

## Control system for AHU with EC motors

### Description

The control system is intended to be used for control of AHU with heat recovery, supply and extract fans with EC motors, supply air electric heater, outside air damper, plate heat exchanger "Bypass" damper.

For the parameters settings and measured data monitoring remote control with touch screen is connected to the control board. The remote control with control board is connected using 4 wire cable and data transmitted in RS485 MODBUS mode.

For economical and accurate AHU control 4 or 5 (depending on AHU type) temperature duct sensors are connected to the control board. The temperature sensors help quickly reach user settings.

For the fan motors control PCB has 0-10VDC control outputs. PCB has input for fans motors TACHO or NC feedback signal connection. With TACHO or NC system gets the fan fault signals.

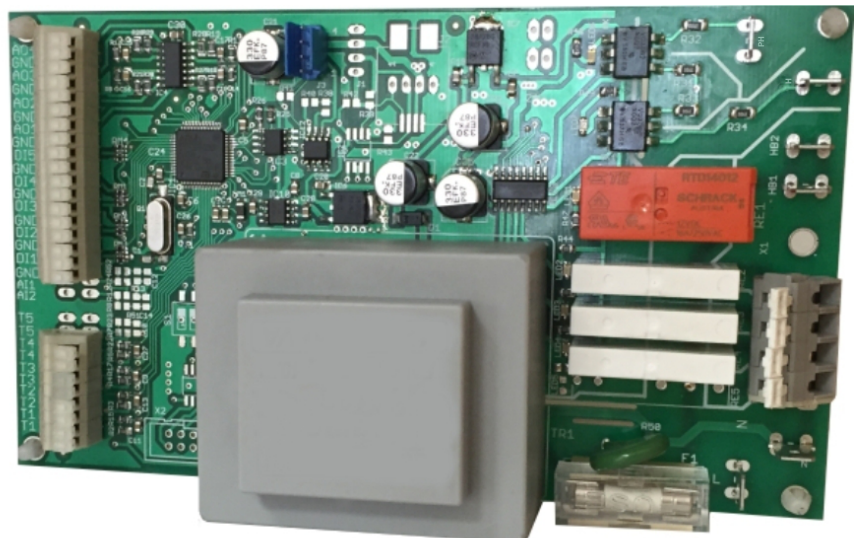
The electric heater is controlled using PID algorithm and this allows to obtain good temperature control accuracy.

The control system has heat exchanger frost protection function. If exhaust air temperature drops below limit, set in the control panel (1-10), freezing risk of heat exchanger appears first pre-heater turns on, then "Bypass" damper opens if exhaust temperature does not rise. If the exhaust temperature still does not rise to above set point, supply and exhaust fan speeds are altered to rise exhaust air temperatures (supply air fan speed is gradually reduced to 30%, then exhaust air fan speed is increased gradually 100%).

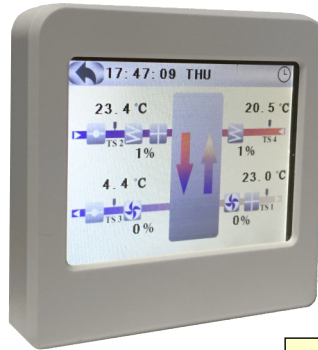
The system controls heat exchanger in heating recovery and free-cooling modes.

The control system also can check external signals status such as filter pollution from pressure switch, fire alarm from fire alarm system.

TECHNICAL DATA	
Power supply	230 VAC, 50 Hz
Remote control connection	RS485 MODBUS
Temperature setpoint range	5..30°C
Fans rotation speed setpoint range	20..100 %
Air damper actuator control	230 VAC
Electric heater and pre-heater control	total power 230 VAC up to 3.6 kW (16A) or 0-10VDC output for heater
Fans control signals	0-10 VDC
Fans motors failure signal	pulse
Air damper actuators control	230 VAC up to 1 A
Temperature sensors quantity and type	5 pcs, NTC10K
Filter pollution alarm digital input	voltage free, NO
Fire alarm digital input	voltage free, NO
Dimensions of PCB	90x160 mm.
Dimensions of remote controller	86x92x19 mm.

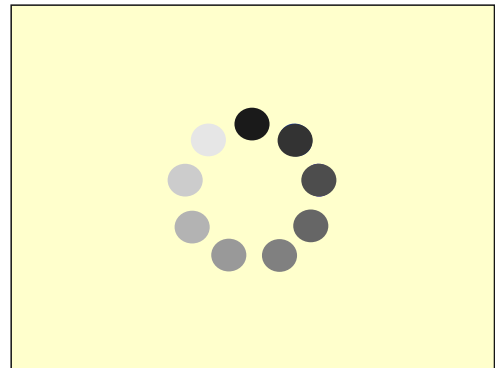


## Remote control with touch screen



### WORKING PRINCIPLES

User can set and monitor parameters of controlled device using remote control with touch screen. After connecting power supply touch screen turns on automatically. Rotating loading icon briefly appears on the main window after turning on the power.



When rotating loading icon disappears the screen gets dim and switches to standby OFF window. Time indication and switch ON key appear on the screen. Unit is off.

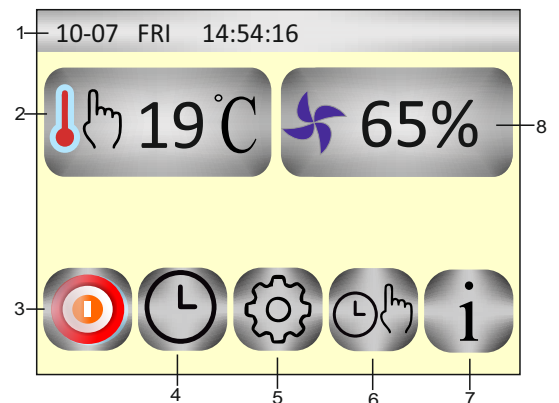
1. Time.
2. Switch ON key.



### Main menu window

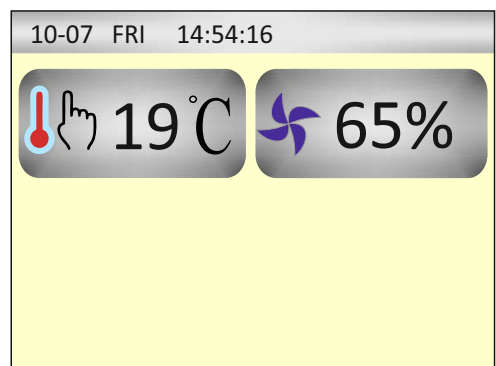
On the main menu window user can turn OFF the device, set the temperature, fan speed, navigate to the information about controlled AHU, adjust settings or weekly work mode schedule programming. Press settings key to open the settings screen.

1. Date and time.
2. Temperature setting key.
3. Switch OFF key.
4. Weekly work mode programming key.
5. Settings key.
6. Work mode selection key. Manual or by weekly work mode.
7. Information about controlled unit key.
8. Fan speed setting key.



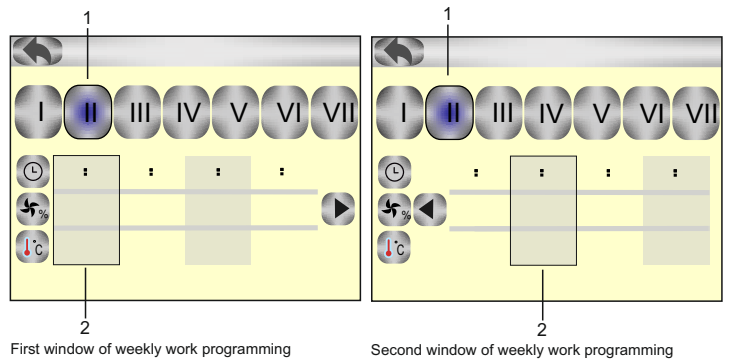
If during previous working session "auto-boot" function was turned ON, then main menu window appears on the screen after switch ON key is pressed.

Screen goes to active standby mode after 30s of displaying (any other window will stay active for 5 min, before standby window activates) temperature and fan speed keys appear on the screen.



**Weekly programming window**

In main window by pressing a clock icon you can enter weekly work programming mode. Weekly programming window allows to set up 8 working events with different settings which are displayed in two windows (4 events in one window) for each day. To start weekly work mode programming week day must be selected. When the week day is selected user must select time, fan speed and temperature of each event. When all necessary events are entered user has to press return key for confirmation. To stop running the unit user has to set 0% for fan speed. To deactivate the event or events set 0% for fan speed, set 0h 00min for time and 5°C for temperature. Any event can be active or inactive.

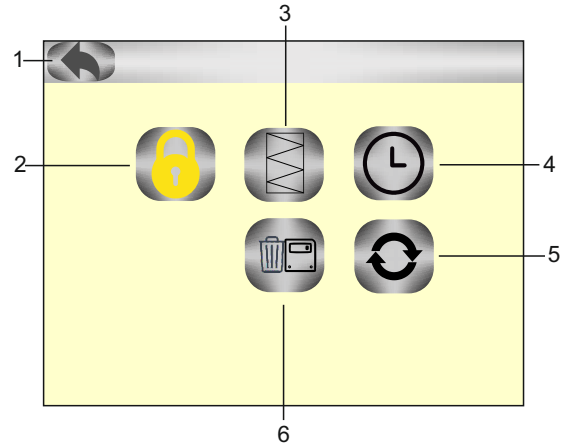


1. Select week day.
2. Event column.

**Settings window**

In the settings window user can set date and time, navigate to the locked settings window, restart the system, delete data.

1. Return to the main screen key.
2. Locked settings.
3. Filter pollution level reset.
4. Date and time setting key.
5. System restart key.
6. Data erase function key.

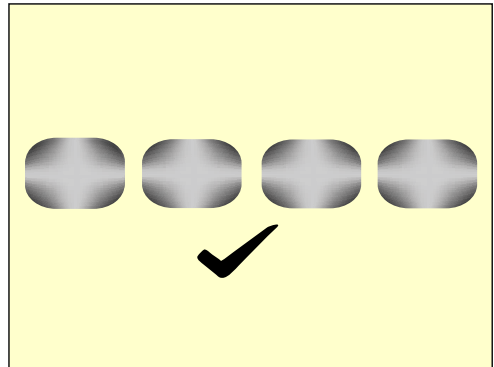


**I. Return to the main screen key**

This key returns user to the main window.

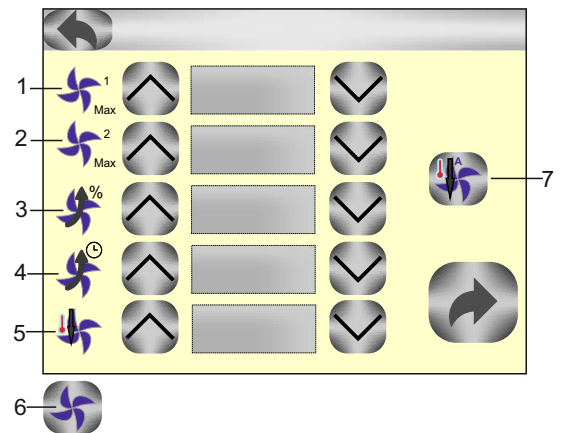
**II. Locked settings window**

When user press locked settings key in the main window appears 4 empty squares and system asks to enter the password. Default password is **3971** to enter locked settings. When locked settings window opens then unit stops previous work mode until new settings will be done, and starts working under new values only after locked settings window is left.



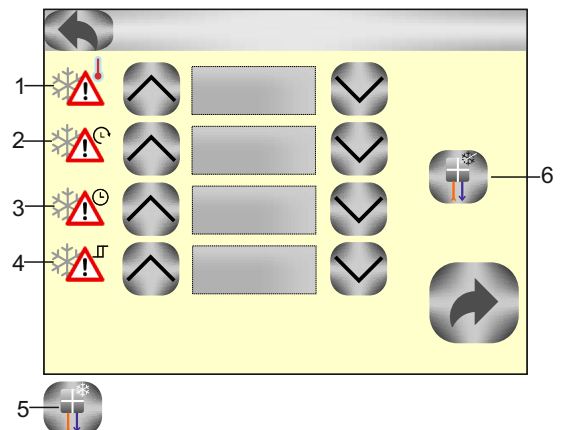
First locked settings window appears after entering the password. In this window user can enter fan settings:

1. Maximum value of supply air fan.
2. Maximum value of extract air fan.
3. Percent of boost/(cooker hood) function.
4. Time of boost/(cooker hood) function.
5. Temperature of auto-slowdown.
6. Auto-slowdown OFF key.
7. Auto-slowdown ON key.



In the second locked settings window user can enter anti-frost function settings:

1. Temperature of anti-frost triggering time (exhaust -T3).
  2. Minimal working time of anti-frost function.
  3. Time after which alarm is triggered and the unit is stopped (if set value is 0 units doesn't stop).
  4. Hysteresis of anti-frost function (the minimum temperature increase which is needed for exhausted air to deactivate anti-frost function).
- \* 5. Active anti-frost function for water heater key.  
 \* 6. Inactive anti-frost function for water heater key.  
 \* 5-6 functions are inactive with units that use electric heaters or do not have any heaters at all.

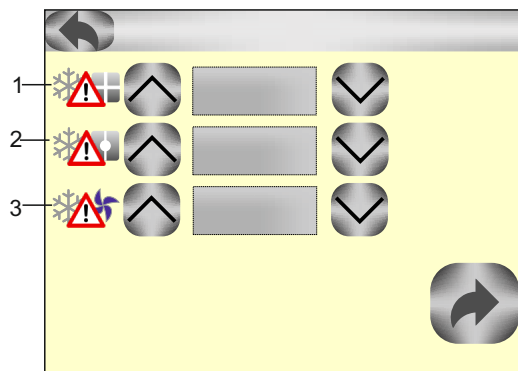


In the third locked settings window user can enter time settings for activation of certain steps of frost protection:

1. Time for pre-heater activation.
2. Time for bypass damper activation.
3. Time for intake air fan speed activation.

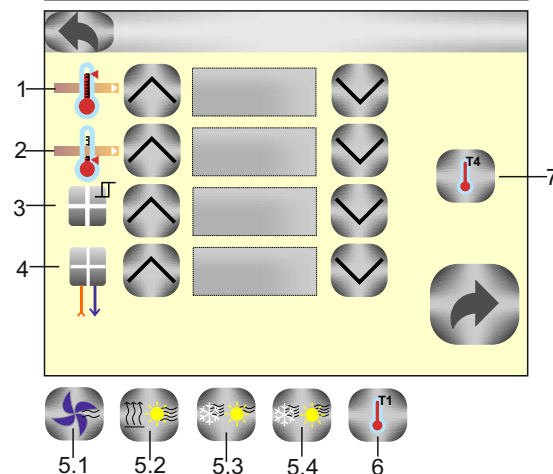
1 and 2 anti-frost functions are active only with plate heat exchanger. For rotary heat exchanger (fan speed adjustment according supply air temperature is active if selected). If room freezing danger appears for system with rotary heat exchanger then intake air fan speed is changed to avoid freezing.

If these functions need to be deactivated time must be set longer or equal to alarm triggering time.



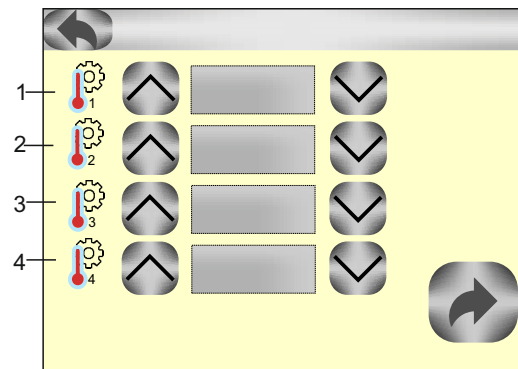
Fourth locked settings window has settings of minimum and maximum supply air temperature.(settings are active only if unit works according to indications of two temperature sensors) , also in this window user can select work modes, and maintained temperature's settings.

1. Maximal temperature of supply air.
2. Minimal temperature of supply air.
3. Hysteresis for a relay heater or cooler.
4. Start temperature of water heater.
5. Work modes:
  - 5.1. Ventilation with passive temperature support.
  - 5.2. Active heating.
  - 5.3. Passive cooling.
  - 5.4. Active heating and cooling.
6. Maintained temperature is supply.
7. Maintained temperature is extract.



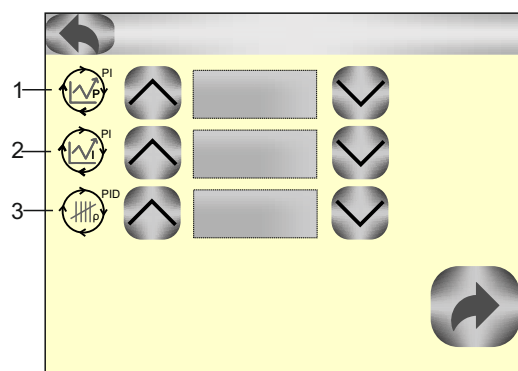
In the fifth locked settings window user can set values of temperature sensors adjustment. Values can be entered only after making sure what is the accuracy of temperature (adjusted temperature can be set +/- 5°C with 0,1 degree interval).

1. Value of first (supply) temperature sensor adjustment.
2. Value of second (intake) temperature sensor adjustment.
3. Value of third (exhaust) temperature sensor adjustment.
4. Value of fourth (extract) temperature sensor adjustment.



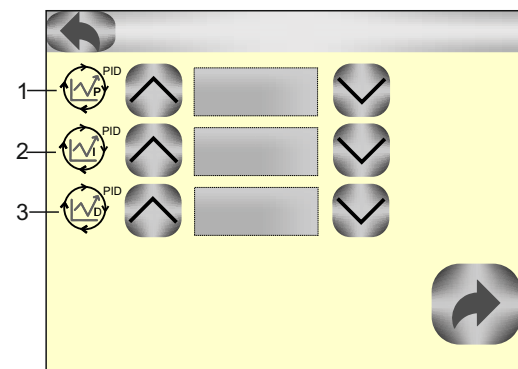
Sixth locked settings window has settings of PI algorithm, and executing frequency of PID.

1.  $K_p$  algorithm.
2.  $K_i$  algorithm.
3. Executing frequency of PID.



In the seventh locked settings window user can set PID coefficient adjustment.

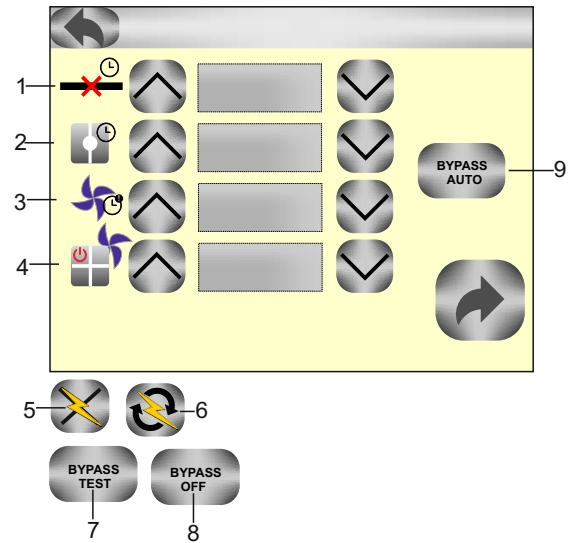
1.  $K_p$  adjustment
2.  $K_i$  adjustment
3.  $K_d$  adjustment



Eight locked settings window has time of connection alarm setting (i.e. time after which the control board will turn off the unit if in RS485 connection won't be found compliant CRC i.e. it is not necessary to enquire the board, important only to have a suitable

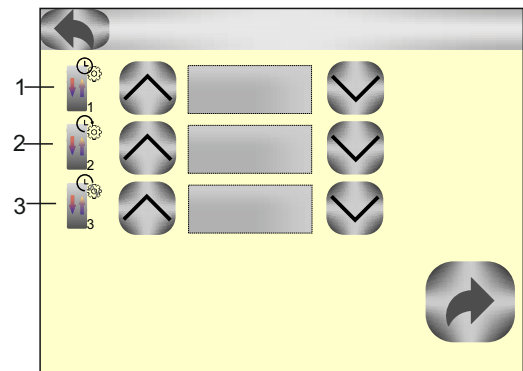
CRC), also user can set opening time of dampers, time of fan delay before run the unit ( when valve starts to open fan control signal is delayed for the set period of time, then the fan starts to run at 20%. Once the dampers are fully open fans start to work according to the set value), heater time setting (electric heater cooling time) (with electric heater: it is minimal time period for fan to work after electric heater is switched off) or warming time with water heater – (time till temperature (T5) off heater’s return water reaches the set one) (temperature set in the fourth settings window) temperature). In this locked setting window also is a key to turn on “auto boot” function and settings of heat exchanger bypass valve TEST/OFF/AUTO (TEST mode - continuously opens and shuts down the valve, bypass OFF – this valve is

1. Time of connection alarm.
2. Opening time of dampers.
3. Time of fan delay.
4. Cooling time for electric heater/Warming time for water heater.
5. „Auto boot” OFF.
6. “Auto boot” ON.
7. Bypass TEST mode.
8. Bypass OFF mode.
9. Bypass AUTO mode.



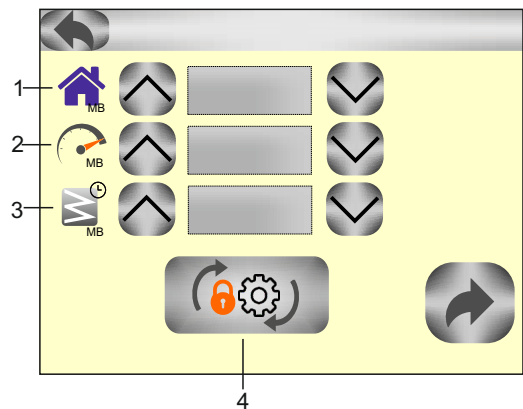
Next locked settings window has rotary heat exchanger settings. User in this window can enter period of rotor rotation also switching time and pulse rate per minute of rotary heat exchanger.

1. Time period of rotor rotation.
2. Switching time.
3. Pulse rate per minute (when 0-> NC).



The last locked settings window has settings of RS485 MODBUS protocol address and baud rate. (in this version of control system these settings are inactive) also there are settings of filter usage time (working time value enters in weeks) and locked settings default restore.

1. RS485 MODBUS protocol address.
2. RS485 MODBUS protocol baud rate.
3. Filter usage time.
4. Default restore.

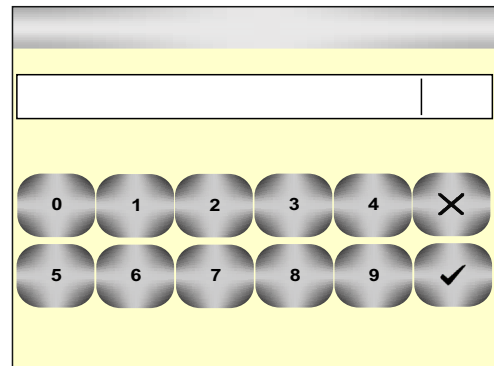


### III. Filter pollution level reset key

If controlled unit works 6 months (set time is 27 weeks in locked settings) on display will occur filter sign. After change of filter user should press filter pollution key to reset time to 0. Same action should be done if filter pollution signal comes from pressure switches.

### IV. Date and time setting window

After pressing date and time setting key, user can set date and time (format YYYY:MM:DD:HH:MM:SS). The date is important to program the device, so it is important to enter the exact time! Date is confirmed by pressing tick or canceled by pressing cancel key.  
 Note: Entered date and time must be from 2000-01-01 00:00:00 to 2099-12-31 :23:59:59.



### V. System restart key

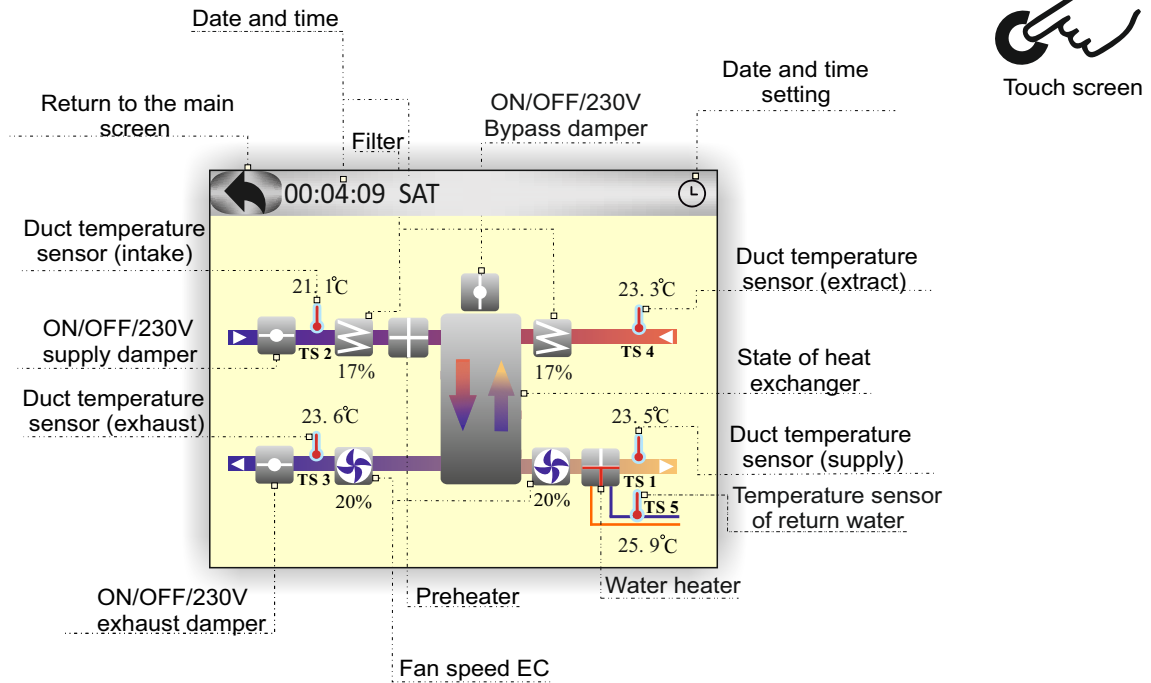
If any alarm occurs after fixing the issue user has to press system restart key to start the unit again.

**VI. Data erase function key**

With this key user can delete : set temperature, set fans speed, weekly work mode. Press key icon for data deleting. At the bottom will appear buttons to confirm or to cancel your selection. After confirmation you have to wait until the process will end. Until confirmation or canceling of the process, all remote controller of touch screen is inactive.

**Information window**

In this window you can monitor supply, extract, exhaust, intake temperatures, dampers position, bypass function, filters pollution level, fans mode and other information related with AHU.



**Alarms**

• Remote control displays alarm symbol if a failure disturbs the work of the device. The sign, that indicates a specific problem will appear in information window.



• The lost connection between touch screen remote control and control board.



Check remote controller if it is connected to the control board. If the line was disconnected or wasn't connected at all, after maintenance works you have restart the system. The function is not active if so selected in "Locked settings".

• Disconnected temperature sensor.



Check if a temperature sensor is connected to the control board. Not working sensor will be indicated in the information window. After checking a sensor you need to restart the system.

• Fans fault.



This fault means that there is no feedback signal from fans motor. Check if:

- fans not blocked.
- feedback of signal (Tacho or NC) wires transmit data to the controller board. In "Locked setting" signal type can be selected between Tacho (pulse), NC (normally close contact).
- fan controlling signal from the board transmits to the fan.

If everything works fine do the system restart.

• Overheating alarm signal.



This alarm means that electrical heater manual thermostat contacts are open the unit stops.

• Filter pollution warning.

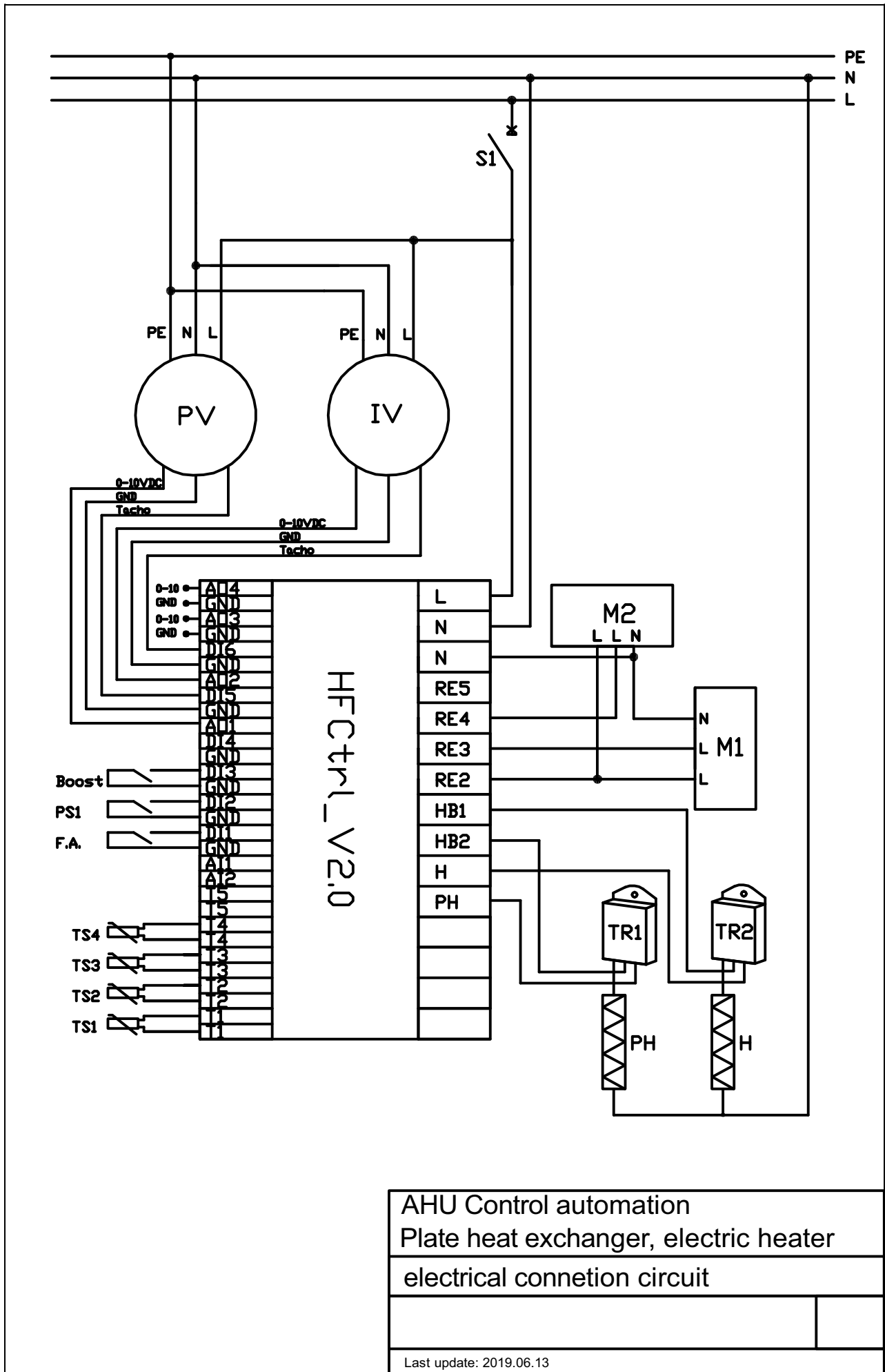


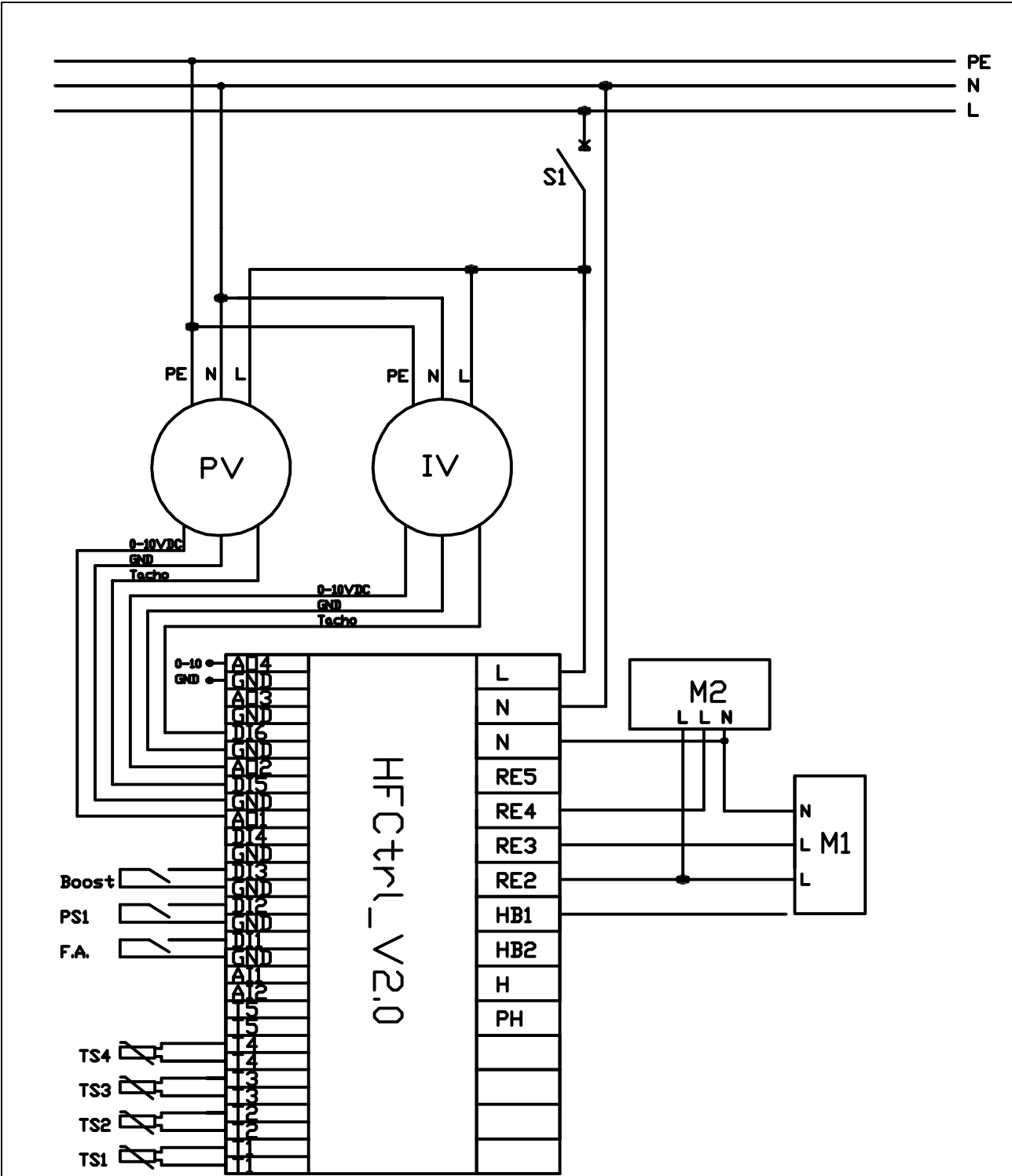
This caution means that there is high level of pollution in air filters. There are 2 ways to monitor filters. One is by time and calculation period is 6 month. Other is if pressure switches connected to PCB.

**Remote controller touch screen calibration**

After 40 clicks in 5 seconds, the calibration mode of touch screen is possible in inactive screen (touch doesn't make any changes). The white crosses which are in corner of blue window help you to calibrate a screen correctly. After calibration, you will be returned to the window, where you was before.

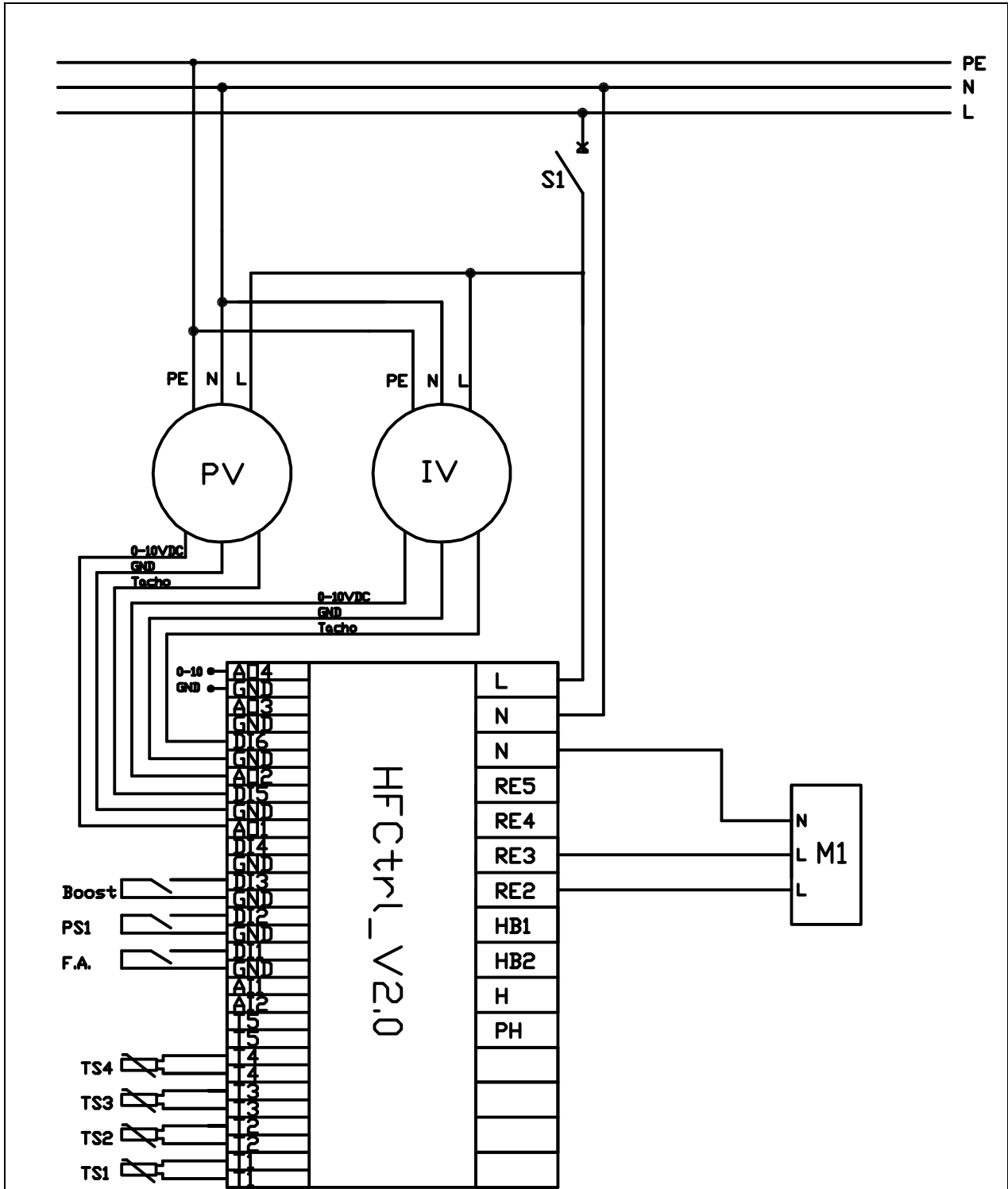






AHU Control automation	
Plate heat exchanger, no heater, no preheater	
electrical connetion circuit	
Last update: 2019.06.13	

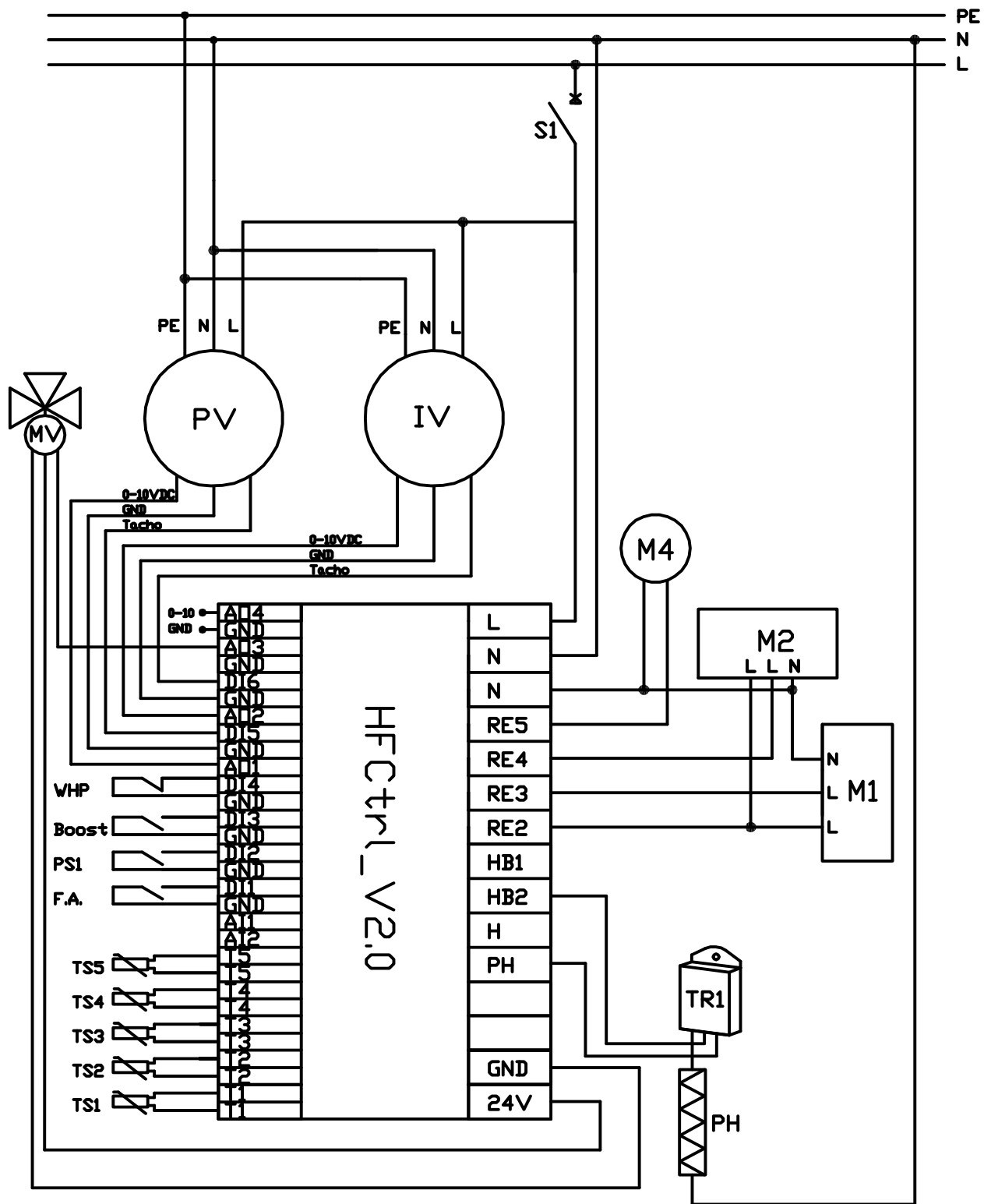




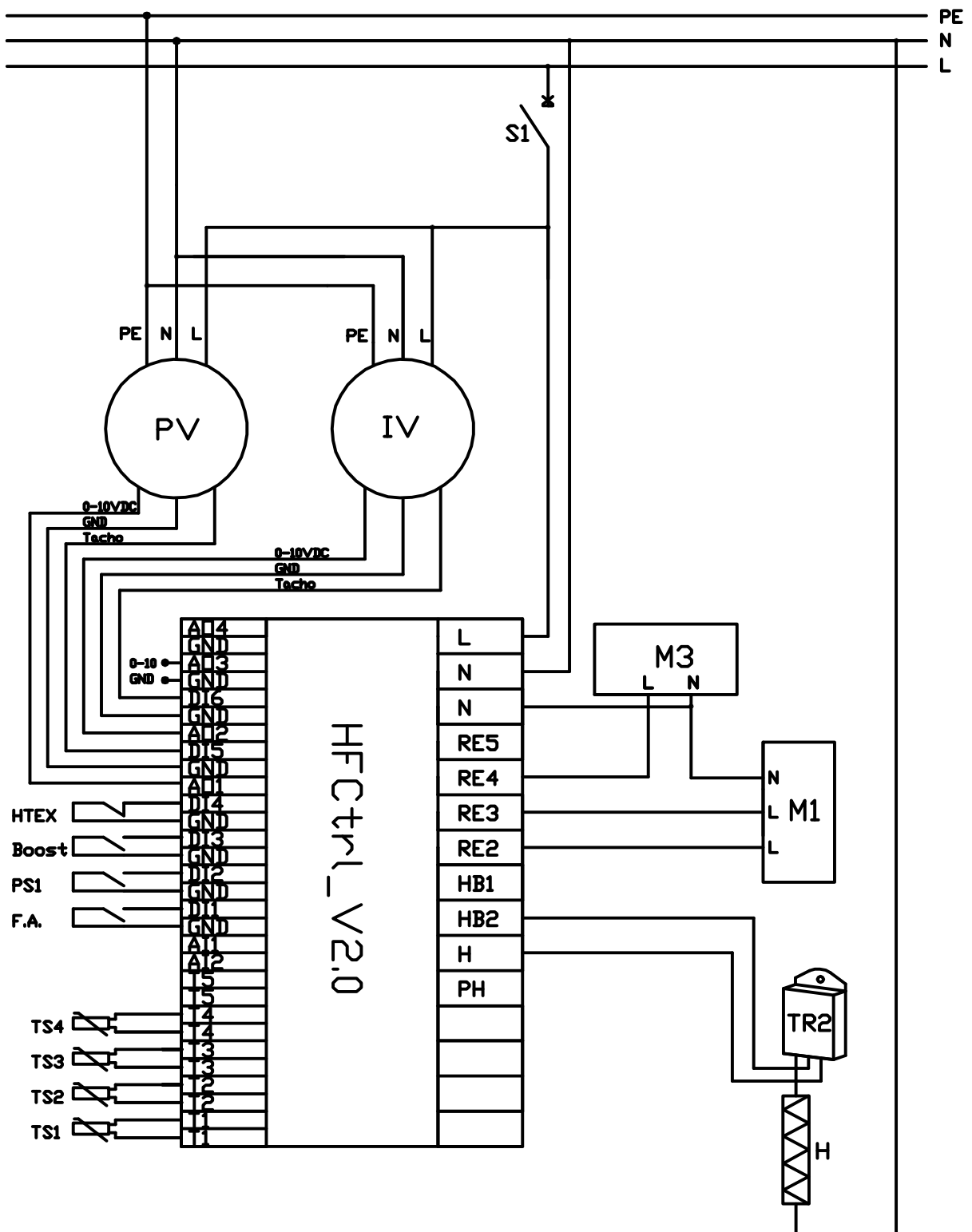
AHU Control automation  
 Plate heat exchanger, no heater, no preheater, no bypass

**electrical connetion circuit**

Last update: 2019.06.13



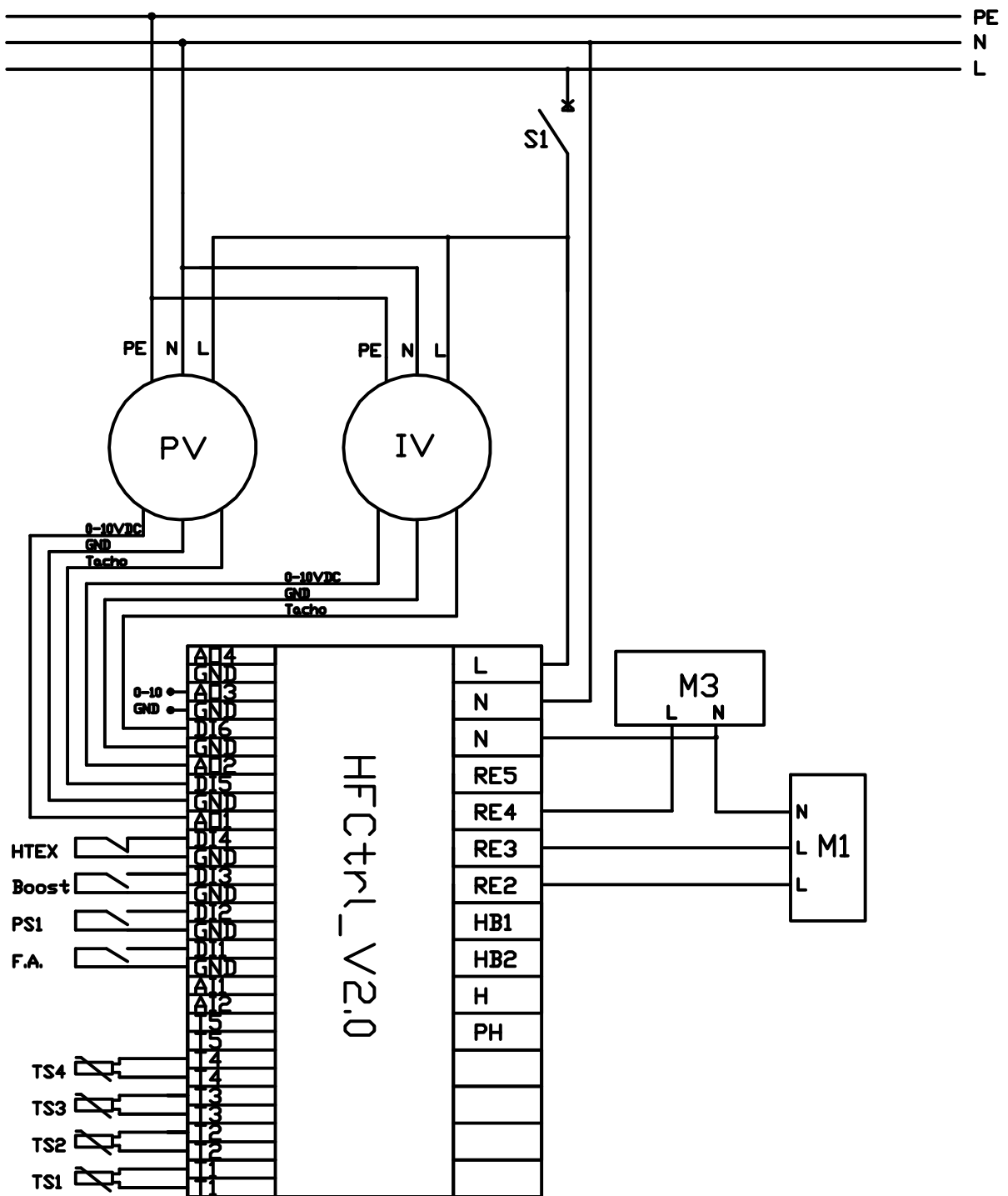
AHU Control automation	
Plate heat exchanger, water heater	
electrical connetion circuit	
Last update: 2019.06.13	



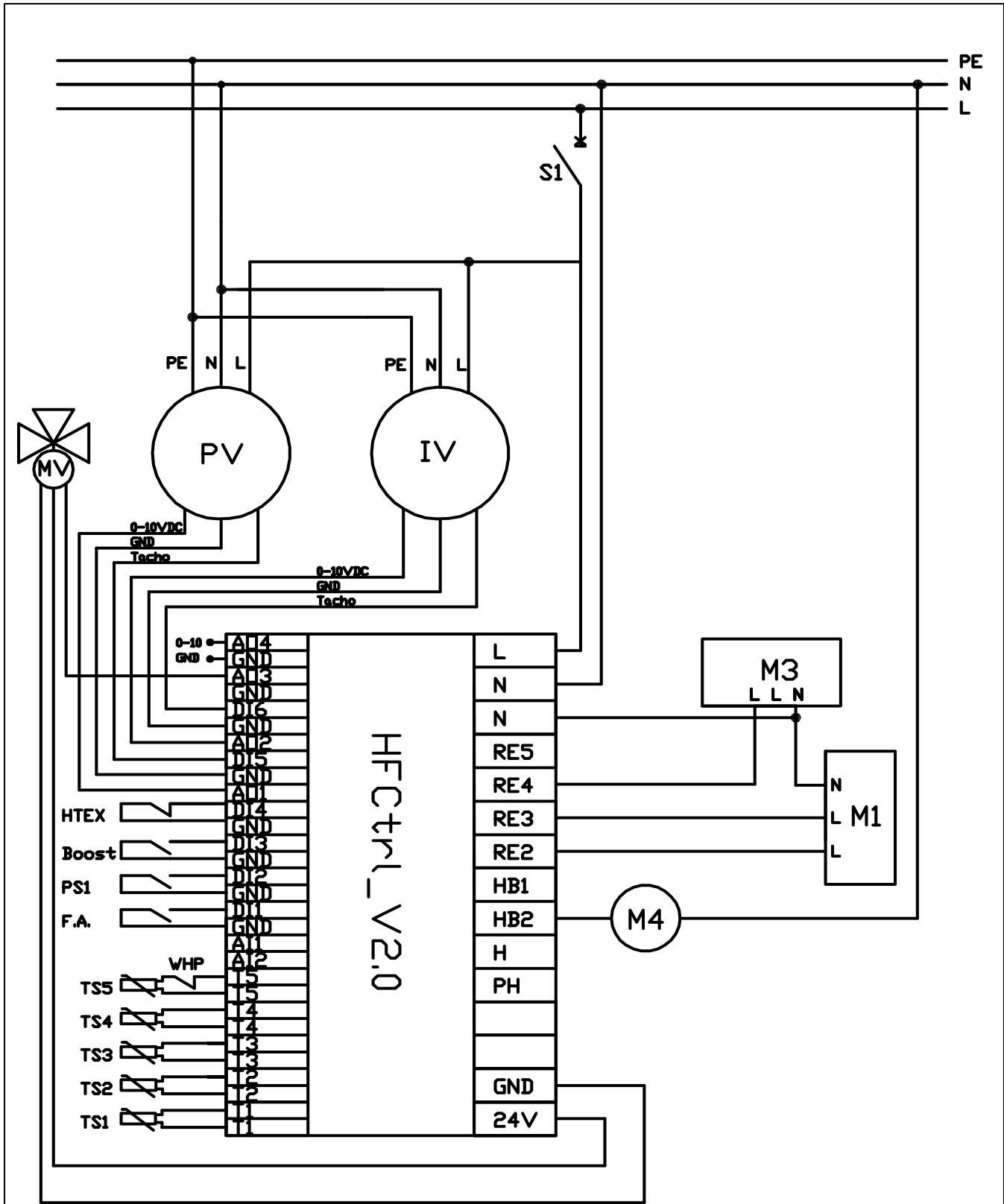
AHU Control automation  
 Rotary heat exchanger, electric heater  
 electrical connetion circuit

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Last update: 2019.06.13



AHU Control automation	
Rotary heat exchanger, no heater	
electrical connetion circuit	
Last update: 2019.06.13	



AHU Control automation  
 Plate heat exchanger, water heater  
 electrical connection circuit

Last update: 2019.06.13

**Markings**

- PE,N,L - 230VAC
- M1 - Intake air valve actuator 230VAC.
- M2 -Bypass valve actuator 230VAC.
- M3 - Rotary heat exchanger actuator 230VAC.
- M4 - Circulating pump
- RE4 - Bypass control signal 230VAC.
- RE3- Intake air valve control signal 230VAC.
- RE2- Intake and Bypass actuator supply 230VAC.
- TR1,TR2 - Power triac.
- H,PH - Heating element.
- S1 - overcurrent breaker.
- IV - Extract air fan.
- PV - Supply air fan.
- MV - Mixing valve.

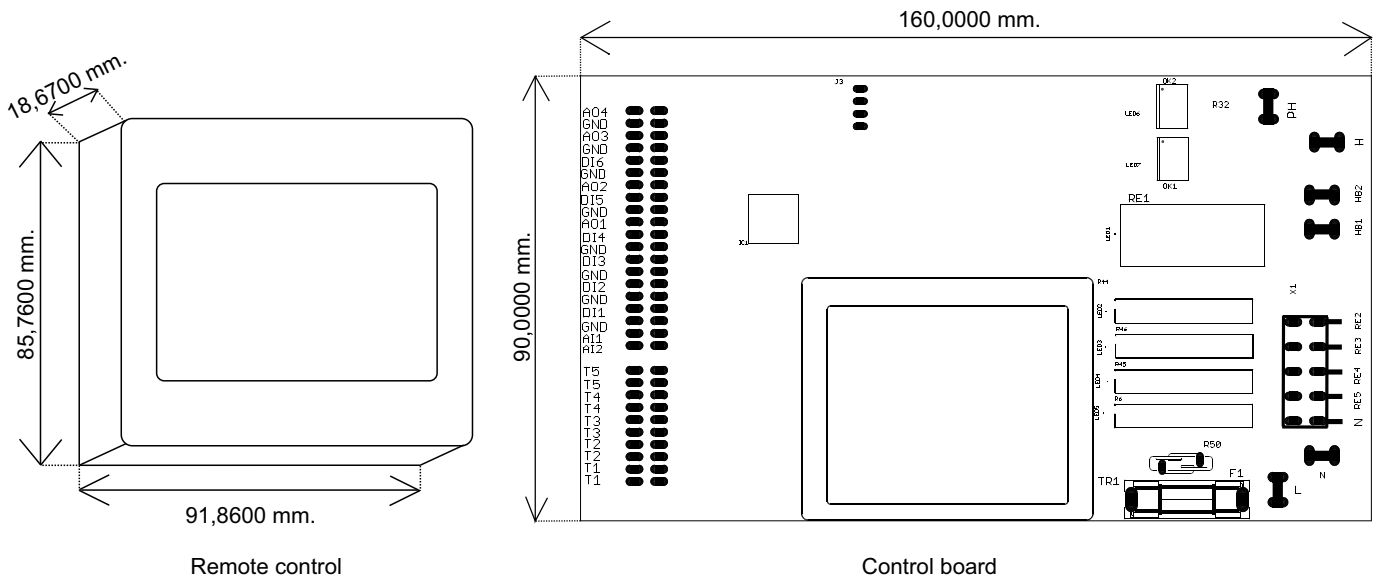
- 0-10 - Control signal 0-10VDC.
- TACHO - fan motor pulse feedback signal.
- GND - Low voltage signal ground.
- Note: AO3 is control signal output for auxiliary or substitute heater.
- TS1 - Supply air temperature sensor.
- TS2 - Intake air temperature sensor.
- TS3 - Exhaust air temperature sensor.
- TS4 - Extract air temperature sensor.
- TS5 - Return liquid temperature sensor.

- HTEX - Rotary heat exchanger pulse or NC contact.
- WHP - liquid heater frost protection thermostat NC type.
- Boost - Switch NO for increased fan speed function.
- PS1 - Air filter differential pressure switch. NO type (multiple switches can be connected in parallel).
- F.A. - Fire alarm signal input. NO type.

**DIP-switch modulation depends from AHU equipment**

OFF	ON
Plate heat exchanger	Rotary
Electric heater	Water heater
TACHO	NC
Damper with 3 wires	Damper
Boost	Cooker hood

**Dimensions of control board and remote control**



\*User can set configuration control system with DIP switches and make an adjustments with remote control according to the controlled of system type and components, i.e. exchanger type- rotary or plate; heater type - electric heater, water heater or pre-heater, Bypass damper and etc.