

Universal control box for air condition with the application MINI

ELP14R18-MOD
ELP14R18-BAC MS-TP



Technical documentation

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1. General information



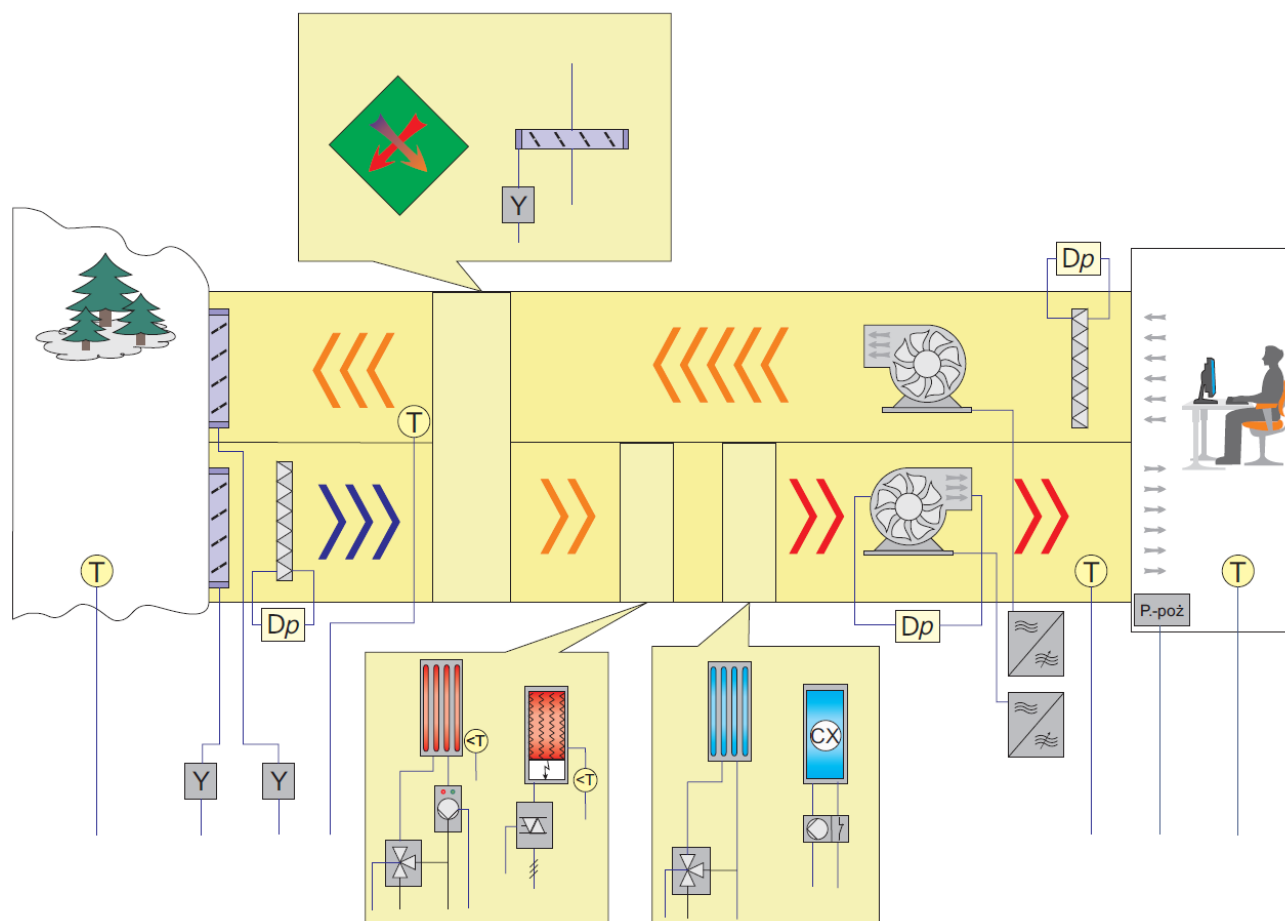
The control box can be handled by untrained personnel.

EL-...-...-...-... controller conforms with requirements of the following standards:

PN-EN 60335-1:2004, PN-EN 60439-1:2003, PN-EN 60439-3:2004, PN-EN 50082-1:1999; PN-EN 50081-1:1996

Intended use

- Supply and Supply & Exhaust Air Handling Units
- Systems with water heaters, electric heaters
- Systems with water cooler, DX cooler
- Systems with plate heat exchanger (with by-pass), plate heat exchanger (without by-pass) or mixing chamber



2. Encryption of control boxes

Type	Recovery	Heater	Cooler
N - supply NW - supply/exhaust	Kx - plate heat exchanger (without by-pass) M - mixing chamber KxM - plate heat exchanger and mixing chamber K 0-10 - plate heat exchanger (with by-pass)	W - water E - electric	W - water F - DX

The universal control box MINI after the right configuration of the controller, offers the work one of the 61 ventilation systems introduced below arrangements for the guidance:

1	N	-	-	-	-	W
2	N	-	-	-	-	F
3	N	-	-	-	W	-
4	N	-	-	-	W	W
5	N	-	-	-	W	F
6	N	-	-	-	E	-
7	N	-	-	-	E	W
8	N	-	-	-	E	F
9	N	-	M	-	-	-
10	N	-	M	-	-	W
11	N	-	M	-	-	F
12	N	-	M	-	W	-
13	N	-	M	-	W	W
14	N	-	M	-	W	F
15	N	-	M	-	E	-
16	N	-	M	-	E	W
17	N	-	M	-	E	F
18	NW	-	-	-	-	W
19	NW	-	-	-	-	F
20	NW	-	-	-	W	-
21	NW	-	-	-	W	W
22	NW	-	-	-	W	F
23	NW	-	-	-	E	-
24	NW	-	-	-	E	W
25	NW	-	-	-	E	F
26	NW	-	K	-	-	-
27	NW	-	K	-	-	W
28	NW	-	K	-	-	F
29	NW	-	K	-	W	-
30	NW	-	K	-	W	W
31	NW	-	K	-	W	F

32	NW	-	K	-	E	-
33	NW	-	K	-	E	W
34	NW	-	K	-	E	F
35	NW	-	KX	-	-	-
36	NW	-	KX	-	-	W
37	NW	-	KX	-	-	F
38	NW	-	KX	-	W	-
39	NW	-	KX	-	W	W
40	NW	-	KX	-	W	F
41	NW	-	KX	-	E	-
42	NW	-	KX	-	E	W
43	NW	-	KX	-	E	F
44	NW	-	M	-	-	-
45	NW	-	M	-	-	W
46	NW	-	M	-	-	F
47	NW	-	M	-	W	-
48	NW	-	M	-	W	W
49	NW	-	M	-	W	F
50	NW	-	M	-	E	-
51	NW	-	M	-	E	W
52	NW	-	M	-	E	F
53	NW	-	KXM	-	-	-
54	NW	-	KXM	-	-	W
55	NW	-	KXM	-	-	F
56	NW	-	KXM	-	W	-
57	NW	-	KXM	-	W	W
58	NW	-	KXM	-	W	W
59	NW	-	KXM	-	E	-
60	NW	-	KXM	-	E	W
61	NW	-	KXM	-	E	F

3. System operations

Tab. 1. The functions of the Air Handling Units.






Functionality			Triggering condition	Description
Starting fans			- set the mode 1 gear, 2 gear, 3 gear STAND-BY, CALENDAR	- The opening external damper - Enabling the supply fan motor (air supply) fans or motors supply and exhaust fans (air supply exhaust)
Temperature control	Description		- Set the mode 1 gear, 2 gear, 3gear Standby, Calendar	- Comparing the current temperature measured by the sensor lead to a set point set on the controller or room unit and the activation of heat exchangers / cooling - Reduction of the minimum and maximum air temperature
	Heating	Water heater	- Temperature of the primary control sensor is below the set temperature	- Increasing the flow of fluid (water or glycol solution) by the water heater - Activation of the antifreeze function the system temperature is too low for the heater (thermostat)
		Electric heater		- Continuous increase in power electric heater - Cooling of the heater during the transition from work mode to stop mode, the system - Study of overheating heater thermostat
	Cooling	Water cooler	- Temperature of the primary control sensor is above the desired temperature	- Increasing the flow of fluid (water or glycol solution) through the cooler
		Cooler with direct expansion		- Activation of one, two stage compressor unit - used to block activation of the cooling system at low temperatures (factory setting 13 ° C) - The minimum time the compressor is running (even if the switching signal is not fed) and minimum rest period (even if the switching signal is given)
	Energy recovery systems		Cooling recovery	- Set the mode 1 gear, 2 gear, 3gear Standby, Calendar - Outside temperature higher than the temperature of exhaust sensor 1 ° C
Heat recovery			- Set the mode 1 gear, 2 gear, 3gear Standby, Calendar - Outside temperature lower than the temperature of exhaust sensor 1 ° C	Plate heat exchanger (with by-pass) - Attaching the recovery the system (START / STOP) - Activation of the antifreeze function of the heat recovery system for low temperature in exhaust part of recovery (decrease recovery power) Cooling recovery is disabled by default (to activate it you need to change the parameter Settings/Recovery/Work mode to Summer/Winter
Mixing chamber			- Set the mode 1 gear, 2 gear, 3gear Standby, Calendar - Work in heating sequence	- regulation of opening damper of air on with controllers - the degree of mixing air blown off from the room with outside air blown in depends from the difference of the temperature measured by the sensor of the ventilation and the set temperature - the regulation of the degree of mixing air is appearing before or after the adjustment of cooling and heating devices depending on placing the priority for the mixing chamber or the heater/cooler - possible of activation of the function of heating up: in the event that the environmental temperature will be below the set temperature the arrangement is undergoing heating into the sequence, head offices with the recirculation will be working with the minimum quantity of fresh air (factory settings min 30% open the damper of outside air) and next the adjuster will start adjusting the temperature with the heater - blocking of the mixing chamber in the sequence of the cooling

4. Symbols and wiring

The elements of automation should be installed in accordance with application scheme and the following standards:

- control cables type LIYY, LIYCY (do not use twisted-pair cable as control cables) and control cables type YLY and communication cables PROFIBUS DP typ BUS O2YS(St)CY 1×2×0,64/2,6 mm should be wired according the chart presented in electric chart and technical demands of this application,
- cables' cross-sections were chosen to be installed in 100m long metal cable tray,
- in order to communicate adjuster, inverter and BMS it has to be used wires type shielded - shielded twisted pair (each pair is twisted and shielded and all together are shielded), type PROFIBUS DP typ BUS O2YS(St)CY 1×2×0,64/2,6 mm,
- there is not allowed to put cables responsible for communication together with control cables and power supply cables. For communication cables needs to be provided separate cable routes,
- inverter should be installed not more than 100m away from the controller,
- HMI panel should be installed not more than 100m away from the controller,
- there is not allowed to use one cable simultaneously for more than one function/equipment. There is an obligation for each hardware/function to have autonomic cable,
- there is not allowed to use twisted-pair cable as control cables for signals on/off 24V, 230V, 0-10VDC.

Tab. 3 Cables description.

Type of the wire	Draw	Description	Description
(1)		Multiple strand cable with copper strands in PVC jacket	Nominal voltage: 450/750V Operating temperature: -40 do 70°C
(2)		Cables with multiple, flexible copper strands in PVC jacket	Nominal voltage: 450/750V Operating temperature: -40 do 70°C
(3)		Communication cables (PROFIBUS DP typ BUS O2YS(St)CY 1×2×0,64/2,6 mm) with copper strands, screened with copper wires, in PVC jacket	Nominal voltage: 100V Operating temperature: - 30 do 70°C
(4)		Cables with multiple, flexible copper strands, screened with copper wires, in PVC jacket	Nominal voltage: 450/750V Operating temperature: -40 do 70°C
(5)		Power cable with copper strands, screened with copper wires, in PVC jacket	Nominal voltage: 450/750V Operating temperature: -40 do 70°C

Power cables for the control box, pumps and fan motors shall be installed in accordance with the scheme and wiring list. Cable dimensions were selected based on long-term power load assumption accordance with the standard EN/PN-IEC 60364-5-523.

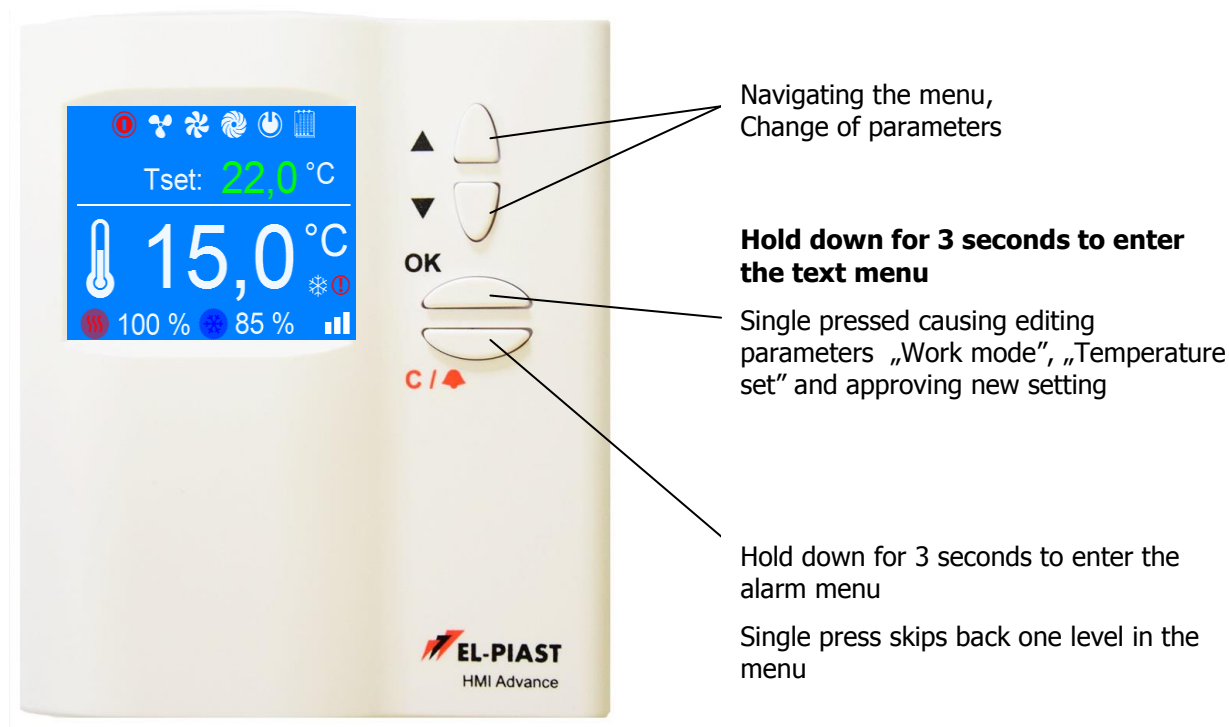
Tab. 4 The standard cable list and symbols of schemes.

Symbol from the application scheme	Description	Type of the wire	Number of x cross - section in mm ²
S1F	Cooperation with the station controller fire-protective	(2)	2x1
Y1	Actuator of the valve of the water heater	(4)	3x1
M1	Connecting of the circulation pump the water heater	(1)	3x1,5
FM1	Protecting the circulation pump of the water heater	-	-
KM1	Relay/contact of the circulation pump of the water heater	-	-
S2F	Thermostat frost-resistant of water heater on the side of air	(2)	2x1
Y2	Actuator of the valve of the water cooler	(4)	3x1
Y3	Actuator of the dumper of the recirculation	(4)	3x1
Y4	Actuator of the cross exchanger	(4)	3x1
Y9	Signal 0-10 V for the freon cooler	(4)	3x1
E1	Signal of attaching the AHU cold	(2)	2x1
CX1	Signal of the controller of the I step of the cold AHU dry contact NO	(2)	2x1
CX2	Signal of the controller of the II step of the cold AHU dry contact NO	(2)	2x1
S4F.NE 9,10	Alarm signal of electric heater	(2)	2x1
Y.NE 3,4	Signal 0-10 V for the electric heater	(3)	2x1
F1M1	Protecting the engine of the air blowing	-	-
1U1	Connecting powering the ventilator for converters supply	(5)	Attachment B
1M1	Connecting powering the engine of the team of the fan inlet	(1)	Attachment B
RS1U1	The control signal link RS485 for supply frequency converter	BUS O2YS(St)CY	1x2x0,64/2,6
E1U1	START/STOP signal and change gears for supply frequency converter (if we don't use control RS485)	(2)	4x1
1UA1	Signal confirming supply frequency converter works	(2)	2x1
F2M1	Protecting the exhaust engine	-	-
2U1	Connecting powering the ventilator for converters exhaust	(5)	Attachment B
2M1	Connecting powering the engine of the team of the fan outlet	(1)	Attachment B
RS2U1	The control signal link RS485 for exhaust frequency converter	BUS O2YS(St)CY	1x2x0,64/2,6
E2U1	START/STOP signal and change gears for exhaust frequency converter (if we don't use control RS485)	(2)	2x1
2UA1	Signal confirming exhaust frequency converter works	(2)	2x1






1Y1	Actuator of the dumper of air blown in	(2) or (4) when 0-10V	3x1
2Y1	Actuator of the dumper of air blown off	(2) or (4) when 0-10V	3x1
B1	Temperature sensor of air blown in	(4)	2x1
B2	Temperature sensor of air blown off	(4)	2x1
B3	Sensor of the outdoor temperature	(4)	2x1
B4	Sensor of the air temperature of the recuperation blown off behind the AHU	(4)	2x1
B5	Leading the optional temperature sensor	(4)	2x1
B8	Temperature sensor of the back water of the heater (optional)	(4)	2x1
B13	Exhaust CO2 meter sensor (optional)	(4)	3x1
1S1F	Differential pressure switch of fan of the air blowing (optional)	(2)	2x1
2S1F	Differential pressure switch of fan of the outlet (optional)	(2)	2x1
1S1H	Differential pressure switch of filter of the preliminary air blowing	(2)	2x1
1S2H	Differential pressure switch of filter of the secondary air blowing	(2)	2x1
2S1H	Differential pressure switch of filter of the preliminary outlet	(2)	2x1
E5	Confirming the start – dry contact NO	(2)	2x1
E4	Collective alerting signal – dry contact NO	(2)	2x1
N1	Controller	-	-
N2	Panel HMI Tiny	(3)	7x1
N3	Panel HMI Advance - communication (max 100m)	BUS O2YS(St)CY	1x2x0,64/2,6
	Panel HMI Advance – power supply (max 100m)	(2)	2x1

5. HMI and Controller specification

HMI Advanced



Main menu icons:

		Setting the operating mode: „Stop“, „1 gear“, „2 gear“, „3 gear“, „Stand-by“, „Calendar“
	Tset: 22,0 °C	Setting the setpoint temperature
	15,0 °C	Read the temperature from the leading sensor
	100 %	The main temperature regulator - heating
	85 %	Main temperature regulator - cooling
		Frost recovery active
		The summary alarm activated
		Activation of fan 1 st , 2 nd , 3 rd gear

After pressing "OK" (about 1 second) display changes to the text menu of the operating system automation.

Single pressed causing editing parameters „Work mode“, „Temperature set“ and approving new setting.

After longer time holding down the keys „▲“ and „▼“ at the same time (about 3 seconds), display changes to the display's setup menu.

HMI parameter description:

Minimal brightness – minimal brightness of the highlight

Maximal brightness – maximal brightness of the highlight

Activity time – time of activity, after this time the display is dimmed

After activity time – action undertaken after activity time (1. nothing, 2. if alarm occurred, then go to alarm menu, else go to the first chart of main menu).

T sensor offset – the adjustment of the temperature sensor measuring in the HMI

Menu skin – Skin selector of the HMI

Communication settings – communication settings menu of the HMI and RS485 Master interface settings of the ELP controller

To exit menu - press C key.

Panel Advance HMI can be connected to the input of the HMI CON (located at the upper side of the driver around the USB connector) or RS485 master (if it is not used to transfer information management system BMS). There is a possibility of simultaneous connecting two panels to the RJ45 connector and RS485 Master. If a sensor leading temperatures is a sensor in panel check HMI whether there is a chosen sensor leading Adjusting/temperature/sensor in accordance with connecting on the menu.

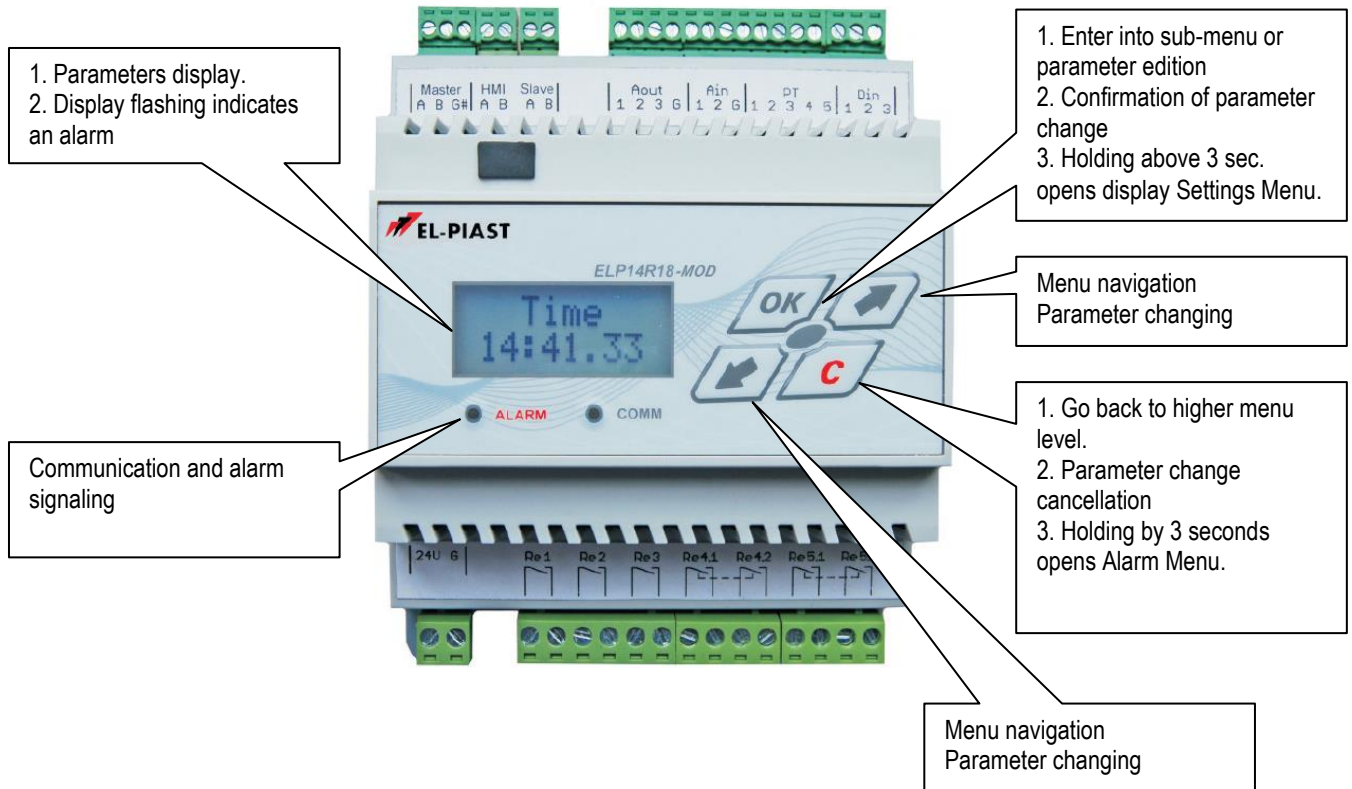
Panel HMI Advance has a jumper "simple/ext" which the opening causes the work for panel with the partly hidden menu, this function won't let the service of the object the entry in "service menu" where we are making the configuration of the ventilation arrangement in.

On the controller screen ELP... the function „simple/ext“ is inactive.

**The USB connection is used to download the application control.
If the application does not meet the control requirements of the customer,
contact the manufacturer or supplier, you can adapt to the requirements of the
application and upload it using any PC.**

ELP14R18-Mod – communication Modbus RTU with BMS through the RS485 (connector RS485 Master)

ELP14R18-Bac – communication with BMS through the BACnet MS-TP (connector RS485 Master)



Longer holding of OK button (more than about 3 seconds) display enters Display Settings Menu.

Parameter description:

Contrast – display contrast

Minimal brightness – minimal brightness of the highlight

Maximal brightness – maximal brightness of the highlight

Backlight time – time of activity, after this time the display is dimmed

After backlight time – action undertaken after activity time (1. nothing, 2. if alarm occurred, than go to alarm menu, else go to the first chart of main menu).

Master bus speed – RS Master speed setting (9600)

Modbus address – MAC address of the Modbus

To exit menu - press C key.

Panel Advanced HMI can be connected to the input of the HMI CON (located at the upper side of the driver around the USB connector) or RS485 master (if it is not used to transfer information management system BMS). You can simultaneously connect two room units HMI CON connector and RS485 master - in this case we cannot connect the controller with the BMS facility.

Panel HMI Advanced has a jumper "simple / ext" the opening adjuster will work with partially hidden menu, this function will use the object to enter the "Service menu" in which we make the ventilation system configuration.

The menu driver is always visible in its entirety.

5.1. Service menu - configuration

Panel HMI Advance has a jumper "simple/ext" which the opening causes the work for panel with the partly hidden diet, this function won't let the service of the object the entry in "service menu" which we are making the configuration of the ventilation arrangement in.

The access to the service menu protected is a password (default: **1111**).

The configuration of the arrangement with the service menu consists on:

- 1) change of the type of the Air Handling Unit (supply, supply/exhaust, water heater, electric heater, water cooler, DX cooler, glycol – run around coils, plate heat exchanger, rotary heat exchanger, mixing chamber)
- 2) accessing menu and configuration:

HMI Tiny – There is ability to active panel „HMI Tiny“ which is using when the reference temperature is done by the knob in the HMI Tiny (for this purpose used the analog input Ain2), start/stop the system is realized by closing/ opening temperature sensor placed in the temperature of the room unit connected by adjuster switch to sensor input PT5 (using the panel HMI Tiny is not possible to work the system in standby mode due to the use of open sensor as STOP system)

Outside temperature sensor – there is ability to deactivation outside temperature sensor, when the sensor is inactive function preheat the water heater and ability to run the freon cooler is based on the time of year selected in menu "Settings/ Season"

Exhaust temperature sensor – there is ability to deactivation exhaust temperature sensor, when the exhaust sensor is inactive function Eco is inactive and is not possible to determine the possibility of heat recovery (mixing chamber opens whenever you need heating)

Alarm A_ColdRec – when the alarm is active, alarm A_ColdRec frost of recovery visible in the alarm menu all the time during the freezing, when the alarm is inactive – alarm A_ColdRec frost of the recovery invisible in the alarm menu, while the alarm in history is written with the moment of an alarm frost, and on graphical screen of HMI freezing icon appears during frost recovery.

Contact work – there is an ability to active one of the relay output as a confirmation of work (make sure that the output is not used for other purpose in the application).

Contact alarm – there is an ability to active one of the relay output as a collective alarm (make sure that the output is not used for other purpose in the application).

Supply 0-10VDC – the possibility of activation of one of the analog outputs as a signal 0-10VDC airflow rate of the supply air fan (make sure the output is not used for other purposes in the application)

Exhaust 0-10VDC – the possibility of activation of one of the analog outputs as a signal 0-10VDC airflow rate of the exhaust air fan (make sure the output is not used for other purposes in the application)

Fan inverter type – the possibility of choose fan inverter type controlled by Modbus RS485 (LG IC5, IG5 lub Danfoss FC51)

Regulator - the possibility of activation one of the two types of control "1" sum of temperature controllers: the main, lim.min., lim.max., "2" new cascade control in which the start-up of the system taking place only with the supply air temperature controller for the time specified in "Settings/Temperature/Tset ramp" and after this time (when the leading sensor is different from the supply temperature sensor) an additional leading temperature controller is activating and generating temperature set setpoint of the supply controller.

Analog outputs – the possibility of rescale the output signal 0-10VDC to 2-10VDC (please check signals compliance with manuals of damper or valve actuators)

After the configuration of the arrangement one should switch the service mode on DISABLED and to conduct the activating procedure of the arrangement.

- 1) check the correctness of connections and the reaction of inputs/outputs to the state of sensors, detectors, switching inputs elements and executing outputs elements.
- 2) test selection of the leading sensor.
- 3) start up the unit and check the process of the temperature control.
- 4) check and select appropriate settings of temperature adjusters (in order to slow down one should reduce the Kp parametric or/and increase the parameter Ti)
- 5) fill up the activating card of the system and permanently fasten the copy of the card to the control box (attachment D)

The service menu has options of the emulation of inputs and forcing outputs. For the correct work of the system emulation and forcing functions must be disabled.

5.2. Tuning of the PI regulators

Properly executed tuning of PI regulators, the work of the Air Handling Unit on the air flow rate specified in the selection card of the unit, proper selection of the unit's components (recommended analog control each of heating/cooling exchanger), the system operation on site where there are no sudden changes of temperature due to generation of large amount of heating/cooling by other devices, allow you to get a stable leading temperature control to an accuracy of ± 0.1 °C.

In order to check the current accuracy of temperature control you can go to the "Service Menu/History of leading temperature" which is written the last 15 measurements from the leading temperature sensor in the selected period of recording) and is given "deviation" which is the maximum difference of actual set point temperature and the last 15 measurements of the leading temperature sensor.

If you do not achieve a satisfactory effect of the temperature control process you should:

- check that the system is working at full airflow rate (compare the fans inverter frequency with frequency of operation specified in the Selection Card of the AHU or with the data obtained from the results of air flow rate measurements)
- check the correct operation of actuators and control systems of the heaters, coolers, heat recovery systems,
- check the correct operation of the air dampers,
- check the installation of temperature sensors,
- check the tuning of PI regulators.

Using the "Service Menu/Configuration/Regulator" check the currently selected type of temperature regulator (**recommended type "2"**).

Regulator type „1" - sum of temperature controllers: the main, lim.min., lim.max.,

The name in menu:	Factory settings	Recommended settings
Heating PI	Kp = 1	Kp = 1
	Ti = 60s	Ti = 60s
Cooling PI	Kp = 1	Kp = 1
	Ti = 60s	Ti = 60s
Supply PI (limit Tmin sup, Tmax sup)	Kp = 1	Kp = 1
	Ti = 90s	Ti = 45s

Supply PI of the controller type „1" has to be always faster than Heating and Cooling PI.

Limit temperature parameters „Tmin supply", Tmax supply" have to be different by at least 5°C from the temperature set.

In the lack of stabilization using recommended settings, increase Ti setting of each of the controller by 10 seconds may be preferred (max. up to 120 seconds).

Lack of stabilization of the such selected settings may indicate an error in the selection of heating/cooling exchangers, their improper operation, lack of required in accordance with the AHU selection card, thermal parameters of the heating/cooling exchangers.

Regulator type „2” - a new cascade regulator in which the start-up of the system taking place only with the supply air temperature regulator for the time specified in menu "Settings/Temperature/Tset ramp" and after this time (when the leading sensor is different from the supply temperature sensor) an additional leading temperature regulator is activating and generating temperature setpoint of the supply regulator.

The name in menu:	Factory settings (recommended)
Heating PI	Kp = 1
	Ti = 60s
Cooling PI	Kp = 1
	Ti = 60s
Supply PI (limit Tmin sup, Tmax sup)	Kp = 1
	Ti = 90s

Supply PI regulator type "2" may be faster or slower than the heating and cooling PI, the slower the smaller oscillations at the minimum and maximum supply temperature but slower response to the limit.

Limit temperature parameters „Tmin supply”, Tmax supply” may be close to the temperature set.

In the lack of stabilization using recommended settings, increase Ti setting of each of the controller by 10 seconds may be preferred (max. up to 120 seconds).

Lack of stabilization of the such selected settings may indicate an error in the selection of heating/cooling exchangers, their improper operation, lack of required in accordance with the AHU selection card, thermal parameters of the heating/cooling exchangers.

5.3. Standard functions of controller's inputs/outputs

Digital inputs (State of the NC access - giving for accessing DIN... enclosing the digital input causes stretching 24 VAC)		During the correct work of the system	The lack of the required state is causing alarm
Din 1	Fire central and confirmation of fans work (and supply ventilator pressure switch at systems with electric heater)	compact	A_StopSystem
Din 2	Thermostat frost-resistant water heater	compact	A_ThHWair, A_3xThHWair
	Alarm of the electric heater	compact	A_ThHE, A_3xThHE
Din 3	Differential pressure switch of filters	obtuse	A_Filter

Analogue inputs devices (Signal inputs devices 0-10VDC)	
Ain 1	CO2 sensor (optional)
Ain 2	HMI Tiny (optional)

Temperature sensors PT1000		The damaged temperature sensor is causing alarm
PT1	Supply	A_Tsup
PT2	Exhaust (optional)	A_Texh
PT3	Outside	A_Tout
PT4	Exhaust after recovery	A_Trec
PT5	Return water of water heater (option when is not using HMI Tiny)	A_TbackWater
	Room (there is in optional panel HMI Tiny)	Stop system

Digital outputs , state OFF - ReC/ReA output obtuse, ON state - ReC/ReA output shorted		
Re1	Pump of the water heater	relay
	Electric heater	relay
Re2	Pump of the water cooler	relay
	1 step of a refrigerating unit	relay
Re3	2 step of a refrigerating unit	relay
Re4.1	Air dampers of the Supply/Exhaust	relay
Re4.2	Fans Start/Stop	relay
Re5.1	Group alarm	relay
Re5.2	Group alarm	relay

Analogue outputs (Signal outputs 0-10VDC)	
Aout1	Heater (water or electric)
Aout2	Cooler (water or DX)
Aout3	Mixing chamber (10-0V), air dampers supply/exhaust (0-10V), plate exchanger (0-10V)

In the service menu you can activate any relay outputs as a confirmation of work or group alarm. When activated, make sure that the output is not used in the application.

6. Control service

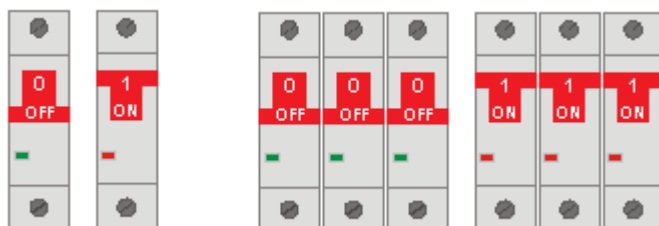


Before start-up by the user the control box should be connected and checked by authorized personnel.

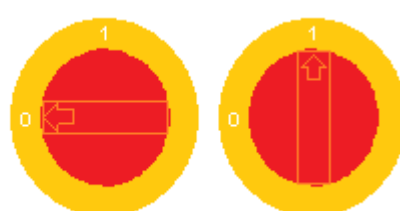
Start-up of the device

Operate Switch Q1M into position ON.

„1-ON” (synthetic switchboard)



„1” (metal switchboard)



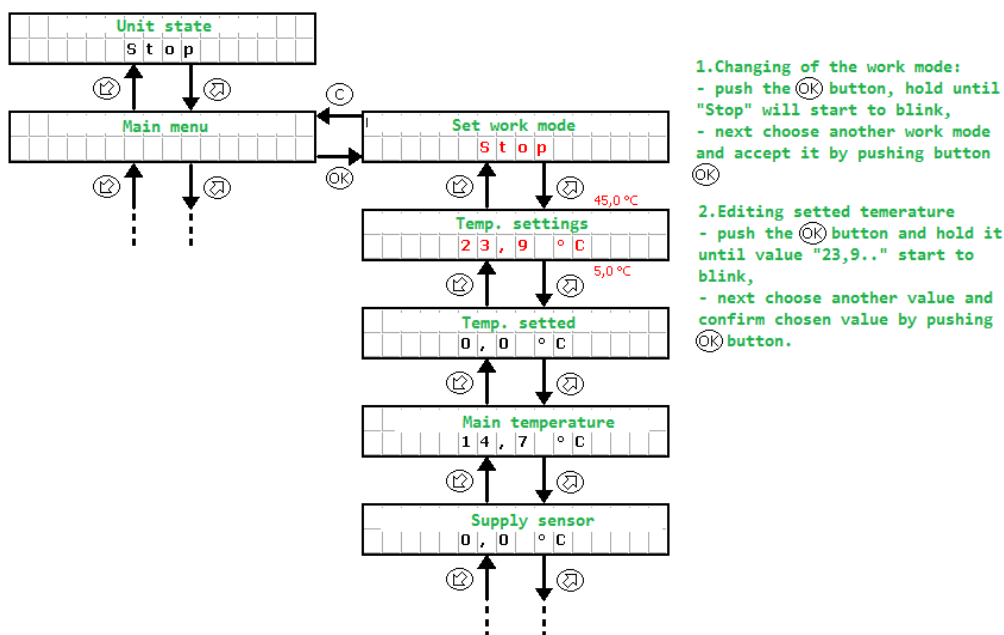
The device is starting-up if:

- isn't appear neither of the alarms of the locking operation of the system and
- parameter **„Set work mode”** on the controller or on the HMI is set to any option other than **Stop**.

ATTENTION: After the power supply disruption, the system automatically returns to work with the last used settings (settings before the power supply disruption).

Changing the temperature set if as panel a "menu" was chosen

Parameter **„Set temperature”** in the main menu of controller or HMI.



Handling of the HMI has been described in point 5 of this manual.

6.1 Alarms

Alarms are indicated by display flashing and red continuous lighting LED on the controller or HMI, Re8 relay output of the controller is set ON.

Information on the alarm can be read from „**Alarm Menu**“. Entering Alarm menu – by holding pressed of „C“ key during about 3 second.

In case of blocking alarm, it is necessary to reset the alarm before restart of automation system will be possible. To reset the alarm one should enter Alarm Menu, choose proper alarm and hold OK. button for some time. If the source of the alarm is still active, the alarm will be supported and „*“ symbol will appear at its description, denoting confirmation of the alarm. If source of the alarm have passed or will pass after confirmation of the alarm, alarm will be reset.

List of alarms

ALARMS	Alarm type	Reaction of the system, proceeding
Digital inputs		
A_StopSystem	Blocking	<p>Cooperation with fire alarm control panel.</p> <p>Alarm is OFF – lack of fire, on digital input appeared signal 24VAC Alarm is ON – fire appeared, on digital input doesn't appeared signal 24VAC</p> <p>Reaction on alarm ON: system is stopped until the fire won't be eliminated; after the fire is extinguished system is coming back to the working mode (state before alarm).</p> <p>and</p> <p>The test proper operation of the supply fan with pressure switch contact:</p> <p>Normal state – 10 seconds after system start contact is closed, the digital input signal is 24VAC Alarm conditions – 10 seconds after system start alarm contact is open, the digital input signal is not 24VAC</p> <p>Responding to an alarm condition: the system is stopped, check the inverter and how to connect the controller and the fan, determine the cause of the error, and the cause of the alarm must be acknowledged and operate the system</p> <p>Digital inputs Din1</p>
A_ThHWair A_3xThHWair	Declining Blocking	<p>Heater anti-frost protection is accomplished by anti-frost thermostat</p> <p>Alarm is OFF – temperature measured right after the heater is higher than temperature set on thermostat, on input digital input is signal 24VAC Alarm is ON – temperature measured right after the heater is lower than temperature set on thermostat, signal 24VAC doesn't appear on input digital</p>

		<p>Reaction on Alarm is ON: system is stopped, heater efficiency will stay on 100% level, until thermostat is warm enough. After thermostat is warmed up, in alarm menu user has to be confirm that process is finished. After conformation in alarm menu and lack of low temperature of thermostat, system comes back to the state of work. If during one hour, alarm A_ThHWair will appear 3 times, system is stopped and alarm A_3xThHWair will be displayed which needs to be confirmed as well.</p> <p>Digital input: Din2</p>
A_ThHE, A_3xThHE	Declining Blocking	<p>Protection against overheating of the electric heater on the input signal is input to the alarm relay HE module mounted on the control box power and control electric heater:</p> <p>Normal state - heater temperature is low, the digital input signal is 24VAC Alarm conditions - the temperature of the heater is too high, there is no 24VAC on the digital input</p> <p>Responding to an alarm condition: the system operates without heating until resolution of overheating, after the disappearance of overheating alarm disappears and takes the work out of the heater, and three times in one hour speech A_ThHE alarm system will stop working and display A_3xThHE alarm that requires confirmation.</p> <p>Digital input: Din2</p>
A_CX	Declining	<p>Cooperation with alarm contact chiller:</p> <p>Normal state - there is no alarm unit, there is no 24VAC on the digital input signal Alarm conditions - an alarm unit, the digital input signal is 24VAC</p> <p>The response to the state of emergency: information signal Able to change the NO to NC - see Table No.5 Chapter 8.3</p> <p>Digital input Din3</p>
A_SupFilter	Declining	<p>Study the degree of contamination of the supply air filter with switch:</p> <p>Normal state - dirty limit, the pressure difference before and after the filter is below the set on the pressure switch, there is no 24VAC on the digital input signal Alarm conditions - dirt unacceptable pressure difference before and after the filter is above the set on the pressure switch, the digital input signal is 24VAC</p> <p>Responding to an alarm condition: the system works, it is a dirty filter alarm is displayed in the case of an alarm should immediately replace the filter with a new one, work with a dirty filter reduces the expenditure control and may cause it to rupture which can lead to contamination and damage to the heat exchanger / cooling from the customer's fault</p> <p>Digital input Din4</p>
A_SupFilter2	Declining	<p>Study the degree of contamination of the air supply fine filter with pressure switch:</p> <p>Normal state - dirty limit, the pressure difference before and</p>

		<p>after the filter is below the set on the pressure switch, there is no 24VAC on the digital input signal</p> <p>Alarm conditions - dirt unacceptable pressure difference before and after the filter is above the set on the pressure switch, the digital input signal is 24VAC</p> <p>Responding to an alarm condition: the system works, it is a dirty filter alarm is displayed in the case of an alarm should immediately replace the filter with a new one, work with a dirty filter reduces the expenditure control and may cause it to rupture which can lead to contamination and damage to the heat exchanger / cooling from the customer's fault</p> <p>Digital input Din5</p>
A_ExhFilter	Declining	<p>Study the degree of contamination of the exhaust filter with switch:</p> <p>Normal state - dirty limit, the pressure difference before and after the filter is below the set on the pressure switch, there is no 24VAC on the digital input signal</p> <p>Alarm conditions - dirt unacceptable pressure difference before and after the filter is above the set on the pressure switch, the digital input signal is 24VAC</p> <p>Responding to an alarm condition: the system works, it is a dirty filter alarm is displayed in the case of an alarm should immediately replace the filter with a new one, work with a dirty filter reduces the expenditure control and may cause it to rupture which can lead to contamination and damage to the heat exchanger / cooling from the customer's fault</p> <p>Digital input Din6</p>
A_SupPres	Blocking	<p>The test proper operation of the supply air fan with switch:</p> <p>Normal state - 30 seconds after the start of the test is whether there is fan pressure, differential pressure upstream and downstream of the fan should be above the set on the pressure switch, the digital input signal is 24VAC</p> <p>Alarm state - 30 seconds after the start there is no fan pressure, differential pressure upstream and downstream of the fan is below the set on the pressure switch, there is no 24VAC on the digital input signal</p> <p>Responding to an alarm condition: the system is stopped, check the fan and determine the cause of the lack of compression, and the cause of the alarm must be acknowledged and operate the system</p> <p>Digital input Din7</p>
A_ExhPres	Blocking	<p>The test proper operation of the supply air fan with switch:</p> <p>Normal state - 30 seconds after the start of the test is whether there is fan pressure, differential pressure upstream and downstream of the fan should be above the set on the pressure switch, the digital input signal is 24VAC</p> <p>Alarm state - 30 seconds after the start there is no fan pressure, differential pressure upstream and downstream of the fan is below the set on the pressure switch, there is no 24VAC on the digital input signal</p> <p>Responding to an alarm condition: the system is stopped, check</p>

		<p>the fan and determine the cause of the lack of compression, and the cause of the alarm must be acknowledged and operate the system</p> <p style="text-align: right;">Digital input Din8</p>
A_SupFC	Blocking	<p>The test proper operation of the inverter supply fan with inverter alarm contact (confirmation of work):</p> <p>Normal state - immediately after the power is not an alarm inverter, inverter alarm contact is closed, the digital input signal is 24VAC</p> <p>Alarm conditions - directly after the power inverter alarm occurs, the inverter alarm contact is open, there is no 24VAC on the digital input signal</p> <p>Responding to an alarm condition: the system is stopped, check the inverter and how to connect the controller and the fan, determine the cause of the error, and the cause of the alarm must be acknowledged and operate the system</p> <p style="text-align: right;">Digital input Din9</p>
A_ExhFC	Blocking	<p>The test proper operation of the inverter supply fan with inverter alarm contact (confirmation of work):</p> <p>Normal state - immediately after the power is not an alarm inverter, inverter alarm contact is closed, the digital input signal is 24VAC</p> <p>Alarm conditions - directly after the power inverter alarm occurs, the inverter alarm contact is open, there is no 24VAC on the digital input signal</p> <p>Responding to an alarm condition: the system is stopped, check the inverter and how to connect the controller and the fan, determine the cause of the error, and the cause of the alarm must be acknowledged and operate the system</p> <p style="text-align: right;">Digital input Din10</p>
A_Rot	Blocking	<p>The test of proper operation of the frequency drive of the heat recovery wheel through the inverter alarm contact:</p> <p>Normal state - there is no alarm inverter, inverter alarm contact is closed, the digital input signal is 24VAC, the work of the recovery</p> <p>Alarm conditions - an alarm inverter, inverter alarm contact is open, there is no 24VAC on the digital input signal, the work without recovery</p> <p>Responding to an alarm condition: the system operates without recovery, check the inverter and how to connect the controller and the motor, determine the cause of the error, and the cause of alarm disappears automatically and recovery back to work as the demand resulting from the process temperature</p> <p style="text-align: right;">Digital input Din11</p>
A_StopS1	Declining	<p>Examination of the maintenance switch:</p> <p>Normal state - there is a notification service disconnect switch contact is closed, the digital input signal is 24VAC</p> <p>State of emergency - there is a notification service disconnect switch contact is open, there is no 24VAC on the digital input signal</p>

		<p>Responding to an alarm condition: the system is stopped with the behaviour of the alarm functions (heating of the heater in winter), after removing the cause of alarm disappears automatically and the system returns to work</p> <p>(There is an option to disabled this alarm and use this digital input Din12 as remote signal of START/STOP)</p> <p style="text-align: right;">Digital input Din12</p>
Sensor inputs PT1000		
A_Tsup	Declining	<p>The test proper operation of air temperature sensor:</p> <p>Normal state - there is no alarm, sensor connected Alarm conditions - an alarm occurs, the sensor disconnected or damaged</p> <p>Responding to an alarm condition: the system is stopped, check the sensor and how to connect to the controller, determine the cause of the error, and the cause of the alarm must be confirmed and the system started-up again</p> <p style="text-align: right;">Sensor input PT1</p>
A_Texh	Declining	<p>The test proper operation of exhaust air temperature sensor:</p> <p>Normal state - there is no alarm, sensor connected Alarm conditions - an alarm occurs, the sensor disconnected or damaged</p> <p>Responding to an alarm condition: the system is stopped, check the sensor and how to connect to the controller, determine the cause of the error, and the cause of the alarm must be confirmed and the system started-up again</p> <p style="text-align: right;">Sensor input PT2</p>
A_Tout	Declining	<p>The test proper operation of the outdoor temperature sensor:</p> <p>Normal state - there is no alarm, sensor connected Alarm conditions - an alarm occurs, the sensor disconnected or damaged</p> <p>Responding to an alarm condition: the system is stopped, check the sensor and how to connect to the controller, determine the cause of the error, and the cause of the alarm must be confirmed and the system started-up again</p> <p style="text-align: right;">Sensor input PT3</p>
A_Trec	Declining	<p>The test proper operation of exhaust temperature sensor for recovery (or glycol contact sensor):</p> <p>Normal state - there is no alarm, sensor connected Alarm conditions - an alarm occurs, the sensor disconnected or damaged</p> <p>Responding to an alarm condition: the system is stopped, check the sensor and how to connect to the controller, determine the cause of the error, and the cause of the alarm must be confirmed and the system started-up again</p> <p style="text-align: right;">Sensor input PT4</p>
A_TbackWater	Declining	<p>The test proper operation of return water temperature sensor with heater:</p>

		<p>Normal state - there is no alarm, sensor connected</p> <p>Alarm conditions - an alarm occurs, the sensor disconnected or damaged</p> <p>Responding to an alarm condition: the system is stopped, check the sensor and how to connect to the controller, determine the cause of the error, and the cause of the alarm must be confirmed and the system started-up again</p> <p style="text-align: right;">Sensor input PT5</p>
A_Tmain	Declining	<p>The test proper operation of the temperature sensor lead:</p> <p>Normal state - there is no alarm, sensor connected</p> <p>Alarm conditions - an alarm occurs, the sensor disconnected or damaged</p> <p>Responding to an alarm condition: the system is stopped, check the sensor lead and how to connect to the controller, determine the cause of the error, and the cause of the alarm must be confirmed and the system started-up again</p> <p style="text-align: right;">Entry depends on the choice of the leading sensor</p>
Other alarms		
A_ComSupFC	Declining	<p>The study proper communication between controller and inverter of the supply fan:</p> <p>Normal state - there is no alarm, correct communication</p> <p>Alarm conditions - an alarm occurs, communication is not correct</p> <p>Responding to an alarm condition: the system is stopped, check the inverter and how to connect to the controller, determine the cause of the error, and the cause of the system automatically returns to normal operation</p>
A_ComExhFC	Declining	<p>The study proper communication between controller and inverter of the exhaust fan:</p> <p>Normal state - there is no alarm, correct communication</p> <p>Alarm conditions - an alarm occurs, communication is not correct</p> <p>Responding to an alarm condition: the system is stopped, check the inverter and how to connect to the controller, determine the cause of the error, and the cause of the system automatically returns to normal operation</p>
A_ColdRec	Declining	<p>Study the possibility of appearing the recovery frost using exhaust air temperature sensor after recovery</p> <p>Normal state - there is no alarm, high temperature</p> <p>Alarm conditions - an alarm occurs, low temperature</p> <p>Responding to an alarm condition Plate heat exchanger (without by-pass) : decrease the supply power ventilator.</p> <p>Responding to an alarm condition Plate heat exchanger (with by-pass) : decrease the recovery efficiency, The system works with recovery or with reduced modulation</p>

A_ThHWwater A_3xThHWwater	Declining Blocking	<p>Heater protection against freezing by contact sensor B8 on the water heater return</p> <p>Normal state - temperature of the contact sensor is higher than the set on the controller or panel</p> <p>Alarm conditions- temperature of the contact sensor is lower than the set on the controller or panel</p> <p>Responding to an alarm condition: the system STOP, the heater 100% until the temperature on the water heater return rise above setpoint. After crossing the temperature measured by the contact sensor, system backs to work, after 3 times occurrence of the alarm A_ThHWwater within an hour, system stopping the operation and alarm A_3xThHWwater is displayed, alarm requires confirmation</p>
A_Code	Blocking	<p>The alarm indicating allowed configuration of air handling unit in service menu/type of air handling unit</p> <p>ATTENTION!!! IN CASE OF SUPPLY AHU SELECTION, SYSTEM RECOVERY MAY ONLY BE MIXING CHAMBER</p>
A_In_Emulation	Declining	<p>Emulation of inputs:</p> <p>Normal state - there is no alarm, no input is in emulation mode</p> <p>Alarm state - at least one of the digital inputs, analog, PT1000 is in emulation mode</p> <p>Responding to an alarm: controller does not react to physical changes emulated input, the system works with the value of the emulator in the service menu</p>
A_OutForce	Declining	<p>Forcing output:</p> <p>Normal state - there is no alarm, no output is in forcing</p> <p>Alarm state - at least one of the digital outputs, analog mode is forcing</p> <p>Responding to an alarm condition: the system works, however, forced output does not respond to the control algorithm, is set by the "force outputs" in the service menu</p>

Attention: Working in forcing or emulation mode can cause damage to the ventilation system caused by the user. Changes I/O in emulation or forcing mode should only be done by qualified and trained personnel.

Alarm reset

In case of blocking alarm, it is necessary to reset the alarm before restart of automation system will be possible. To reset the alarm one should enter Alarm Menu, choose proper alarm and hold OK. button for some time. If the source of the alarm is still active, the alarm will be supported and „*” symbol will appear at its description, denoting confirmation of the alarm. If source of the alarm have passed or will pass after confirmation of the alarm, alarm will be reset.

7. Control operation

7.1 Main menu

Tab. 4 Main Menu

Name	Default value	Decription
State of the AHU	Service mode	<p>Service mode – the arrangement is in the course of the configuration, lack of ability of the start of the arrangement, active protective functions of chosen exchangers heating/cooling</p> <p>Stop - the AHU is stopped, air dampers are closed , fans do not work, active protective functions of the AHU</p> <p>Alarm - stop – the AHU is stopped, an at least one blocking alarm is appearing, check the list of alarms, describe the reason for the failure, after repairing erase the blocking alarm</p> <p>Preliminary warming up - in case of the low outdoor temperature preliminary warming up is taking place in AHU with the water heater</p> <p>Warming up - in AHU with the water-heater at reporting the alert from the thermostat frost-resistant warming the water-heater up is taking place</p> <p>Cooling - in AHU with the electric heater and the DX cooler stopping the functioning of fans is taking place late cooling from stopping the functioning of the electric heater or/and the DX cooler</p> <p>Work 1,2.3 step - correct work on 1,2 or 3 step of fans</p>
Main menu	-	Choice of the work mode of AHU, the set temperature of the leading sensor, the reading of temperatures and states of the functioning of the fans and heating/cooling exchangers
Calendar	-	Enables the programming of the calendar. Thorough description in the 7.2 subsection Calendar.
Settings	-	Parameters of the control system. Thorough description in the 7.3 subsection Settings.
Service menu	-	Enables the configuration of the AHU.
PL/EN/RU	-	Choice of the language menu (Polish/English/Russian).

7.2 Calendar

In Calendar options one can set date and time of real time clock. When operating mode is set at „**Calendar**” control will be realized according to recorded programs. Programs can cover a day or exceptions.

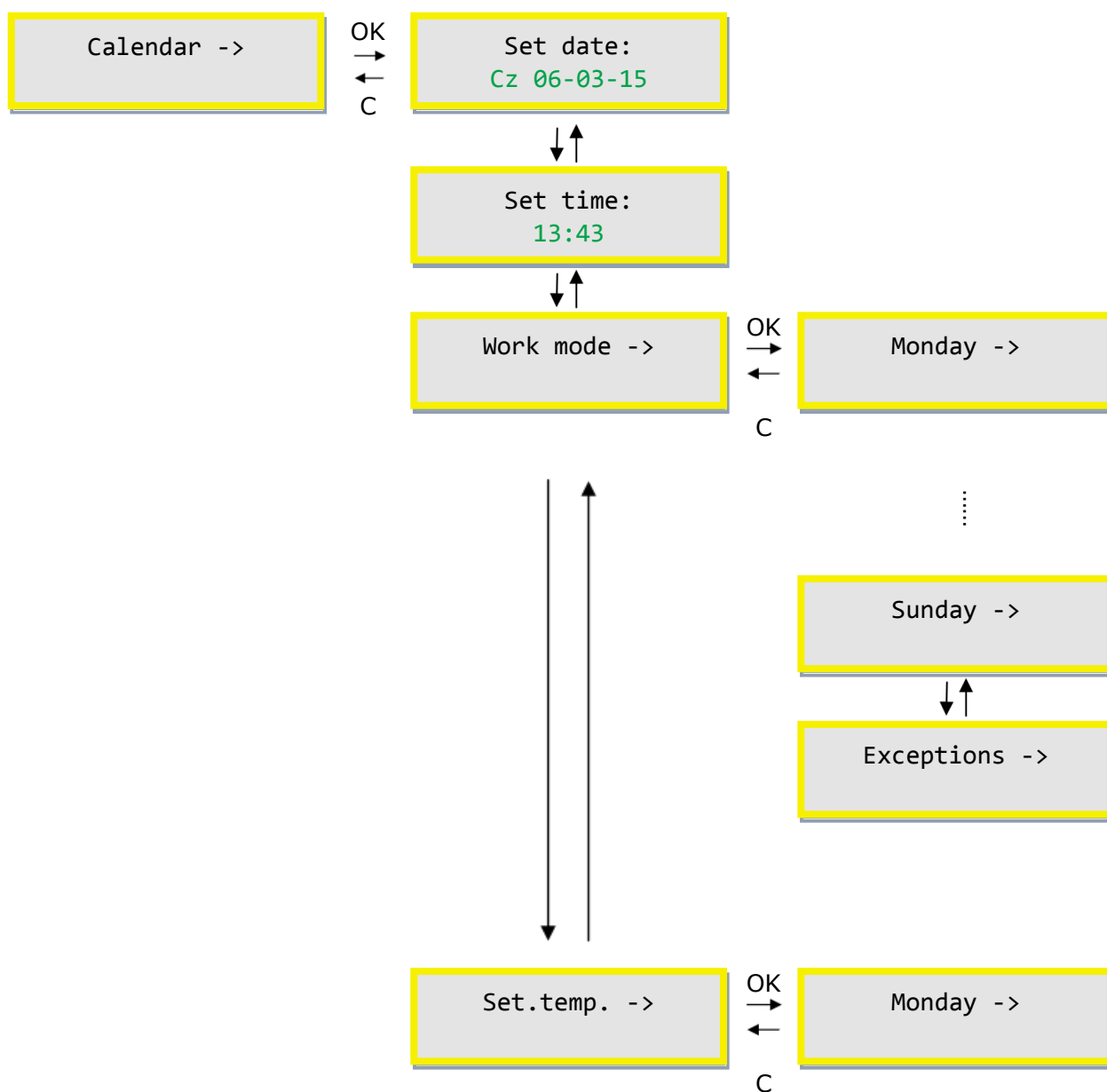
Program includes parameters:

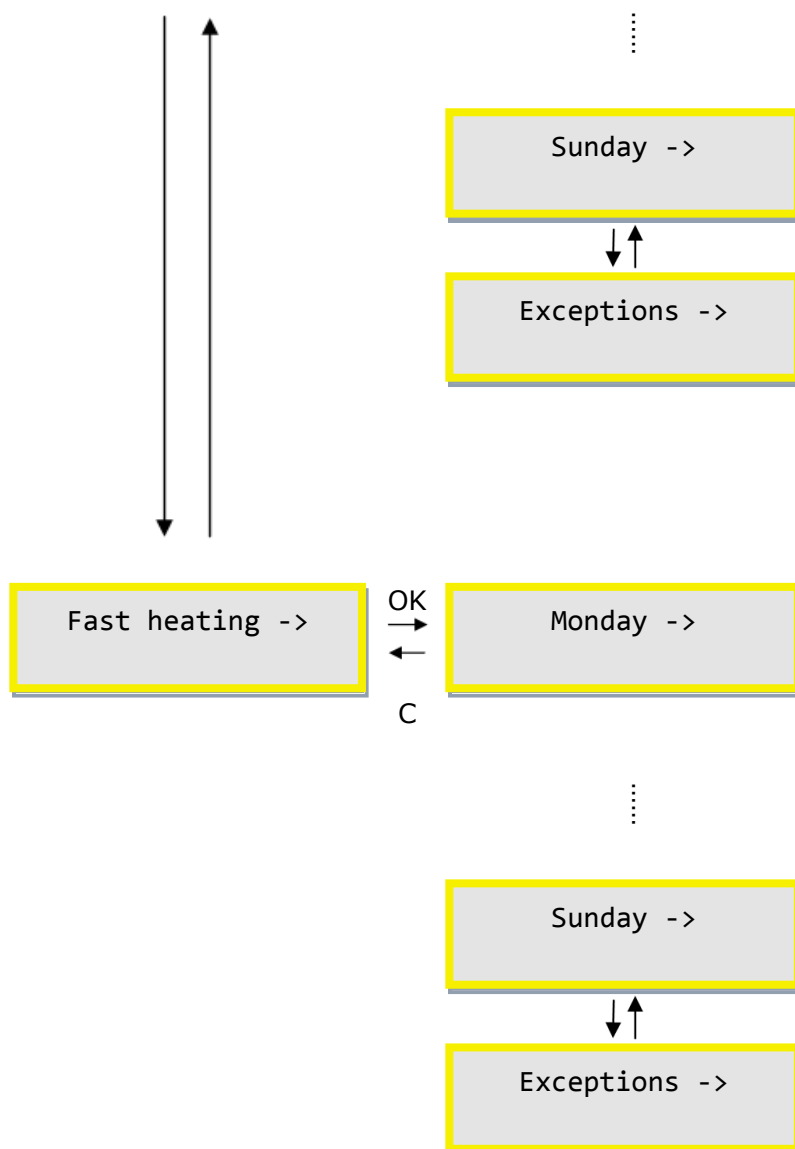
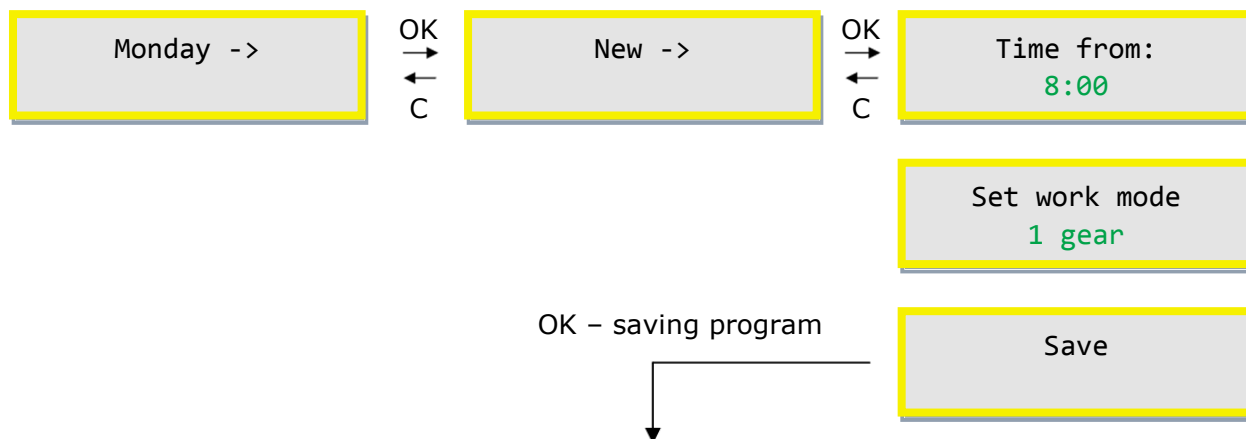
Work mode – possible selections: Stop, Start 1 step, Start 2 step Start 3 step and the Stand-by.

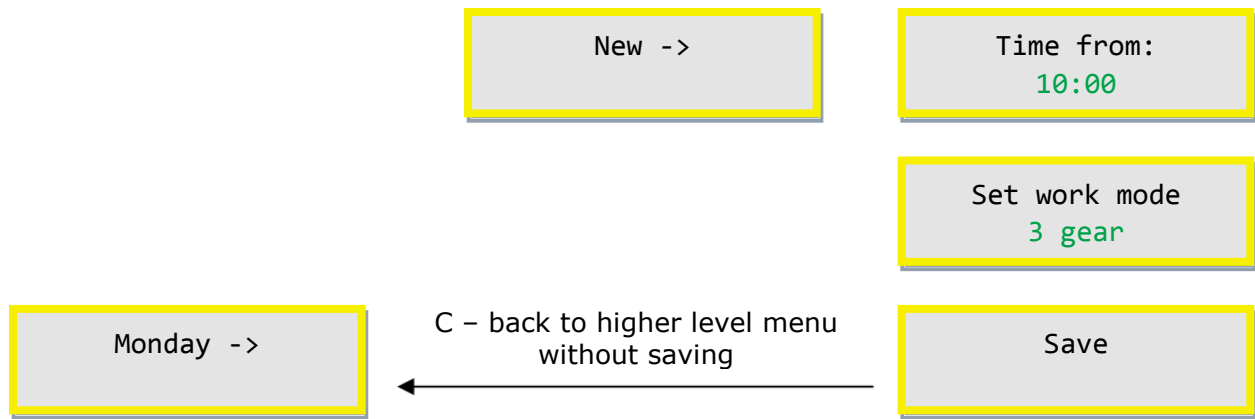
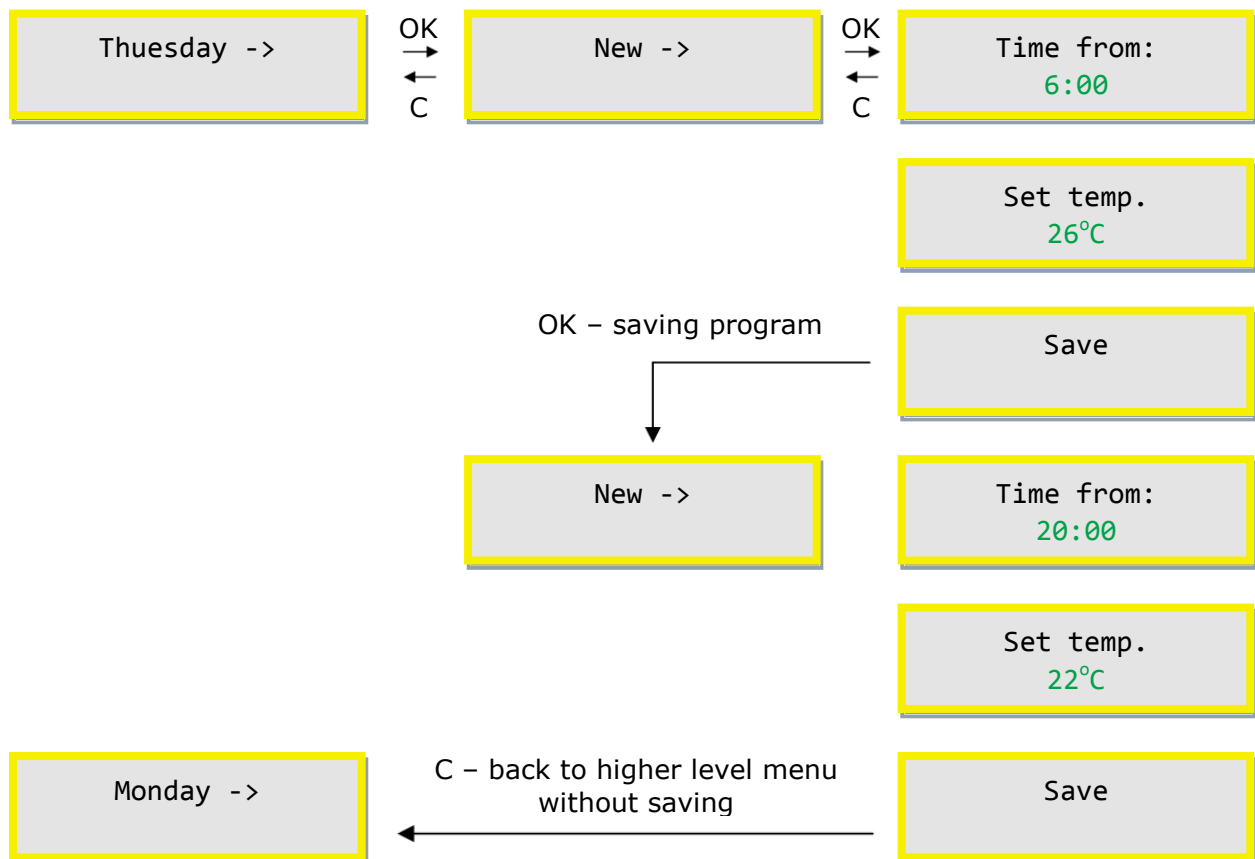
Temperature set – temperature setting

Fast heating - there is possibility of activate fast heating using a mixing chamber (there is in system with mixing chamber)

Calendar menu:




Work mode:



Temperature setting:


7.3 Settings

Access to the this settings is password protected (by default: **1111**).

Tab. 5 Settings menu.

Group	Name	Default	Description
Year season	Mode	Auto	Important to preheat the water heater and possibility to freon cooler work Auto – season determined automatically based on the outside temperature sensor Winter – manual setting winter mode Summer – manual setting summer mode
	Summer since	March	Set the month from which recognize SUMMER
	Summer to	November	Set the month from which recognize WINTER
Temperatures	Main sensor	Supply	HMI CON - temperature control according to the temperature sensor in the room unit HMI terminal connected by HMI CON HMI RS485 - temperature control by temperature sensor HMI room unit connected via RS485 interface Supply - temperature control by temperature sensor supply Exhaust - temperature control by the exhaust temperature sensor PT5 - temperature control by temperature sensor connected to sensor input PT5
	Eco temp. difference	15°C	Eco temp. difference – this is used both for heating and cooling, which does not allow the heating/cooling when the outdoor temperature is higher/lower the set point temperature of the exhaust sensor (the function is only active in the supply and exhaust systems)
	Tset ramp	300 s	Tset ramp - fall time increased setpoint (and activation delay of the cascade temperature regulator, if it is active)

	<i>Tset correction</i>	5°C	Tset correction - adjustment to increase the set point and minimum air temperature at the start of the system
	<i>Offset</i>	-	adjustment of the temperature sensors measuring
Temperature limits	Temp air blow	15°C	Tmin air blow - minimum supply temperature (related to setting of the supply PI regulator)
		40°C	Tmax air blow - maximum temperature of the supply (related to setting of the supply PI regulator)
Temperature regulators	PI heating	1	Kp - heating regulator gain
		60s	Ti - integration constant of the heating regulator
	PI cooling	1	Kp - cooling regulator gain
		60s	Ti - integration constant of the cooling regulator
	PI air blow	1	Kp - air regulator gain
		90s	Ti - integration constant of the supply air regulator
Part of regulation	-	15%	Recovery - Involved in the regulation of recovery (parameter editable)
		15%	Mixing chamber - Involved in the regulation of the mixing chamber (parameter editable)
		...%	Heater/cooler - participation in the regulation of the heater/cooler (read parameter)
Standby mode	Main sensor	HMI CON	HMI CON - enabling the system to operate the sensor in the room unit HMI terminal connected by HMI CON HMI RS485 Master - enabling the system to operate the sensor in the room unit HMI connected via RS485 Master Exhaust - enabling the system to operate the exhaust temperature sensor PT5 - enabling the system to operate the temperature sensor connected to sensor input PT5

	Active for	Heating and cooling	<p>Heating – system will start when the sensor temperature falls below the leading standby mode, the set temperature of the hysteresis mode</p> <p>Cooling – system will start when the temperature sensor exceeds a leading standby mode, the set temperature of the hysteresis mode</p> <p>Heating and cooling – system will start when the temperature sensor lead stand will rise or fall below or above the melting point of the hysteresis mode, standby</p>
	Standby hysteresis	4°C	Standby hysteresis – the difference in temperature sensor mode and set point temperature below which the system will be enclose when in standby mode
Vent.	-	10 s	Starting delay - the time from the start throttle operation of the fans
		15 s	Damp.off delay - The time from switching on operation mode "Stop" and start stopping fans to start closing the air dampers actuators of the AHU
		30 s	Pressure delay - the time of operation of the fans after the pressure test on the filters.
		180 s	Cooling time - the time from the operating mode "1,2,3 gear" in the operating mode "Stop" and stopping the electric heater and/or DX cooler to stop the fans (cooling is at the lowest efficiency).
	Supply	... %	Setting efficiency supply fan for 1,2,3 gear
	Exhaust	... %	Setting efficiency exhaust fan for 1,2,3 gear
	RS485	Active	Sup. via RS485 - activate communication with inverter supply fan
		Active	Exh. Via RS 485 - activation of communication with the exhaust fan inverter
		0 Hz	Sup.freq.min. – setting the minimum frequency of the supply air fan, corresponding setting performance 0%

		60 Hz	Sup.freq.max. - setting the maximum frequency of the supply air fan, corresponding setting performance 100% (the maximum frequency should be chosen according to DTR and performance measurement)
		0 Hz	Exh.freq.min. - setting the minimum frequency of the supply air fan, corresponding setting performance 0%
		60 Hz	Exh.freq.max. - setting the maximum frequency of the supply air fan, corresponding setting performance 100% (the maximum frequency should be chosen according to manual and performance measurement)
		1	Sup.inv.adress - address of the inverter supply fan
		2	Exh.inv.adress - address of the inverter exhaust fan
		60 s	T.acc. - start time inverters
		60 s	T.dec. - the time to stop the inverter
		0,3 s	Tcom - time communication with inverter
		2 s	Twait - waiting for a response in communication with the inverter
Mixing chamber	Work mode	Temperature	<p>Hand - the mixing chamber isn't participating in the process of the temperature control, CO2, the opening degree in main menu of the controller</p> <p>Temperature - the mixing chamber is participating in the process of the temperature control (when is the demand for heating there is increase in modulation of the mixing chamber and reducing the fresh air)</p> <p>Temperature/CO2 - the mixing chamber is participating in the process of the temperature control (when is the demand for heating there is increase in modulation of the mixing chamber and reducing the fresh air, (In case of low level of fresh air in exhaust starts to increase level of fresh air)</p>

	Priority for	Mix chamber	<p>Heating/cooling – in the process of the temperature control in the automatic mode of the mixing box, are holding shares one by one: 1. heater/cooler, 2. mixing box</p> <p>Mix chamber - in the process of the temperature control in the automatic mode of the mixing box, are holding shares one by one: 1. mixing box, 2. heater/cooler</p>
	Min. fresh air	30%	Min. fresh air – establishing minimal opening air dampers of the supply/exhaust of AHU in the automatic mode
	Max. fresh air	100%	Max. fresh air – establishing maximum opening air dampers of the supply/exhaust of AHU in the automatic mode
	Fast heating	Inactive	Fast heating – function enabling fast heating up the AHU to the set temperature. When the mode of the fast heating is active and a need of starting his action will appear air dampers entirely are closing the inflow of the fresh air to the moment of reaching the demanded temperature
		20°C	Temperature set point - demanded temperature for the function of the fast heating
		4°C	Hysteresis - Hysteresis of the Temperature set point
	CO ₂ regulation	600 ppm	Set CO₂ – demanded value of concentration CO ₂ in exhaust air
		0,1	Kp – gain of the fresh air regulator
		90s	Ti – integration constant of the fresh air regulator
		-	Sensor range – the ability to set the measurement range of the CO ₂ sensor
Recovery	-	450 s	Starting ramp - after the start-up, system operates with recovery of 100% with the ramp descent to the current drive the recovery resulting from the process control

		Winter	Work mode: Summer –possible cooling recovery Winter –possible heating recovery Summer/Winter – possible heating and cooling recovery
		2°C	Frost limit - temperature below (sensor B4) which the function is acting frost-resistant
		1	Kp frost.prot - gain of anti-frost function
		60s	Ti frost.prot - integration constant of the anti-frost function
Heater	Preheating	10°C	Max T.out – maximum temperature scale to pre-heat
		15%	Max.Tout.valve – scale of the valve relative to the outside temperature
		0°C	Min T.out – maximum temperature scale to pre-heat
		75%	Min.Tout valve – scale of the valve relative to the outside temperature
		15s	Preh.100% time - Time of preliminary with 100% open valve, irrespective of Tmin, Tmax scale
		30s	Preh.scale time - Time of preliminary with proportional open valve, depending on the Tmin, Tmax scale and temperature of return water (if the sensor B8 is active)
		Active	Falling ramp – the possibility to activate / deactivate the function of the falling ramp valve opening degree after preliminary heating
		30s	Fall ramp - time of decrease after preliminary heating
	Pump work temp.	5°C	Pump work temp. - the temperature below which the pump is running all the time
	Min.valve open	10%	Min.valve open - The minimum heating valve opening
	Water frost	Inactive	B8 sensor – activation of protection heater the sensor on return water

		10°C	Frost temp.out. – activation of Frost protection on the water side to the outdoor temperature which is lower than this parameter
		15°C	Frost - Stop – the setting of return temperature below the system is working in Frost heating mode (during the stop)
		20°C	Frost - Start – the setting of return temperature below the system is working in Frost heating mode (during the work)
		25°C	Regulation - Stop – temperature setting of the return water of the water heater, when the temperature in low the valve is opening, regardless of main control signal heater (during the stop)
		30°C	Regulation - Start – temperature setting of the return water of the water heater , when the temperature in low the valve is opening, regardless of main control signal heater (during the work)
		1	Kp – regulator gain of the setpoint temperature on the water return
		30s	Ti – integration constant of the setpoint temperature on the water return regulator
	Pump protect	Active	Set protection - a recurring feature of the pump
		7days	Period - active when the protective function is active pump,
		30s	Run time - active when protective function is active pumps,
DX cooler	-	30s	Break time min. – minimal stop time refrigerating unit
		30s	Work time min. - the minimal working hours of a refrigerating unit
		13°C	Temp.out work min. – the minimal outdoor temperature by which the functioning of a refrigerating unit is active
		Inactive	Stage 2 – the possibility of activation II step cooling

		Inactive	Cascade – the possibility of activation cascade control two-stage DX cooler (1 – I step, 2 – II step, 3 – I i II step), use for two coolers of different efficiency
		50%	Stage 2 – the possibility of adjust threshold control signal level at which the II step of cooling is attached
		75%	Stage 3 – the possibility of adjust threshold control signal level at which the III step of cooling is attached (only on cascade)

7.4 Service menu

Access to these settings is password protected (default: **1111**).

Tab. 6 Service menu

Name	Name	Default value	Description
Service mode	-	Active	Active – possible configuration of the AHU, lack of ability of the start of AHU, protective functions of the chosen arrangement active Not active – configuration of the AHU is not possible, the possibility of the AHU start-up
AHU type	Type	Supply	Supply – Supply Air Handling Units Supply/exhaust – Supply and Exhaust Air Handling Units
	Recovery	None	None – in the AHU a system of the recovery exchanger wasn't applied Cross – AHU equipped with the Plate heat exchanger without by-pass Mix chamber – AHU equipped with the mixing chamber, controlled with one signal 0-10 VDC damper actuators of supply, exhaust and mixing chamber (0V-supply/exhaust OFF (closed), mixing chamber ON (open)) Cross / Mix chamber – AHU equipped with plate heat exchanger and mixing chamber Cross 0-10 – AHU equipped with the Plate heat exchanger with by-pass

	Heater	None	<p>None – in the AHU heater wasn't applied</p> <p>Electric – AHU equipped with the electric heater, controlled by signal 0-10 VDC, start/stop signal and with reflexive alarm signal.</p> <p>Water – AHU equipped with the water-heater, controlled by the valve actuator and pump</p>
	Cooler	None	<p>None – in the AHU cooler wasn't applied</p> <p>DX – AHU equipped with the DX cooler, controlled by signal 0-10VDC and digital signals being used for switching 1 and 2 of degree of the cooling, from a refrigeration unit we are taking the failure signal</p> <p>Water – AHU equipped with the water-heater, controlled by the valve actuator and pump</p>
Configuration	HMI Tiny	Inactive	There is ability to active panel „HMI Tiny“ which is using when the reference temperature is done by the knob in the HMI Tiny (for this purpose used the analog input Ain2), start/stop the system is realized by closing/ opening temperature sensor placed in the temperature of the room unit connected by adjuster switch to sensor input PT5 (using the panel HMI Tiny is not possible to work the system in standby mode due to the use of open sensor as STOP system)
	Outside temperature sensor	Inactive	There is ability to deactivation outside temperature sensor, when the sensor is inactive function preheat the water heater and ability to run the freon cooler is based on the time of year selected in menu "Settings/ Season"
	Exhaust temperature sensor	Inactive	There is ability to deactivation exhaust temperature sensor, when the exhaust and outside sensor is inactive function Eco is inactive and is not possible to determine the possibility of heat recovery (mixing chamber opens whenever you need heating)

	Alarm A_ColdRec	Inactive	<p>Active – alarm A_ColdRec frost of recovery visible in the alarm menu all the time during the freezing,</p> <p>Inactive – alarm A_ColdRec frost of the recovery invisible in the alarm menu, while the alarm in history is written with the moment of an alarm frost, and on graphical screen of HMI freezing icon appears during frost recovery.</p>
	Work - contact	Inactive	Optional activation of the one of the relay outputs as work conformation (make sure that output is not already used by application)
	Alarm – contact	Inactive	Optional activation of the one of the relay outputs as a group alarm (make sure that output is not already used by application)
	Supply 0-10VDC	Inactive	The possibility of activation one of the analog outputs as a signal 0-10VDC airflow rate of the supply air fan (make sure the output is not used for other purposes in the application)
	Exhaust 0-10VDC	Inactive	The possibility of activation one of the analog outputs as a signal 0-10VDC airflow rate of the exhaust air fan (make sure the output is not used for other purposes in the application)
	Fan inverter type	-	The possibility of choose fan inverter type controlled by Modbus RS485 (LG IC5, IG5 lub Danfoss FC51)
	Regulator	„2”	<p>The possibility of activation one of the two types of regulation:</p> <p>„1” - sum of temperature regulators: the main, lim.min., lim.max.,</p> <p>„2” - new cascade control in which the start-up of the system taking place only with the supply air temperature regulator for the time specified in "Settings/Temperature/Tset ramp" and after this time (when the leading sensor is different from the supply temperature sensor) an additional leading temperature regulator is activating and generating temperature set setpoint of the supply regulator.</p>

	Analog outputs	-	<i>The possibility of rescale the output signal 0-10VDC to 2-10VDC (please check signals compliance with manuals of damper or valve actuators)</i>
History of leading temperature	-	-	History of leading temperature which is written the last 15 measurements from the leading temperature sensor in the selected period of recording) and is given "deviation" which is the maximum difference of actual set point temperature and the last 15 measurements of the leading temperature sensor.
-	-	-	<i>Reading inputs, outputs of the controller, possibility of the emulation of inputs and forcing outputs of the controller during normal operation of the AHU, during the emulation or forcing activities alarm is reported but AHU is still normally working.</i>
Change the password	-	-	<i>Change of password of the access to the advanced options. Default password: 1111 Attention: losing, forgetting the password will cause loss of the possibility of amending of advanced parameters.</i>
Restore the default setting	-	-	<i>Restoring the initial values of all settings.</i>

8. Communication Modbus RTU

The controller has implementations of the Modbus RTU protocol. In order to make the network interface one should connect RS-485 trunk lines to the MASTER port on the slot of the controller. The Modbus address is being placed on ELP14R18 display as **MAC Address**. Longer holding of OK button (more than about 3 seconds) display enters Display Settings Menu.

Default parameters of the communication:

- MAC address 1
- transmission speed 9600 bps (possibility of amending from the level of inbuilt HMI or outside HMI)
- 8 bits of frame
- 2 bits of stop
- without parity

All variables are 32-bits with values of the type *Holding Register*. Modbus registers are 16-bits therefore one 32-bits variable is filling two 16-bits variables. The reading of variables is causing itself with Modbus 0x03 command, however writing single variable of the 16-bits using command of 0x06 or many variables with 0x10 command.

Representatives of variables

In the table below all variables of the control system were described. Variables have a few numerical representations:

- **Multistate** - correspond to total values of the variable described states
- **Decimal** - the value of the variable is treated to 32-bits as the total type with the sign
- **Fixed** -point type in 8 least significant whipped-in is allocated for the fractional part, however 24 remaining bits are a total part with the sign. Results from it that accuracy of the Fixed value it 1/256. In order to scale the value Fixed represented in the form on target (appropriate) one should multiply it through $1/256 = 0.00390625$.

Variables for the reading and the edition

Address	Variable	Description	State
0x 02	Tset	Set temperature (not available in the mode calendar)	1°C = 256 (22 °C = 22*256 = 5632 = 0x1600)
0x 04	Mode	Mode	0 - stop, 1 - work I step, 2 - work II step, 4- work III step, 8 - stand-by, 16 - calendar
0x 06	FHEn	Fast heating mixing chamber	0 - not active, 1 - active
0x 08	ResAl	Erasing blocking alerts	0 - lack of erasing, 1 - erasing

Variables read-only

Address	Variable	Description	State
0x 0A	B1	Temperature inlet	1°C = 256 (22 °C = 22*256 = 5632 = 0x1600)
0x 0C	B2	Temperature outlet	1°C = 256 (22 °C = 22*256 = 5632 = 0x1600)
0x 0E	B3	Temperature outside	1°C = 256 (22 °C = 22*256 = 5632 = 0x1600)
0x 10	B4	Temperature recuperation	1°C = 256 (22 °C = 22*256 = 5632 = 0x1600)
0x 12	B5	Return water temperature or the optional leading temperature (input PT5)	1°C = 256 (22 °C = 22*256 = 5632 = 0x1600)
0x 14	HMI RS485	Temperature of the sensor in panel with HMI Complex connected by RS485 Master	1°C = 256 (22 °C = 22*256 = 5632 = 0x1600)
0x 16	HMI CON	Temperature of the sensor in panel with HMI Complex connected by HMI CON	1°C = 256 (22 °C = 22*256 = 5632 = 0x1600)
0x 18	Main	Temperature leading sensor	1°C = 256 (22 °C = 22*256 = 5632 = 0x1600)
0x 1A	MainStdby	Temperature of the sensor of the leading stand-by mode	1°C = 256 (22 °C = 22*256 = 5632 = 0x1600)
0x 1C	TsetActual	The current temperature setpoint	1°C = 256 (22 °C = 22*256 = 5632 = 0x1600)

0x 1E	CO2exh	CO2 exhaust	1ppm = 256 (22ppm = 22*256 = 5632 = 0x1600)
0x 20	Y1	As controlled by water heater	1% = 256 (22% = 22*256 = 5632 = 0x1600)
0x 22	M1	Circulation pump heater	0 - stop, 1 - start
0x 24	Y2	As controlled water cooler	1% = 256 (22% = 22*256 = 5632 = 0x1600)
0x 26	E_CW	Feedback cooling demand	0 - stop, 1 - start
0x 28	Thr	As controlled of dumper inlet and outlet in the event that a mixing chamber isn't appearing in the AHU	0 - stop, 1 - start
0x 2A	1_2Y1	As controlled of dumper inlet and outlet in the event that a mixing chamber is appearing in the AHU	1% = 256 (22% = 22*256 = 5632 = 0x1600)
0x 2C	Y3	As controlled mixing chamber	1% = 256 (22% = 22*256 = 5632 = 0x1600)
0x 2E	Recovery	Recovery state	1% = 256 (22% = 22*256 = 5632 = 0x1600)
0x 30	RecState	Recovery state	0 - stop, 1 - start, 2, 3 - defrosting
0x 32	HEster	As controlled electric heater	1% = 256 (22% = 22*256 = 5632 = 0x1600)
0x 34	Y_CX	As controlled freon cooler	1% = 256 (22% = 22*256 = 5632 = 0x1600)
0x 36	CX_State	As controlled freon cooler	0 - stop, 1 - step I, 2 - step II, 3 - step I,II
0x 38	Vent	Start/stop the signal of fans station controller	0 - stop, 1 - start
0x 3A	PreHeat	Preliminary warming up	0 - stop, 1 - start
0x 3C	Cool	Cooling the electric heater or the freon cooler	0 - stop, 1 - start
0x 3E	ServiceMode	Service mode	0 - stop, 1 - start
0x 40	Work	Confirming of the work the system	0 - stop, 1 - praca
0x 42	PwrSup	As controlled supply inverter	1% = 256 (22% = 22*256 = 5632 = 0x1600)
0x 44	PwrExh	As controlled exhaust inverter	1% = 256 (22% = 22*256 = 5632 = 0x1600)
0x 46	Fsup	Frequency inverter supply	1Hz = 256 (22Hz = 22*256 = 5632 = 0x1600)
0x 48	Fexh	Frequency inverter exhaust	1Hz = 256 (22Hz = 22*256 = 5632 = 0x1600)
0x 4A	Usup	Engine voltage supply fan	1V = 256 (22V = 22*256 = 5632 = 0x1600)
0x 4C	Uexh	Engine voltage exhaust fan	1V = 256 (22V = 22*256 = 5632 = 0x1600)

0x 4E	Isup	Engine current supply fan	1A = 256 (22A = 22*256 = 5632 = 0x1600)
0x 50	Iexh	Engine current supply fan	1A = 256 (22A = 22*256 = 5632 = 0x1600)
0x 52	A_Code	Wrong central type code (do not set supply + glycol, rotary or cross recovery)	0 - an alarm is missing, 1 - an alarm is appearing
0x 54	A_StopSystem	Fire-prevention, supply, exhaust fan alarm	0 - an alarm is missing, 1 - an alarm is appearing
0x 56	A_ThHWair	Alarm of the thermostat frost-resistant	0 - an alarm is missing, 1 - an alarm is appearing
0x 58	A_3xThHWair	Alarm of the thermostat frost-resistant (3 times appearance of the alarm within an hour)	0 - an alarm is missing, 1 - an alarm is appearing
0x 5A	A_ThHWwater	Low temperature alarm of return water water heater	0 - an alarm is missing, 1 - an alarm is appearing
0x 5C	A_3xThHWwater	Low temperature alarm of return water water heater (3 times appearance of the alarm A_ThHWwater within an hour)	0 - an alarm is missing, 1 - an alarm is appearing
0x 5E	A_ThHE	Alarm of the thermostat electric heater	0 - an alarm is missing, 1 - an alarm is appearing
0x 60	A_3xThHE	Alarm of the thermostat electric heater (3 times appearance of the alarm within an hour)	0 - an alarm is missing, 1 - an alarm is appearing
0x 62	A_ColdRec	Alarm of frosting the recuperation	0 - an alarm is missing, 1 - an alarm is appearing
0x 64	A_SupExhFilter	Alarm of the dirty filter of the inlet, outlet	0 - an alarm is missing, 1 - an alarm is appearing
0x 66	A_Tsup	Alarm of the temperature sensor of the air blowing	0 - an alarm is missing, 1 - an alarm is appearing
0x 68	A_Texh	Alarm of the temperature sensor of the outlet	0 - an alarm is missing, 1 - an alarm is appearing
0x 6A	A_Tout	Alarm of the temperature sensor outside	0 - an alarm is missing, 1 - an alarm is appearing
0x 6C	A_Trec	Alarm of the temperature sensor behind the recuperation	0 - an alarm is missing, 1 - an alarm is appearing
0x 6E	A_TbackWater	Alarm of the contact temperature sensor return water heater	0 - an alarm is missing, 1 - an alarm is appearing
0x 70	A_Tmain	Alarm of the temperature sensor leading	0 - an alarm is missing, 1 - an alarm is appearing
0x 72	A_InEmul	Alarm of the emulation of entries of the controller	0 - an alarm is missing, 1 - an alarm is appearing
0x 74	A_OutForce	Alarm of pushing exits of the controller	0 - an alarm is missing, 1 - an alarm is appearing
0x 76	Alarm	Collective alarm	0 - an alarm is missing, 1 - an alarm is appearing

9. Communication Bacnet MS-TP with BMS system

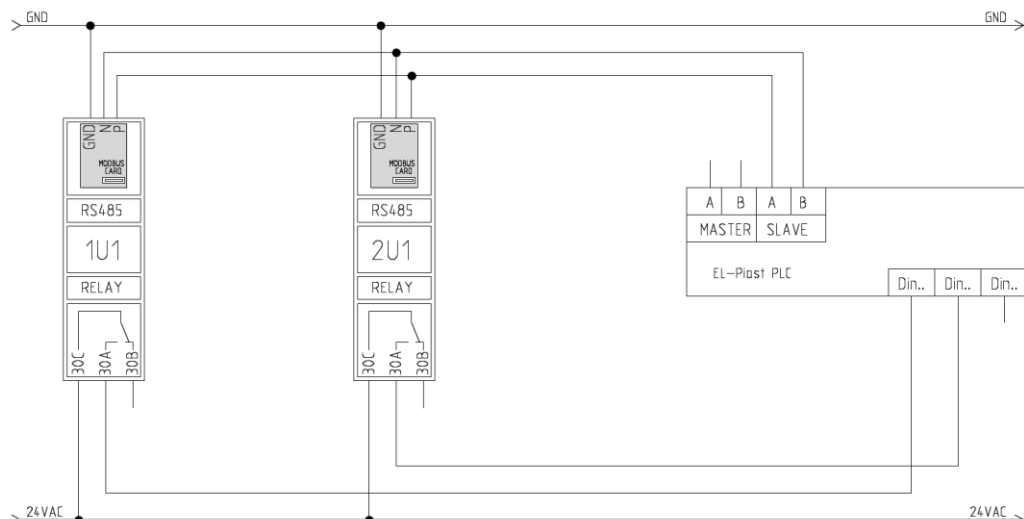
Variables BacNet should look after connecting the powered controller and the introduction of appropriate BacNet network settings (see item5)

10. Communication RS485 Slave, Modbus RTU with inverters LG IC5

<http://www.aniro.pl/do-pobrania/do-pobrania/finish/31-instrukcja-eng/16-ig5a-manual-v2-4-110131-1/0.html>



Example for system with supply, exhaust



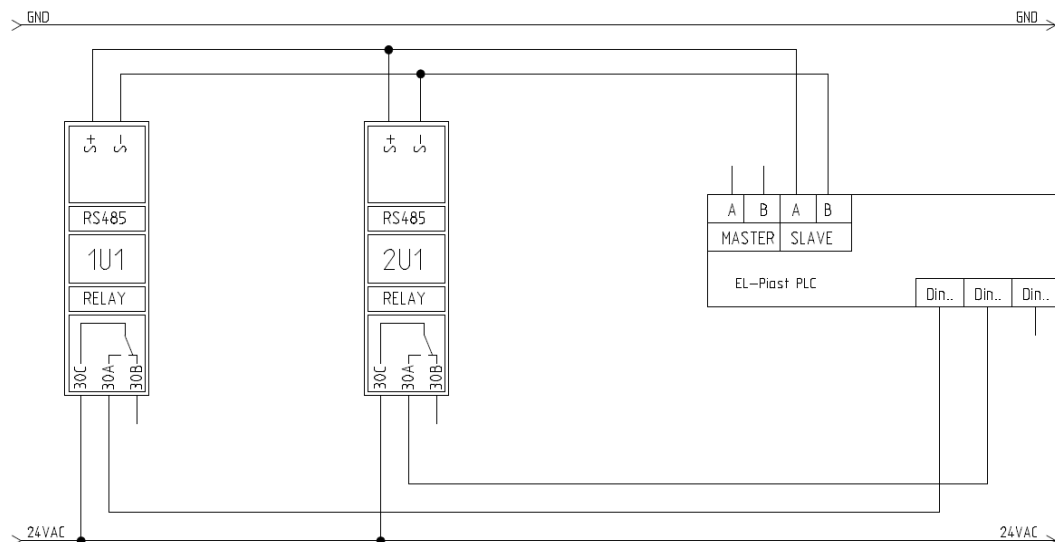
Configuration drive LG IC5 control RS485:

Code	Name	Value to be set	Description
drv	Control mode	3	Communication RS485
Frq	The method of frequency	8	Communication Modbus-RTU
F21	Maximum output frequency	Fz max	Set individual
F22	Rated motor frequency	...Hz	Set individual
F23	The minimum frequency reference	0.000	Always enter the value
F30	Characteristic U/F	0	Linear
F50	Motor overload protection	1	active
H30	Rated motor power	...kW	With the motor nameplate
H33	Rated motor current	...A	With the motor nameplate
I55	Relay function	12	Work without alarm
I60	Drive address	1	Inverter supply fan
		2	Inverter exhaust fan
I61	transmission speed	3	9600
I62	Reaction to loss of communication	2	stop
I63	Communication time	10.0	

Fz max - frequency inverter for work at maximum efficiency fan (resulting from the adjustment of air distribution system). On the beginning should be entered the frequency of documentation. The same value must be entered in the menu Settings/Fans/RS485 in the "Maximum frequency supply/exhaust"

11. Communication RS485 Slave, Modbus RTU with inverters LG IG5

Example for system with supply, exhaust



Configuration drive LG IG5 control RS485:

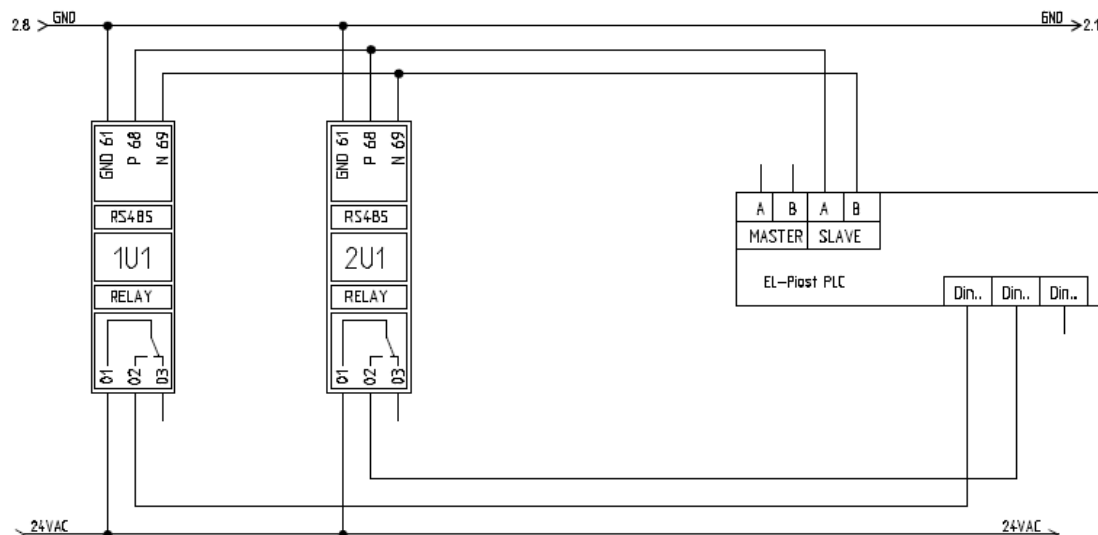
Code	Name	Value to be set	Description
drv	Control mode	3	Communication RS485
Frg	The method of frequency	7	Communication Modbus-RTU
F21	Maximum output frequency	Fz max	Set individual
F22	Rated motor frequency	...Hz	Set individual
F23	The minimum frequency reference	0.000	Always enter the value
F30	Characteristic U/F	0	Linear
F50	Motor overload protection	1	active
H30	Rated motor power	...kW	With the motor nameplate
H33	Rated motor current	...A	With the motor nameplate
I55	Relay function	12	Work without alarm
I60	Drive address	1	Inverter supply fan
		2	Inverter exhaust fan
I61	transmission speed	3	9600
I62	Reaction to loss of communication	2	Stop
I63	Communication time	10.0	

Fz max - frequency inverter for work at maximum efficiency fan (resulting from the adjustment of air distribution system). On the beginning should be entered the frequency of documentation. The same value must be entered in the menu Settings/Fans/RS485 in the "Maximum frequency supply/exhaust"

12. Communication RS485 Slave, Modbus RTU with inverters Danfoss FC51

<http://www.danfoss.com/poland/businessareas/drivessolutions/frequency+converters/vlt+micro+drive.htm>

Example for system with supply, exhaust



Configuration drive Danfoss FC51 control RS485

Code	Name	Value to be set	Description
1-03	Characteristic U/F	0	Linear
1-20	Rated motor power	...kW	With the motor nameplate
1-24	Rated motor current	...A	With the motor nameplate
1-25	Rated motor speed	...rpm	With the motor nameplate
1-90	Motor overload protection	4	Emergency off ETR
3-02	The minimum frequency reference	0.000	Always enter the value
3-03	The maximum frequency reference	Fz max	Set individual
3-17	Control input	11	Modbus
4-14	Maximum output frequency	Fz max	Set individual
4-16	Output current limitation	110.0	-
5-40	Relay function	6	Work without alarm
8-01	Control	0	Digital and communication
8-02	Control	1	FC RS485
8-03	Wait to communication	10.0s	-
8-04	Lost communication reaction	2	Stop
8-30	Choose communication protocol	2	Modbus RTU
8-31	Drive address	1	Inverter supply fan
		2	Inverter exhaust fan
8-32	Transmission speed	2	9600
8-33	Parity FV port	3	No parity, 2 stop bits

Fz max - frequency inverter for work at maximum efficiency fan (resulting from the adjustment of air distribution system). On the beginning should be entered the frequency of documentation. The same value must be entered in the menu Settings/Fans/RS485 in the "Maximum frequency supply/exhaust"