
 Klimor GDYNIA	DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT UNITS MCKT-HPX	DTR.MCKT-HPX. AUT-009.5.0	PAGE
		2016	1/35

DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT VENTILATION UNIT MCKT-HPX


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 GDYNIA	DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT UNITS MCKT-HPX	DTR.MCKT-HPX. AUT-009.5.0	PAGE
		2016	2/35

CONTENTS:	PAGE
1. INTRODUCTION	3
1.1 DESCRIPTION OF CONTROL SYSTEM	3
1.2 FUNCTIONS OF CONTROL SYSTEM	3
1.3 ELECTRIC PROTECTION	3
1.4 COMMUNICATION	3
2. SUPPORTED DEVICES	3
2.1 FANS	3
2.1.1 RPM ADJUSTMENT OF MCKT-HPX 1 AND MCKT-HPX 2 FAN MOTORS	3
2.1.2 RPM ADJUSTMENT OF MCKT-HPX 3 FAN MOTORS	3
2.2 HEAT EXCHANGER	5
2.3 HEAT PUMP	5
2.4 FILTERS	5
2.5 OPTIONAL DEVICES	5
2.5.1 PRELIMINARY ELECTRIC HEATER	5
2.5.2 INLET AND OUTLET AIR DAMPERS	5
3. CONTROL PANEL	6
3.1 ASSEMBLY AND CONNECTION OF CONTROL PANEL	6
3.2 CONTROL PANEL USER GUIDE	7
4. PRELIMINARY HEATER	7
5. AIR DAMPERS: INLET AND OUTLET AIR DAMPERS	7
6. OPERATION OF THE CONTROL PANEL	8
6.1 DESCRIPTION OF THE SCREENS	8
6.1.1 SIMPLIFIED MENU SCREENS	8
6.1.2 MAIN SCREEN	9
6.1.3 MAIN MENU	10
7. WIRING DIAGRAMS	19
8. DANFOSS FC 51 INVERTERS FOR MCKT-HPX 3	27
9. BMS VARIABLE LIST – RTU MODBUS PROTOCOL	28
10. CONTROL MODULES OF PRELIMINARY ELECTRIC HEATERS	33
10.1 FUNCTIONAL DESCRIPTION	33
10.2 COOPERATION OF THE PRELIMINARY HEATER CONTROL MODULE WITH THE MCKT-HPX CONTROL SYSTEM	33

 GDYNIA	DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT UNITS MCKT-HPX	DTR.MCKT-HPX. AUT-009.5.0	PAGE
		2016	3/35

1. INTRODUCTION

1.1 Description of Control System

The control system is specifically designed for MCKT-HPX AHUs. The control algorithm, making use of up to 5 temperature sensors in total, enables highly efficient heat recovery from the air extracted from rooms. Application of EC motors in MCKT-HPX 1 and MCKT-HPX 2 as well as AC motors controlled with inverters in MCKT-HPX3 also enables stepless adjustment of fan RPM in entire control range.

The control system supports the heat pump as well as option's air dampers and preliminary electric heater.

The room panel equipped with 4-line display, enables communication between a user and the control system installed in the MCKT-HPX. A panel equipped with temperature sensor can be located in any room, which facilitates operation and improves the comfort of usage.

The application of the MODBUS RTU protocol enables connecting the controller to the facility's BMS system and remote control and adjustment of the AHU.

1.2 Functions of control system

The control system is in charge of the following functions:

- Power supply: 1×230VAC – MCKT-HPX 1 i 3×400V MCKT-HPX 2 i MCKT-HPX 3
- power supply, protection and independent control of fan motors, heat pump compressor
- 24VAC power supply of optional air damper actuators
- power supply of control panel
- 2× communication ports RS 485
- 3× analog outputs 0-10V
- 5× non-voltage relay digital outputs, switched
- 5× digital temperature sensor inputs
- 4× non-voltage digital inputs
- 2× analog inputs 0-10V
- 2× quick transistorized output (PWM)
- weekly calendar with possible 4 time zones for each day

1.3 Electric protection

The control system has to be energized in accordance with the wiring diagram and has to be protected with a circuit breaker with an appropriate rating for the receivers used.

Protection of fans, heat pump compressor and compressor casing heater depend on their output and are provided on appropriate wiring diagrams.

1.4 Communication

The automatic control system enables communication with the BMS system using the MODBUS RTU –RS485 protocol.

[Summary of variables in point 9.](#)

2. SUPPORTED DEVICES

2.1 Fans

The control system enables independent control using 0÷10V voltage signals of air supply and air exhaust fans equipped with 1-phase EC motors for MCKT-HPX 1 i MCKT-HPX 2 and 3-phase (3x230V) AC with inverters for MCKT-HPX 3 size. It also enables providing power supply and protecting each of them individually.

2.1.1 RPM adjustment of MCKT-HPX 1 and MCKT-HPX 2 fan motors

The controller provides a 0÷10V signal directly to the EC motor

2.1.2 RPM adjustment of MCKT-HPX 3 fan motors

The controller provides the 0÷10V signal to the inverter which in a proportional way changes frequency of the fan motor current.

AHUs are equipped with inverters with 1×230V 50Hz power supply, which control fan motors powered with 3x230V 50Hz. Each inverter is equipped with control panel shown below.



Picture 1 Inverter control panel for the MCKT-HPX 3

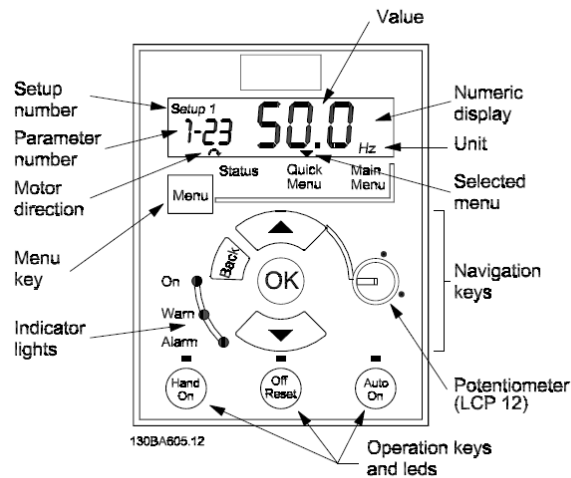


Illustration 1.7 Description of Buttons and Display

Picture 2 Description of inverter control panel for the MCKT-HPX 3

Use the [Menu] key to select one of the following menus:

Status

For readouts only.

Quick Menu

For access to Quick Menus 1 and 2, respectively.

Main Menu

For access to all parameters.

Navigation Keys

[Back]: For moving to the previous step or layer in the navigation structure.

[▲] [▼]: For manoeuvring between parameter groups, parameters and within parameters.

[OK]: For selecting a parameter and for accepting changes to parameter settings.

Pressing [OK] for more than 1 s enters 'Adjust' mode. In 'Adjust' mode, it is possible to make fast adjustment by pressing [▲] [▼] combined with [OK].

Press [▲] [▼] to change value. Press [OK] to shift between digits quickly.

To exit 'Adjust' mode, press [OK] more than 1 s again with changes saving or press [Back] without changes saving.

Operation Keys

A yellow light above the operation keys indicates the active key.


[Hand on]: Starts the motor and enables control of the frequency converter via the LCP.

[Off/Reset]: The motor stops except in alarm mode. In that case the motor will be reset.

[Auto on]: The frequency converter is controlled either via control terminals or serial communication.

[Potentiometer] (LCP12): The potentiometer works in two ways depending on the mode in which the frequency converter is running.

In *Auto Mode* the potentiometer acts as an extra programmable analog input.
In *Hand on Mode* the potentiometer controls local reference.

 GDYNIA	DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT UNITS MCKT-HPX	DTR.MCKT-HPX. AUT-009.5.0	PAGE
		2016	5/35

2.2 Heat exchanger

The control system controls defrosting of the cross-flow heat exchanger. When the controller receives a signal from the temperature sensor (Tr) installed at the exchanger's air exhaust outlet regarding a drop of this temperature below the setting (factory default: 0°C), it initiates the defrosting mode. It consists in turning on the preliminary heater, heat pump compressor and air supply fan. Once the situation is under control (temperature above the setting) and after 3minutes, the AHU switches back to the normal operation mode.

2.3 Heat pump

The control system contains a complete algorithm of heat pump control with reverse operation option. It covers the following functions:

- Turning on/off the compressor
- Turning on/off the solenoid valve controlling the compressor
- Turning on/off the 4-way valve switching the system operation
- Read out of high pressure gauge alert
- Read out of low pressure gauge alert
- Controlling the compressor casing heater

The MCKT-HPX AHU can be equipped with the preliminary electric heater (optional), which heats up fresh air and ensures correct operation of the heat pump at low external temperatures (below -5°C).

2.4 Filters

The pressure gauges installed at filters indicate filter contamination and the need to replace them. When excessive pressure drop on any of the filters is detected an alarm signal is displayed. It is necessary to plan filter exchange/cleaning. The system should not operate for a longer with contaminated filters as it can cause damage of the heat pump and/or fans' motors.

2.5 Optional devices

The MCKT-HPX control systems enable control of other devices which are not provided as standard AHU equipment. They contain:

2.5.1 Preliminary electric heater

Preliminary electric heater energized and controlled with a separate module.

Power supply for the heater MCKT-HPX 1 – 1×230V/50Hz, for MCKT-HPX 2,3 – 3×400V/50Hz.

Heaters electric data – see point 10.

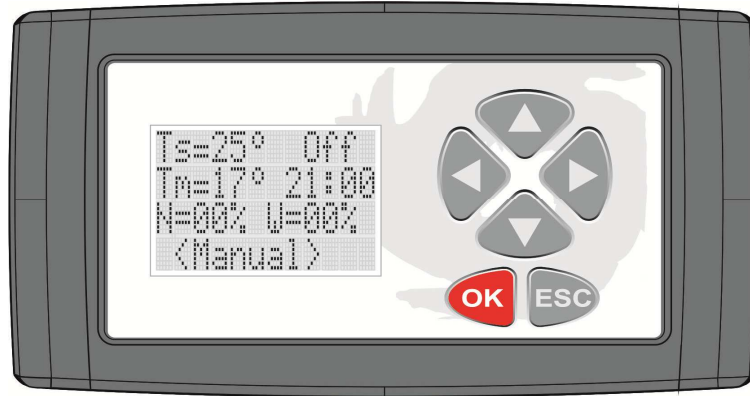
It is recommended to use pressure gauge pf air supply fan connected to appropriate terminals of electric heater module.

2.5.2 Inlet and outlet air dampers

Inlet and outlet air dampers with on/off-controlled actuators, with 24VAC power supply.

3. CONTROL PANEL

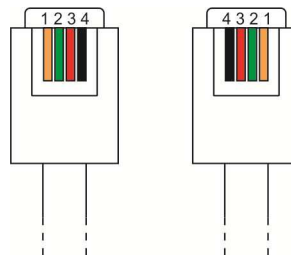
The main component designed for communication with the controller of the control system is the control panel (it is also possible to control the equipment with the BMS in the MODBUS RTU protocol).



Picture 3 Control panel view

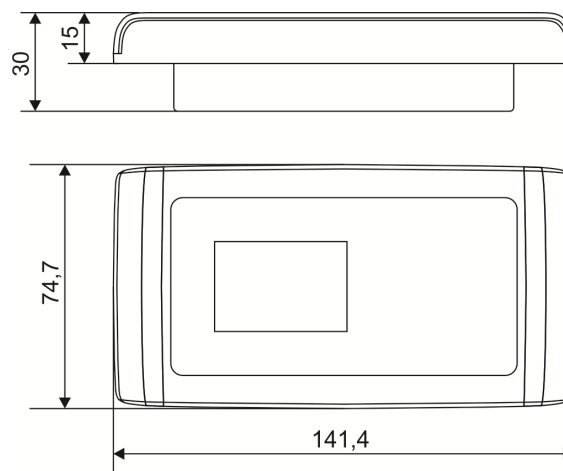
3.1 Assembly and connection of control panel

The DEN16-C panel is energized with 12VDC supply from the Unibox controller. The power supply and control is carried out both using 4-strand communication cable. It can be terminated at each side with RJ11 connectors (4-pin, size 6) or can be connected directly to COM1 clamp connection. The cable with RJ connectors should be interlaced as shown:




Picture 4 RJ clamp terminal view

If cables longer than 5 meters are used, it is recommended to use twisted-pair cables, eg. UTP (1st pair: +12V, G0; 2nd pair: A, B).




Picture 5 Panel diameters

 GDYNIA	DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT UNITS MCKT-HPX	DTR.MCKT-HPX. AUT-009.5.0	PAGE
		2016	7/35

3.2 Control panel user guide

SWITCHING SYSTEM ON – press the OK button and hold it for 2s
 SWITCHING SYSTEM OFF – press the ESC button and hold it for 2s

Menu navigation:

Active menu row is indicated with symbols, depending on editing capabilities of related parameters.
 The ● symbol indicates that a parameter can be modified in the active menu line.
 The ○ symbol indicates that a parameter cannot be modified (preview only)
 The ► symbol indicates that there is an embedded menu in the active line.
 The  symbol indicates that there is a locked embedded menu or unavailable parameter in the active line.
 UP – scrolling menu line up
 DOWN – scrolling menu line down
 RIGHT – lower menu level
 LEFT – higher menu level
 OK - entering parameter edit mode/leaving edit mode with confirming changes
 ESC – back to STANDBY screen/leaving edit mode and withdrawing changes

Navigation in the simplified menu:

RIGHT/LEFT – scrolling menu right/left

Description of each controller screens – see point 6.

NOTE!

1. The MCKT-HPX AHU is supplied with factory settings of individual parameters provided to the controller.
2. The user has to configure the system according to conditions in a facility where the MCKT-HPX is installed.
3. Changing most of the parameters entered by a user requires the password.

4. PRELIMINARY HEATER

In order to ensure appropriate operation of heat pump at external air temperature <-5°C it is recommended to use preliminary electric heater installed at fresh air input for MCKT-HPX.
 Electric connection of the heater – based on data provided in point 10.

The preliminary heater is energized and controlled with a separate control module which is energized independently from the MCKT-HPX control cabinet.

MCKT-HPX 1 – 1×230V 20A power supply.

MCKT- HPX 2 and 3 – 3×400V power supply, 22.5A and 33.9A respectively.

Setting up the controller – “Settings” screen > “Preliminary heater”.

5. AIR DAMPERS: INLET AND OUTLET AIR DAMPERS

It is recommended to install dampers with actuators cutting out airflow when the unit is not in operation.

Air damper actuators, on/off-controlled with 24VAC power supply.

Electric connection of actuators to the control system – according to diagrams provided in point 7.

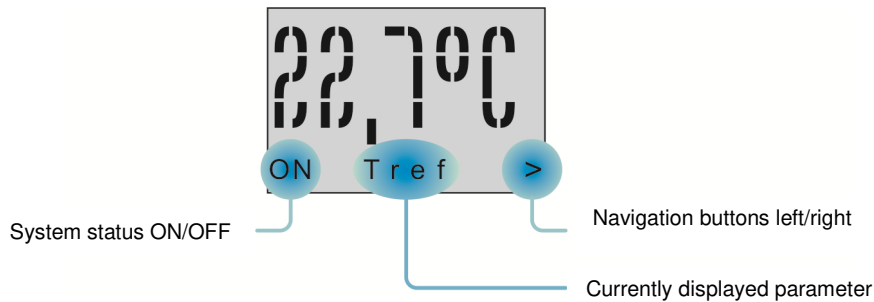
6. OPERATION OF THE CONTROL PANEL

6.1 Description of the screens

6.1.1 Simplified menu screens

First six screens scrolled with the LEFT/RIGHT buttons enables in easy way the preview and settings of the most important parameters of AHU operation. Use the UP/DOWN buttons to change parameters. Implemented changes do not require confirmation with the OK button. Changing parameters at screens 4, 5, 6 is only possible in the MANUAL mode.

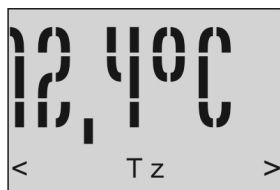
6.1.1.1 Simplified menu screen 1



[Tref] – current value of temperate readout from a reference sensor

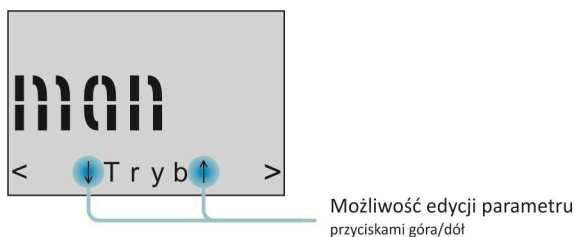
[ON/OFF] – turning on/off the AHU using this screen requires pressing and holding down OK/ESC button for 2 seconds.

6.1.1.2 Simplified menu screen 2



[Tref] – current value of temperate readout from external sensor

6.1.1.3 Simplified menu screen 3




[Mode] – {MANUAL, MAX, 1d, 2d+5d, 7d} – currently selected operation mode

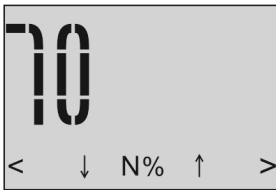
6.1.1.4 Simplified menu screen 4



[Tzad] – currently requested temperature – this parameter can be edited in manual mode only

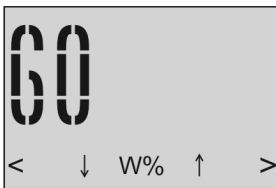
 GDYNIA	DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT UNITS MCKT-HPX	DTR.MCKT-HPX. AUT-009.5.0	PAGE
		2016	9/35

6.1.1.5 Simplified menu screen 5



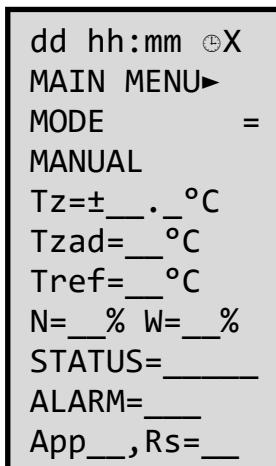
[N%] – current setting of air supply fan – the parameter is editable only in manual mode, changes at 10% intervals between min and max values defined in the advanced settings.

6.1.1.6 Simplified menu screen 6



[W%] – current setting of air exhaust fan – the parameter is editable only in manual mode, changes at 10% intervals between min and max values defined in the advanced settings.

6.1.2 MAIN SCREEN



[dd] – current day

[hh:mm] – current time

[⊕X] – {X=1|2|3|4} – indication of operation in week mode timer and calendar zone, in which the controller currently operates

[MODE] – {MANUAL, MAX, 1d, 2d+5d, 7d} – currently selected operation mode

[Tz] – current value of external temperature

[Tzad] – currently preset temperature

[Tref] – current value of temperature readout from a master (reference) sensor

[N=, W=] – current speed of air supply and exhaust fans

[STATUS] – system's current operation mode:

{STOP} – system is not working

{INIT} – opening dampers

{WORK} – standard operation

{RPRT} – standard operation, activation of the exchanger anti-freeze protection


{WOUT} – fan coasting after finished operation

{AST} – indication of AUTO STOP function operation

[ALARM] – current status of system alarms – see ALARMS menu

[App_] – information on currently chosen application

[Rs] – info about the master (reference) sensor selected for control

 GDYNIA	DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT UNITS MCKT-HPX	DTR.MCKT-HPX. AUT-009.5.0	PAGE
		2016	10/35

6.1.3 MAIN MENU

MAIN MENU Operation mode ▶ Input ▶ Outputs ▶ Settings ▶ Adv.Settings ▶ Alarms ▶ Passwords ▶ Info ▶ Time/Language ▶ Revert settings▶

6.1.3.1 OPERATION MODE

/OPERATION MODE MODE=MANUAL MANUAL setting ▶ ZONE setting ▶ MAX setting ▶

[TRYB] – this parameter enables choosing a required operation mode:

{**MANUAL**} – operation in manual mode, all operating parameters set by the operator

{**MAX**} – turning on operation for FW time, preset fan speed at MAX level, once preset time elapses, switching back to operation in the previously selected mode

{**1d**} – operation in automatic mode – specific settings for each weekday

{**2d+5d**} – operation in automatic mode – separate settings for MO–FR and separate ones for SA–SU

{**7d**} – operation in automatic mode – common settings for MO–SU

Settings of MANUAL mode

\\MANUAL setting N=___% W=___% Tzad=___°C

This screen enables setting preset fans speed and temperature in the MANUAL mode:

[**N**] – setting the air supply fan control value

[**W**] – setting the air exhaust fan control value

[**Tzad**] – temperature requested in MANUAL mode

Settings of ZONE mode

//ZONE setting Zone1 ▶ Zone2 ▶ Zone3 ▶ Zone4 ▶	///Ust.STR.1 DN=dd T=___°C N=___% W=___% Kon.Str.=___ FS=___
--	---

These screens enable setting operating AHU parameters in the ZONE mode:

[**DN**] – selection of weekday, which zones will be programmed

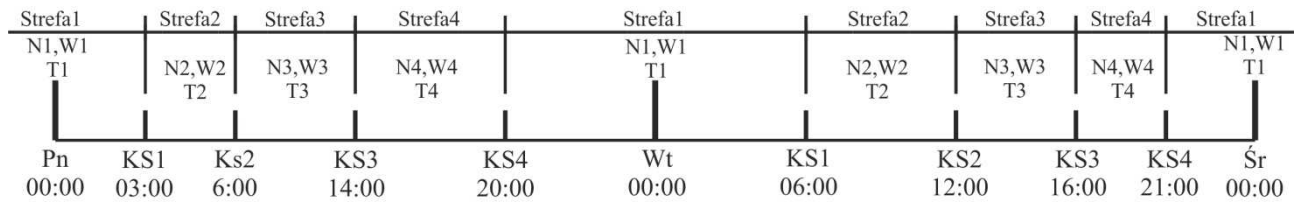
{**MO, TU, ... , SU**} – setting for selected weekday of the 1d schedule

{**5d**} – settings for MO–FR of the 2d+5d schedule

{**2d**} – settings for SA–SU of the 2d+5d schedule

{**7d**} – settings for MO–SU of the 7d schedule

[T] – setting preset temperature in the selected zone
 [N] – setting the air supply fan control value
 [W] – setting the air exhaust fan control value
 [Kon.Str.] – end time of the selected zone



Picture 6 Programming of time zones

[FS] – turn ON/OFF setting in a selected zone:
 {STOP} – system is not working
 {RUN} – system is working

Settings of the MAX mode

```
//MAX setting
FW=__min
N=__% W=__%
FL=__min
```

[FW] – quick ventilation function: enables turning on fans regardless of the fan calendar in the MAX mode for the preset time {1min–5h}, once the preset time elapses the system switches back to the operation according to the ZONE/MANUAL settings (depending on the previously selected mode)
 [N] – setting the control value of air supply fan in the MAX mode
 [W] – setting the control value of air exhaust fan in the MAX mode
 [FL] – current time left to the end of quick ventilation function


6.1.3.2 INPUTS

```
/INPUTS
Sensors ▶
Digital ▶
Analog ▶
```

Sensors

```
//SENSORS
Tz =±__._°C
Tn =±__._°C
Tn2=±__._°C
Tp =±__._°C
Tw =±__._°C
Tr =±__._°C
```

[Tz] – current external temperature
 [Tn] – current air supply temperature downstream of the counterflow heat exchanger
 [Tn] – current air supply temperature downstream of the heat pump
 [Tp] – current air temperature indicated by the sensor located in the DEN16-C panel
 [Tw] – current temperature of air exhausted from rooms
 [To] – current air temperature downstream of the heat recovery at the air exhauster

 GDYNIA	DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT UNITS MCKT-HPX	DTR.MCKT-HPX. AUT-009.5.0	PAGE
		2016	12/35

Digital inputs

```
//DIGITAL INPUTS
DI0=_
DI1=_
DI2=_
DI3=_
DI4=_
DI5=_
DI6=_
```

Status indication of the Unibox digital inputs and Extender [0|1] module:

- {DI2} – input 0 (DI0) – not used
- {DI1} – input 1 (DI1) – pressure gauge of low pressure
- {DI1} – input 2 (DI2) – pressure gauge of air supply/exhaust filter
- {DI3} – input 3 (DI3) – fire alarm
- {DI4} – input 4 (DI4) – pressure gauge of high pressure
- {DI5} – input 5 (AIN0) – fan inverter alarm
- {DI6} – input 6 (AIN1) – preliminary heater alarm

Analog inputs

```
//WE . ANALOG .
AIN0=00%
AIN1=00%
```

Indication of analog inputs:

- [AIN0] – fan inverter alarm
- [AIN1] – preliminary heater alarm

6.1.3.3 OUTPUTS


```
OUTPUTS
Digital   ▶
Analog    ▶
PWM       ▶
```

Digital outputs

```
//DIGITAL
OUTPUTS
DO1=_
DO2=_
DO3=_
DO4=_
DO5=_
```

Indicating the status of the Unibox relay outputs [0|1]:

- {DO1} – relay 1 (OUTPUT1) – solenoid valve 1
- {DO2} – relay 2 (OUTPUT2) - 4-way valve
- {DO3} – relay 3 (OUTPUT3) – air supply/exhaust dampers
- {DO4} – relay 4 (OUTPUT4) – heat pump compressor
- {DO5} – relay 5 (OUTPUT5) – solenoid valve 2

 GDYNIA	DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT UNITS MCKT-HPX	DTR.MCKT-HPX. AUT-009.5.0	PAGE
		2016	13/35

Analog outputs

```
//ANALOG OUTPUTS
OUTA=00%
OUTB=00%
OUTC=00%
```

Current status of the Unibox controller's analog outputs:

[OUTA] – current adjustment of the analog output of the supply fan's control [%]

[OUTB] – current adjustment of the analog output of the exhaust fan's control [%]

[OUTC] – current control level of the analog output of the preliminary electric heater control [%]

PWM output

```
//PWM
PWM1=00%
PWM2=00%
```

[PWM1] – switching on the preliminary electric heater: 0% off, 99% on

[PWM2] – current control level of the PWM output of the preliminary electric heater control [%]

Enter service password 11-02 to enter the menu

6.1.3.4 SETTINGS

```
/SETTINGS
Reg.Temp. ▶
Heating ▶
Cooling ▶
Pre.heater ▶
Display ▶
Communication ▶
```

Temperature controller

```
//TEMP
CONTROLLER
Rsn=
Thi=± °C
Tlo=± °C
H2TzEn= °C
CTzEn= °C
```

[Rsn] – this parameter enables selection of the reference sensor according to which temperature control will be carried out:

{TN} – air supply temperature sensor 1: control of temperature in the air supply duct;

{TN2} – air supply temperature sensor 2: fixed-value control algorithm is executed; requested fixed temperature in the air supply duct is maintained;

{TW} – exhaust temperature sensor: the controller determines the supply air temperature based on the averaged temperature of the exhausted air, while maintaining air supply threshold temperatures

{TP} – room temperature sensor: the controller determines the air supply temperature based on the air temperature in the room, where the DEN16-C is located, while maintaining air supply threshold temperatures


Limiting supply air temperature:

[Thi] – upper temperature threshold

[Tlo] – lower temperature threshold

[H2TzEn] – external temperature over which the heat pump with heating function does not receive permission to operate

[CTzEn] – external temperature below which the heat pump with cooling function does not receive permission to operate

 GDYNIA	DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT UNITS MCKT-HPX	DTR.MCKT-HPX. AUT-009.5.0	PAGE
		2016	14/35

Heat pump heating cycle

```
//HEATING
RunH2=___
H2on=___%
H2off=___%
```

[RunH2] – {ON|OFF} – permission to operate the heat pump in heating function

[H2on] – heat pump turn-on threshold value in heating sequence function

[H2off] – heat pump turn-off threshold value in heating sequence function

Heat pump cooling cycle

```
//COOLING
RunC=___
Con=___%
Coff=___%
```

[RunC] – {ON|OFF} – permission to operate the heat pump in cooling function

[Con] – heat pump turn-on threshold value in cooling sequence function

[Coff] – heat pump turn-off threshold value in cooling sequence function

Preliminary heater

```
//PRE.HEATER
RunH1=___
TzOn=±___°C
TnOff=±___°C
H1=___
```

[RunH1] – {ON|OFF} – preliminary heater operation permit

[TzOn] – turn-on temperature of the preliminary heater in the external temperature function

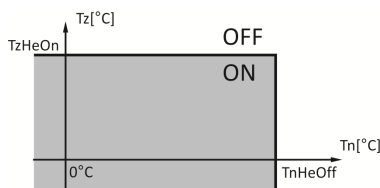
[TnOff] – temperature of deactivating the preliminary heater in the Tn air supply temperature function

When the external temperature drops below TzOn, the preliminary heater receives the operation permit. It operates till the external temperature rises or the Tn air supply temperature exceeds the TnOff value.

[H1] – current status of the preliminary electric heater:

{1} – heater turned on

{0} – heater turned off



Picture 7 Heater programming

Display

```
//Display
Contrast=___
Backlight=___
Sound=___
```


[Contrast] – adjusting display contrast

[Backlight] – {1-9 min} switch off time of the display backlight

[Sound] – activation of the panel speaker

{YES} – speaker ON

{NO} – speaker OFF

 GDYNIA	DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT UNITS MCKT-HPX	DTR.MCKT-HPX. AUT-009.5.0	PAGE
		2016	15/35

Communication

```
//Communication
CtrlCOM2=___
COM2=___
BR2=___
CtrlCOM3=___
COM3=___
BR3=___
WifiPIN=___
```

[**CtrlCOM2, CtrlCOM3**] – selection of remote or local control using COM2/COM3 port:

{**Loc**} – local control with use of the DEN16-C panel; possibility of reading data via MODBUS

{**Rem**} – remote control, possibility of writing and reading data via MODBUS

[**COM2, COM3**] – {YES|NO} enables switching on communication with the use of the COM2/COM3 port and the MODBUS RTU (RS485) data bus.

[**BR2**] – {9600|19.200} data transmission speed for COM2 (can only be changed in the STOP mode) [bits/s]

[**BR3**] – {9600|19.200|57.600|115.200} data transmission speed for COM3 (can only be changed in the STOP mode) [bits/s]

[**WifiPIN**] – 4-digit PIN of the wireless communication module

The menu is available after entering the factory password

6.1.3.5 ADVANCED SETTINGS


```
/ADVANCED SETTINGS
Inputs      ▶
Fan         ▶
Sensors     ▶
Temp control ▶
Heat recovery▶
Heat pump   ▶
Time blocks ▶
Auto Stop   ▶
Factory settings ▶
```

Inputs

```
\\*INPUTS
DI0f=Din
  S=_ R=_
DI1f=LoP
  S=_ R=_
DI2f=Flt
  S=_ R=_
DI3f=POZ
  S=_ R=_
DI4f=HiP
  S=_ R=_
DI5f=VAL
  S=_ R=_
DI6f=!HE
  S=_ R=_
AINfn=___
```

[**DI0f**]:[**DI6f**] – selecting alarm message displayed for the digital input's signal:

{**DIN**} – digital input, no message

 GDYNIA	DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT UNITS MCKT-HPX	DTR.MCKT-HPX. AUT-009.5.0	PAGE
		2016	16/35

- {FLT} – collective alarm of the air supply and exhaust filters
- {FRS} – anti-frost alarm
- {!HE} – electrical heater alarm
- {POZ} – fire alarm
- {VNP} – air supply (or air supply and exhaust) fan compression too low
- {VAL} – air supply/exhaust fan's TK/inverter alarm
- {LoP} – low pressure signal of heat pump compressor
- {HiP} – high pressure signal of heat pump compressor
- [S] – status of an individual input with the alarm message
 - {0} – alarm at open connector (the connector is normally closed - NC)
 - {1} – alarm at closed connector (the connector is normally open - NO)
- [R] – selection of the alarm statuses number occurring during one hour to cancel the alarm
 - {0} – no need to confirm an alarm – alarm decay results in returning to normal operation
 - {1} – the first alarm from a particular input requires canceling
 - {2-6} – the number of alarms that needs to appear in an hour from the first alarm status in order for the alarm to require confirmation on screen 0
- [AINFn] – selecting a method to display universal inputs
 - {AI} – analog input
 - {DI} – digital input

Fans

```

\\*FANS
Nmin=_%
Wmin=_%
MaxRpmN=_%
MaxRpmW=_%
```

[Nmin, Wmin] – the parameters limit the min requested RPM of the air supply and exhaust fans – it is not possible to reduce the fan RPM below that value.

[MaxRpmN] – max air supply motor's RPM value expressed by percentage of rated RPM (RpmN)

[MaxRpmW] – max air exhaust motor's RPM value expressed by percentage of rated RPM (RpmW)

Sensors

```

//*SENSORS
TpCor=-_._°C
```

[TpCor] – value read correction of the room sensor in the range (- 3°C; 0°C)

Temperature controller

```

//*TEMP.
CONTROLLER
Ti1=_
1/Kp1=_
Ti2=_
1/Kp2=_
Ti3=_
1/Kp3=_
```

Settings of the controller of the main heating/cooling loop:

[Ti1] – integration constant

[1/Kp1] – reinforcement converse

Settings of the controller of the lower limit of the air supply temperature:

[Ti2] – integration constant


[1/Kp2] – reinforcement converse

Settings of the controller of the upper limit of the air supply temperature:

[Ti3] – integration constant

[1/Kp3] – reinforcement converse

Heat recovery

 GDYNIA	DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT UNITS MCKT-HPX	DTR.MCKT-HPX. AUT-009.5.0	PAGE
		2016	17/35

```

// *HEAT RECOVERY
Rpr=___
Sice=___
Tice=±___°C
RpOFF=___min

```

[Rpr] – {YES|NO} – activation of anti-frost protection

[Sice] – selecting a sensor, based on which the anti-frost function will be carried out:

{Tr} – air exhaust sensor downstream the heat recovery

[Tice] – temperature of the anti-frost protection's activation limit {0-30°C}

[RpOFF] – {0-59min} – delay after the system start, when the Rpr anti-frost protection function is activated

Heat pump

```

// *HEAT PUMP
AFPraca=___

```

[AFPraca] – {YES|NO} – operation permit of the heat pump compression

Time blocks

```

// *TIME BLOCKS
T1on =1m
T1off=0s
T2on =0s
T2off=0s
T3on =0s
T3off=0s
T4on =0s
T4off=10s
T5on =0s
T5off=10s
T6on =5s
T6off=5s
TRS1on=2m
TRS2on=1s

```

[T1on] – activation delay of the fans after start

[T1off] – fans coasting time after stopping operation

[T2on] – not used

[T2off] – not used

[T3on] – not used

[T3off] – not used

[T4on] – not used

[T4off] – cooling OFF delay

[T5on] – not used


[T5off] – heating OFF delay

[T6on] – compressor ON delay in relation to the solenoid valve

[T6off] – compressor OFF delay in relation to the solenoid valve

[TRS1on] – min pause time between a switching off and switching on again the compressor

[TRS2on] – 4d valve opening time once the operation is finished, to compensate the system pressures

 GDYNIA	DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT UNITS MCKT-HPX	DTR.MCKT-HPX. AUT-009.5.0	PAGE
		2016	18/35

Auto Stop function

```

/**AUTO STOP
AS=___
Int=___h
ASdurat=___
Tleft=___min
Count=___

```

[AS] – {YES|NO} activation of the AUTO STOP function forcing cyclic breaks in the 24h work cycle for the period of time defined by the **[ASDurat]** parameter {1-30 min}, by number of hours defined by the **[Int]** parameter {1-23}

[Tleft] – current duration of device operation when the AUTO STOP function is activated

[Count] – number of the AUTO STOP function calls during 24h

Factory settings

```

/**FACTORY SETTINGS
Ust.Fab.=___
Ap=___

```

[Factory settings] - {YES|NO} – selecting revert to factory settings (all parameters)

[Ap] – {App22} – does not apply to the MCKT HPX AHU

6.1.3.6 ALARMS

```

/ALARMY
RESET=___
AL =___
AL0=___
AL1=___
AL2=___
AL3=___
AL4=___
AL5=___
AL6=___

```

[RESET] – {0|1} changing status into 0 enables alarm reset. If a current alarm status does not require deleting the message will disappear automatically after the alarm decays. Before the alarm can be reset the alarm condition must decay.

[AL] – current status of the internal system's alarms:

{COM} – no communication between the DEN16-C panel and Unibox controller

[AL0-AL6] – current status of the external system alarms:

{OK} – no alarms

{FRS} – anti-frost alarm

{FLT} – collective alarm of the air supply and exhaust filters' pressure gauges

{!HE} – electrical heater alarm


{POZ} – fire alarm

{VNP} – air supply (or air supply and exhaust) fan compression too low

{VAL} – air supply/exhaust fan's TK/inverter alarm

{LoP} – low pressure signal of heat pump compressor

{HiP} – high pressure signal of heat pump compressor

 GDYNIA	DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT UNITS MCKT-HPX	DTR.MCKT-HPX. AUT-009.5.0	PAGE
		2016	19/35

6.1.3.7 PASSWORDS

```

/PASSWORDS
Password: __-__

```

[Password] – 4-digit access password to the service (11-02) or factory settings

6.1.3.8 INFO

```

/INFO
Soft ver.:
Sw____
Mb____

```

[Soft ver.] – current software version:
{sw} – DEN16-C panel
{mb} – UNIBOX controller

6.1.3.9 Time/Language

```

/TIME      AND
LANGUAGE
Day: ____
Time: hh-mm
Lang= ____

```

[Day] – setting the current weekday
[Time] – setting the current time
[Lang] – {PL|ANG} – language selection

6.1.3.10 Reverting the factory defaults

```

/FACTORY
DEFAULTS
Ust.Dom.= ____

```

[Ustaw.Dom.] – {YES|NO} – reverting default parameters' values of week timer and service presets

7. WIRING DIAGRAMS

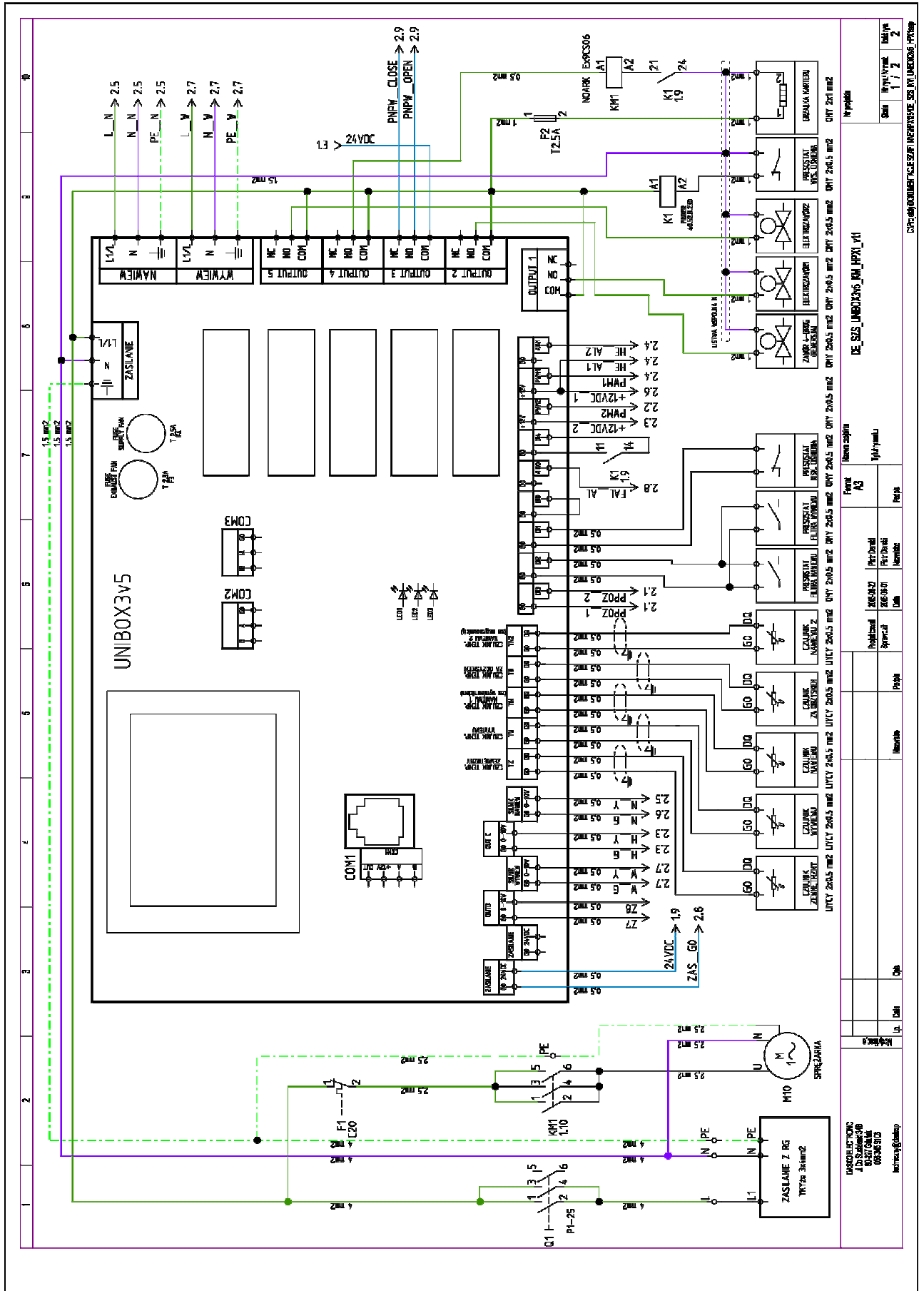
Dimensions of the control cabinet for MCKT-HPX (the same for all sizes): LxHxB - 380x300x120 mm

Wiring diagrams present STANDARD (right) version of the MCKT-HPX.

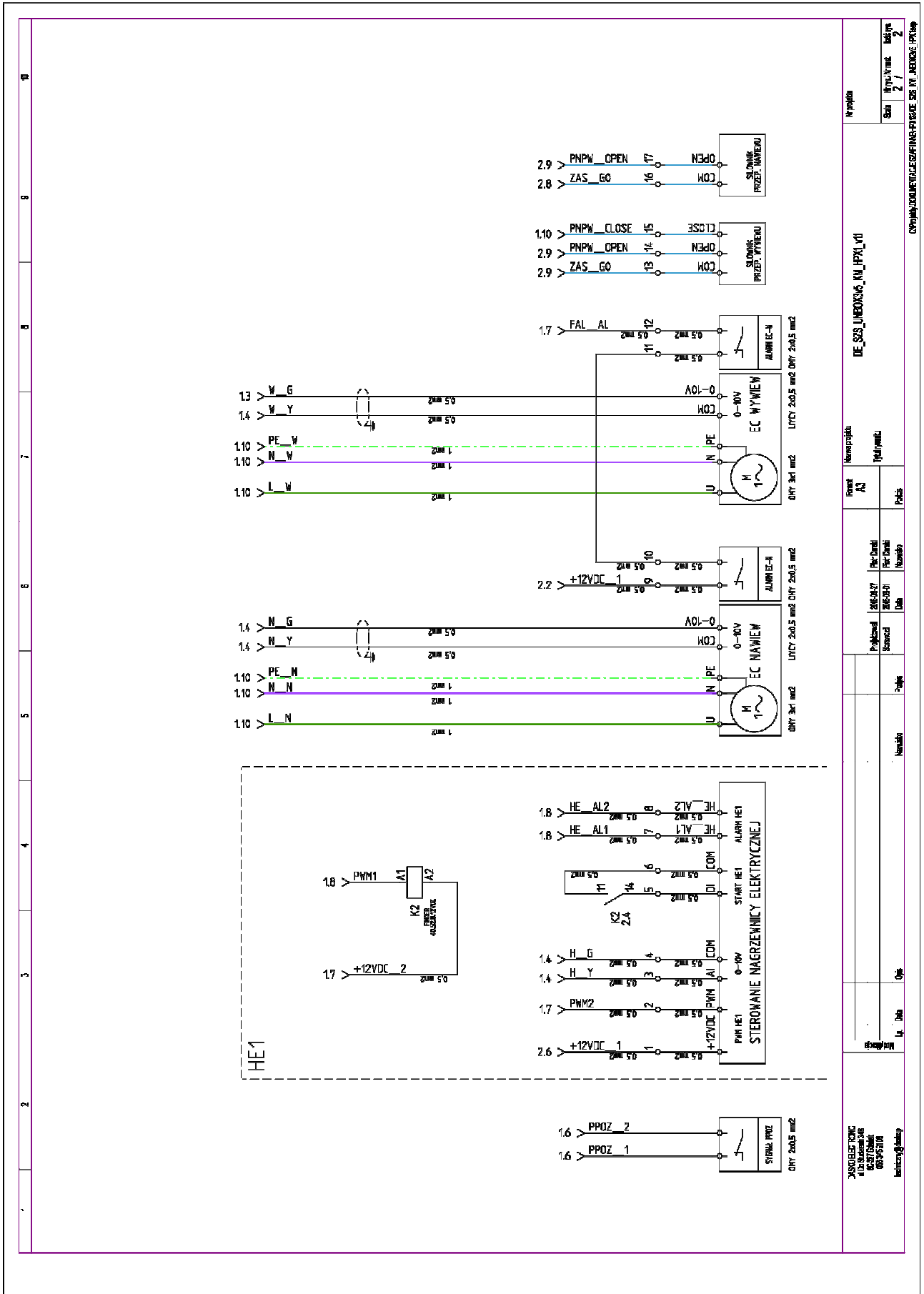
In non-standard version (left) of the MCKT-HPX, the 4-WAY VALVE is connected to the “NC” connector of the “OUTPUT 2” relay.

The next pages of the manual contain information regarding:

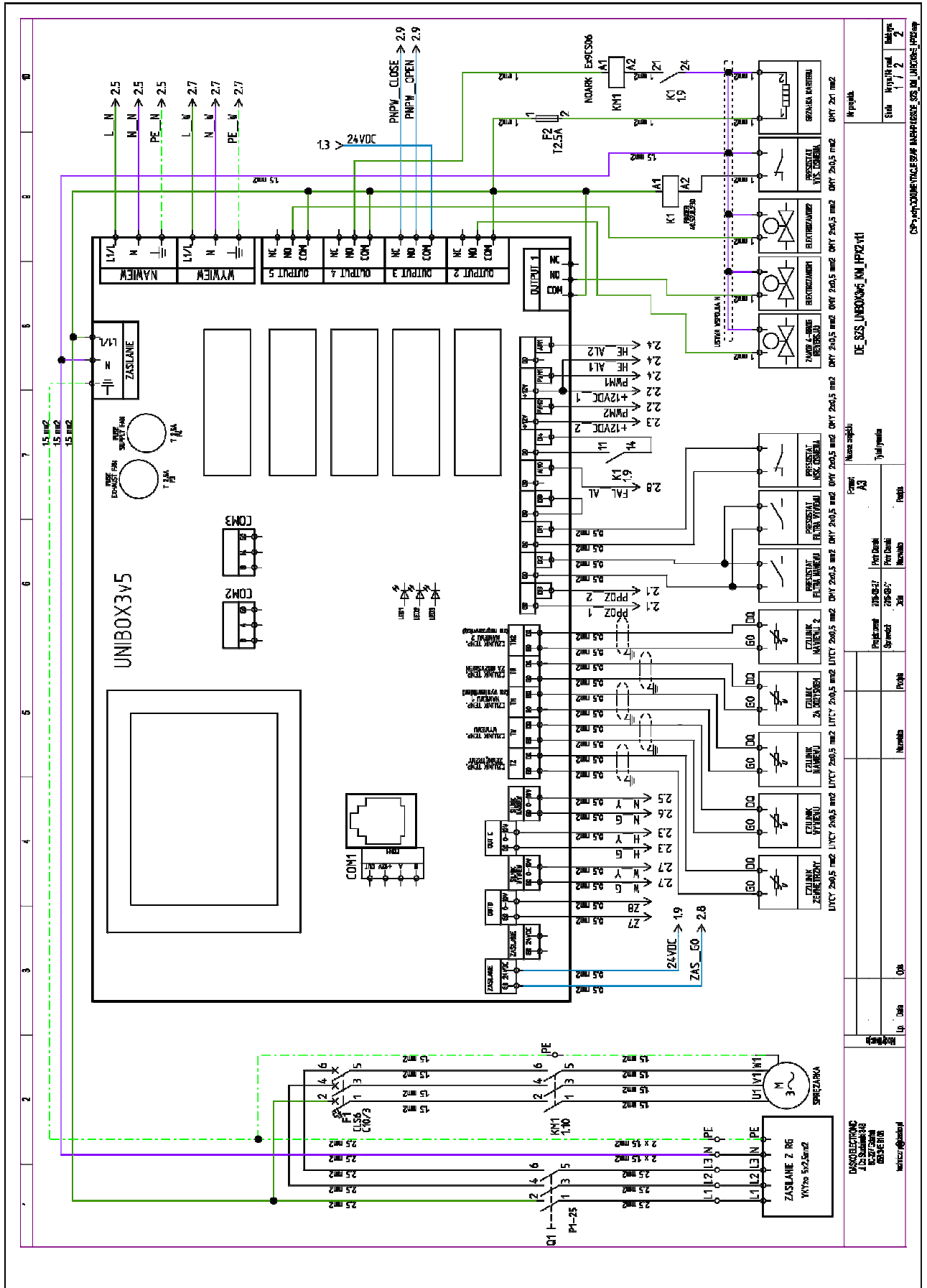
- Wiring diagram of MCKT-HPX1
- Wiring diagram of MCKT-HPX2
- Wiring diagram of MCKT-HPX3



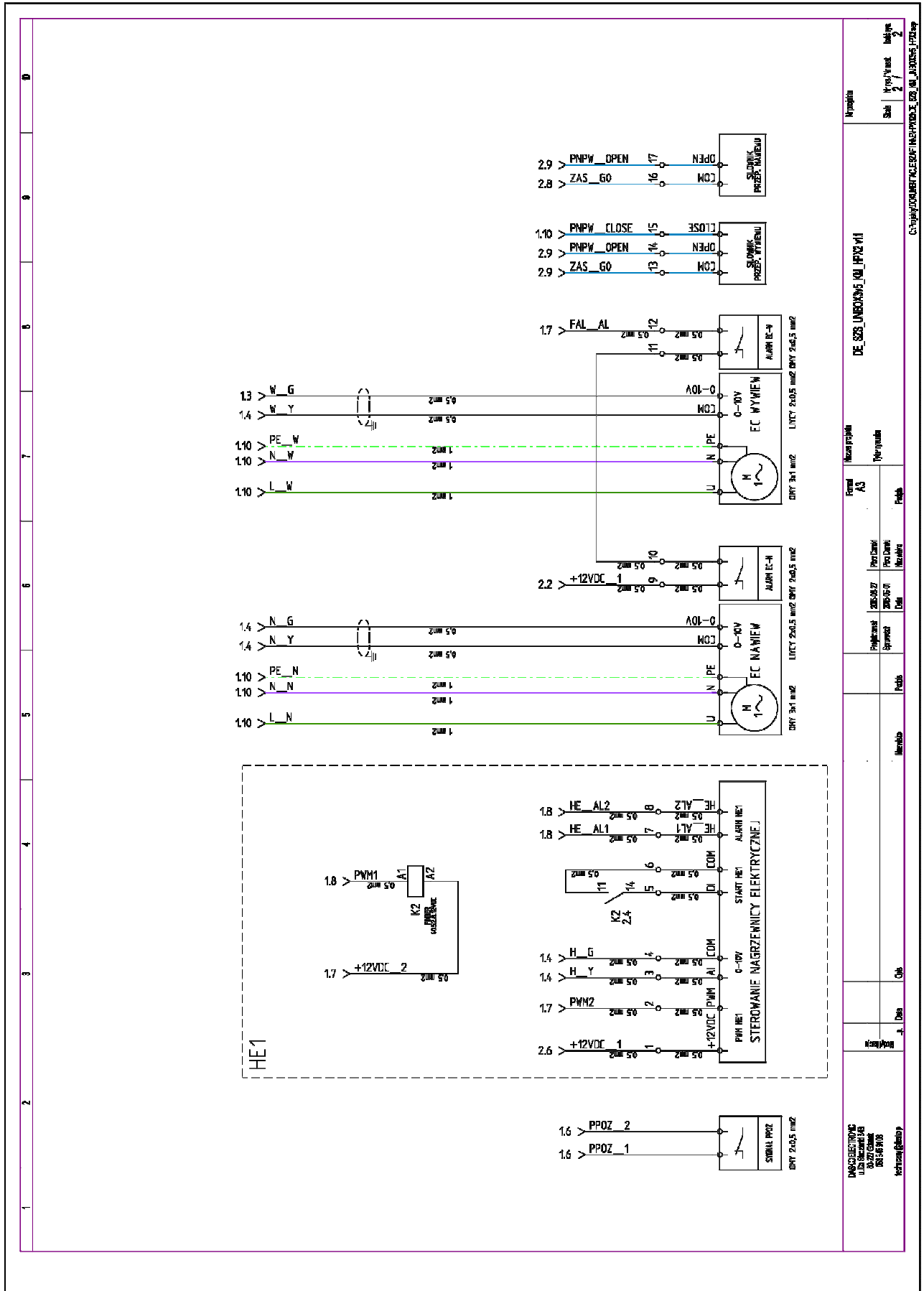
Picture 8.1 MCKT-HPX 1 wiring diagram



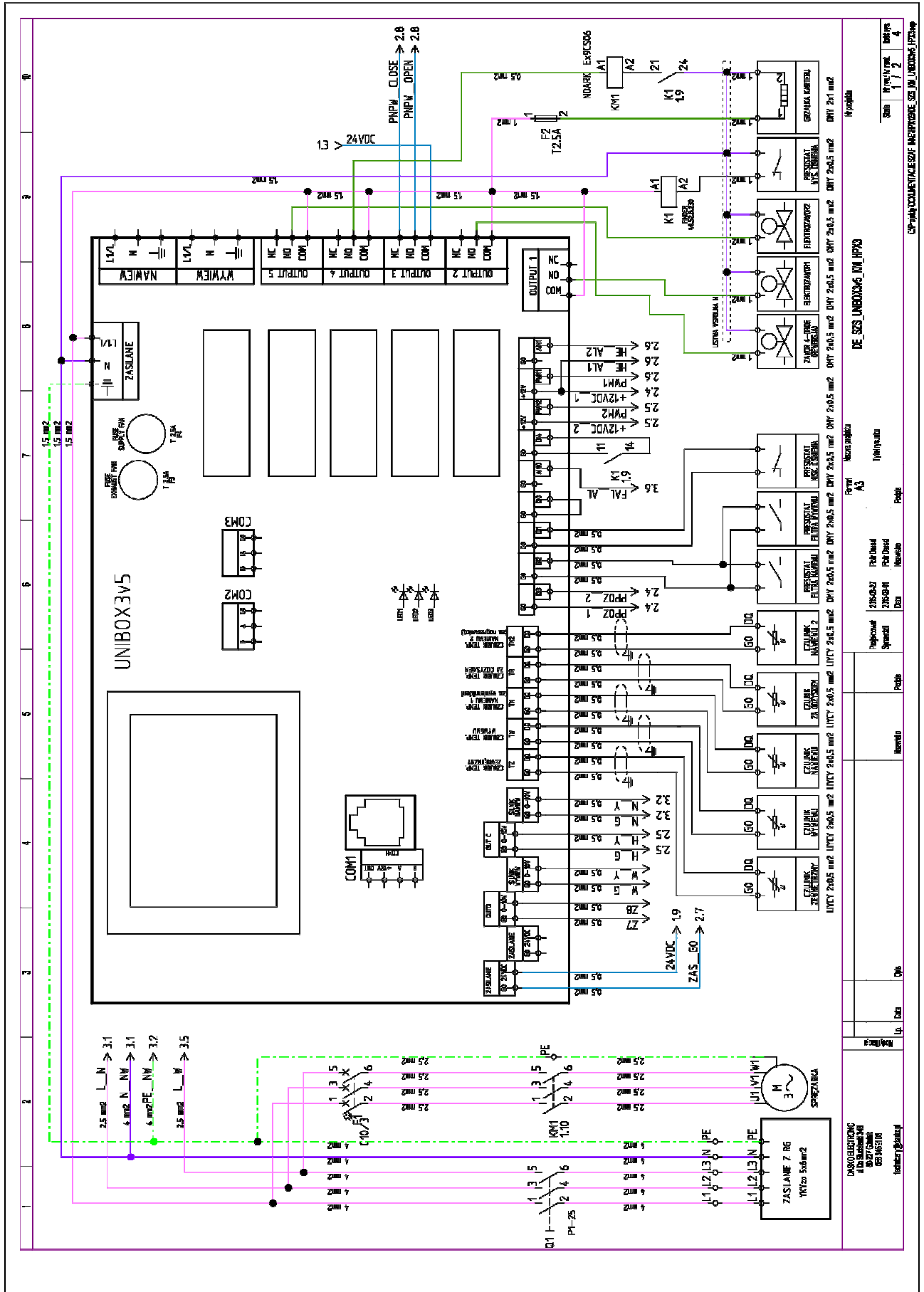
Picture 8.2 MCKT-HPX 1 wiring diagram



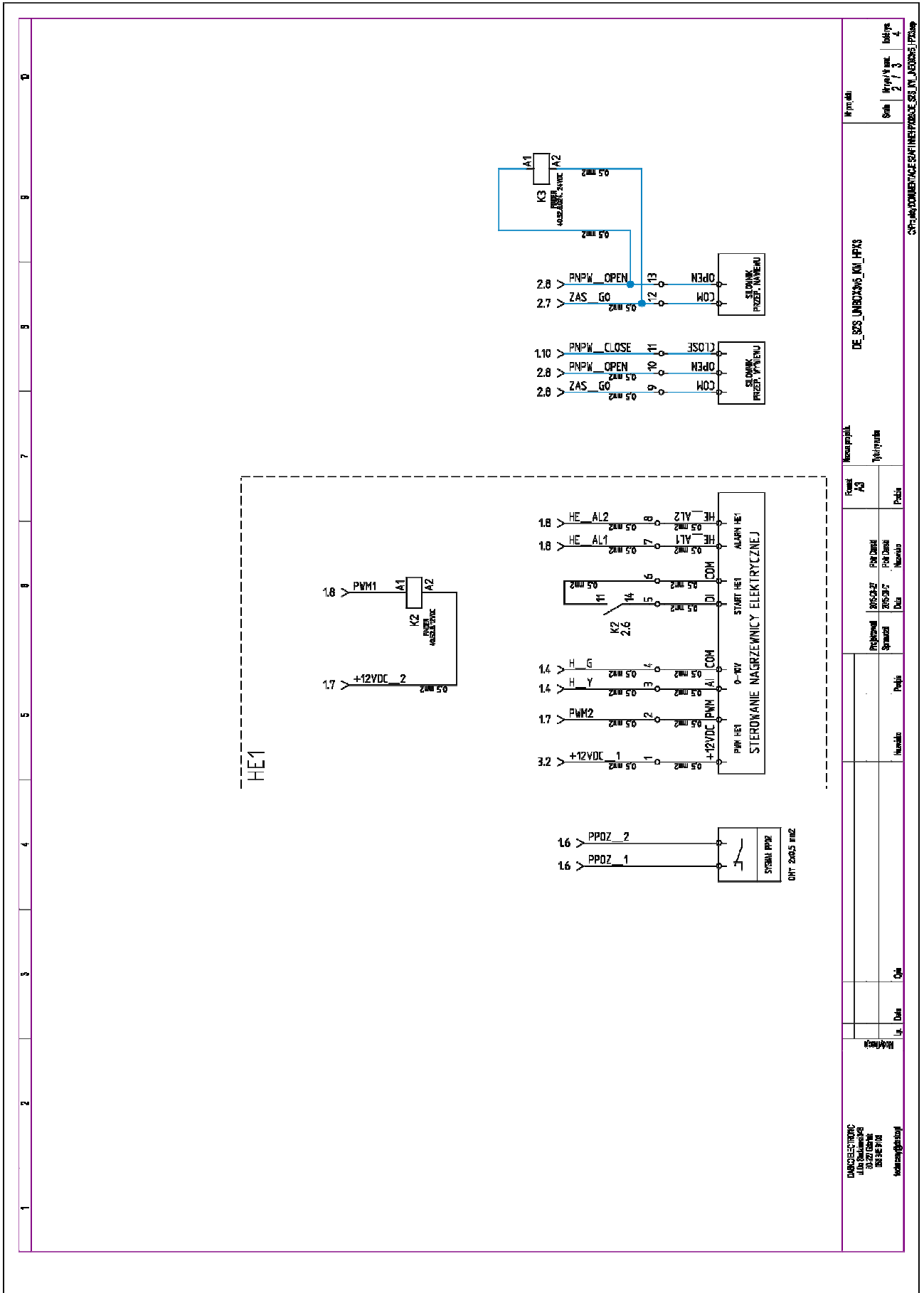
Picture 9.1 MCKT-HPX 2 wiring diagram



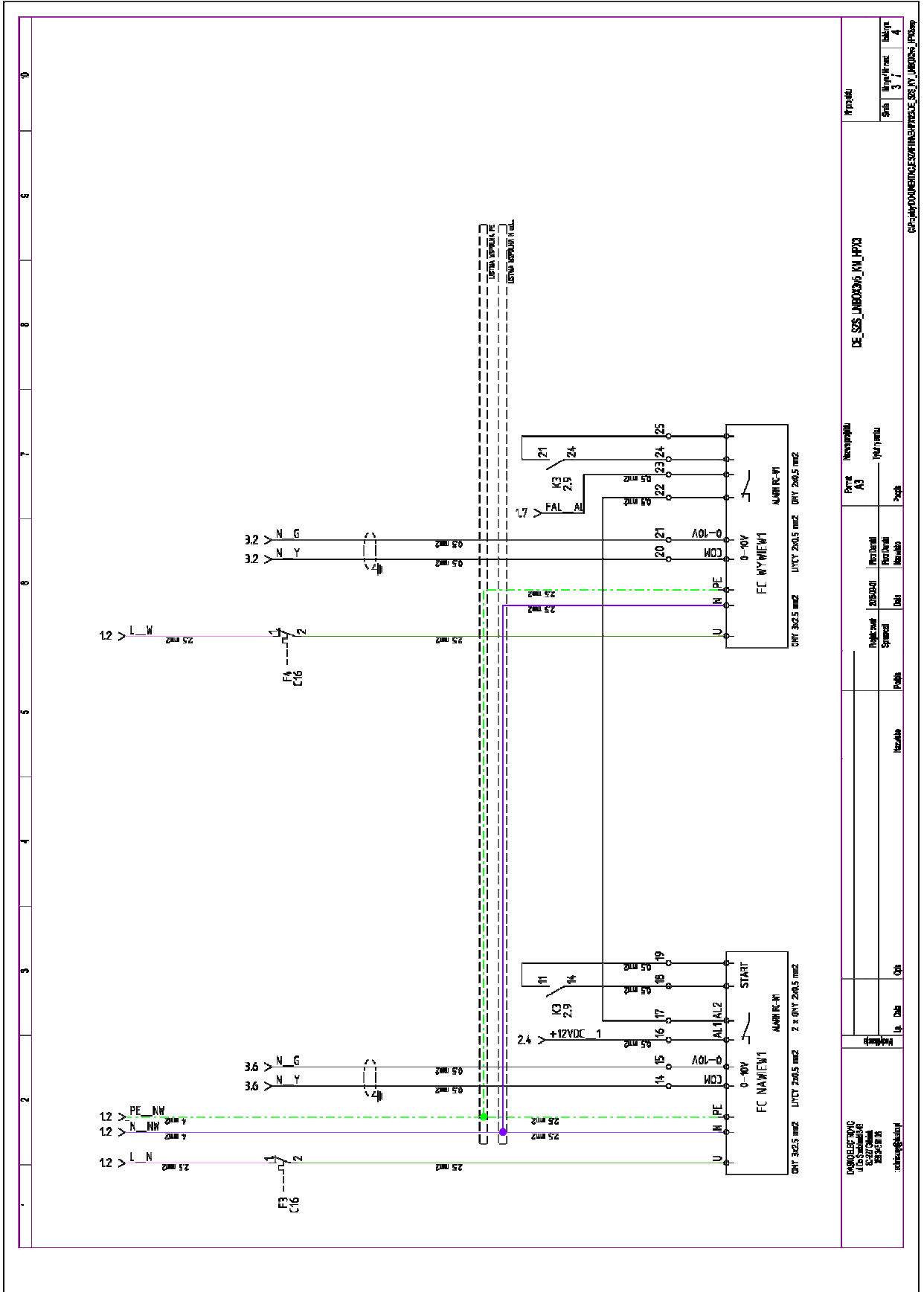
Picture 9.2 MCKT-HPX 2 wiring diagram



Picture 10.1 MCKT-HPX 3 wiring diagram



Picture 10.2 MCKT-HPX 3 wiring diagram



Picture 10.3 MCKT-HPX 3 wiring diagram

8. DANFOSS FC 51 INVERTERS FOR MCKT-HPX 3


Basic parameters for programming Danfoss FC 51 inverter.
Settings for adjusting speed by analogue 0÷10V signal

Sample setting for the motor and converter 0,75kW/1×230V

	Parameter no.	Parameter name	Entered data	Unit
QUICK MENU 1	120	Motor rated power	0.75	kW
	122	Motor rated voltage	400	V
	123	Motor rated frequency	50	Hz
	124	Rated motor current	2	A
	125	Motor rated RPM	1450	RPM
	129	Auto matching with AMT motor	Switch on [2]	
	302	Min set Hz value	10	Hz
	303	Max set Hz value	50	Hz
	341	Acceleration time in s from min to max Requested value	30	s
	342	Breaking time in s from min to max Requested value	30	s
MAIN MENU	190	Motor thermal protection	ETR Trip 1 [4]	
	412	Motor low speed limit in Hz	10	Hz
	414	Motor high speed limit in Hz	50	Hz
	416	Limit of torque in %	110	%
	610	Terminal 53 Low voltage level	0.07	V
	611	Terminal 53 High voltage level	10	V
	614	Terminal 53 Minimum set value	10	Hz
	615	Terminal 53 Maximum set value	50	Hz

* / After setting this parameter to function [2] there will be the PRESS HAND START message displayed on the screen. When the HAND START button on the control panel is pressed, the converter proceeds with the auto matching. When the auto matching is complete, press OK on the control panel and the parameter is automatically set to [0] value. Now you can proceed with the programming.

The User Manual of the FC 51 inverter and the full programming manual can be found at the manufacturer's website:
<http://www.danfoss.com/Poland/BusinessAreas/DrivesSolutions/frequency+converters/VLT+Micro+Drive.htm>

 GDYNIA	DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT UNITS MCKT-HPX	DTR.MCKT-HPX. AUT-009.5.0	PAGE
		2016	28/35

9. BMS VARIABLE LIST – RTU MODBUS PROTOCOL

UNIBOX3v4x control units are equipped with 3 COM1 and COM2 communication ports. The COM1 port supports communication with external panel – DEN16-C, as RS232/RS485. COM2 used as RS485 enables communication with external devices via instructions in MODBUS standard. Communication via COM2 supports {9600|19200} rate (without parity check, 1 stop bit). Communication via COM2 is activated by selecting appropriate parameter **[COM2]** on the control panel.

Supported frames:

- 03 Read Holding Register** – data group reading (2-byte registers)
- 06 Preset Single Register** – selected register preset (2-byte registers)
- 16 Preset Multiply Register** – register group preset

Limits:

- Max number of registers read out in a single frame cannot exceed 10 registers (20 bytes)
- Max number of preset data in a single frame cannot exceed 5 registers (10 bytes)
- Recommended cable: UTP twisted-pair In case of distance over 200 meters please use 120 ohm line terminator.
- Min time-out between read or write frames for COM2 is 300ms.
- Read out registers appear in 2-byte format


Status:

- COM2 activity status is indicated by LED2.
- No activity for COM2 with the **[COM2] parameter set to ={YES}** for 30 seconds activates an alarm with LED1 (two short blinks).


NOTE:

Address 40xxx is for data queries of length equal to 1, address (40xxx) is for data queries of length > 1


Register address	Code	Description	Type
40000	DS3_HI	MSB temperature byte Tp	Read only
	DS3_LO	LSB temperature byte Tp	Read only
40001	DS0_HI	MSB temperature byte Tz	Read only
	DS0_LO	LSB temperature byte Tz	Read only
40002	DS1_HI	MSB temperature byte Tn	Read only
	DS1_LO	LSB temperature byte Tn	Read only
40003	DS2_HI	MSB temperature byte Tw	Read only
	DS2_LO	LSB temperature byte Tw	Read only
40004	DS4_HI	MSB temperature byte To	Read only
	DS4_LO	LSB temperature byte To	Read only
40005	DS5_HI	MSB temperature byte Tn2	Read only
	DS5_LO	LSB temperature byte Tn2	Read only
40006	DI	MSB: Digital inputs DI: [UI2][UI1][DI5][DI4][DI3][DI2][DI1][DI0]	Read only
	TSET	LSB: Requested temperature set via COM2	Read only

 GDYNIA	DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT UNITS MCKT-HPX	DTR.MCKT-HPX. AUT-009.5.0	PAGE
		2016	29/35

Register address	Code	Description	Type
40007	CRS1	MSB: Condition register 1: [T1][T2][MODE1][MODE0][DS2present][RUN] [DS1present][DS0present] Current operation mode [MODE1] [MODE0] 00 – MIN mode 01 – MAX mode 10 – ULUB mode 11 – STREFA mode Master sensor selected at the [T1] [T2] panel 11 – DS3 sensor (Tp) 10 – DS2 sensor (Tw) 01 – DS1 sensor (Tn) 00 – DS5 sensor (Tn2) RUN – ON/OFF override from the panel DS0present – presence of the Tz temperature sensor DS1present – presence of the Tn temperature sensor DS2present – presence of the Tw temperature sensor	Read only
	CRS2	LSB: Condition register 2: [DS3present][VDI1][VDI2][VDI3][VDI4] [VDI5][DS5present][DS4present] VDI1 – operation permit provided by the Calendar in case of operation in the ZONE mode) VDI2 – bypass actuator operation VDI3 – switching on the preliminary electric heater/ground heat exchanger VDI4 – anti-frost protection active VDI5 – alarm with confirmation (1 – no alarm with confirmation, (0 – alarm with confirmation is present) DS3present – presence of the Tp temperature sensor DS4present – presence of the To temperature sensor DS5present – presence of the Tn2 temperature sensor	Read only
40008	CRS3	MSB: Condition register3: [VDI13][VDI12][VDI11][VDI10][VDI9][VDI8][VDI7][VDI6] VDI6 – operation permit for the H2 heater VDI7 – operation permit for the H1 preliminary heater VDI8 – operation permit for the C cooler VDI9 – not used VDI10 – cooling sequence lock based on external temperature VDI11 – heating sequence lock based on external temperature VDI12 – heater H2 pump control based on external temperature VDI13 – not used	Read only
	EFF	LSB: Heat exchanger efficiency calculated according to the formula $(Tn - Tz) / (Tw - Tz) * 100\% \text{ [%], } \{0-99\%$	Read only

 GDYNIA	DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT UNITS MCKT-HPX	DTR.MCKT-HPX. AUT-009.5.0	PAGE
		2016	30/35

Register address	Code	Description	Type
40009	---	---	Read only
	TZAL_BY	MSB: Bypass damper switch on temperature [°C], {5÷35}	Read only
40010	TWYL_BY	MSB: Bypass damper switch off temperature [°C], {5÷35}	Read only
	AppNo	LSB: Active application number (0x0F mask)	Read only
40011	TOchrony	MSB: Protection threshold temperature of heat recovery (0x3F mask) [°C], {0÷30}	Read only
	HeatThOn	LSB: Secondary heater switch on threshold in heating sequence function [%], {0÷99}	Read only
40012	HeatThOff	MSB: Secondary heater switch off threshold in heating sequence function [%], {0÷99}	Read only
	CoolThOn	LSB: Cooler switch on threshold in cooling sequence function [%], {0÷99}	Read only
40013	CoolThOff	MSB: Cooler switch off threshold in cooling sequence function [%], {0÷99}	Read only
	TO	LSB: Digital outputs	
40014	OUTA	MSB: Analog output OUTA {0-255}	Read only
	OUTB	LSB: Analog output OUTB {0-255}	Read only
40015	OUTC	MSB: Analog output OUTC {0-255}	Read only
	OUTD	LSB: Analog output OUTD {0-255}	Read only
40016	PWM_OC	MSB: Pulse output {0-255}	Read only
	ALCRS1	LSB: Alarm condition register	Read only
40017	UNIBOX3v4x_SOFT_VER	MSB: Firmware version: UNIBOX3v4x [msb7][msb6][msb5][msb4].	UNIBOX3v4x_SOFT_VER
	ALCRS2	LSB: Alarm status register [x][x][x][x][AL_STOP_IN_PROGRESS] [AL_AF_HIGH_PREASSURE] [AL_AF_LOW_PREASSURE][AL_HEATER_HE]	Read only
40018	SET_REG1	MSB:[MODBUS_T1][MODBUS_T2][x][x] [x] [x] [x] [COM2ctrlSTART_bit] COM2ctrlSTART_bit – external start after COM2 Selection of master sensor by ModBus [MODBUS_T1][MODBUS_T2]: 00 – TN2 01 – TN 10 – TW 11 – TP	Change possible from the BMS/Readout level
	AIR_SUPPLY_MANUAL	LSB: Air supply fan RPM setting {0-255}	Change possible from the BMS/Readout level

 GDYNIA	DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT UNITS MCKT-HPX	DTR.MCKT-HPX. AUT-009.5.0	PAGE
		2016	31/35

Register address	Code	Description	Type
40019	AIR EXHAUST_MANUAL	MSB: Air exhaust fan RPM setting {0-255}	Change possible from the BMS/Readout level
	TSET	LSB: Setting of the TSET requested temperature using the ModBus [°C], {0-50}	Change possible from the BMS/Readout level
40020	TOCHRONY	MSB: [SICE_SEL][x][Tochr5][Tochr4][Tochr3][Tochr2][Tochr1][Tochr0] SICE_SEL: Selection of sensor for anti-frost protection algorithm 0 – To 1 – Tn [Tochr5]:[Tochr0] Protection threshold temperature [°C],{0-50}	Change possible from the BMS/Readout level
	---	---	Read only
40030	H2TzEN	MSB: [x][x][H2TzEn5][H2TzEn4][H2TzEn3][H2TzEn2][H2TzEn1][H2TzEn0] [H2TzEn5]:[H2TzEn0] External temperature, above which the secondary heater will not receive the operation permit [°C],{0-30}	Read only
	CTzEN	LSB: [x][x][CTzEn5][CTzEn4][CTzEn3][CTzEn2][CTzEn1][CTzEn0] [CTzEn5]:[CTzEn0] External temperature, below which the cooler will not receive the operation permit [°C],{0-35}	Read only
40031	OUTE	MSB: Analog output OUTE {0-255}	Read only
	OUTF	LSB: Analog output OUTF {0-255}	Read only
40032	AIN0	MSB: 0÷10V analog input at the UNIBOX3v41 controller PCB {0-255}	Read only
	UI1	LSB: UI1 0÷10V analog input at the UNIBOX_EXTENDER_v1.1 controller PCB {0-255}	Read only
40033	UI2	MSB: UI2 0÷10V analog input at the UNIBOX_EXTENDER_v1.1 controller PCB {0-255}	Read only
	PuTzOn	LSB: [PuTzON_EN][x][PuTzOn5][PuTzOn4][PuTzOn3][PuTzOn2][PuTzOn1][PuTzOn0][PuTzOn5]:[PuTzOn0] External temperature of starting the water heater pump. The pump always operates below the indicated temperature, independent of the operation mode and heat demand [°C], {0÷30}, (0xBF mask) PuTzON_EN – pump operation permit in the Tz temperature function	Read only
40034	THiConst	MSB: Upper limit of air supply temperature (adjustment against Tn2) [°C], {0÷50}	Read only
	TLoConst	LSB: Lower limit of air supply temperature (adjustment against Tn2) [°C], {0÷50}	Read only

Register address	Code	Description	Type
40035	RpOFFDuration	MSB: Delay after the system start, when the anti-frost protection function is activated Rprot [min], {0÷59}	Read only
	--	---	Read only
40036	ASTInt	MSB: Beginning of time interval in hours (1–23) in which the device is stopped for the period determined by the ASDuration (0x1F mask) parameter	Read only
	ASDuration	LSB: Device stop time [min], {1÷30}	Read only
40037	RefSensHi	MSB: reference sensor temperature byte	Read only
	RefSensLo	LSB: reference sensor temperature byte	Read only

Example of temperature calculation:

$$T_n = ((DS1_HI \ll 8) + DS1_LO) / 16$$

E.g.: DS1_HI = 1, DS1_LO=120 -> $T_n = 376 / 16 = 23.5 \text{ } ^\circ\text{C}$

Device start condition using COM2 (COM2ctrlSTART_bit bit in the 40019-MSB register):

- Setting the [COM2] = {YES} parameter at the DEN16-C panel
- Setting the [Ctrl] = {Rem} parameter at the DEN16-C panels
- turning-on DEN16-C panel: ON/OFF status

Note1: *Once the power is turned on the communication via COM2 port is blocked during first 30 seconds.*

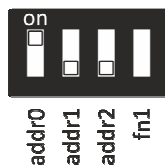
Note: *Temperature calculation is required for: $T_z, T_n, T_w, T_n2, T_r, T_p$.*

Note3: *The AIN0 analog input is an universal input. The [AinFn] parameter = {A|D|I} determines the output function. For the UI1 and UI2 analog inputs selection of the input function determines the UI1f i UI2f = {A|D|I} parameter.*

Note4: *Reading registers starting from the 40030 address is possible from firmware ver. 2.10 (0x2A).*


Device addressing

Device addressing is carried out using the S1MX dip-switch located on the MCKT-HPX control PCB.

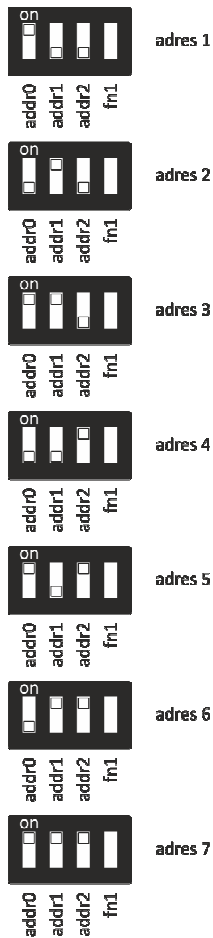


Address 0 - reserved

The address is set by switching on individual bits of the binary word. addr0 switch is for 0. Bit, addr1 – 1.bit, addr2 – 2.bit. Fn1 is not used.

 GDYNIA	DOCUMENTATION OF AUTOMATIC CONTROL FOR COMPACT UNITS MCKT-HPX	DTR.MCKT-HPX. AUT-009.5.0	PAGE
		2016	33/35

Configurations – examples:



10. CONTROL MODULES OF PRELIMINARY ELECTRIC HEATERS

10.1 Functional description

Modules for preliminary electric heaters enables power supply and stepless control of the heater using signals provided by the AHU controller. When the thermal protection alarm is activated, the control system of control unit cuts off the power supply and sends info regarding the alarm status to the controller.

LXHXB dimenstions without the equipment:

- MCKT-HPX 1 – 311×205×95 mm
- MCKT-HPX 2 and 3 – 311×404×95 mm

The preliminary heater's control module contains the control cabinet with provided dimensions and 1 separate temperature sensor with 3m cable

10.2 Cooperation of the preliminary heater control module with the MCKT-HPX control system

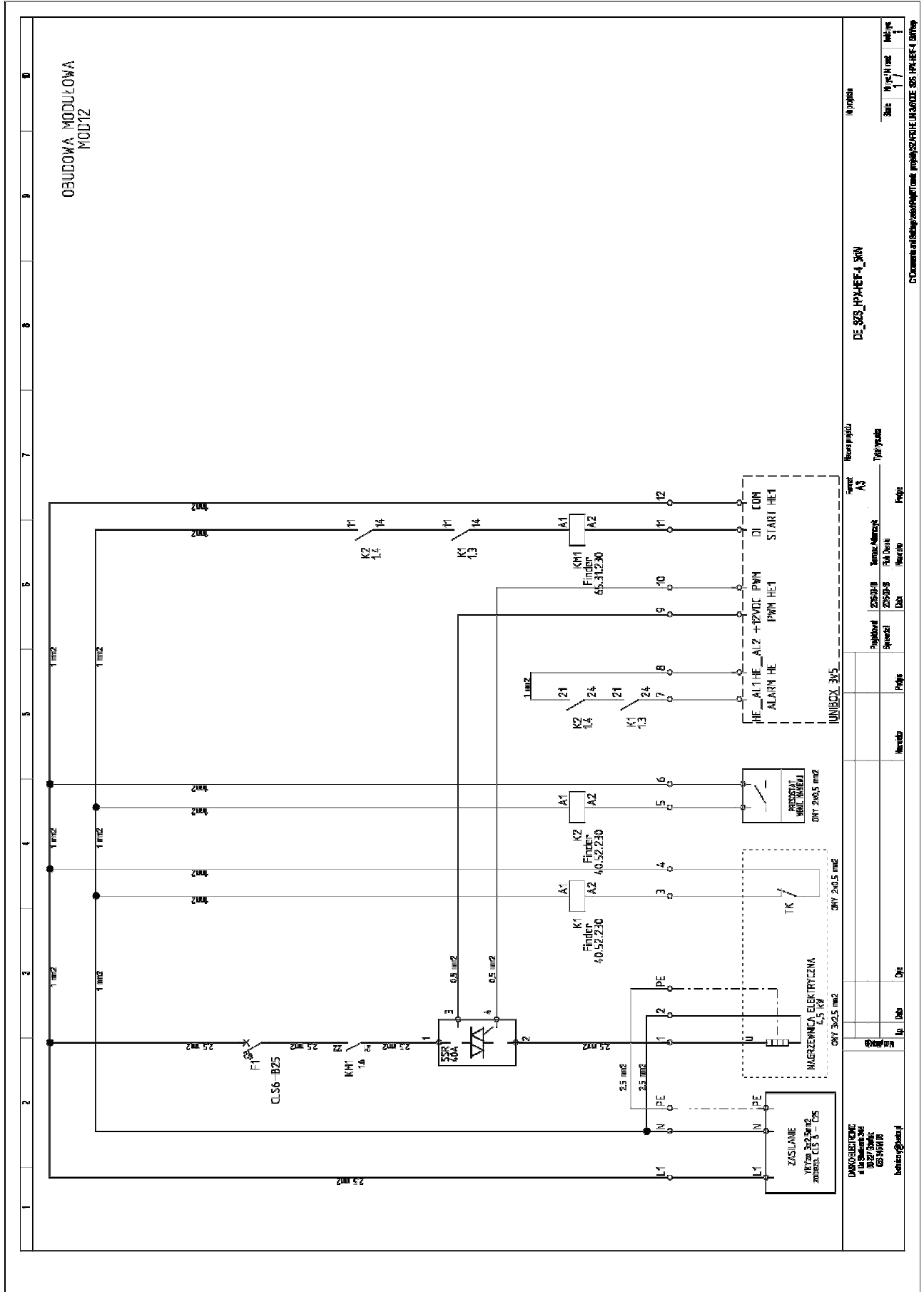
During on-site installation – switch the “TZ” temperature sensor at the MCKT-HPX control PCB from the current position into the “TN” terminals.

Connect an additional temperature sensor, provided with the preliminary heater control cabinet, to the released “TZ” terminals.

Lead a wire of the new “TZ” sensor outside the MCKT HPX and install it in the air supply duct **UPSTREAM** the preliminary heater.

Connect the MCKT-HPX control cabinet to the preliminary heater control module according to the diagrams 10.3 and 10.4.

Activate “RunH1 – ON” function in the “Settings – Preliminary heater” menu of the MCKT HPX controller.



Picture 11 Wiring diagram of the 230V electric heater control cabinet for MCKT-HPX1

