap if the unit is placed on the legs, in other cases condensate hose can be connected in any direction) should be connected by following order: AHU (1), pipe (2), and drainage system. Pipes (3) should be bended not less than 3° degrees (1 meter of pipe must be bended 60 mm downwards)! Before turning on AHU (1) the draining system should be filled up with at least 0.5 l of water (pipe loop (3) must be always filled with water), also check if water reaches sewerage system! In other case premise can be flooded during AHU operation!

Draining system must be installed in the premise where the temperature is not lower than 1°C. If temperature falls below 0°C the draining system should be isolated with thermal isolation. The pipe loop 2) not necessarily must be mounted below the AHU (1), but below the AHU (1) level.

**Note.** If the collector is situated upstream, install a system with a condensate pump (offered as an accessory).



Before every heating season the condensate tube shall be filled with water as indicated during the first start-up! Before every heating season the condensate tube shall be filled with water as indicated during the first start-up!

Control Board and its Functions



Air Handling Unit uses two types of boards, depending on the selected product version: miniMCB or miniMCB basic. Their functionality is different, thus check the board name by the product version.

Control board functions and logics are designed according to Standards DIN 1946-6:2009-05 and EN 12098-3.

MCB control board can be controlled by: Stouch remote control panel or MB - GATEWAY web application. Description of remote control panel functions is provided in the remote control panel technical documentation or on the website [www.salda.it](http://www.salda.it).



The unit can be configured only with MB-Gateway web application.  
 The following control board functions can be fully controlled only with MB-Gateway web application. In case of Stouch remote control panel use the description of remote control panel functions for MCB control board.

**Descriptions of Unit Functions**

**1.1 System modes**

System modes:

- Stand-by
- Building protection
- Economy
- Comfort

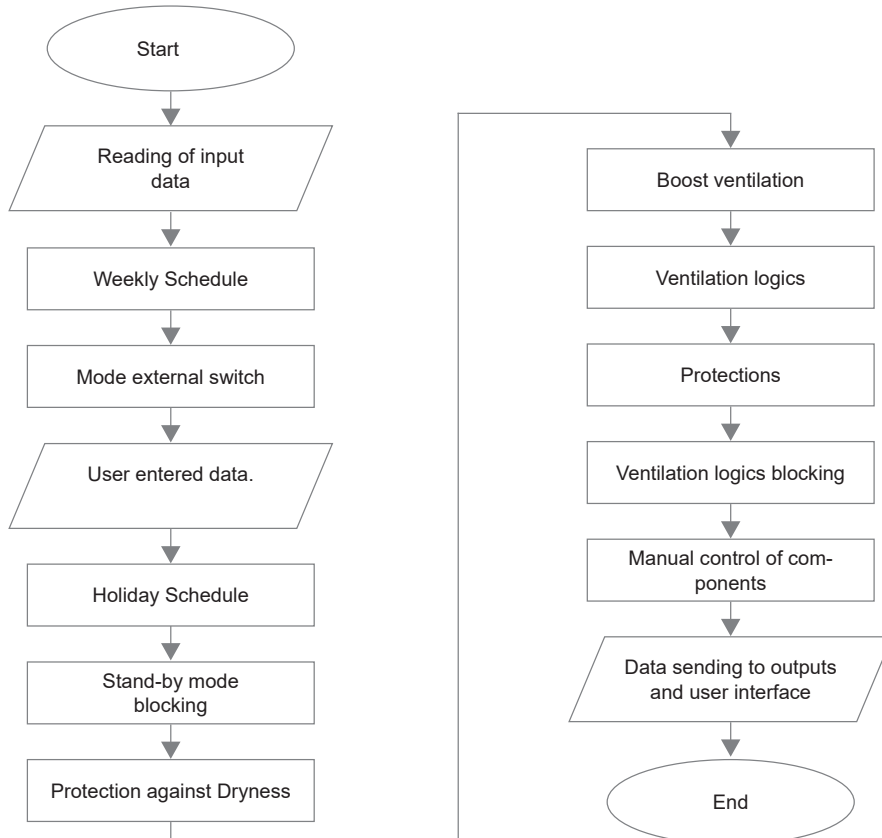
In stand-by mode the system is shut down for a permissible shutdown period (based on the stand-by mode blocking function settings).  
 The building protection mode is designed to protect a building against moisture accumulation. In this mode the system operates at speed 1. By default, in this mode temperature maintenance is controlled (preferred temperature is indicated). However, if necessary, temperature maintenance can be switched off.  
 Economy mode is designed to save energy when people are not in the room. In this mode the system operates at speed 2. By default, in this mode temperature maintenance is controlled (preferred temperature is indicated). However, if necessary, temperature maintenance can be switched off.  
 Comfort mode is used when people are present in the room. In this mode the system operates at speed 3. In this mode the temperature is always maintained.

**1.2 System Control**

System mode can be changed automatically by the functions (in a sequential order as indicated):

- 1 - Weekly Schedule
- 2 - Mode is activated from an external contactor
- 3 - User's manual mode selection
- 4 - Holiday Schedule
- 5 - Stand-by mode blocking

Based on the weekly schedule the system decides which mode it will be operating in; however, the user may change the existing mode manually. The system will inform when the next mode change is scheduled. After power loss the mode is selected based on the weekly schedule; however, if the schedule is not set, the mode used before the power loss will be activated.  
 The user may change modes only when the mode is activated from an external contactor. The only case when the user cannot change the mode is when the period of a holiday schedule is active. The system informs that the holiday schedule mode is active. To prevent blocking, the period of the holiday schedule must be changed.  
 Stand-by mode can be blocked based on selected parameters. If at least one of the above functions changes its mode into stand-by mode, it must be checked whether this mode is not currently blocked. If it is blocked, the previous selected mode is on.  
 The function order is provided below.



### 1.3 System status

The field of a system status is designed to notify a user of the existing system status. The table below provides possible system statuses.

System status	Description
Stand-by mode	System operates in stand-by mode.
Building protection mode	System operates in building protection mode.
Economy mode	System operates in economy mode.
Comfort mode	System operates in comfort mode.
Emergency run	System operates in emergency mode. For more information see alarms.
Preparing	System is preparing for operation (pre-heating water heaters, etc.).
Opening dampers	Dampers are opened.
BOOST function activated	"BOOST" function is active.
Cooling heaters	Electric heaters are cooled down prior to stopping fans.
Closing dampers	Dampers are closed.
Critical alarm	Critical failure, system is shut down. For more information see alarms.
Fire alarm	Fire protection from an external contactor is activated.
Heat exchanger frost protection activated	Heat exchanger frost protection is activated.
Change filters	Warning on clogged filters. Pressure relays are activated or filter timer is activated.
Room RH 3 days average is lower than 30%. Limiting 3 speed.	Protection against dryness is activated. Room 3-day humidity average is lower than 30%. Air flow is reduced.

### 1.4 Indications of Functions, Alarms and Warnings

Function indications are designed to inform a user on active functions and on the presence of at least one warning or alarm. The table below provides indications and their descriptions.

Functions indications	Description
Working indication output	Working indication output is activated
Alarm indication output	Failure indication output is activated
System mode switch	Mode is activated from an external contactor
Custom fans speed switch	Selected fan speed from an external contactor is activated
Winter	Active winter mode
Stand-by mode blocking activated	Stand-by mode blocking is activated
Slowing down fans	Fans are slowed down
Slowing down fans by temperature	Fans are slowed down based on supply air temperature
Night cooling function activated	Night cooling function is activated
Hydronic pump exercise activated	Preventive maintenance of circulation pumps is activated
Service stop function	Ventilation logic operation is blocked. Service activities are carried out
Holidays	Holiday schedule interval is active. System mode can be changed only upon changing the holiday schedule interval.
Reducing CO <sub>2</sub> level	CO <sub>2</sub> reduction function is activated
Full recirculation	Full recirculation function is activated

### 1.5 Setting Date and Time

Proper date and time must be set to have proper functioning of schedules, event log and winter/summer function. Fast synchronization with the computer time is possible in user and adjuster environments.

### 1.6 Weekly Schedule

A weekly schedule consists of 10 weekly events. They can be added, deleted, activated and deactivated. One event indicates time, mode and days of the week.

The system changes modes based on the weekly schedule only when the indicated time comes; therefore a user can always change the existing mode manually. This schedule notifies the user of the upcoming mode change by indicating the time remaining till the next event.

### 1.7 Holiday Schedule

A holiday schedule is used when the unit has to operate in an indicated mode during holidays. The user interface shows when the schedule period is active as the mode activated by this function (except for protections) can be changed by no-one. In order to control the system in a normal manner, the holiday schedule period must be deactivated, i.e. zero values must be indicated or period dates must be changed. Up to five holiday periods can be indicated.

### 1.8 Winter/Summer Mode

The winter/summer function is used to set upcoming cold periods, because some part of the system need to be protected against cold outdoor air. During the winter period it is recommended to leave the unit on, therefore it is possible to set that the system switch-off is blocked during the winter period. Water heaters must be always on during the entire winter period.

The winter mode may be indicated:

- Manually
- By date
- Based on 3-day mean outdoor air temperature. The mean is calculated only when the fresh air (outdoor) pre-heater is off.

### 1.9 “BOOST” Function

Boost ventilation function is used for fast ventilation of the rooms. This function activates the maximum air flow (speed 4). Boost ventilation must be temporary, i.e. it must be a final condition (e.g. CO<sub>2</sub> limit, time). The reason for this limitation is protection against dryness. The function is activated manually and from the external system contactor.

The function is inactive in stand-by mode. Time limit shall be set to this function. Once the function is activated, the indicated time is set for the function timer and time is counted till the function deactivation. This time may be adjusted in real-time, i.e. when the function is on.

### 1.10 Protection against Dryness

This function is designed to protect premises against dryness. If the function is active, it calculates the 3-day mean humidity of extract air from the premises. If the mean drops below 30%, fans start operating at speed 2 in comfort mode. A user is notified of the activated protection and limited air flow.

If the humidity mean exceeds 30% or the function is switched off manually, fans start operating at speed 3 in comfort mode.

### 1.11 Night Cooling Function

This function is designed to save energy which is used to cool a building in the morning by cool night air.

If the function is on but not active, activation conditions are checked:

- 1 - System time is between function start and function end (hours/minutes).
- 2 - Time is every hour since the start.
- 3 - If “Stand-by” mode is set, the unit operates in “Building protection” for 5 minutes so that the actual temperature data is available. Temperatures are checked after purging. If wrong temperatures are received the unit returns to “Stand-by” mode.
- 4 - Outdoor temperature is higher than the set outdoor temperature.
- 5 - Extract air temperature is higher than the set temperature.
- 6 - Extract air temperature is higher than the outdoor temperature by at least 2 °C.
- 7 - Summer time.

If all conditions are fulfilled the unit starts operating in “Comfort” mode (without temperature maintenance). The main window shows that the night cooling function is active.

Where the function is active, the deactivation conditions are regularly checked:

- 1 - Time does not correspond to the start/end interval.
- 2 - Extract air temperature drops below the set point.
- 3 - Outdoor air temperature drops below the set point.
- 4 - Mode other than “Comfort” was switched or the unit has been shut down

If at least one condition is correct, the unit switches off the night cooling function and it switches to the mode that was on prior to activating the function.

### 1.12 Air Filter Timer

The air filter timer is designed to inform the user on filter replacement. After filters have been replaced, the timer must be reset. The user can always see how many days remain till the filter replacement. When the time expires, the warning on filter replacement is displayed. The filter timer limit can be set in the service environment. Maximum permissible time – 1 year. Time is calculated only when fans are rotating.

This timer also shall be automatically reset to cancel filter clogging warning.

### 1.13 Display and Cancellation of Alarms and Warnings

The system notifies the user of system failures by alarms and warnings. Warnings are cancelled automatically, whereas alarms must be cancelled manually. It is recommended that alarms are cancelled by a specialist prior to finding out the causes of the alarm. If at least one alarm is active, the system is shut down and external failure indication is activated. All possible alarms and warnings are provided in the table below.

Indication	Alarms list
!!01	Warning! Rotor broken belt alarm
R.02	Alarm! Fireplace protection activated
!!03	Warning! Dryness protection activated
!!04	Warning! Plate heat exchanger frost protection activated
R.05	Alarm! Plate heat exchanger frost protection system stopped
!!06	Warning! Plate heat exchanger frost protection (pressure relay)
R.07	Alarm! Hydronic heater frost protection. System stopped
!!08	Warning! Too low supply temperature
!!09	Warning! Too high supply temperature
R.10	Alarm! Too low supply temperature. System stopped
R.11	Alarm! Too high supply temperature. System stopped
!!12	Warning! Change supply air filter (pressure relay)

U.13	Warning! Change extract air filter (pressure relay)
U.14	Warning! Change supply and extract filters (timeout)
R.15	Alarm! Power supply failure. Please, check F1 fuse
U.16	Warning! Supply air temperature sensor failure. Emergency run
U.17	Warning! Extract air temperature sensor failure. Emergency run
U.18	Warning! Exhaust air temperature sensor failure. Emergency run
U.19	Warning! Fresh air temperature sensor failure. Emergency run
U.20	Warning! Hydronic heater water temperature sensor failure. Emergency run
U.21	Warning! Hydronic pre-heater water temperature sensor failure. Emergency run
U.22	Warning! Hydronic cooler water temperature sensor failure. Emergency run
U.23	Warning! Controller cabinet temperature sensor failure. Emergency run
R.24	Alarm! Supply air temperature sensor failure. System stopped
R.25	Alarm! Extract air temperature sensor failure. System stopped
R.26	Alarm! Exhaust air temperature sensor failure. System stopped
R.27	Alarm! Fresh air temperature sensor failure. System stopped
R.28	Alarm! Hydronic heater water temperature sensor failure. System stopped
R.29	Alarm! Hydronic pre-heater water temperature sensor failure. System stopped
R.30	Alarm! Hydronic cooler water temperature sensor failure. System stopped
R.31	Alarm! Controller cabinet temperature sensor failure. System stopped
U.32	Fire damper test OK
U.33	Warning! Fire damper test failed
R.34	Alarm! Heater manual protection. System stopped!
U.35	Warning! Heater automatic protection
R.36	Alarm! Pre-heater manual protection. System stopped!
U.37	Warning! Pre-heater automatic protection
R.38	Alarm! Supply fan failure
R.39	Alarm! Extract fan failure
R.40	Alarm! DX cooler failure
R.41	Alarm! Fire
R.42	Alarm! Supply fan pressure protection. System stopped
R.43	Alarm! Extract fan pressure protection. System stopped.
R.44	Alarm! Internal system error.
R.45	Alarm! Heater manual protection. Boosting.
R.46	Alarm! Pre-heater manual protection. Boosting.
R.47	Alarm! Internal communication error
U.48	Warning! DX cooler defrosting
U.49	Warning! Too high 3 days extract humidity. Increasing air flow.
U.50	Warning! Too high extract humidity. Boosting.
R.51	Alarm! Rotor broken belt alarm. System stopped.

### 1.14 Event Log (History)

The system records 50 recent events (failures, alarms, fire damper testing results, etc.). The log stores the event description and time.

### 1.15 System Versions and Running Time

Every unit has a configuration version specific to this unit, which is saved in the production line. Besides the system configuration and software versions the running time is also displayed since the unit manufacture date. Running time is calculated when fans are rotating.

### 1.16 Air Flow Adjustment

4 air flows are used in the system and they are dedicated to specific modes:

1. Building protection
2. Economy
3. Comfort
4. "BOOST" function

The flows are displayed in ascending order, i.e. when "Comfort" mode is set to lower air flow than that of "Economy" one, the "Economy" mode air flow will be reduced automatically. With respect to the system configuration, air flows are indicated in percentage or pressure or amounts of air. 100% value of air flow is indicated in service environment.

### 1.17 PID Controller Adjustment

This function is used to adjust the coefficients of the existing PID controllers. The number of coefficients depends on the system configuration. If the system operation for any reasons is unstable (fluctuating), PID coefficients may be adjusted. We recommend this to be done by a specialist.

### 1.18 Manual Control of Components

The function of manual control of components is designed to activate/deactivate the components manually. Components are controlled by digital and analogue outputs. Analogue outputs are controlled in percentage, and digital output are controlled by "on/off". By default, all components are attributed "Auto" status which means that a component is controlled based on ventilation logic. Components are displayed by the system configuration. Settings must be saved so that they remain the same after power loss.

The minimum unit consumption in stand-by mode is ensured only when all the manual control components are set to "Auto" position.

Prior to using the manual control function, it is recommended to activate the force shutdown function which blocks the ventilation logic functions.

This function may be useful, if you need to check whether everything is properly connected. Moreover, in the event of failure, certain component can be activated so that the unit operates irrespective of sensors and protections. Of course, this method should be applied in exceptional cases until the failure is rectified.

If an external ("Remote") type of a temperature sensor is displayed, the sensor temperature may be indicated manually, and the values may be indicated via the Modbus interface.

### 1.19 System Monitoring

This function is used to monitor controller input and output values, versions of connected modules, system date and time, fan speeds, temperatures, CO<sub>2</sub> value, pressure, etc. The amount of information depends on the system configuration. This tool is designed for preventive maintenance of the system.

### 1.20 Stand-By Mode Blocking

This function is designed to protect the system against the impermissible unit shutdown. It is recommended to limit the unit shutdown up to 1 hour within 12 hours during the winter period. Possible function modes:

- Always allow shutdown
- Block shutdown
- Block shutdown during winter period
- Block shutdown during summer period

It must be indicated for the function for how long the switch-off is permissible within 12 hours. If the switch-off is blocked and the system is shut down, the system counts the time and informs the user on the remaining time.

If the time has expired and stand-by mode is blocked, the user is informed by the function indication.

### 1.21 Supply Air Temperature Control and Compensation

Temperature may be indicated for supply air or room temperature. The temperature can be maintained based on supply or extract air temperature. If control by room temperature is selected, the function calculates the temperature to be supplied to maintain proper room temperature. Temperature is limited based on supply air temperature permissible limits.

The ventilation unit is not designed to heat premises; therefore it is not necessary to use full capacity for low temperature differences as the compensation in percentage is provided for in this function. This parameter indicates a percentage part of the temperature difference (between the set point and room temperature) to be compensated by this function. E.g. set point is 20°C, room temperature is 16°C, compensation is 50%, difference between the indicated and existing temperatures is 20-16=4°C. Since 50% is compensated, then 4\*50%=2°C, and when the received value is added to the set point we get the required supply air temperature 2+20=22°C. As this temperature is within the supply air temperature protection limits, it is not limited. In this case the system will maintain the supply air temperature at 22°C. The closer room temperature is to the set point (20°C), the closer required supply air temperature is to 20°C.

It can be also too hot in the room, therefore this function is compensating in both directions (both heats and cools). The required (compensated) temperature is displayed in the window "Monitoring" ("Required supply t."). If it is displayed that the required temperature is equal to 0°C it means that the supply air temperature maintenance is switched off.

The supply air temperature is maintained by the following components (in a sequential order as indicated):

- Fans (if too hot the speed is decreased)
- Cooler
- Recirculation damper (in case of favourable outdoor air temperature)
- Bypass damper (in case of favourable outdoor air temperature)
- Heater
- Fans (if too cold the speed is decreased)

The system first of all tries to maintain the supply air temperature by means of a heat exchanger. If plate heat exchanger is used, the bypass damper is used. The heat exchanger can both cool and heat with respect to outdoor and room air temperatures. The heat exchanger is controlled based on PID controller assigned to it. When the heat exchanger operates at full capacity and required temperature is not reached, the recirculation damper, then the heater or cooler is activated (if necessary) etc. Only the components configured for temperature maintenance are activated. From one component to another one the system switches over in 60 seconds.

### 1.22 Supply Air Temperature Limits

This function is designed to limit the supply air temperature. The minimum and maximum supply air temperatures are indicated for the function as well as permissible time and protection actions (display only an alarm or shut down the unit). This function limits supply air temperature set by the user and other functions. If the temperature is controlled based on room temperature, this function does not allow supplying warmer or cooler air than that indicated in the protection.

If the system fails to maintain the right temperature, i.e. supply air temperature remains outside the limits for an indicated period of time, the unit is shut down (if indicated) and alarm is displayed. By default, the minimum permissible supply air temperature is 16.5°C, maximum temperature is 40.0°C.

### 1.23 Mode from an External System Contactor

This function is designed to activate the preferred system mode by means of an external contactor. The function indicates a type of a signal to be sent to the input.

Possible types of signals:

- *Not used*
- Button click. Selected system mode is activated. Function is activated when it receives an impulse. It is deactivated when it receives the impulse again.
- *On/off*. Selected system mode is activated. Mode is active when contactor is on.
- PIR sensor. When the sensor is activated, the selected system mode is activated. If the signal is not received within 30 minutes, the mode is deactivated.

### 1.24 Fan Speeds from an External System Contactor

This function is designed to activate/deactivate the boost ventilation function or preferred combination of fan speeds by means of an external contactor. The function indicates a type of a signal to be sent to the input and components controlled by it. Possible combinations of signal types and functions:

- *Not used*.
- *On/off*. Selected fan speed combination is activated. Function is on when contactor is on.
- Button click. Selected fan speed combination is activated. Function is activated when it receives an impulse. It is deactivated when it receives the impulse again.
- *On/off*. Boost ventilation function is controlled. Function is on when contactor is on. If the boost ventilation function is not terminated by means of this function within the boost ventilation time limit, force shutdown is used after the time expires.
- Button click. Boost ventilation function is controlled. Function is activated when it receives an impulse. It is deactivated when it receives the impulse again.
- If the boost ventilation function is not terminated by means of this function within the boost ventilation time limit, force shutdown is used after the time expires.

It is also indicated whether boost ventilation will be activated or combination of fan speeds is preferred, i.e. it is possible to indicate preferred supply and extract air fan speeds individually.

#### 1.24.1 Chimney Sweep Function

When the function of fan speed from an external contactor is used, the function can be adjusted so that it helps to light a fire in a fireplace. The external contactor may be connected to the switch of the fireplace door. It must be indicated in the function that "On/Off" signal will be used, minimum extract air fan speed and maximum supply air fan speed must be indicated. This combination will create the pressure in a room, which will improve the smoke extract through a chimney as well as burning. When the fireplace door is opened, the function will be activated. When the door is closed, the function will be deactivated.

### 1.25 Filter Protections

#### 1.25.1 Filter Timer Settings

Filter timer limit is set to the function. The maximum setting can be 1 year.

#### 1.25.2 Air Filter Protections based on Pressure Relays (only Smarty 4X V 1.1)

The function checks if the filters are clogged by means of pressure switches. Available function operating combinations:

- Not available
- Supply air
- Extract air
- Supply and extract air

When pressure switches are activated an alarm is displayed.

### 1.26 Fire Protection against External System Contactor

A fire protection signal can be connected to this controller. By default, the signal input is normally closed (NC). Input configuration can be changed. When the signal is lost for an indicated period of time, the protection is activated, warning is displayed and indicated mode is performed. Protection is terminated upon cancelling the warning. It is possible to set a timespan during which the system does not activate. It is possible to select system behaviour when this function activates:

- Stop the system
- Run supply air fan in full speed and stop extract air fan
- Run extract air fan in full speed and stop supply air fan
- Run supply and extract air fans in full speed

### 1.27 CO<sub>2</sub> Reduction Function (only using additional extract air CO<sub>2</sub> sensors)

This function is designed to maintain a proper quality of room air.

Where CO<sub>2</sub> exceeds the permissible limit, CO<sub>2</sub> reduction is activated and air flow is increased. When CO<sub>2</sub> reaches the set point, this function is switched off.

### 1.28 Changing Passwords

Login passwords can be changed in the service environment. To change passwords of service and adjuster environments the password must be activated.

The password consists of 4 digits. If password is not necessary for parameter review and change, set the password (number "0").

### 1.29 Restoring Factory Defaults

This function allows to restore the factory defaults.



### 1.30 Fan Control

The preferred air flow can be indicated in percentage or 4 fixed speeds where each of them is dedicated to a relevant system mode:

1. Building protection
2. Economy
3. Comfort
4. "BOOST" function

Fan speed can be controlled based on:

- Percentage value. Speed percentage is indicated. 0% corresponds to 0V control signal voltage, 100% corresponds to 10V control signal voltage.
- Pressure. The maximum system pressure is indicated which means 100% air flow.
- Air flow (m<sup>3</sup>/h). Supply and extract air factor K and maximum system air flow (m<sup>3</sup>/h) is indicated which means 100% air flow.

The fans are controlled by PID controller based on air flow and pressure. Every fan is controlled individually.

It is possible to limit the minimum and maximum fan control signal voltage. By default, minimum 2V voltage is indicated which means that 0V voltage signal is sent when fans are off, and 2V voltage signal is immediately sent when rotation is required.

#### 1.30.1 Fan Protection based on Rotating Speed

If fans have "tacho" outputs, the fan failure can be identified based on their rotating speed. If the system sends the signal for fans to rotate and they fail to rotate, then protection is activated, system operation is shut down and alarm is displayed.

#### 1.30.2 Air Flow Protection based on Pressure (only in Smarty 4X V 1.1 version)

Where this protection is activated the system must reach the required pressure or air flow. If the system fails to reach the required air flow or pressure within the indicated period of time, the protection is activated, unit is shut down and alarm is displayed. This may happen due to failures of air flow/pressure transmitters, pressure hose defect, clogged flow, impeller defects, incorrect factor K, etc.

#### 1.30.3 Protection of Premises with a Fireplace (only in Smarty 4X V 1.1 versions)

This protection is used for premises with a fireplace. It protects against improper air pressure difference which can result in presence of flue gas (carbon black) in premises. Pressure switch must be connected to the assigned digital input to measure pressure drop in the premises and inside the chimney. Upon activation of this protection the pressure switch will shut down the unit and display the alarm.

#### 1.30.4 Slowing Down Air Flows based on Temperature

If supply air temperature is more important than air flow, the function of air flow slowing down based on temperature may be switched on. If full heating/cooling capacity is used to reach the desired temperature and it is not reached, the air flow is slowed down to have sufficient power to maintain the desired temperature.

#### 1.30.5 Continuous Temperature Maintenance by Slowing Fans Down

This function is designed to save energy when air flow is changed. It is active when fans are controlled based on percentage, since PID controllers do it automatically if it is controlled based on air flows or pressure. Fast change of air flows imbalances the temperature maintenance function and consumes energy until it is balanced again. If a user sets a higher air flow, this function starts gradually increasing the air flow and gradually slows down the conversion speed when it approaches the set value. In this way the temperature maintenance function suffers less stress and consumes less energy. If the user reduces the air flow, the system switches off coolers and heaters to prevent from the heat/cold wave and gradually changes the air flow. After the air flow has been reduced, heaters and coolers continue operating as required.

### 1.31 Damper Control

The following dampers can be connected to the system:

- Supply/extract air dampers (On/Off or Open/Close type). The damper is opened prior to starting fans and closed after fan shutdown.

If On/Off or Open/Close type damper is indicated, proper opening time must be indicated.

### 1.32 Heat Exchanger Control

#### 1.32.1 Cold - Heat Recuperation

Cold-heat recuperation function is designed to control a heat exchanger. The plate heat exchanger power is controlled by means of a bypass damper. When the damper is closed, the heat exchanger is used at full capacity. When opening the damper the heat exchanger power is reduced.

The heat exchanger can both heat and cool based on outdoor air temperature. If it is colder outdoors than in the room, the heat exchanger pre-heats outdoor air by using the room air heat. If it is colder in the room than outdoors, the heat exchanger cools down the outdoor air by using the room air. The heat exchanger power is reduced to the minimum when the system required supply air temperature is the same as outdoor air temperature. The higher the difference between required and supply air temperatures, the higher the heat exchanger power is used. Only when the heat exchanger is used at full capacity, it is allowed to activate other heating/cooling components.

The coefficients of the heat exchanger, heat exchanger PID controller are set to this function.

PID controller output limits are set to bypass damper from which point to start operation. If the bypass damper opens only at several percent the noise can occur, thus its minimal opening limit is limited. This limit also applies when approaching the full opening.

#### 1.32.2 Plate Heat Exchanger Anti-Frost Protection

This protection is designed to protect the heat exchanger against accumulation of ice as the accumulated ice can damage the structure of the heat exchanger. Protection activation/deactivation is possible based on:

- Indicated outdoor air temperature
- Indicated extract air temperature
- Indicated extract air temperature difference from the calculated freezing point (this temperature is calculated based on outdoor air temperature,

room air temperature and humidity)

- Based on pressure switch

Possible safeguards (performed in a sequential order as indicated):

- 1 - Reduction of supply air flow (-30 %)
- 2 - Outdoor air heating with pre-heater
- 3 - Bypass damper opening
- 4 - Unit shut down (based on supply air temperature)

Protection activation conditions and safeguards can be activated optionally. Also time is indicated to switch over from one protection to another one after time expires. If at least one activation condition is fulfilled, the protection is activated and warning is displayed. It begins from the least energy consuming safeguards, i.e. if allowed, the supply air flow is reduced. If the protection does not help during the indicated period of time, then the other protection is activated. Switching over from one protection to another one is done in a sequential order.

Outdoor and extract air recirculation is effective and energy-saving protection, but supplies the extract air to the supply air flow.

Outdoor air pre-heater can be used at full capacity or to maintain the set temperature. If temperature maintenance is selected, at first the activated protection will switch on the pre-heater at full capacity for a certain time period and then maintain the indicated temperature.

When using the bypass damper the supply air heater must be connected. The opening of the damper will reduce the cold air flow through the heat exchanger, but it will cool down the supply air which must be heated up by the supply air heater. This protection slowly opens the bypass damper as far as activation conditions are fulfilled. When suitable conditions are met the damper will be stopped for 5 min. and then slowly closed. If the supply air temperature drops below the permissible limit (insufficient heater power), then the damper will be closed by force based on supply air temperature.

### 1.33 Heaters



**Only either pre-heater or heater can be connected to MiniMCB basic board.**

#### 1.33.1 Supply Air Heater

Supply air heaters are designed to additionally pre-heat the supply air when the heat exchanger heating power is insufficient. The heater is controlled by means of a PID controller based on temperature indicated by the system and data of the supply air temperature sensor. One supply air heater can be connected to this system.

Possible options of supply air heaters in this system:

- Supply air heater is not used.
- Electric heater is controlled by 0..10VDC signal
- Electric heater is controlled by On/Off signal. PWM control interval in seconds is indicated to control this heater.

Also it is possible to swap the connectors of pre-heater and heater protections and control signals.

#### 1.33.2 Electric Heater Thermal Protections

The electric heater can have two protections. One is automatic, another one is manual. The automatic protection is automatically off when the heater cools down, whereas the manual protection must be deactivated by pressing the switch on the heater.

When the automatic protection is activated, the heater and its power circuit are off, warning is displayed. Minimum switch-off time – 5 minutes. When the protection is restored, the warning is no longer displayed.

If the manual protection is activated, the heater and its power circuit are off, an alarm is displayed, the indicated protection action is performed. By default, full speed blowing is performed so that maximum cooling of the heater is ensured as there is a probability that the manual protection can jam and leave the heater running. Of course, if the manual protection is properly activated, the supply air temperature can quickly drop to critical temperature during winter period if full speed blowing is on and the system would be shut down in any case.

#### 1.33.3 Electric Heater Cooling

If an electric heater is used and the system wants to stop the fan, heaters are switched off prior to shutting fans down and they are cooled down by blowing for an indicated period of time. A user is notified of heater cooling.

#### 1.33.4 Outdoor Air Pre-Heater (not applicable to Smarty 4X V 1.1 versions as they have integrated internal pre-heater)

Outdoor air pre-heaters are controlled based on anti-frost protection. Possible options of outdoor air heaters in this system:

- Supply air pre-heater is not used.
- Electric pre-heater is controlled by 0..10VDC signal
- Electric pre-heater is controlled by On/Off signal. PWM control interval in seconds is indicated to control this heater.

### 1.34 Digital Input Configuration

In this system it is possible to indicate a normal status of every digital input, i.e. indicate whether the contactor is normally open or closed (Normally Open (NO), Normally Closed (NC)). The fire protection contactor must be NC as in case of fire the contactor may break if a cable burns.

### 1.35 Sensor Configuration

In this system two 0-10VDC air quality sensors and eight temperature sensors may be used.

The following can be connected to two 0-10VDC inputs:

- Supply air RH sensor
- Extract air CO<sub>2</sub> sensor
- Extract air RH sensor
- Supply air pressure sensor
- Extract air pressure sensor

0V and 10V values are indicated for these sensors. Types of temperature sensors:

- “None” – sensor is not connected
- “Remote” – remote sensor. Sensor temperature can be indicated via Modbus.
- “NTC 10K 3997” – NTC sensor is connected.

In this system all types of sensors and failure action are indicated. Possible failure actions:

- Do nothing – only warning is displayed
- Shut down the system – the system is shutdown, alarm is displayed.
- Emergency mode – operation is continued, but sensor-dependent functions are switched off. Warning is displayed.

### 1.36 Communications Line Configuration

MiniMCB controller has two independent communications lines. One line is dedicated for remote control panels, another one is for BMS network. The line dedicated to the BMS network is galvanized. Used communication protocol – Modbus RTU.

By default:

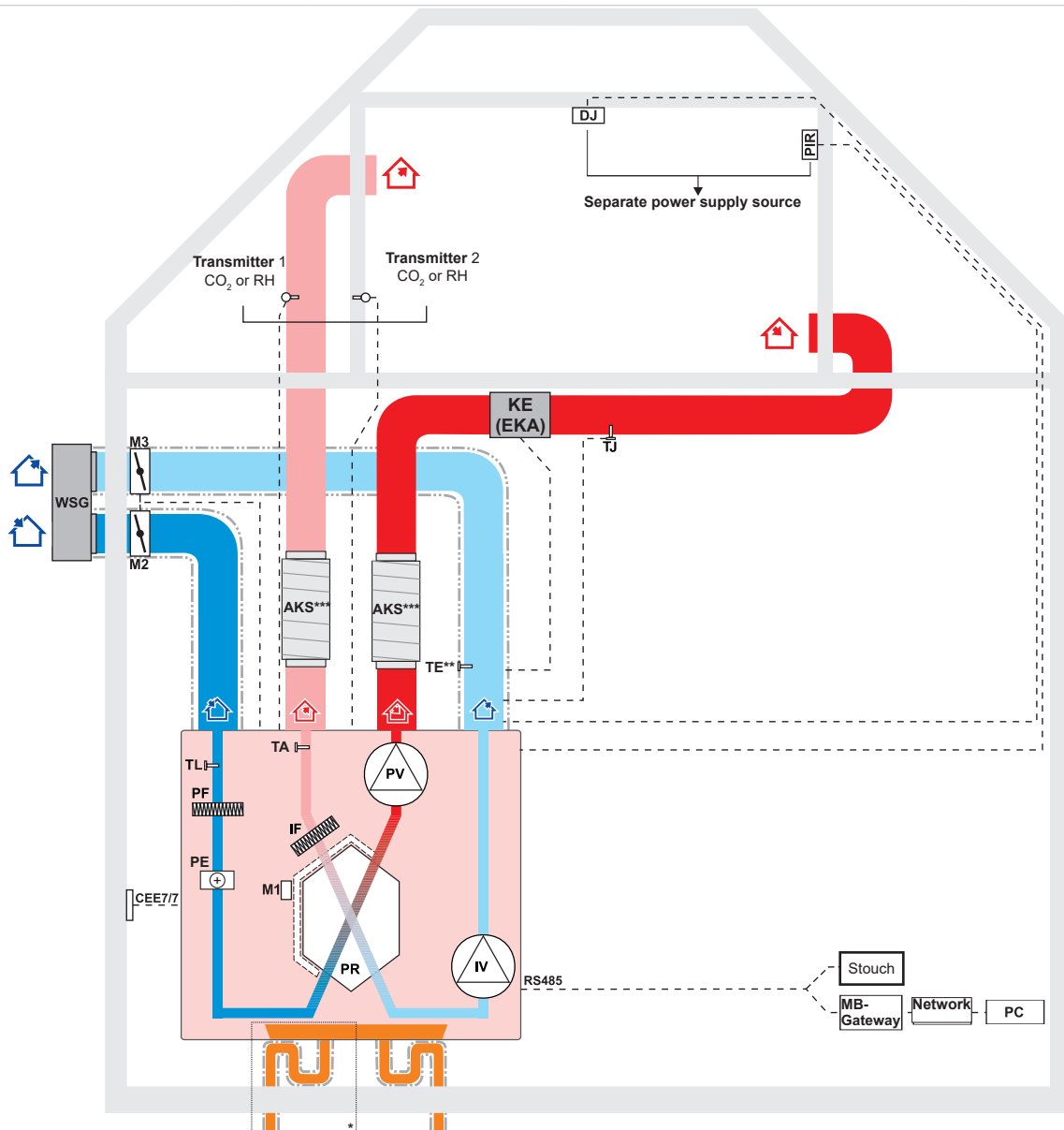
- Modbus address: 1
- Baudrate: 19200
- Frame: E,8,1 (parity: Even)



If necessary, a complete description of miniMCB functions can be downloaded from [www.salda.it](http://www.salda.it).

Principle mounting diagram Smarty 4X V 1.1

🏠 outdoor air     
 🏠 supply air     
 🏠 exhaust air     
 🏠 extract air

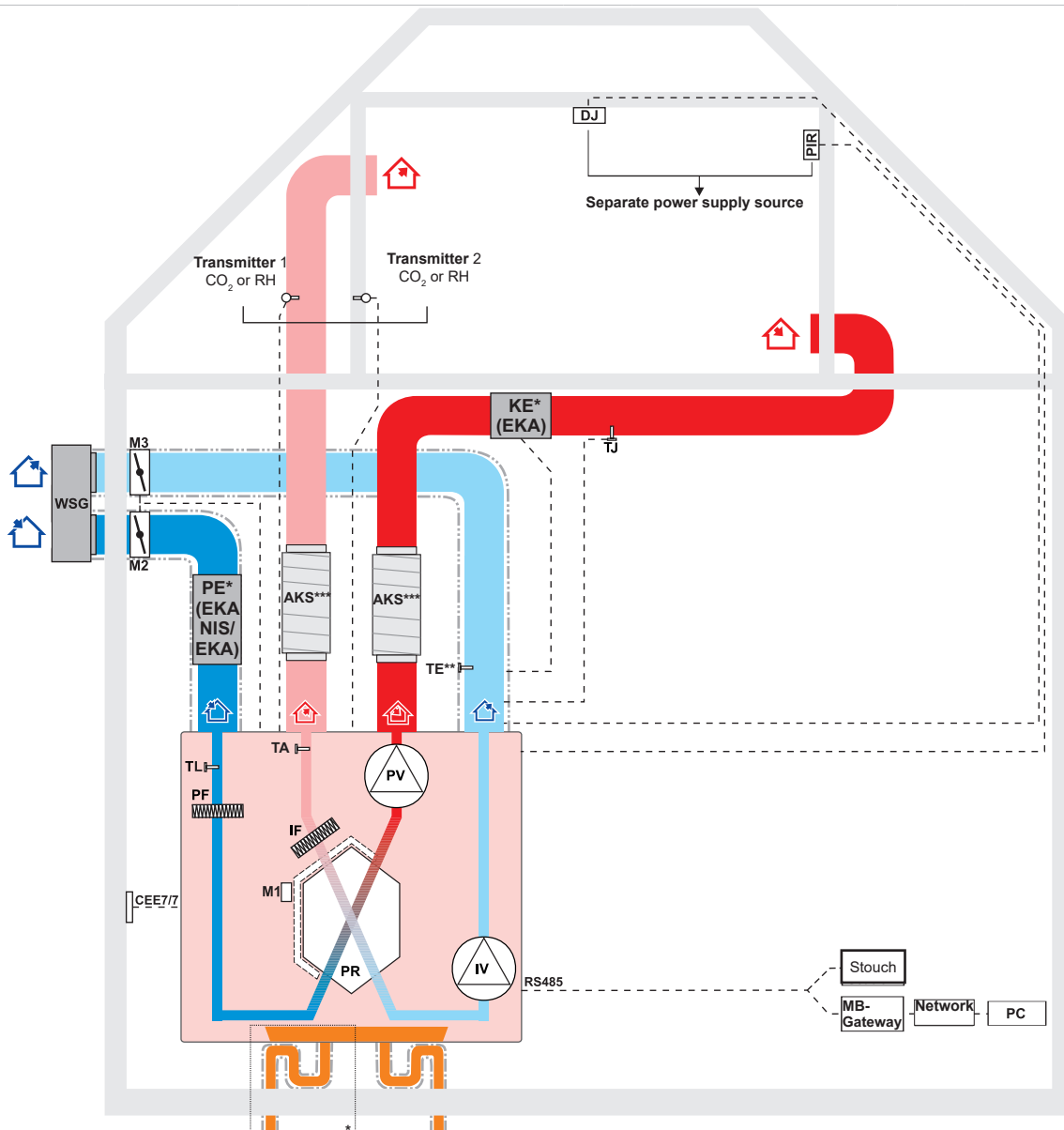


- - - - - It's recommended to insulate by 50 mm mineral wool
- - - - - It's recommended to insulate by 25 mm mineral wool
- ☐ - Possibility to choose a direction of the drainage pipe

<b>WGS</b>	Supply and exhaust air grilles	<b>IF</b>	Filter for extract air (G4)
<b>PIR</b>	Motion detector	<b>TA</b>	Extract air temperature sensor
<b>KE (EKA)</b>	Electric heater	<b>PV</b>	Supply air fan
<b>TJ</b>	Supply air temperature sensor	<b>PR</b>	Plate heat exchanger
<b>M2</b>	Fresh air damper actuator. Recommended to use with return spring	<b>IV</b>	Extract air fan
<b>M3</b>	Exhaust air damper actuator	<b>RS485</b>	Control panel connection place
<b>TE**</b>	Exhaust air temperature sensor (** - shall be ordered separately)	<b>M1</b>	ByPass motor
<b>TL</b>	Outdoor air temperature sensor	<b>Stouch</b>	Control panel
<b>PF</b>	Filter for supply air (G4/(F7 - optional))	<b>MBGateway</b>	Net module
<b>PE</b>	Electric preheater	<b>PC</b>	Personal computer
<b>CEE7/7</b>	Power cable with plug	<b>AKS***</b>	Silencer (***) - recomendet)
<b>DJ</b>	Smoke detector		

Principle mounting diagram Smarty 4X V 1.2

🏠 outdoor air     
 🏠 supply air     
 🏠 exhaust air     
 🏠 extract air

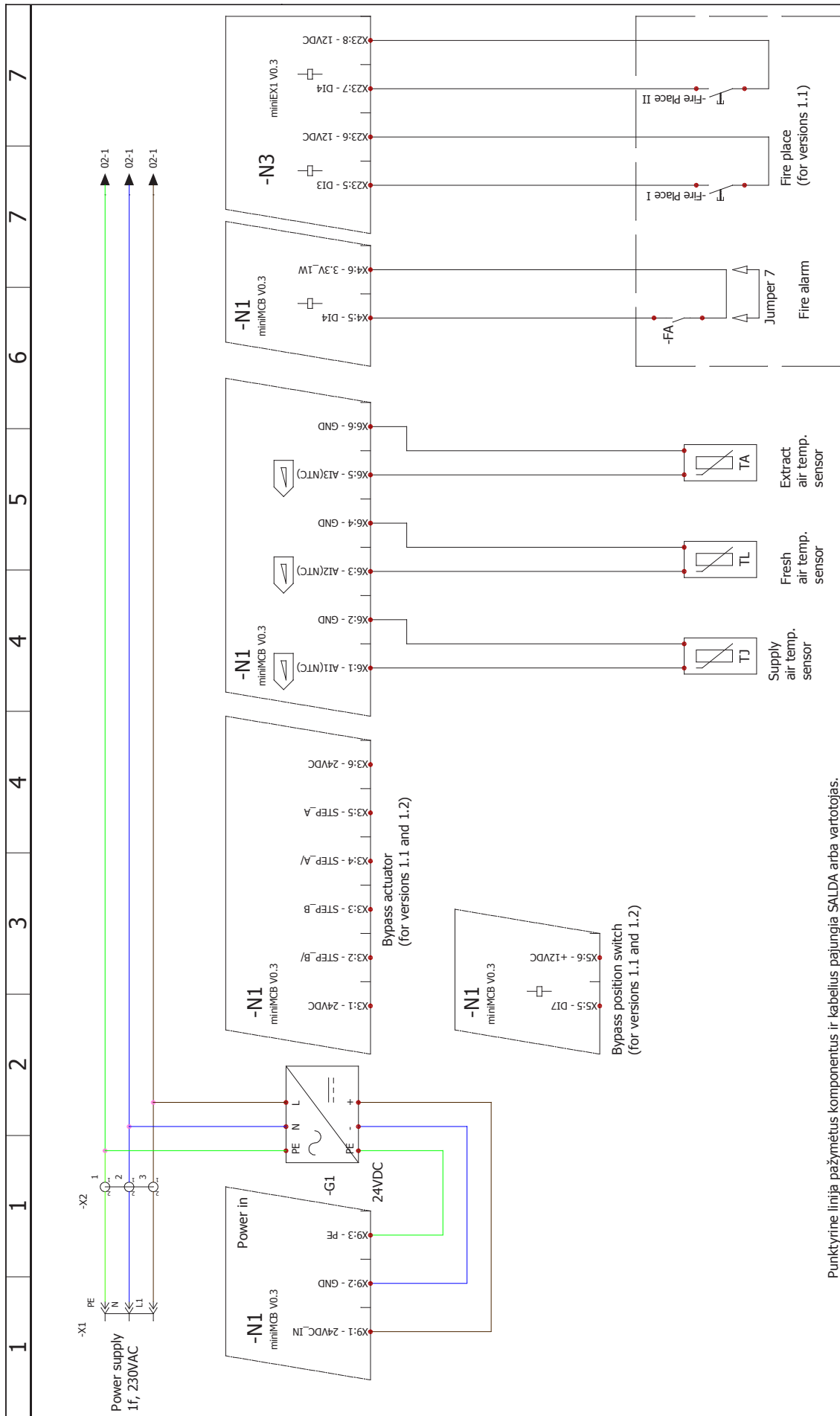


- - - - - It's recommended to insulate by 50 mm mineral wool
- · - · - It's recommended to insulate by 25 mm mineral wool
- ☐ - Possibility to choose a direction of the drainage pipe

KE\* or PE\* - either pre-heater PE or heater KE shall be connected.

<b>WSG</b>	Supply and exhaust air grilles	<b>IF</b>	Filter for extract air (G4)
<b>PIR</b>	Motion detector	<b>TA</b>	Extract air temperature sensor
<b>KE (EKA)</b>	Electric heater	<b>PV</b>	Supply air fan
<b>TJ</b>	Supply air temperature sensor	<b>PR</b>	Plate heat exchanger
<b>M2</b>	Fresh air damper actuator. Recommended to use with return spring	<b>IV</b>	Extract air fan
<b>M3</b>	Exhaust air damper actuator	<b>RS485</b>	Control panel connection place
<b>TE**</b>	Exhaust air temperature sensor (** - shall be ordered separately)	<b>PE* (EKA NIS or EKA)</b>	Electric preheater
<b>TL</b>	Outdoor air temperature sensor	<b>Stouch</b>	Control panel
<b>PF</b>	Filter for supply air (G4/(F7 - optional))	<b>PC</b>	Personal computer
<b>M1</b>	ByPass motor	<b>MBGateway</b>	Net module
<b>CEE7/7</b>	Power cable with plug	<b>AKS***</b>	Silencer (***) - recomendet)
<b>DJ</b>	Smoke detector		

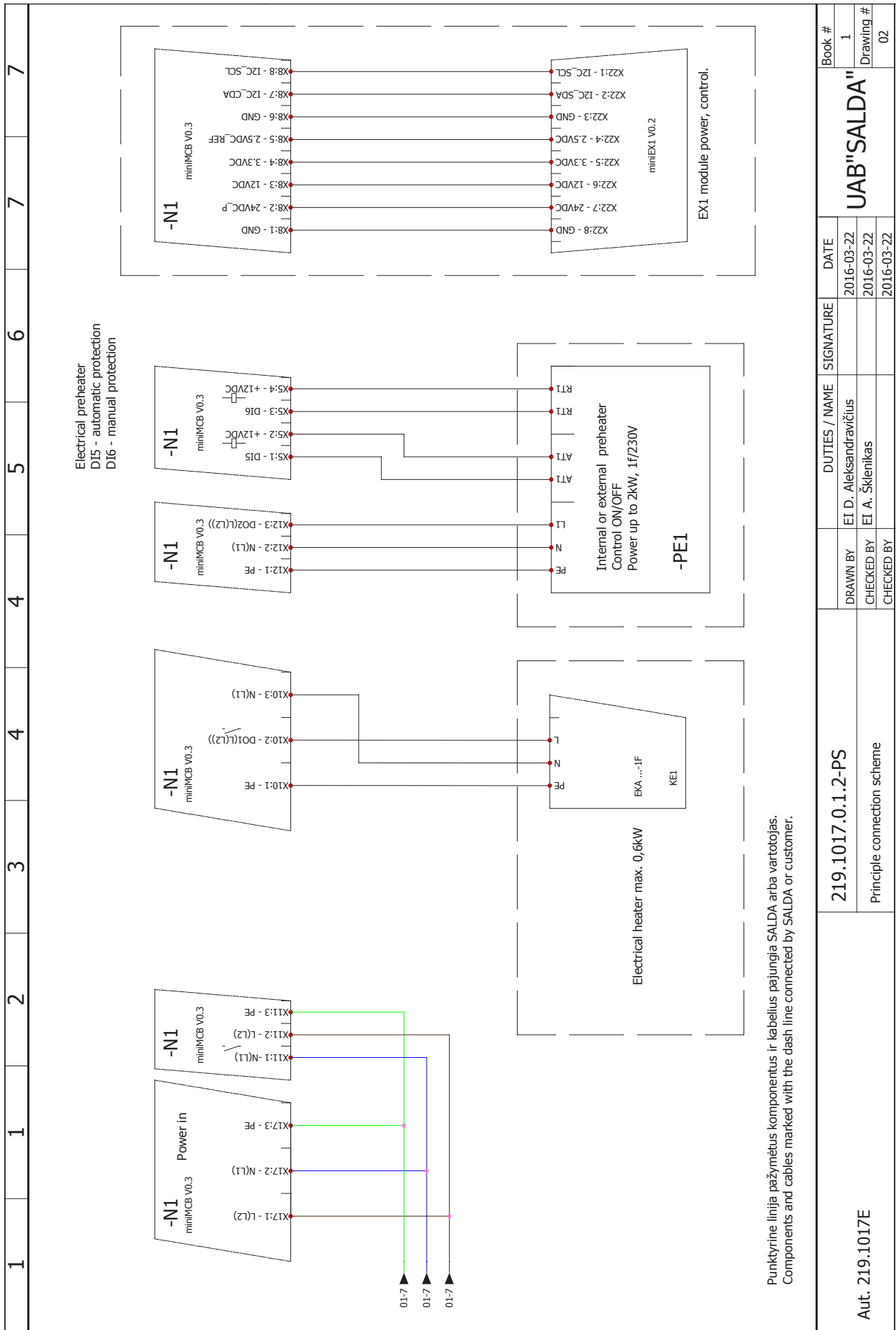
The principal connection scheme of internal and external components



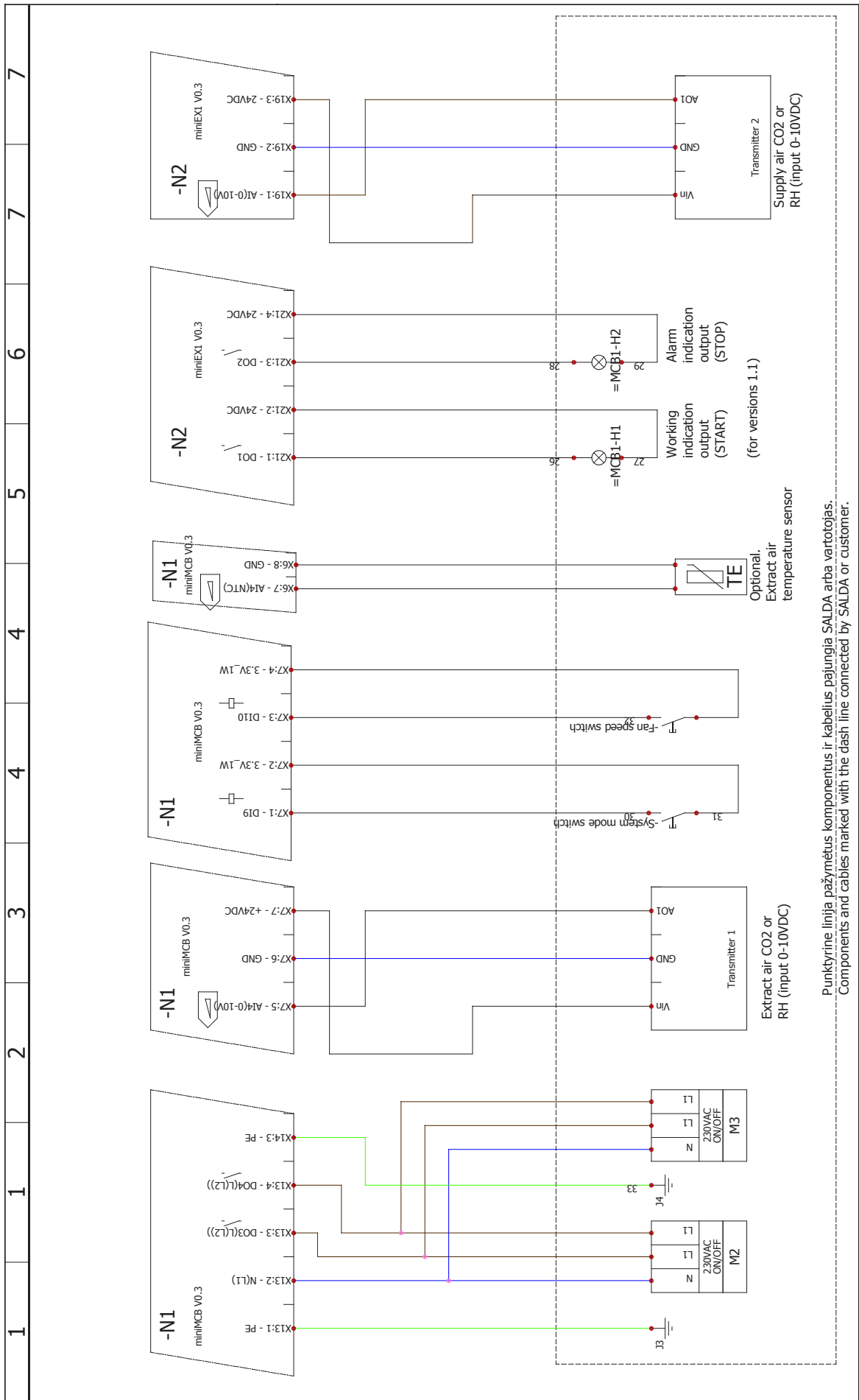
Punktyrinė linija pažymėtus komponentus ir kabelius pajungia SALDA arba vartotojas.  
Components and cables marked with the dash line connected by SALDA or customer.

Aut. 219.1017E	219.1017.0.1.1-PS		DUTIES / NAME	SIGNATURE	DATE	Book #
	Principle connection scheme		EI D. Aleksandravičius		2016-03-22	1
			EI A. Šklenikas		2016-03-22	Drawing #
			CHECKED BY		2016-03-22	01
			CHECKED BY			
						<b>UAB "SALDA"</b>

The principal connection scheme of internal and external components



The principal connection scheme of internal and external components



Punktyrinė linija pažymėtus komponentus ir kabelius pajungia SALDA arba vartotojas.  
Components and cables marked with the dash line connected by SALDA or customer.

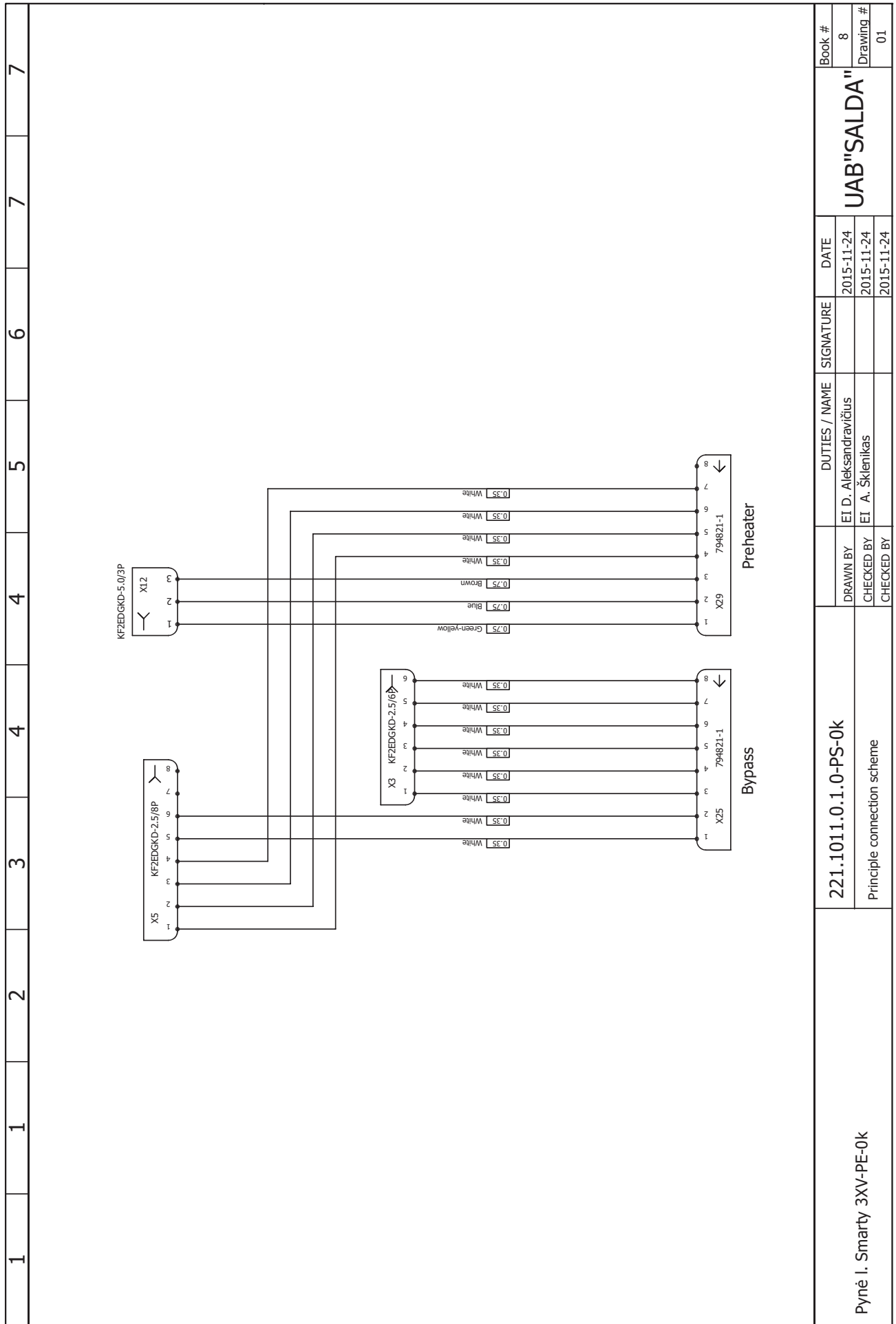
Aut. 219.1017E	219.1017.0.1.3-PS		DUTIES / NAME		DATE		Book #	
	Principle connection scheme		DRAWN BY EI D. Aleksandravičius	CHECKED BY EI A. Šklenikas	2016-03-22	2016-03-22	1	Drawing # 03
			SIGNATURE		UAB "SALDA"			



The principal connection scheme of internal and external components

1	2	3	4	4	5	6	7	7
<p style="text-align: center;">Bypass position switch</p> <p style="text-align: center;">Bypass actuator motor</p>								
<p>Pynė I. SMARTY ZP3XV-0k</p>			<p>221.1007.0.1.1-PS-0k</p>			<p>Principal connection scheme</p>		
<p>DRAWN BY Ei D. Aleksandravičius</p>			<p>DUTIES / NAME</p>			<p>SIGNATURE</p>		
<p>CHECKED BY Ei A. Škenikas</p>			<p>DATE</p>			<p>DATE</p>		
<p>CHECKED BY</p>			<p>2015-11-19</p>			<p>2015-11-19</p>		
<p>BOOK #</p>			<p>6</p>			<p>BOOK #</p>		
<p>DRAWING #</p>			<p>01</p>			<p>DRAWING #</p>		
<p><b>UAB "SALDA"</b></p>								

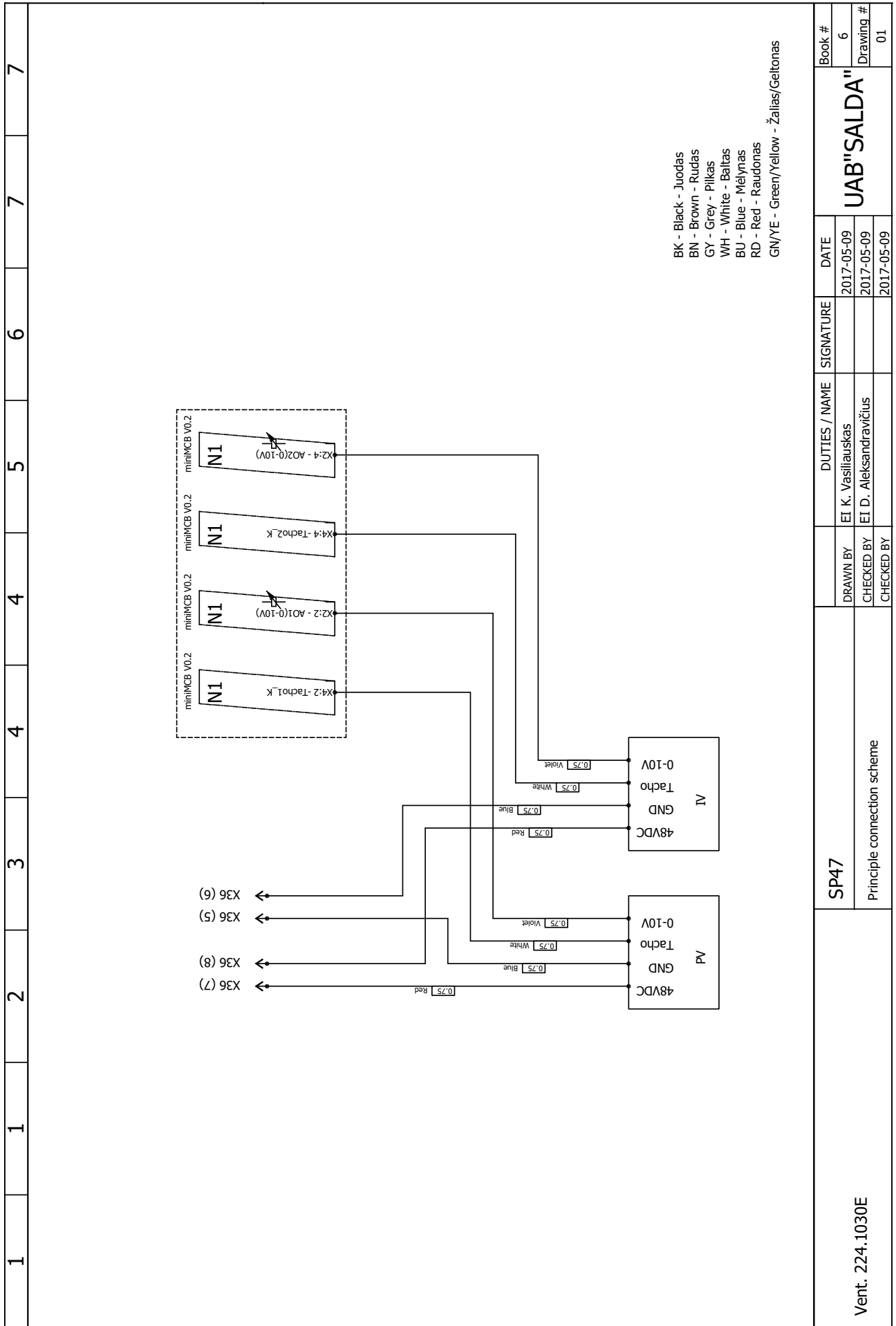
The principal connection scheme of internal and external components



1	1	2	3	4	4	5	6	7	7
---	---	---	---	---	---	---	---	---	---

Pynė I. Smarty 3XV-PE-0k	221.1011.0.1.0-PS-0k			UAB "SALDA"			Book #
	Principle connection scheme						8
	DRAWN BY	DUTIES / NAME	SIGNATURE	DATE	Drawing #		
	EI D. Aleksandravičius	EI D. Aleksandravičius		2015-11-24	01		
	CHECKED BY			2015-11-24			
	EI A. Šklėnikas			2015-11-24			
	CHECKED BY			2015-11-24			

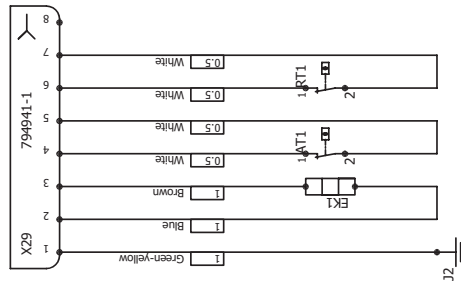
The principal connection scheme of internal and external components



Vent. 224.1030E	SP47	DUTIES / NAME	DATE	Book #
Principle connection scheme		EI K. Vasiliauskas	2017-05-09	6
		EI D. Aleksandravičius	2017-05-09	Drawing #
		2017-05-09		01
<b>UAB "SALDA"</b>				

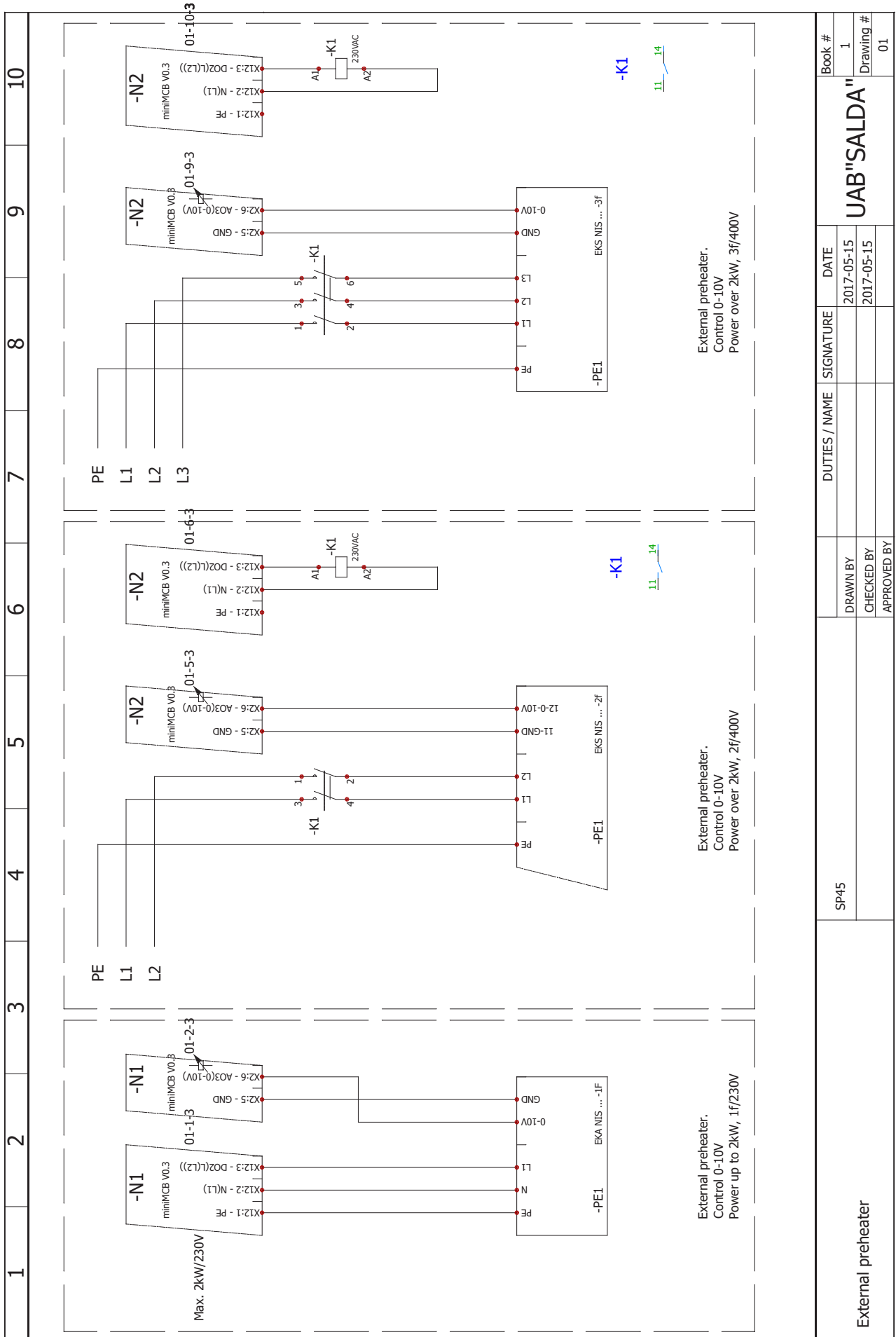
The principal connection scheme of internal and external components

1	1	2	3	4	4	5	6	7	7
---	---	---	---	---	---	---	---	---	---



Heater	SP35		Principle connection scheme		DRAWN BY	SIGNATURE	DATE	Book #
					CHECKED BY		2015-11-24	13
					CHECKED BY		2015-11-24	Drawing #
					CHECKED BY		2015-11-24	01
					<b>UAB "SALDA"</b>			

The principal connection scheme of internal and external components



External preheater		SP45		DUTIES / NAME		SIGNATURE		DATE		Book #	
External preheater.		External preheater.						2017-05-15		1	
Control 0-10V		Control 0-10V						2017-05-15		Drawing #	
Power up to 2kW, 1f/230V		Power over 2kW, 2f/400V								01	
										UAB "SALDA"	

## System protection

### System protection

Unit controller miniMCB has integrated protection against short-circuit.  
F1 - 1A (5x20) controller power supply 230VAC/24VDC protection.



To ensure safe maintenance of the unit, it is necessary to remove the plug from the power network.

### Recommendations before the start of the unit (before the final user)

Prior to start-up the system must be thoroughly cleaned. Check whether:

- operation systems and unit elements as well as automation and automation devices were not damaged during installation,
- all consumers are connected to power supply and fit for service,
- all necessary automation elements are installed and connected to power supply and miniMCB basic, EX1 terminal blocks,
- cable connection to miniMCB basic, EX1 terminal blocks comply with the existing power connection diagrams,
- all electrical equipment protection elements are properly connected (if they are additionally used),
- cables and wires correspond to all applicable safety and functional requirements, diameters, etc.,
- earthing and protection systems are properly installed,
- condition of all seals and sealing surfaces is proper.

### Possible faults and troubleshooting

Failure	Cause	Explanation / corrective actions
Unit is not operating	No supply voltages	Check whether the device is connected to the plug socket
	Two-pole protection device is off or a current leakage relay is active (if installed by the installer)	Switch on only if the unit condition has been evaluated by a qualified electrician. If the system failed, the failure MUST BE rectified prior to switching it on.
Air supply heater or heater is not operating or malfunctioning (if installed)	Too low air flow in air ducts activates automatic protection	Check if air filters are not clogged Check if fans are rotating
	Manual protection is activated	Possible heater or unit failure. MUST address the servicing staff for failure detection and its elimination.
Too low air flow at rated fan speed	Clogged supply and/or extract air filter(s)	Filter replacement needed
Filters are clogged and no message is shown on the remote control	Wrong time in filter timers	Shorten filter timer time till the message of clogged filters

### Sensors and their technical information

The controller is used with NTC sensors.

Default sensor NTC

10 kΩ β (25/85) 3977

Limits for temperature measurement -30 ...105 °C.

Accuracy - ± 0,2 %

Safety class – IP-54

Controller miniMCB EX1 V1.0

Controller miniMCB EX1 V1.0 zones

Fig. 1. Unit automation:

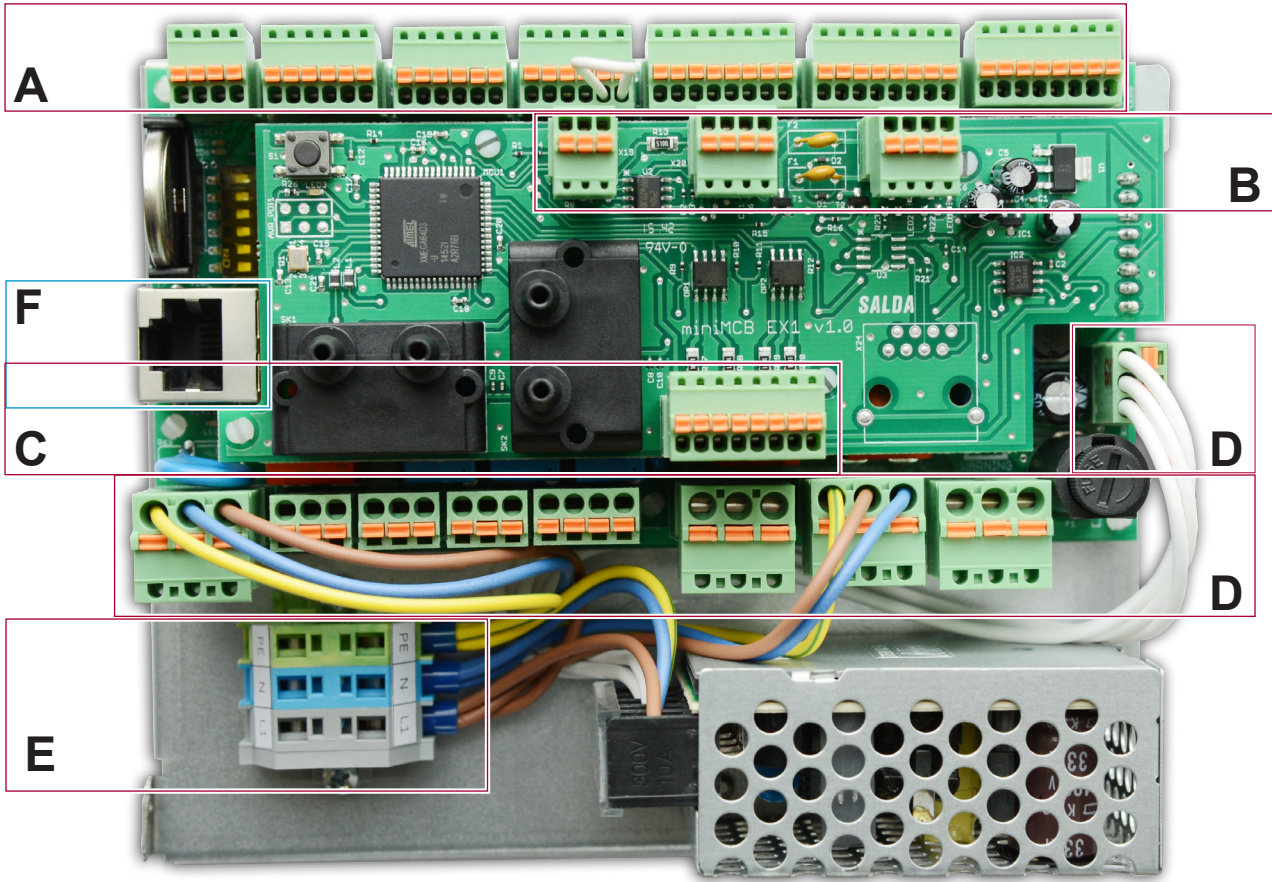
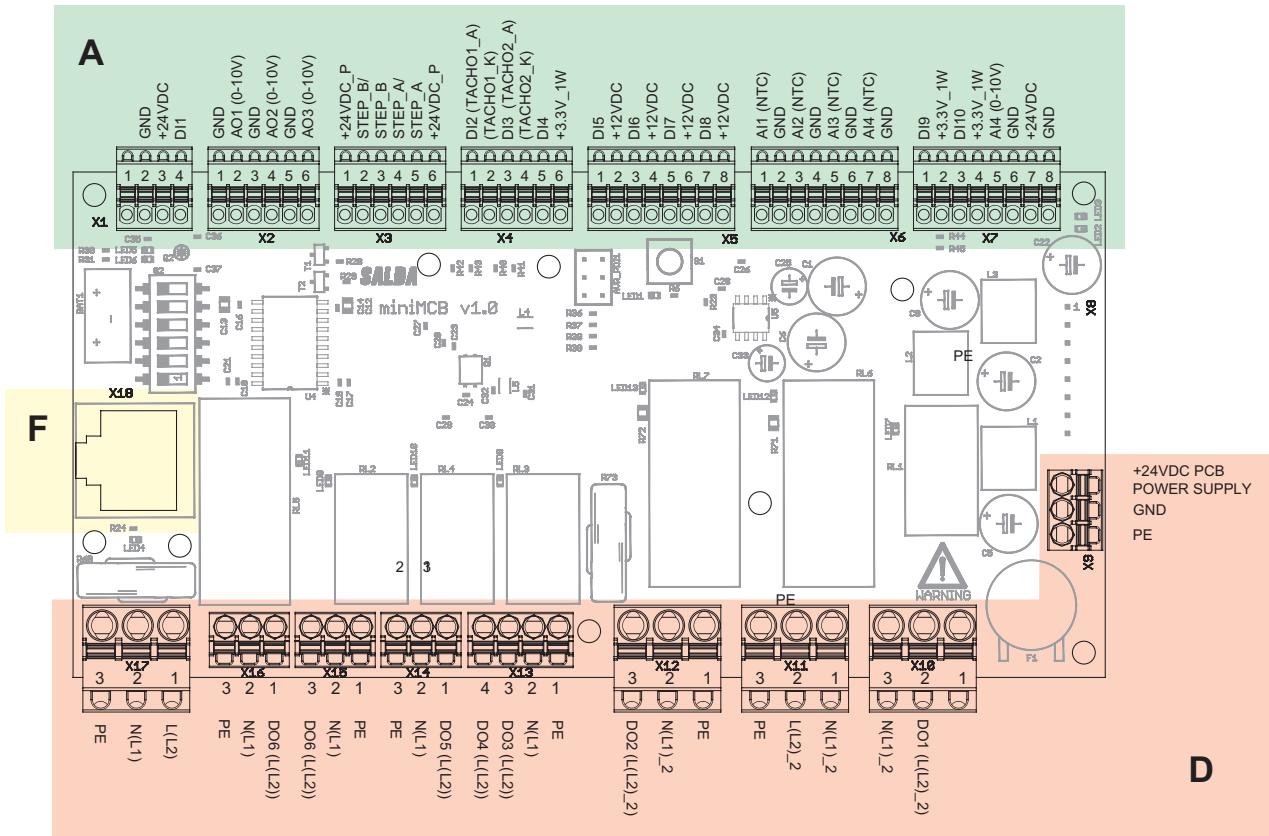


Fig. 2. miniMCB controller zones:



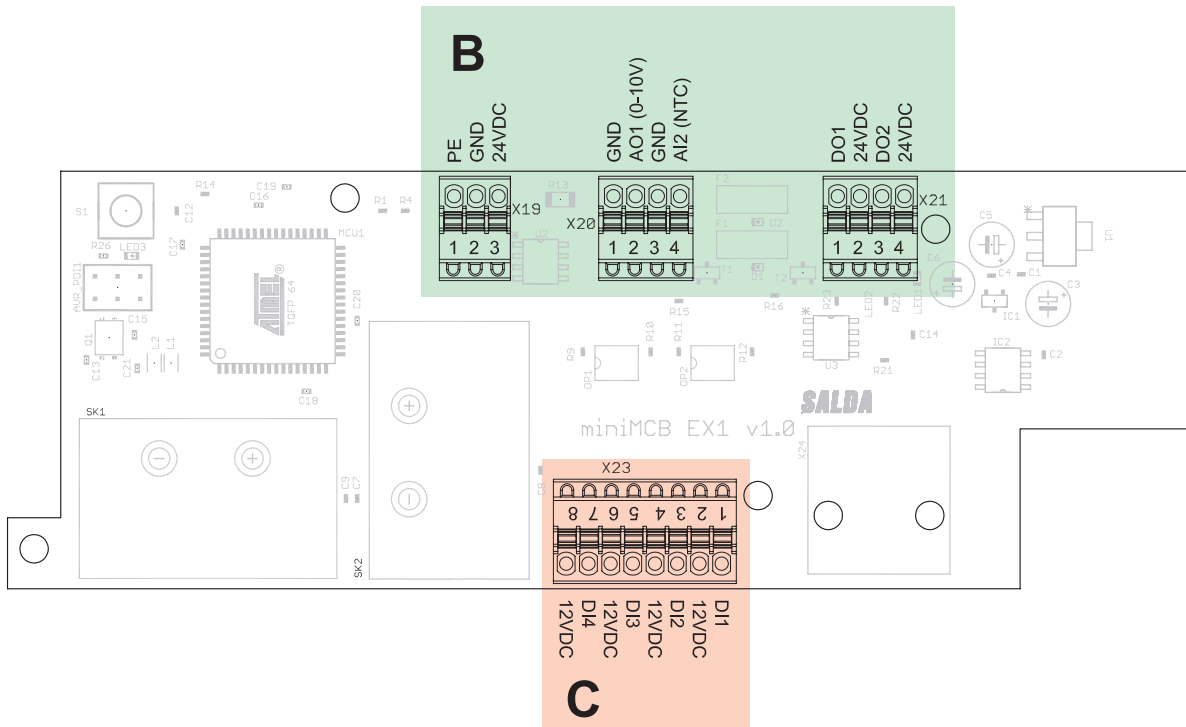
A			
Connector	Contact No.	Contact name	Functional block name
<b>miniMCB</b>			
X1	1	PE	Not used
	2	GND	
	3	24VDC	
	4	DI1 (HOLO)	
X2	1	GND	Supply air fan control (output 0-10VDC)
	2	AO1 (0-10V)	Extract air fan control (output 0-10VDC)
	3	GND	
	4	AO2 (0-10V)	
	5	GND	Electric/Water preheater control (output 0-10VDC)
	6	AO3 (0-10V)	
X3	1	24VDC_P	Bypass step motor control
	2	STEP_B/	
	3	STEP_B	
	4	STEP_A/	
	5	STEP_A	
	6	24VDC_P	
X4	1	DI2 (TACHO1_A)	Supply fan speed RPM
	2	(TACHO1_K)	Extract fan speed RPM
	3	DI3 (TACHO2_A)	
	4	(TACHO2_K)	
	5	DI4	Fire protection input (NC)
	6	3.3V_1W	
X5	1	DI5	Electric Preheater automatic protection (NC)
	2	12VDC	Electric Preheater manual protection (NC)
	3	DI6	
	4	12VDC	
	5	DI7	Bypass closed (NC)
	6	12VDC	Not used
	7	DI8	
	8	12VDC	
X6	1	AI1 (NTC)	Supply air temperature sensor
	2	GND	Fresh air temperature sensor
	3	AI2 (NTC)	
	4	GND	
	5	AI3 (NTC)	Extract air temperature sensor
	6	GND	Exhaust air temperature sensor (optional)
	7	AI4 (NTC)	
	8	GND	



X7	1	DI9	System mode switch
	2	3.3V_1W	
	3	DI10	Fan speed switch
	4	3.3V_1W	
	5	AI4 (0-10V)	A2-Extract air CO <sub>2</sub> or RH (input 0-10VDC)
	6	GND	
	7	24VDC	24VDC Power supply for Air quality transmitter I
	8	GND	
<b>D</b>			
Connector	Contact No.	Contact name	Functional block name
<b>miniMCB</b>			
X9	1	24VDC POWER	24VDC power supply input
	2	GND	
	3	PE	
X10	1	PE	Electric/Water Heater power line/circulation pump (max.0,6kW)
	2	DO1 (L(L2)_2)	
	3	N(L1)_2	
X11	1	N(L1)_2	230VAC Power supply for X10 and X12
	2	L(L2)_2	
	3	PE	
X12	1	PE	Preheater power line (max. 2kW)
	2	N(L1)_2	
	3	DO2 (L(L2)_2)	
X13	1	PE	Supply/extract air damper control output DO3 (Open) DO4 (Close) 0,5A
	2	N(L1)	
	3	DO3 (L(L2))	
	4	DO4 (L(L2))	
X14	1	DO5 (L(L2))	Not used
	2	N(L1)	
	3	PE	
X15	1	PE	Supply fans power line - PV
	2	N(L1)	
	3	DO6 (L(L2))	
X16	1	DO6 (L(L2))	Extract fans power line - IV
	2	N(L1)	
	3	PE	
X17	1	L(L2)	230VAC Power supply for X13, X14, X15, X16
	2	N(L1)	
	3	PE	

F			
Connector	Contactor No.	Contactor name	Functional block name
<b>miniMCB</b>			
X18	1	RS422_Z	RS422/485 communication port
	2	RS422_Y	
	3	-	
	4	RS422/485_A	
	5	RS422/485_B	
	6	RS_GND	
	7	24VDC	
	8	GND	

Fig. 3. EX1 controller zones



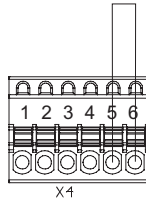
B			
Connector	Contactor No.	Contactor name	Functional block name
<b>miniEX1</b>			
X19	1	AI1 (0-10V)	A1-Supply air CO <sub>2</sub> or RH (input 0-10VDC)
	2	GND	
	3	24VDC	
X20	1	GND	Electric/Water heater control (output 0-10VDC)
	2	AO1 (0-10V)	Hydraulic heater water temperature sensor
	3	GND	
	4	AI2 (NTC)	
X21	1	DO1	Working indication output (START). 24VDC; 1,2W max.
	2	24VDC	Alarm indication output (STOP). 24VDC; 1,2W max.
	3	DO2	
	4	24VDC	

C			
Connector	Contact No.	Contact name	Functional block name
<b>miniEX1</b>			
X23	1	DI1	Electric heater manual protection (NC)
	2	12VDC	
	3	DI2	Electric heater automatic protection (NC)
	4	12VDC	
	5	DI3	Filter relay/Fire place I, DI (NC)
	6	12VDC	
	7	DI4	Filter relay/Fire place II, DI (NC)
	8	12VDC	

**Fire Protection Signal Input (Fire protection input (NC))**

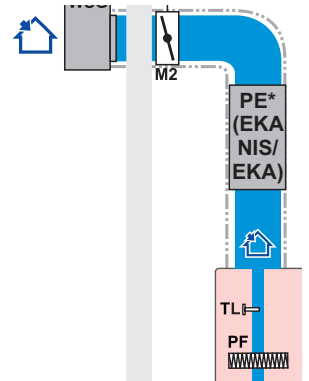
Fire protection signal input must be normally closed, until the fire protection system is not connected a jumper is installed in the factory.

Automation controller A zone X4.



**Outdoor Air Pre-Heater**

In product versions 1.1 pre-heater is integrated inside the product. In product versions 1.2 and 1.3 pre-heater is integrated on the outdoor air channel. Pre-heater is controlled by 0-10V signal.

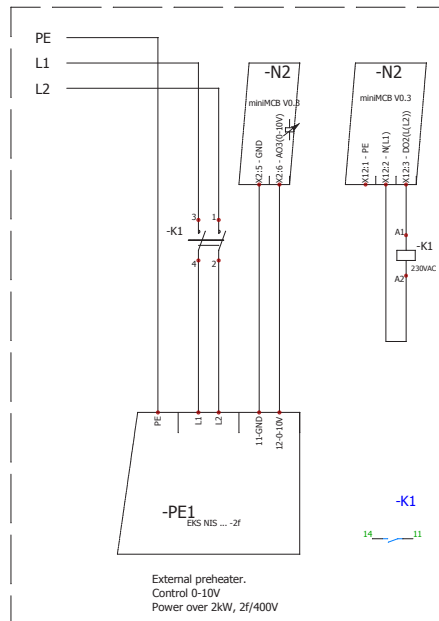
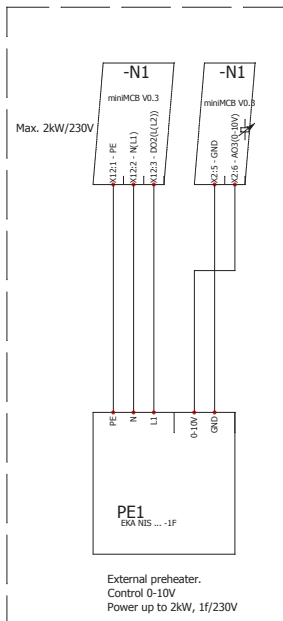


**Installation diagram.**

Installation based on air direction Air Damper M2 -> Pre-Heater PE -> Recuperator.

**Wiring diagram.**

Automation controller A (X2) and D (X12) zones



**System mode ir Fan speed switch**

Functions are activated with external switches.  
Automation controller A zone.

System mode switch X7: 1, 2

Fan speed switch X7: 3, 4

**Supply air CO<sub>2</sub> or RH (input 0-10VDC)**

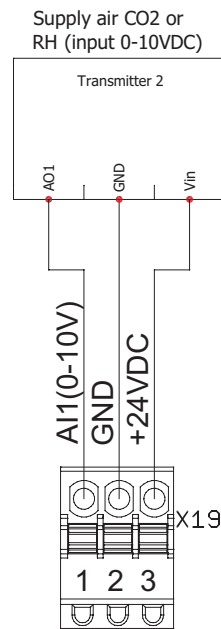
Supply air CO<sub>2</sub> or RH (input 0-10VDC) connection. This connection is possible for unit version 1.1 miniMCB basic with EX1 controller.

**Installation diagram.**

Transmitter shall be installed inside supply air duct.

**Wiring diagram.**

Automation controller B zone X19.



**Extract air CO<sub>2</sub> or RH (input 0-10VDC)**

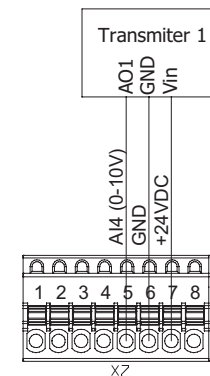
Extract air CO<sub>2</sub> or RH (input 0-10VDC) connection.

**Installation diagram.**

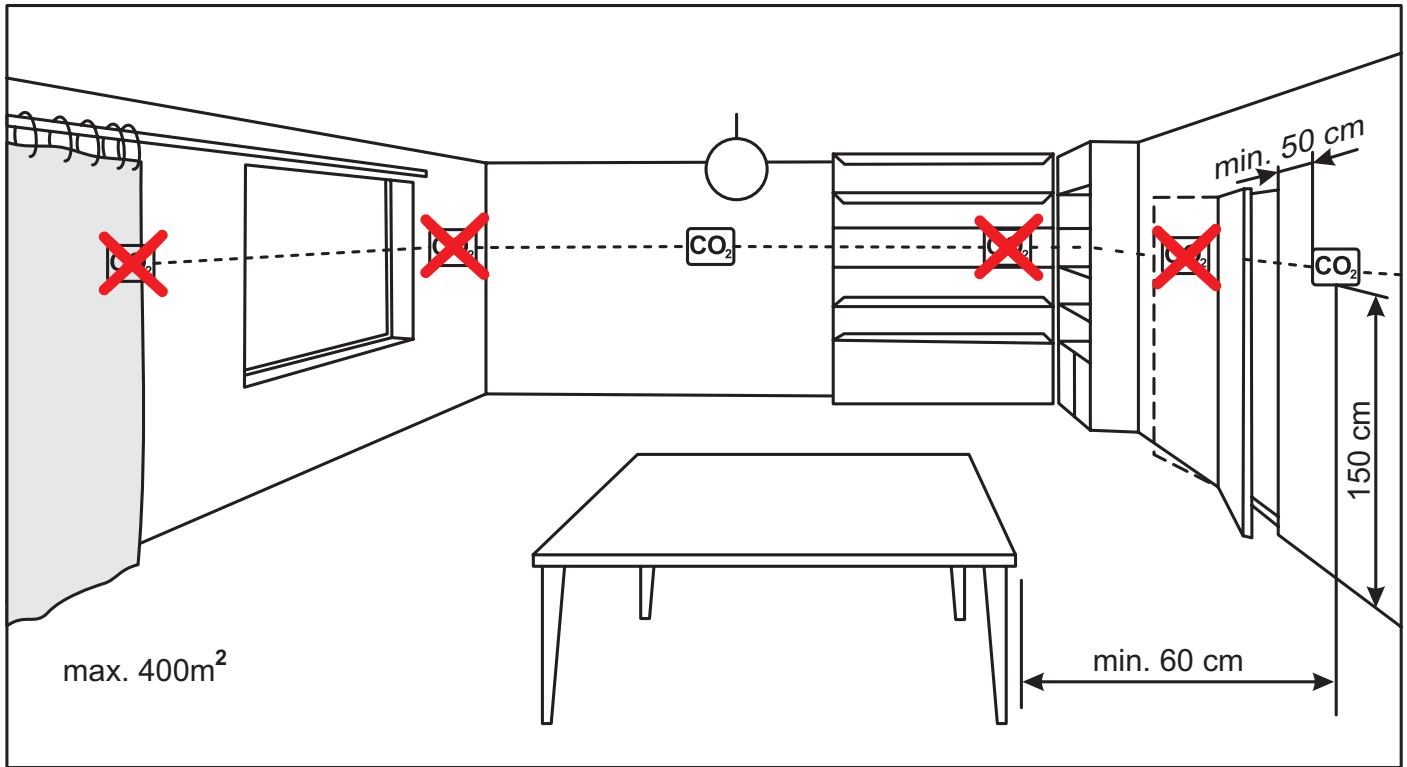
Transmitter shall be installed inside extract air duct or room.

**Wiring diagram.**

Automation controller A zone X7.

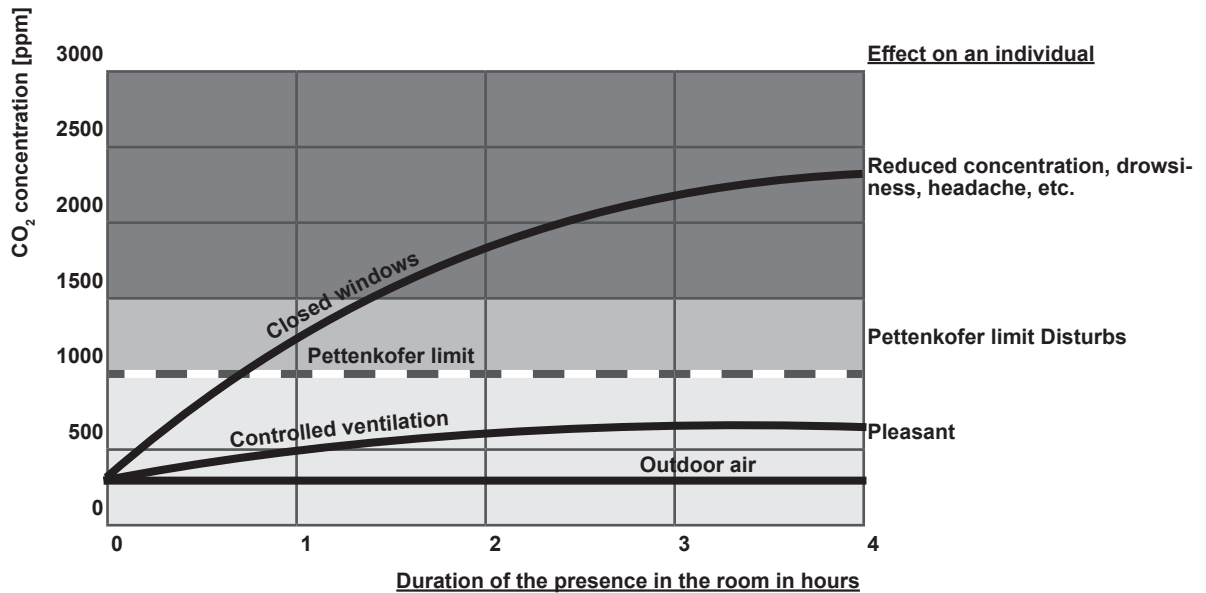


Room CO<sub>2</sub> transmitter installation recommendation



Where the channel CO<sub>2</sub> transmitter is used: it must be installed in the extract air duct. Tool for drilling holes are required for its installation.

CO<sub>2</sub> concentration according to Pettenkofer limit



Smarty 4X V 1.1 Version - Heater Control

Product Smarty 4X V 1.1 version can be equipped with either electric or water heater.

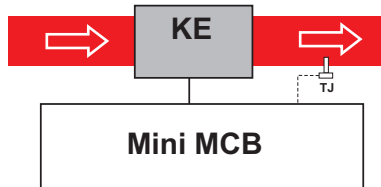
The electric heater can be controlled by:

- On/Off – control of electric heater up to 0.6kW/230V or the circulation pump.
- 0-10V – control of electric or water heater.

- Electric heater control by On/Off.

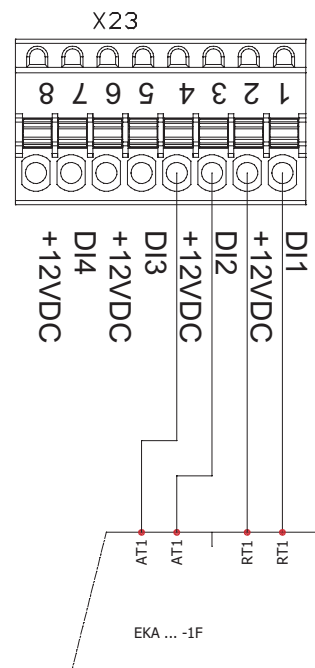
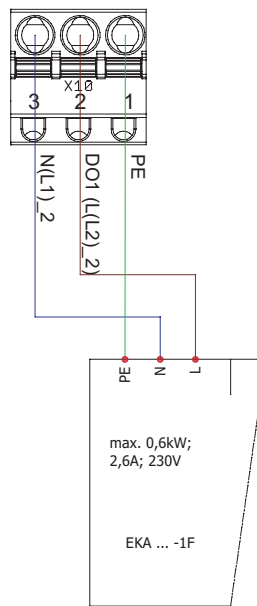
**Installation diagram.**

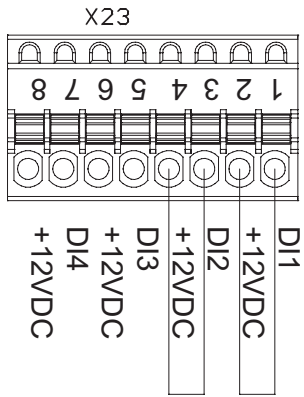
Electric heater shall be installed inside air duct. Arrangement based on air direction Electric Heater -> Supply Air Sensor (TJ).



**Wiring diagram.**

On/Off heater connection. Automation controller D zone X10 and C zone X23. This control method is suitable only to electric heaters up to 0.6 kW/230 V. In order to control more powerful heater above 0.6 kW by On/Off method, intermediate relay shall be used where power circuit shall be connected to a separate power supply.



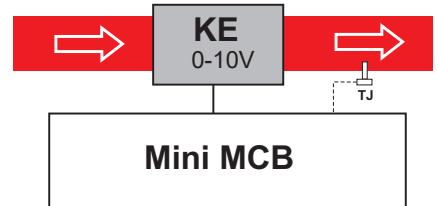


- Automatic and manual protection shall be connected to EX1 controller X23 connector if the electric heater is equipped with these connection terminals.
- Otherwise jumpers are installed on X23 connector protection inputs.

- Electric heater control 0-10V.

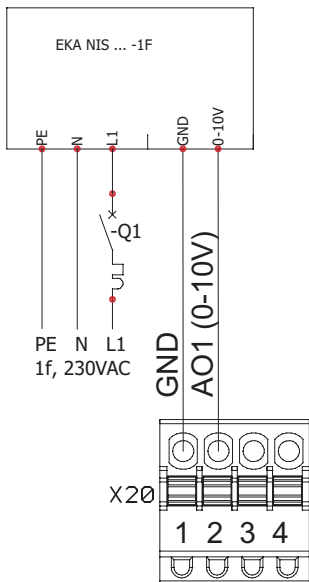
**Installation diagram.**

Electric heater shall be installed inside air duct. Arrangement based on air direction Electric Heater -> Supply Air Sensor (TJ).

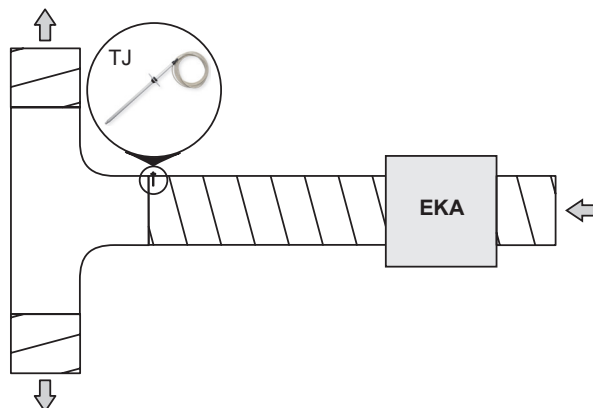


**Wiring diagram.**

0-10V heater connection. Automation controller B zone, X20 connector.



When using the supply air heater, the supply air sensor (SS) shall be installed downstream the heater (or cooler) as the sensor cable allows or until the first branching, bend of the air transportation system.



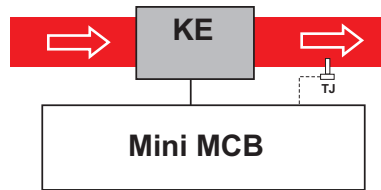
Smarty 4X V 1.2 Version - Heater Control

Smarty 4X V 1.2 version of the product can be connected which an electrical heater, which can be controlled by

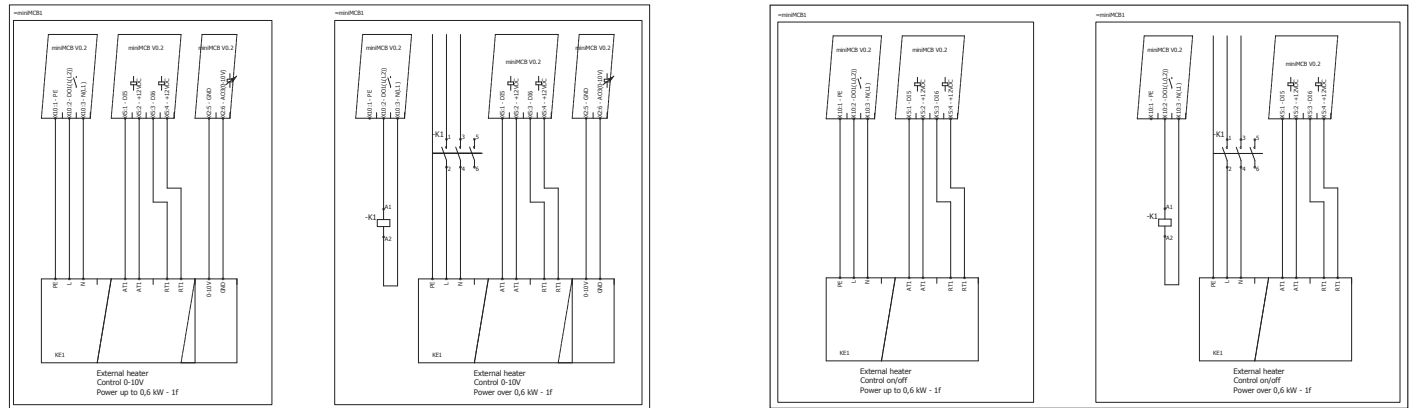
- On/Off signal EKA;
- 0-10V signal EKA NIS.

Installation diagram

The electrical heater shall be installed in the air duct. The arrangement procedure in the direction of air: electrical heater -> TJ supply air sensor.



Connection diagrams SP55 and SP56:

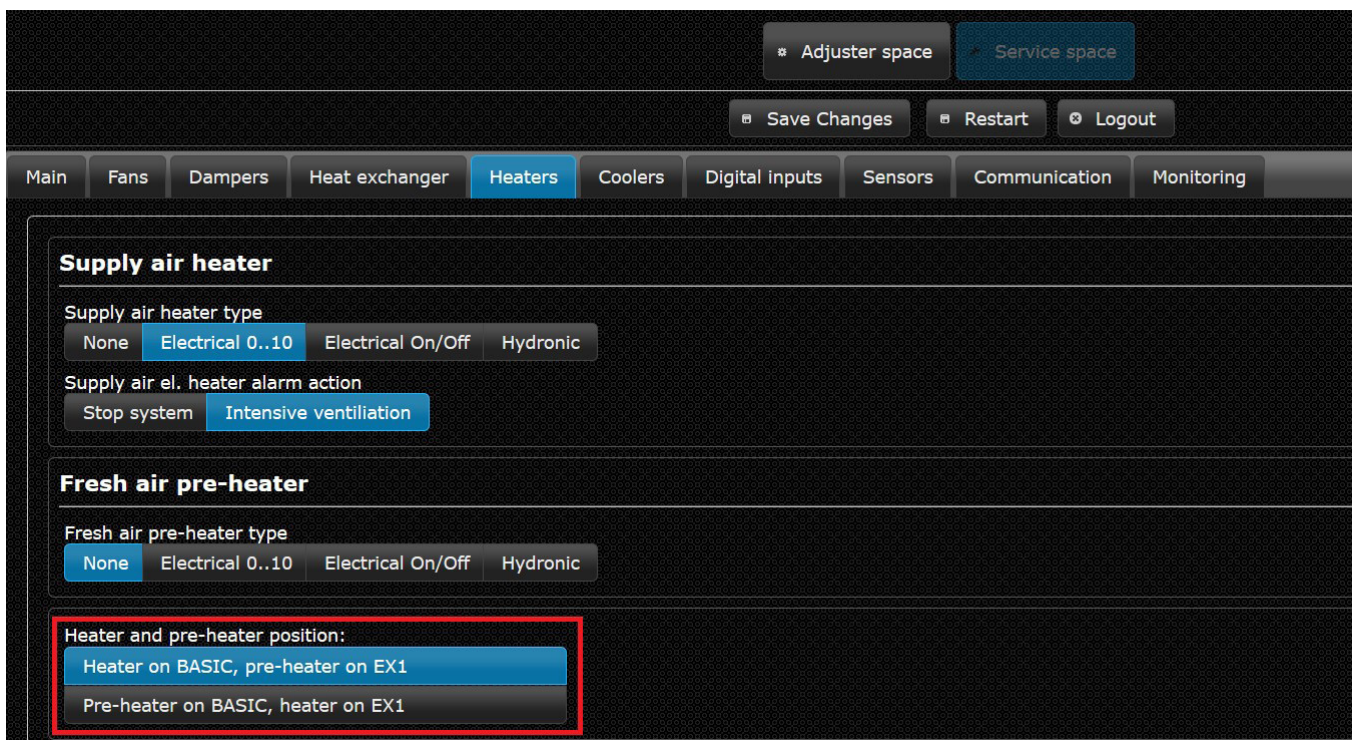


Since a pre-heater is to be connected according to the factory settings, settings should be changed in the environment of the MB-Gateway WEB application service.

Settings in the environment of the MB-Gateway WEB application service

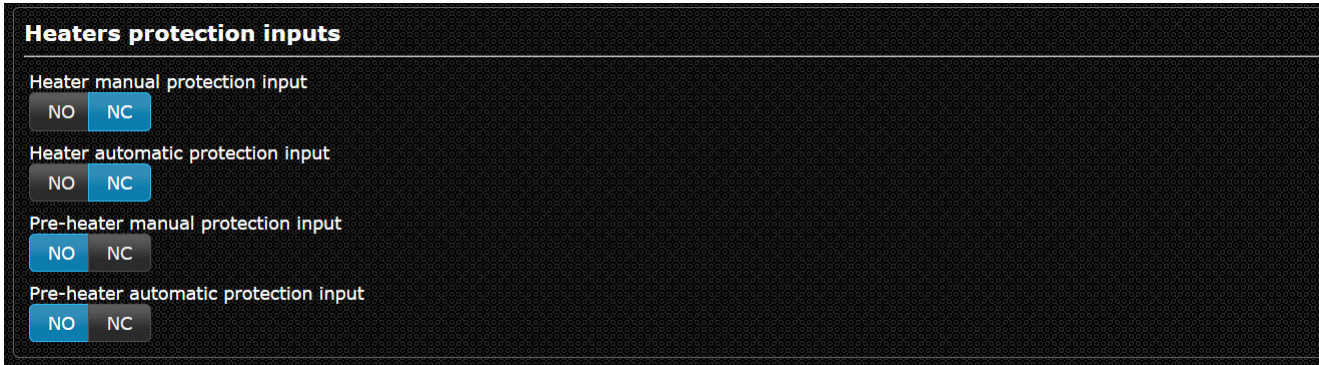
Change the settings as follows:

- Service password 4444;
- Service -> Heaters -> Heater and pre-heater position;
- Select either the heater or pre-heater to be switched on MiniMCB basic.

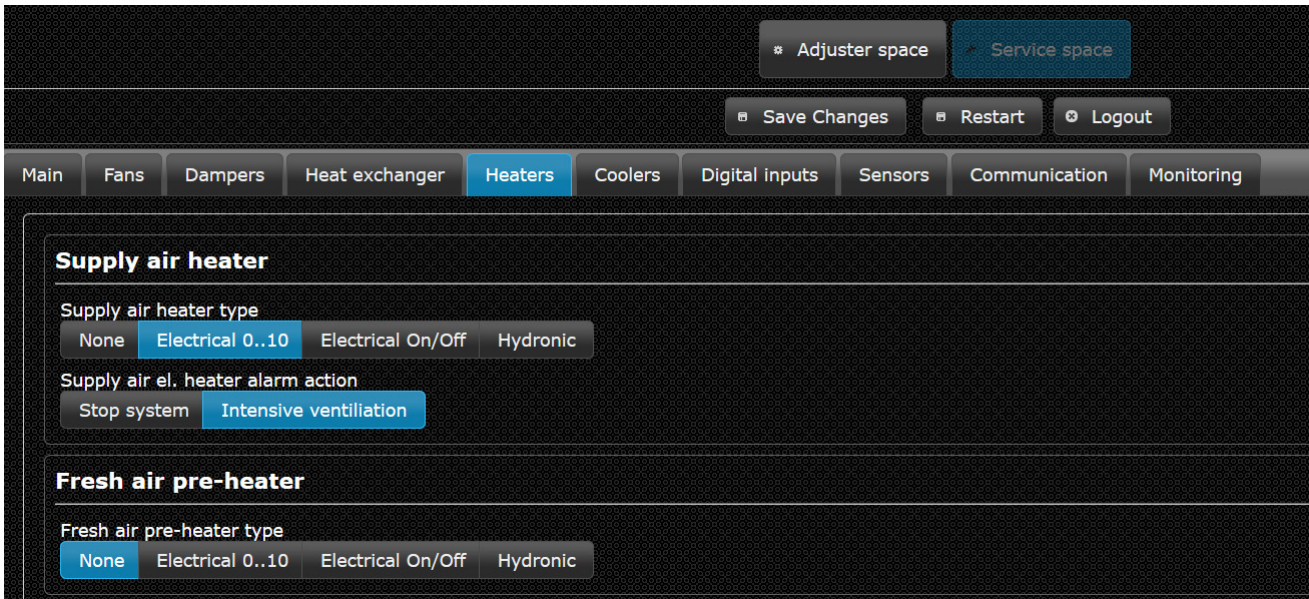




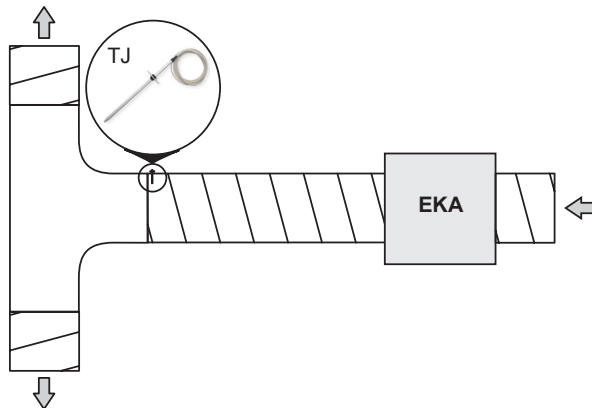
• Service -> Digital inputs -> Heaters protection inputs  
Set the manual and automated protection statuses of the heater or pre-heater – according to the standards, it should be NC.



• Service -> Heaters -> Supply air heater or Fresh air pre-heater  
Set whether it is a heater or pre-heater as well as the type of the heater or pre-heater and actions to be performed in case of the activation of a danger signal.



When using the supply air heater, the supply air sensor (SS) shall be installed downstream the heater (or cooler) as the sensor cable allows or until the first branching, bend of the air transportation system.



Connection of Supply and Extract Air Dampers

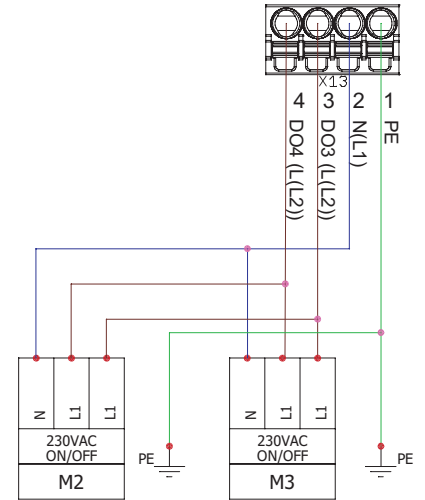
Product Smarty 4XV all versions can be equipped with fresh air damper and extract air drives. They are controlled by 3-point.

Installation diagram.

See "Principle mounting diagram" - 28-30 p.

Wiring diagram.

Automation controller D zone. Upon activation of output X13:3 the dampers shall open, Upon activation of output X13:4 the dampers shall close.



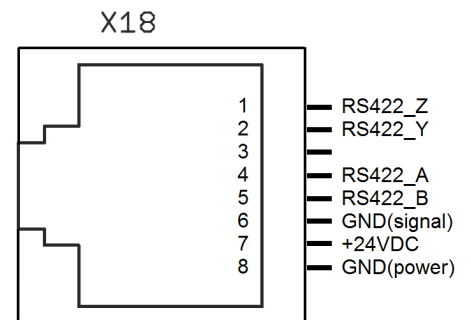
Connection of Remote Control Panel or ModBus

Wiring diagram.

Automation controller F zone, X18 connector.

Switch positions for X18 connector configuration

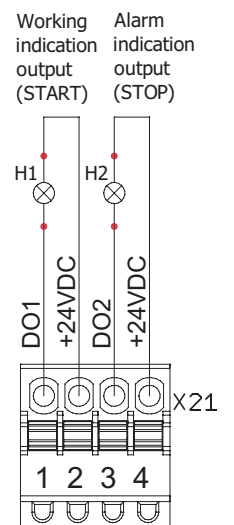
Switch	Position	Purpose
S2	1	A+Y (RS422->RS485)
	2	B+Z (RS422->RS485)
	3	120R line termination resistor
	4	1kR line pull-up resistor
	5	1kR line pull-down resistor
	6	Galvanic isolation disable (turn ON when connecting Remote Controller - RS_GND will be shorted to GND, OFF - when connecting to BMS)



Operation and Alarm Indication (Smarty 4X V 1.1)

Wiring diagram.

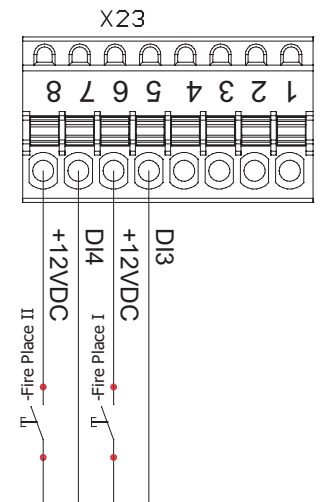
Automation controller B zone, X21 connector.



## Fire Place Connection (Smarty 4X V 1.1)

**Wiring diagram.**

Automation controller C zone, X23 connector.

**LED indication****miniMCB**

LED1	3.3V miniMCB power indication (1W mode)
LED2	12V miniMCB power indication
LED3	3.3V miniMCB power indication (ON mode)
LED4	MiniMCB status LED
LED5	Communication line Transmit indication
LED6	Communication line Receive indication
LED7	24V peripheral POWER ON indication

**miniEX1**

LED1	EX1 status LED
------	----------------

Smarty 4X V Accessories



Electrical heater  
**EKA 160 0.3-1f**  
PSIEKA075



Electrical preheater  
**EKA 160 3.0-1f**  
PSIEKA16002



Electrical preheater  
**EKA 160-5.0-2f**  
PSIEKA16007



Electrical preheater  
**EKA 160-6.0-3f**  
PSIEKA019



Electrical preheater  
**EKA NIS 160-3,0-2f**  
PSIEKANIS26



Electrical preheater  
**EKA NIS 160-5,0-2f**  
PSIEKANIS27



Electrical preheater  
**EKA NIS 160-6,0-3f**  
PSIEKANIS29



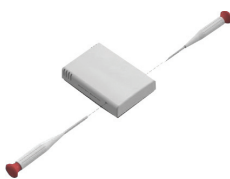
CO<sub>2</sub> sensor  
**S-RCO2-F2**  
ZAKKT0048



CO<sub>2</sub> sensor  
**S-KCO2**  
ZAKKT0049



Channel humidity transmitter  
**S-KFF-U**  
ZAKKT0051



Humidity transmitter  
**S-RFF-U-D-F2**  
ZAKKT0050



Remote control panel with  
rj45 cable  
**Stouch**  
PRGPU051\_rj45



Net module  
**MB Gateway**  
GAUMBGATEWAY001



Switch  
**774451+774411**  
ZEPSM001



Duct smoke detector  
**UG-3-A40 incl VR-0,6M**  
ZAKKT0110



Wall presence detector  
**IR24-P**  
ZAKJT019



Ceiling presence detector  
**IR24-P**  
ZAKJT020



Motion detector  
**PATROL-701**  
ZAKJT021



Actuator for damper  
**CM230-F-L**  
ZAKP0076



Temperature sensor 3  
**mTE**  
PJUT0063



Silencer  
**MUTE 160x600**  
GSOMUTE010



Silencer  
**MUTE 160x900**  
GSOMUTE012



Silencer  
**AKS 160-10**  
GSOAKS029



Silencer  
**MUTE 160x1200**  
GSOMUTE013



Damper  
**SKG 160**  
GSKSKG003



NEW filter  
www.newfilter.it

Filter 475x134x25 G4 with  
band  
**MPL**  
ZFEPF120



NEW filter  
www.newfilter.it

Filer 475x180x25 G4 with  
band  
**MPL Z**  
ZFEPF121

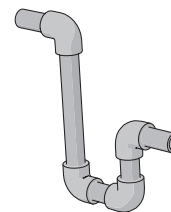


NEW filter  
www.newfilter.it

Filer 475x134x25 F7 with  
band  
**MPL**  
ZFEPF119  
(optional)



Condensate pump  
**MAXI BLUE SET**  
PRGSIK002



Siphon  
**Siphon D20**  
GKIS001

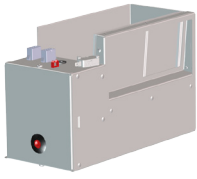


Legs  
**Smarty legs**  
GAGSMARTY168\_1004

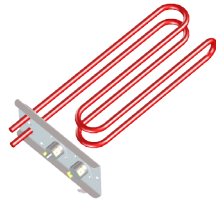


Supply and extract air  
grating  
**WSG 160**  
GGRWSG0126\_509

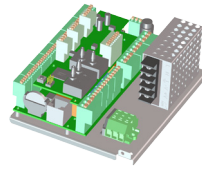
Smarty 4X V Spare Parts



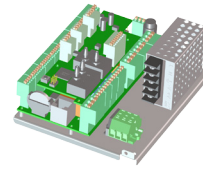
Damper  
**Damper**  
GPUSK227\_1004\_1016



Electric heater  
**Heater\***  
ZESS220\_1017\_1018



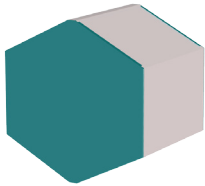
Control board  
**Mini MCB\***  
GAUSM219\_1017\_1056



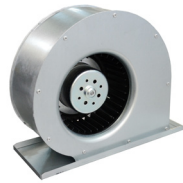
Control board  
**Mini MCB Basic\*\***  
GAUSM219\_1017\_1064



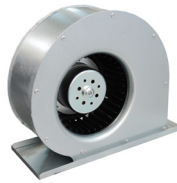
Smarty 4X V door  
**Door**  
GPUD232\_1028\_0



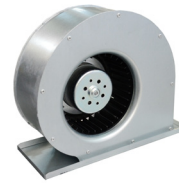
Heat exchanger  
**Heat exchanger**  
ZSLPLGS0023



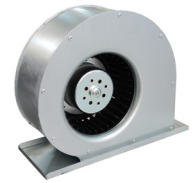
Supply/extract air fan  
**Fan\*\***  
GPUVM224\_1068\_1068



Supply/extract air fan  
**Fan\***  
GPUVM224\_1030\_1030



Supply/extract air fan  
**Fan\***  
GPUVM224\_1031\_1031



Supply/extract air fan  
**Fan\*\***  
GPUVM224\_1069\_1069



Temperature sensor 3 m  
**TJ**  
PJUT0063



Temperature sensor 1,5 m  
**TL/TA**  
PJUT0062



Switching Power Supply  
**G2**  
GPYSM221\_1164E

\* only Smarty 4X V 1.1  
\*\* only Smarty 4X V 1.2

## Warranty

1. All equipment manufactured in our factory is checked in operating conditions and tested before delivery. Test protocol is supplied together with the unit. The equipment is shipped in good working order and condition to the direct client. The unit is warranted for the period of two years from the invoice date.
2. If equipment is found to have been damaged during transportation, a claim should be made against carrier, as we assume no responsibility for such damage.
3. This warranty does not apply:
  - 3.1. when transportation, storage, installation and maintenance instructions of the unit are violated;
  - 3.2. when the equipment is improperly maintained, mounted - inadequate maintenance;
  - 3.3. when the equipment without our knowledge and permission has been upgraded or unskilled repairs were made;
  - 3.4. when the unit was used not for its original purpose.
4. This warranty does not apply at these malfunction cases:
  - 4.1. mechanical damage;
  - 4.2. damage caused by entering outside objects, materials, liquids;
  - 4.3. damage caused by natural disaster, accident (voltage change in the electricity network, lightning, etc..).
5. The company assumes no liability for its products either directly or indirectly damage, if the damage is caused by failure to comply with installation and mounting regulations, deliberate or careless users or third-party behavior.

These conditions are readily discernable when the equipment is returned to our factory for inspection.

If the direct client determines that equipment is found to be faulty, or a breakdown occurred, he should inform the manufacturer within five working days and deliver the equipment to manufacturer. Delivery costs should be covered by customer.

Unit's maintenance table

Product name	*1
gu/lu number	*1

	Interval	Date
Installation		
Fan cleaning	Once a year *2	
Heat exchanger cleaning	Once a year *2	
Filter replacement	Every 3-4 months *2	

\*1  
-Look at the product label.

\*2  
- At least.

NOTE. The purchaser is required to fill in the "Product maintenance table".