ENGINEERING
TOMORROW

Data Sheet

Evaporator control
Type **EKE 450** and **EKE 400**

It is a dedicated controller for evaporators typically used in industrial refrigeration applications which also includes the Danfoss NeoCharge® **control**

The EKE 400 controller is a dedicated evaporators typically used in industrial refrigeration applications. The EKE 400 will be able to manage the complete operation in cooling and defrost mode.

The EKE 450 shares the same functionality as the EKE 400 but also includes the Danfoss NeoCharge® control.

1 Key features

- **Danfoss NeoCharge control (EKE 450 only)**
- **Control of refrigerant injection in direct expansion (DX) applications**
- **Thermostat control**
- **Evaporation pressure control**
- **Control of hot gas, electrical, and water defrost**
- **Fan control**
- **Control of reheat coils**
- **Can be connected to Danfoss system controllers, AK-SM 8xxA series**
- **Can be connected to third party system controllers (like PLCs) via integrated MODBUS**

Use CoolConfig for easy configuration of EKE 400 and EKE 450:

https://CoolConfig.danfoss.com

2 Contents

3 Introduction and Controller startup

The EKE 400/450 controller is developed specifically to control every aspect of running an industrial evaporator. The controller handles refrigerant injection, air/media temperature, defrost, fans, etc. Everything that is needed to run an evaporator safely and efficiently.

The details of all the features and how to set them up will be explained in this document, but you are encouraged to use CoolConfig for setting up the controller – even though all settings can be accessed through the display on the controller.

3.1 Connecting CoolConfig to the EKE 400/450

To be able to connect CoolConfig to the controller, you will need to connect a USB port of your PC to the controller using a "Modbus to USB" cable. Most of the available "Modbus to USB" cables will do just fine.

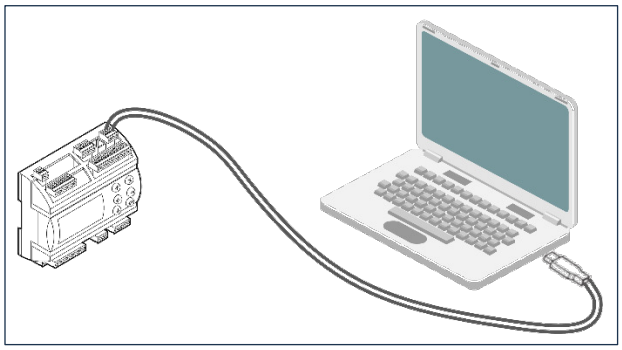


Figure 1. Connecting a PC with CoolConfig to EKE 400/450 using a USB to Modbus cable

Before connecting the controller to CoolConfig, you will need to start up the EKE 400/450 controller and possibly assign a Modbus address. As default, the controller has address 1, but if you are configuring more than one controller on the Modbus network, you need to assign the different controller addresses using the display of the controller (note that CoolConfig supports easy configuration of multiple controllers in a network).

To change to controller Modbus address do the following:

1. **Power up controller and enter password:**
    a. **Press a key on the controller**
    b. **Press and hold the Enter key until the password screen appears**
    c. **Enter password using arrow keys (move to next digit by pressing Enter) and finish pressing Enter. Default passwords:**
        i. **100 Password level 1. Read only access**
        ii. **200 Password level 2. For installer for adjusting parameters**
        iii. **300 Password level 3. For system configuration**
2. **Set Modbus address:**
    a. **Enter level 3 password**
    b. **Go to "System | Network" menu**
    c. **Select "Modbus address" and set the wanted modbus address of the controller**

You are ready to use CoolConfig to configure the controller – or controllers – when you connect the controller to your PC's USB port using a "Modbus to USB" cable.

The basic steps of configuring an EKE 400/450 controller using CoolConfig are:

1. **Fill out settings on the "Basic control functions" tab**
2. **Go to the "I/O functions" tab and select any additional IO's you want to configure**
3. **Go to the "Quick setup" tab and check the settings**

4. **Go to details tab and check if you need to change default settings for any of the parameters**
5. **Check IO configuration – i.e. which valve/sensor/… is connected to which physical port on the controller.**

When this is done you can write the configuration to the controller(s) in your network and be ready to start.

Note that it is always very important to check which digital and analog inputs and outputs are configured for which functionality (for example that DO1 is used for set the fan On/Off and not DO2), and make sure that these functions are matched by correct physical wiring.

3.2 Main switch parameter

The EKE 400/450 controller has a parameter called "Main switch", which can be accessed through the display or through CoolConfig. The controller does not start controlling until "Main switch" is set On, and moreover a lot of the parameters in the EKE 400/450 requires "Main switch" to be Off before they can be changed – this means that these parameters require you to stop controlling before they can be changed. See "Modbus parameter overview" for a complete list of parameters and whether they require "Main switch" to be off before they can be changed.

When Main switch is turned on, the controller will – for safety reasons –run through the final steps of a defrost cycle (if defrost is defined). The startup sequence is a bit different whether the Main switch is just turned on, or the controller restarts after a power failure.

If the controller is powered on and Main switch is turned from Off to On, then the following will happen:

- No defrost defined or defrost externally controlled
  - Valve in wet return/suction line is defined: the controller will start in the "WR open delay" state.
  - No valve in wet return/suction line is defined: the controller will go to Cooling mode immediately.
- Hot gas defrost
  - Valve in wet return/suction line is defined: the controller will start in the "WR open delay" state.
  - No valve in wet return/suction line is defined: the controller will start in the "Fan start delay" state.
- Electrical or water defrost
  - Valve in wet return/suction line is defined: the controller will start in the "WR open delay" state.
  - No valve in wet return/suction line is defined: the controller will start in the "Fan start delay" state.

If the Main switch is on, and there is a power failure, then the controller will start in the following state after power-up:

- No defrost defined or defrost externally controlled
  - Valve in wet return/suction line is defined: the controller will start in the "WR open delay" state.
  - No valve in wet return/suction line is defined: the controller will go to Cooling mode immediately.
- Hot gas defrost
  - The controller will start in the "Drip off time" state.
- Electrical or water defrost
  - Valve in wet return/suction line is defined: the controller will start in the "Drip off time" state.
  - No valve in wet return/suction line is defined: the controller will start in the "Fan start delay" state

The statup sequence for a system including defrost control and valves in the wet return/suction line is illustrated below:

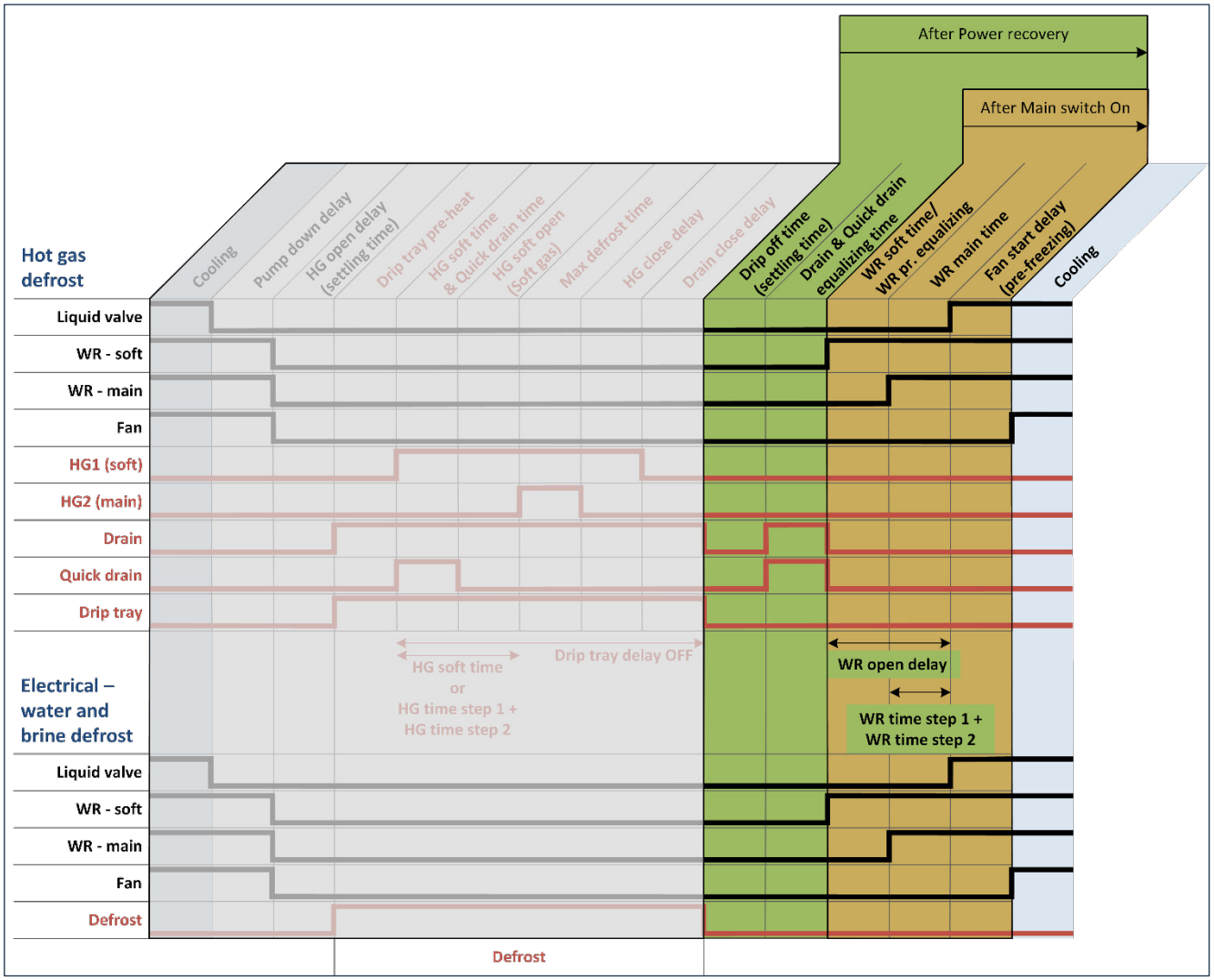


Figure 2. Startup sequence for system including defrost control and valves in wet return/suction line

3.3 Real Time Clock

The EKE 400/450 comes with a build in clock to enable setting up defrost schedules etc.

Important: The battery driving the Real Time Clock during power failure has a limited capacity. This means that the time in the EKE 400/450 should always be checked after a power failure. See also chapter 21.15.1 on instructions how to set the real time clock using Modbus.

3.4 Controller software update

If CoolConfig is connected to a controller and the PC running CoolConfig is connected to the internet, CoolConfig will automatically check if the connected controller has the latest device software installed.

If a new device software is found, then CoolConfig will display a message that a new device software is found, and is ready for install. The installation process will take a few minutes, and the controller will restart one or more times depending on the update.

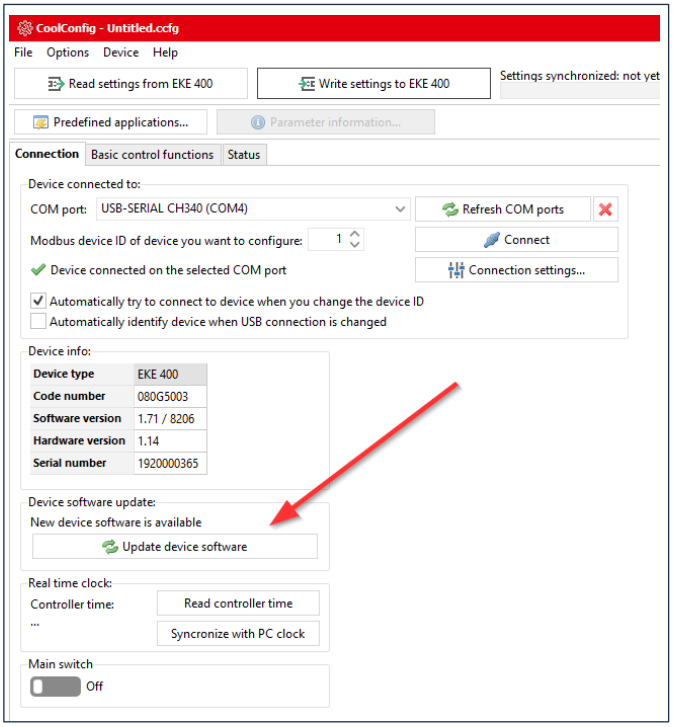


Figure 3. New device software check in CoolConfig

NOTE: It is strongly recommended to save the controller setup before updating the device software! Do this by reading the controller setup using CoolConfig and save it to a file before updating the device software.

NOTE: It is strongly recommended to remove CANbus and Modbus connection to other controllers while updating.

NOTE: When setting up a new controller, always check if there is a new controller software available.

3.5 Connecting controllers in Modbus network

Connecting multiple controllers in a Modbus network is essentially just connecting the individual controllers with a suitable cable while observing some basic rules for handling data communication.

A description of different suitable cable types and how to use them to connect controllers can be found in the Danfoss Data communication design guide:

Data communication design guide

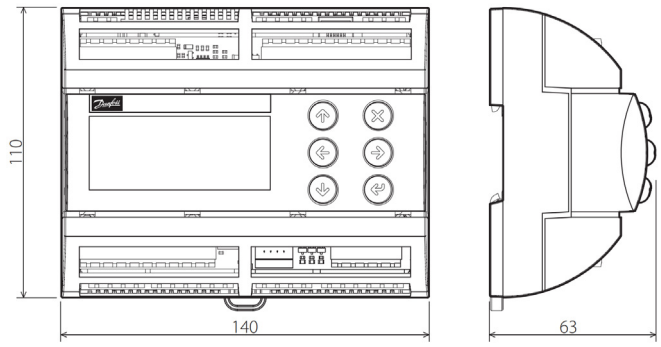
4 EKE 400/450 technical data

Technical data	
Supply voltage	Depending on model: 85 – 265 V AC, 50/60 Hz. Maximum power consumption 20 VA 20 – 60 V DC and 24 V AC ± 15% 50/60 Hz. Maximum power consumption 10 W, 17 VA.
Communication, Modbus	It is important that the installation of the data communication cable is done correctly. See for example separate literature No. RC8ac. Remember termination at the bus termination.
Communication, CAN--bus	H-R connection must be made on the first and the last local EKE 400/450. Connection as close as possible to the connector.
Power supply +5 V	On upper level. Use to power analog inputs, 100 mA max. 50 mA max for 4 / 20 mA transmitter (total on all outputs).
Power supply +12 V	On upper level. Use to power analog inputs, 120 mA max. 80 mA max for 0 / 5 V transmitter (total on all outputs).
Electrical noise	Signal cables for sensors, digital inputs, data communication and display must be kept separate from high voltage (230 V) electric cables: Use separate cable trays Keep a distance between high voltage and signal cables of at least 10 m

CE

IP20
-20 – 60 °C
(0 – 140 °F)
RH max. 90% non-condensing

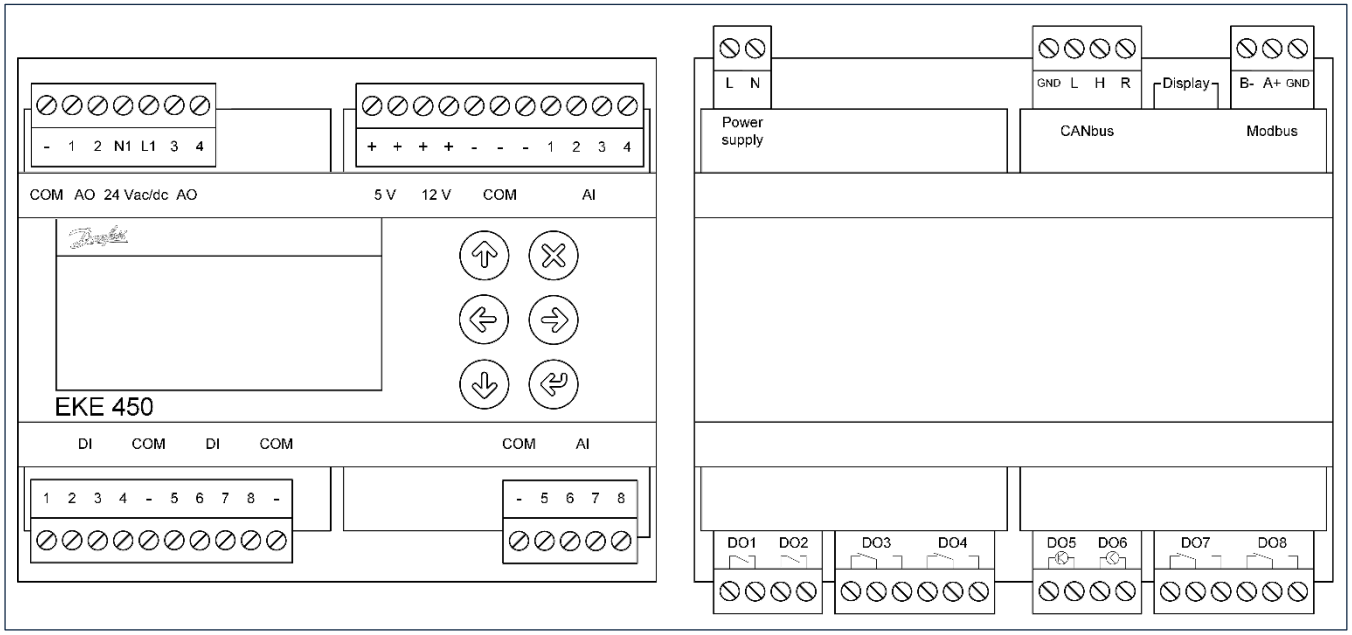
Dimensions in mm



4.1 Connections

Upper level

Lower level



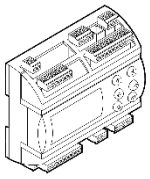
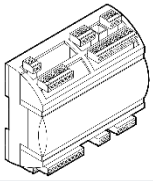
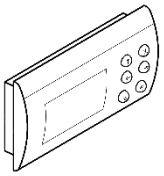
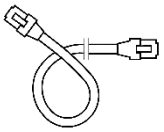
Analog inputs	Specifications
AI1, AI2, AI3, AI4	Universal analog inputs selectable via HMI or CoolConfig between: General: 0 – 5 V, 2 – 10 V, 0 – 10 V : impedance is greater than 1 MΩ 0 – 20 mA, 4 – 20 mA Pressure transmitters: AKS 32R 5 V. Ratiometric 10 – 90% of supply AKS 32. 1 – 5 V, 0 – 10 V AKS 33. 4 – 20 mA (supply = 12 V) Temperature sensors: NTC (10 kΩ at 25 °C) PT1000 12 V+ power supply 12 V DC, 50 mA max for 4 / 20 mA transmitter (total on all outputs) 5 V+ power supply 5 V DC, 80 mA max for 0 / 5 V transmitter (total on all outputs)
AI5, AI6, AI7, AI8	Function defined via the HMI or CoolConfig in the parameter list: General: 0 – 5 V, 2 – 10 V, 0 – 10 V : impedance is greater than 1 MΩ Pressure transmitters: AKS 32R 5 V. Ratiometric 10 – 90% of supply Ratiometric: 10 – 90% of supply, AKS 32R 1 – 5 V, AKS 32 Temperature sensors PT1000 ohm, AKS 11, or AKS 21. NTC 86K ohm @ 25 °C.

Analog outputs	Specifications
4 pcs. AO1 to AO4	Function defined via HMI or CoolConfig
AO1, AO2	0 – 10 V DC minimum load 1 kΩ (10 mA) for each output
AO3, AO4	Opto-insulated 0 – 10 V DC minimum load 1 kΩ (10 mA) for each output. Referenced to contact N1. External power supply 24 V AC/DC on N1 and L1 in upper level of controller. OBSERVE Connect 24 V on N1 and L1 (separate supply). Avoid earth fault current. Use double-insulated transformer. The secondary side must not be connected to ground. Obtain 0 – 10 V from terminals N1 and AO3, respectively N1 and AO4. PAY ATTENTION TO THE POLARITY of N1.

Digital inputs	Specifications
8 pcs. DI1 to DI8	Voltage free contact. Current consumption 5 mA. The connection may be a shut-down or interruption function. Select what is to be activated during configuration in HMI or CoolConfig.
Cables	Cables longer than 10 m (33 ft) is not recommended. With cables longer than 10 m (33 ft), it is recommended to use auxiliary relays, placed within 10 m (33 ft) of the EKE 450. Typically, these auxiliary relays are placed in the same panel as the EKE 450.

Digital outputs	
DO1 to DO8	Function defined via HMI or CoolConfig Total current load limit: 32 A
DO1, DO2	High inrush current (80 A - 20 ms) normally open contact relays 16 A Characteristics of each relay: 10 A 250 V AC for resistive loads – 100.000 cycles 3.5 A 250 V AC for inductive loads – 230.000 cycles with cos(phi) = 0.5
DO3, DO4, DO7, DO8	Changeover contacts relay 8 A. Characteristics of each relay: 6 A 250 V AC for resistive loads – 100.000 cycles 3.5 A 250 V AC for inductive loads – 100.000 cycles with cos(phi) = 0.6
DO5, DO6	Solid State Relays Imax. = 0.5 A Imin. = 50 mA Leakage current < 1.5 mA Not short-circuit protected OBSERVE: AC only

5 Ordering

Ordering EKE 400

Display	Supply voltage	Code number
Yes	230 V AC	**080G5003**
Yes	24 V DC or AC	**080G5004**
No	230 V AC	**080G5005**
No	24 V DC or AC	**080G5006**

Accessories (for both EKE 400 and EKE 450)

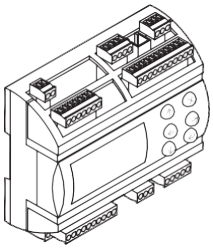
Type	Code number
Remote display (HMI), type MMIGRS2	**080G0294.** Note: the remote display cannot be used with Russian, Chinese, Korean or Japanese languages.
Cable between remote display and controller	**080G0075** = 1.5 m **080G0076** = 3 m

Ordering EKE 450 and NeoCharge solution

Identification

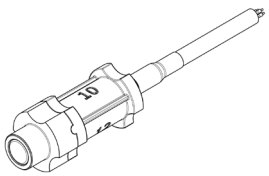
084H1150 = EKE 450 24 V AC/DC + 10, 12, 16 mm NeoCharge clamp and sensor + NeoCharge solid state relay
084H1151 = EKE 450 230 V AC + 10, 12, 16 mm NeoCharge clamp and sensor + NeoCharge solid state relay
084H1152 = EKE 450 24 V AC/DC + 20, 22, 27 mm NeoCharge clamp and sensor + NeoCharge solid state relay
084H1153 = EKE 450 230 V AC + 20, 22, 27 mm NeoCharge clamp and sensor + NeoCharge solid state relay
Spare part code numbers listed below

NeoCharge controller EKE 450 with HMI



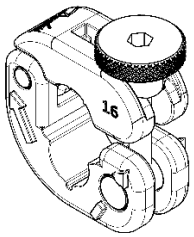
080G5007 = 230 V AC 20 VA
080G5008 = 24 V AC / DC 17 VA

NeoCharge sensor



084H1101 = 10, 12, 16 mm
084H1102 = 20, 22, 27 mm

NeoCharge clamp



084H1103 = 10, 12, 16 mm
084H1104 = 20, 22, 27 mm

NeoCharge solid state relay

080G5011

6 Basic control functions

The EKE 400 supports the following evaporator control modes:

- Flooded evaporator control. This is used for controlling standard pump circulation systems.
- DX control. This is used for controlling standard direct expansion systems – i.e. systems where an expansion valve is controlled by measuring the superheat out of the evaporator.

The EKE 450 has exactly the same functionality, but it also includes Danfoss NeoCharge control for controlling:

- Flooded evaporators with controlled circulation rate (CCR systems)
- DX control with zero superheat (WDX systems)

Depending on the selected evaporator control mode, several other control modes can be selected:

- Evaporation pressure control. Is used to control evaporation pressure by adding a control valve in the wet return/suction line (evaporation pressure control is not available with WDX and CCR evaporator control). See chapter 12 for more information.
- Fan control. Several control modes for handling the fan are available. See chapter 13 for more information.
- Thermostat function. Typically used to control the air temperature. Both traditional on/off and modulating thermostat modes are available. Details can be found in chapter 9.
- Defrost control. Both hot gas defrost and electrical/water defrost is supported. Details can be found in chapter 14.
- Reheat function. Which enables control of a reheat coil after the evaporator. Control is simply turning a solenoid valve On/Off depending on a setpoint for a reletive humidity sensor. Details can be found in chapter 15.

Depending on these settings, the refrigeration system configuration is defined by selecting the type of valves used to control the different functions (see table of available valve selections below).

6.1 Po-optimization

If you connect the EKE 400/450 to a Danfoss system manager, you are able to do Po-optimization, i.e. raising the evaporation pressure depending on the load on the evaporators in a system (requires that a thermostat function is defined in the EKE 400/450). See the Danfoss System Manager documentation for more information.

Figure 4. Danfoss System Manager

Parameters for selecting basic control functions

Label	Name	Description	Details
M01	Main switch	Control On/Off switch	The controller does not start controlling until Main switch is set On, and moreover a lot of the parameters in the EKE 400/450 requires Main switch to be Off before they can be changed – this means that these parameters require you to stop controlling before they can be changed. If Main switch is On and there is a power failure, the Main switch will On when power returns (but the same procedure as switching Main switch Off/On will be run).
Evaporator control mode			
R01	Evap. Ctrl mode	Evaporator control mode	EKE 400. Select between: "Flooded evaporator On/Off control" or "DX control"
R1A	Evap. Ctrl mode	Evaporator control mode	EKE 450. Select between: "Flooded evaporator On/Off control", "DX control", "NeoCharge CCR control" or "NeoCharge WDX control". See chapter 8 for details on CCR and WDX control.
Evaporation pressure control			
T26	Evap.Pres.Control	Evaporation pressure control	Set evaporation pressure control On or Off. See chapter 12.
R04	Evap.Pres.Ctrl by	Evaporation pressure controlled by	Select between: "Room temperature or "Pressure"
Refrigerant			
R20	Refrigerant	Refrigerant	The EKE 400/450 comes with an extensive list of refrigerants supported. If you cannot find the wanted refrigerant, then you can select "User defined" and enter parameters for the Antoine equation, which is used to calculated saturation temperature based on measured pressure
R23	Refrig fact. A1	User defined refrigerant. Factor A1	The factors A1, A2 and A3 are used in the Antoine equation: $$ln(p) = A1 + \frac{A2}{A3 + T}$$ Note that in this equation, the pressure, *p*, is in bar and the temperature, *T*, is in °C.
R24	Refrig fact. A2	User defined refrigerant. Factor A2	
R25	Refrig fact. A3	User defined refrigerant. Factor A3	
Fan control			
F01	Fan control mode	Fan control mode	The following modes are supported: "No control", "On-Off control (1 DO) ", "On control (1 DO) ", "Two step control (2 DO) ", "0-10V EC fan ctrl (1 AO) ", "0-10V EC fan ctrl+DO (1 AO + 1 DO) ", "0-10V VFD variable (1 AO) ", "0-10V VFD var.+DO (1 AO + 1 DO) ", "On-Off ctrl cycling". Details are in chapter 13.
Thermostat control			
T1A,B,C,D,E	Ther. mode	Thermostat control mode depending on evaporator control mode	See chapter 9 for details
Defrost control			
D1A	Defrost method	Defrost method	Select between "No defrost", "Hot gas", "Electrical or water" and "Ext. controlled" See chapter 14 for details
D2B	HG Drip tray line	Separate line for hot gas drip tray	
Reheat function			
RH0	Reheat enable?	Enable Reheat function	Select if you want to control a reheat coil. If selected an analog input is reserved for a humidity sensor. Details are in chapter 15.
RH1	Setpoint RH%	Setpoint Humidity	Set the humidity setpoint for the reheat control.

6.2 Valves

The EKE 400/450 allows you to define the valves needed for the selected control functionality. The valve selection is important as it will define the needed analog and digital output connections between the controller and the valves/actuators. The valve, which can be selected are explained below according to the line they are located in.

Valves in liquid/liquid feed line

Label	Name	Description	Details
R2A	Liq. feed line valve	Valve in liquid line, flooded evaporator (not PWM liquid control)	Selected valve can be: • Solenoid (ICFE) • Solenoid (ICS) • Solenoid (ICM) Any of the above results in assignment of one digital output. The valve is used to switch refrigerant flow On/Off when using On/Off thermostat mode
R2C	Liq. feed line valve PWM	Valve(s) in liquid line, flooded evaporator, PWM liquid control	Selected valve(s) can be: • AKV • AKV + Solenoid • 2 AKV • 2 AKV + Solenoid Note that only DO5 and 6 can be used for connecting the AKV valves (the Solid-state digital outputs). See below for explanaition of PWM liquid control
R2B	Liq. line valve for DX	Valve(s) in liquid line, DX control	Selected valve(s) can be: • AKV • AKV + Solenoid • Modulating ICM • Modulating ICM + solenoid • 2 AKV; • 2 AKV + solenoid Depending on selection, DO's and/or AOs are assinged. Note that if AKVs are selected, only DO5 and 6 (the solid-state digital outputs) can be used for connecting the valves.
R2D	Liq. line valve NeoCharge	Valve(s) in liquid line, NeoCharge	Selected valve(s) can be: • AKV • AKV + Solenoid • Modulating ICM • Modulating ICM + Solenoid Depending on selection, DO's and/or AOs are assinged. Note that if an AKV valve is selected, then only DO5 or 6 can be used for connecting the valve (the Solid-state digital outputs)

Valves in wet return/suction line

Label	Name	Description	Details
D3A	WR/SL valve	Valve in wet return/suction line	Valve in wet return line or suction line (if evaporation pressure control is not selected): • No valve • Soft (ICS+EVRST) • Soft (ICSH) • Soft (ICLX) • Solenoid (ICS) • Solenoid (ICM) • Slow (ICM) A slow opening or a two-step valve in the wet return line or suction line is recommended to release the pressure in the evaporator after defrost slowly.
D03	WR/SL valve	Valve in wet return/suction line	Valve in wet return line or suction line (if evaporation pressure control is selected): • Mod (ICM) • Mod+PE (ICM+EVRST) • Mod (CVE) • Mod+PE (CVE+EVRST) • Mod+PE (CVE+EVM+EVRST)

Hot gas defrost valves

Label	Name	Description	Details
D2A	Hot gas line valve	Valve in hot gas line	The valve in the hot-gas line: • No valve • Soft (ICS+EVRST) • Soft (ICSH) • Solenoid (ICFE) • Solenoid (ICS) • Solenoid (ICM) • Slow (ICM)
D1B	HG Drain valve	HG drain valve	The valve in the defrost drain line: • Pressure (OFV) • Pressure (ICS+CVP) • Liquid drain (ICFD) Note that the EKE 400/450 is not controlling this valve. It is reserved for future use, but this also means a correct selection can be important for future features.
D4A	Drain solenoid?	Drain solenoid valve	Set this if you have a solenoid valve in the drain line. If so, a digital output will be reserved for controlling it.
D4B	Quick Drain?	Quick Drain	Set this if you have a quick drain solenoid valve in the drain line. If so, a digital output will be reserved for controlling it.
D09	Water valve?	Water spray on the evaporator during hot gas defrost	Select this if water is sprayed on the evaporator during hot gas defrost. This can help loosen ice on an evaporator. If selected a digital output will be reserved for the valve controlling the water. The water valve opens when the following criteria are met: • The hot gas main valve is ON and the “D67, Water valve start delay” limited has expired (see chapter 14.4) When the water valve is opened a timer starts (running time is defined by “D68, Water valve time”) and the water closes when: • The timer reaches the end time • Or when the defrost reaches the "D59, Drip off time" (see chapter 14.4).

6.2.1 Valve states

Depending on selection of valves, you can set valve status (open/closed) when cooling is On or Off, and you can define analog feedback signals from ICM valves with an ICAD. The feedback signal can be used to compare the requested opening degree to the actual opening degree of the ICM valve.

The following parameters define valve states at cooling On/Off:

Label	Name	Description	Details
D3B	WR/SL at Cool. stopped	State of wet return/suction line valve when cooling is stopped	
D24	WR/SL soft at cooling	State of soft valve (EVRST) when cooling is on	

6.3 Basic control functions IO definition

Depending on the control function and valve selections the following IO's will be defined and needs to be assigned a physical analog or digital channel.

IO's related to valves in liquid or liquid feed line

IO	Type	Description	Details
LF sol	DO	Solenoid valve	Solenoid in liquid/liquid feed line when using PWM liquid control, DX, CCR or WDX control
LF sol ICFE	DO	ICF solenoid valve	Solenoid for standard On/Off thermostat for flooded evaporator On/Off control
LF sol ICS	DO	ICS solenoid valve	Solenoid for standard On/Off thermostat for flooded evaporator On/Off control
LF sol ICM	DO	ICM solenoid valve	Solenoid for standard On/Off thermostat for flooded evaporator On/Off control
LF AKV	DO	AKV(A) valve used for injection/expansion valve or PWM liquid control	Only DO 5 or 6 can be used (one of the solid-state relays)
LF AKV2	DO	Second AKV(A) valve used for injection/expansion valve or PWM liquid control (if two valves are used)	Only DO 5 or 6 can be used (one of the solid-state relays)
Mod ICM	AO	ICM valve used as expansion valve	

IO's related to valves in wet return/suction line. No evaporation pressure control.

IO	Type	Description
WR/SL soft EVRST	DO	EVRST soft solenoid valve (step 1) in the wet return/suction line
WR/SL main ICS	DO	ICS + EVM main solenoid valve in the wet return/suction line
WR/SL soft ICSH1	DO	Step 1 of a two-step ICSH solenoid valve in the wet return/suction line
WR/SL soft ICSH2	DO	Step 2 of a two-step ICSH solenoid valve in the wet return/suction line
WR/SL sol ICLX	DO	2-step ICLX solenoid valve in the wet return/suction line
WR/SL sol ICS	DO	1-step ICS solenoid valve in the wet return/suction line
WR/SL sol ICM	DO	1-step ICM solenoid valve in the wet return/suction line (the ICAD can be configured to automatically open the ICM valve from 0 to 100% on a digital input signal)
WR/SL slow ICM	AO	Slow opening ICM in the wet return/suction line

IO's related to valves in wet return/suction line. Evaporation pressure control.

IO	Type	Description
PC WR/SL EVRST	DO	EVRST solenoid valve in suction or wet return line
PC WR/SL EVM	DO	EVM solenoid valve in suction or wet return line
PC WR/SL ICM	AO	ICM valve in suction or wet return line
PC WR/SL CVE	AO	CVE pilot on ICS in suction or wet return line

IO's related to hot gas valves

IO	Type	Description
HG soft EVRST	DO	EVRST soft solenoid valve (step 1) in the hot gas defrost line
HG main ICS	DO	ICS + EVM main solenoid valve in the hot gas defrost line
HG soft ICSH1	DO	Step 1 of a two-step ICSH solenoid valve in the hot gas defrost line
HG soft ICSH2	DO	Step 2 of a two-step ICSH solenoid valve in the hot gas defrost line
HG sol ICFE	DO	1-step ICFE solenoid valve in the hot gas defrost line
HG sol ICS	DO	1-step ICS solenoid valve in the hot gas defrost line
HG sol ICM	DO	1-step ICM solenoid valve in the hot gas defrost line (the valve ICM can be setup to automatically open from 0 to 100% on a digital input)
DD sol	DO	1-step solenoid in the defrost drain line
DD quick	DO	1-step quick drain solenoid
HG Drip tray	DO	1-step solenoid for a separate drip tray line
HG slow ICM	AO	Slow opening ICM in the hot gas defrost line
Water valve	DO	Water valve for spraying water on evaporator during hot gas defrost

Other outputs:

IO	Type	Description
Fan output	DO	Digital output for controlling fan on/off
Fan output 2	DO	Digital output for controlling fan step 2 if two step control is defined
EC fan out	AO	Analog output for controlling EC fan
VFD fan out	AO	Analog output for controlling variable speed fan
Defrost On/Off	DO	Digital output for controlling electrical or water defrost
Reheat sol	DO	Reheat solenoid valve
NC sensor power	DO	NeoCharge sensor power. Only DO 5 or 6 can be used (one of the solid-state relays)

Analog inputs required (from sensors) depending on selections:

IO	Type	Description
Ther. air	AI	Air temperature. This input will be visible if the thermostat function is different from "None" or if the room temperature alarm function (B01) refers to "Thermostat temperature" (see chapter 9)
Pe Evap. press	AI	Evaporation pressure analog input. Visible if a pressure reading is needed (DX, CCR, WDX control, or evaporation pressure control by pressure). Pressure transmitter can be connected to any of the 8 analog inputs, but if a 4 – 20 mA pressure transmitter is used, then only analog input 1 to 4 can be used.
S2 suction pipe	AI	S2 suction pipe temperature (standard superheat sensor – see NeoCharge application manual for positioning of the S2 sensor on CCR and WDX systems)
NC sensor temp	AI	NeoCharge Pt1000 temperature sensor. Only for CCR and WDX control.
Humidity sens.	AI	Humidity sensor analog input. Only when reheat coil is selected.

7 I/O functions

Depending on selection of control functionlity and valves, a number of IO's can be defined, which can be used to start/stop functions from external controllers (PLC's) or used to get controller or valve/actuator status.

7.1 Cooling status

Label	Name	Description	Details
P03	Main switch by DI	Main switch by DI. Start and stop regulating using signal from digital input	Turn the Main switch parameter On/Off by digital input – for example from a PLC. Note that turning Main switch off, will stop controlling immediately.
T09	Cool. status DO	Actual cooling status to be read on a DO	If defined, the cooling status (on/off) will be routed to a digital output
T22	Min. Cooling OD	Min Cooling OD to turn On the Cooling Status (Digital Output and info on screen)	If application is DX, CCR or WDX then Cooling on signal is not routed to digital output until valve opening degree is higher than this value

7.2 Defrost status

Label	Name	Description	Details
D06	Defrost allowed	Defrost allowed signal via network	Control whether defrost is allowed using Modbus. Typically used by a PLC to allow/disallow defrost depending on availability of hot gas.
D07	Defrost allowed via DI	Define a DI so that 'Defrost allowed' signal can be controlled via a digital input	Control whether defrost is allowed using a digital input (any of the 8 DI's can be used). Typically used by a PLC to allow/disallow defrost depending on availability of hot gas.
D14	Def. start by DI	Define a DI so that defrost can be started via a digital input	When selected, a digital input is reserved for an external defrost start signal (for example from a PLC or a push button). If the controller is already in defrost, successive changes of the digital input will be ignored.
D42	Defrost stop via DI	Define a DI, so that 'Defrost stop' signal can be controlled via a digital input	When selected, a digital input is reserved for an external defrost stop signal (for example from a PLC). Note that stopping a defrost will finish all defrost states after the "Max defrost time" state to end the defrost safely.
D18	Hot gas valve On/Off DO	Hot gas valve On/Off digital output	When selected, a digital output is reserved for the status of the hot gas valve. If a 2-step hot gas valve is selected, the signal follows the first step (see also Figure 20).
D08	Def. status on DO	Defrost status (on/off) on a digital output	Can for example be used to control an ICS+CVPP valve in the discharge line to raise discharge pressure during hot gas defrost. The DO is set to on at defrost start (right after the liquid line valve is closed) and to Off at defrost end (when the liquid line valve is opened again).

7.3 Evaporator control

Label	Name	Description	Details
R05	Cool On/Off by DI	Cooling on/off by digital Input	Reserves a digital input for starting and stopping cooling by an external controller (for example a PLC). Note though that if signal for example is send during defrost, then the defrost will be ended safely before cooling is started.
R06	Forced closing	Forced cooling stop via network	Set this parameter over Modbus (or on controller) to stop cooling. The parameter will automatically be reset. If set On, the parameter will automatically go back to Off after 15 minutes.
R08	Forced close by DI	Forced cooling stop by digital Input	Will reserve a digital input, which – when enabled – will force cooling to stop.
R07	Forced cooling	Forced cooling start via network	Set this parameter over Modbus (or on controller) to start cooling. The parameter will automatically be reset. Note though that if signal for example is send during defrost, then the defrost will be ended safely before cooling is started. If set On, the parameter will automatically go back to Off after 15 minutes.
R09	Forced cool by DI	Forced cooling start by digital Input	Will reserve a digital input, which – when enabled – will force cooling to start. Note though that if signal for example is send during defrost, then the defrost will be ended safely before cooling is started.

7.4 Valve status

Label	Name	Description	Details
D3H	WR/SL valve AI feedback	Feedback from ICAD of ICM/CVE valve in wet return/suction line	Will reserve 1 analog input for feedback signal – the actual opening degree in pct – from ICAD. Signal can be used to check if requested opening degree is the same as actual opening degree.
D2C	HG valve AI feedback	Feedback from ICAD of ICM valve in hot gas defrost line	Will reserve 1 analog input for feedback signal – the actual opening degree in pct – from ICAD. Signal can be used to check if requested opening degree is the same as actual opening degree.
R10	LL valve AI feedback	Feedback from ICAD of ICM valve in Liquid feed line	Will reserve 1 analog input for feedback signal – the actual opening degree in pct – from ICAD. Signal can be used to check if requested opening degree is the same as actual opening degree.

7.5 Additional AI's

Label	Name	Description	Details
P25	Gas Conc.tra. AI?	Gas Concentration Analog Input	Enables gas detector to be connected to EKE 400/450 and the concentration to be read from Modbus. The concentration range from the gas detector is selected.
SS1	Temperature sensor	Extra temperature sensor	Reserves an analog input for an extra temperature sensor, which can be read from Modbus
SP1	Pressure sensor	Extra pressure sensor	Reserves an analog input for an extra pressure transmitter, which can be read from Modbus

7.6 Fan status

Label	Name	Description	Details
F11	Fan DI	Fan status digital input	Reserves a digital input for a fan status signal. You can select if signal should just be used for an alarm, or if both an alarm and a stop sequence should be initiated when DI is enabled. The stop sequence is: 1. All valves in liquid/liquid feed line will be closed (Injection and/or solenoid valves) 2. Fan will be stopped 3. Defrost will be finished (if it's running) and there will be no new defrost cycle initiated
F10	Fan DI status	Status for Fan DI	Readout of status of F11 parameter

7.7 Safety stop

Label	Name	Description	Details
A71	Safety stop by DI	Safety stop and alarm by digital input	If selected a digital input will be reserved for a safety stop signal. If the safety stop is enabled, the following will happen: • Liquid/liquid feed line valves will be closed • Hot gas valves will be closed • Drip tray valve will be closed • Quick drain valve will be closed • Drain valve will be closed • An alarm will be raised Note that the state is persistent (i.e., stored in controller even if power goes off).
S70	Manual alarm reset	Require manual reset of safety stop alarm	If set, it will always require a manual reset of the alarm in the controller.
A72	WR/SL status	Wet return/suction line valve status at safety stop	Select whether valve should be open or closed at safety stop
A73	Fan status	Fan status at safety stop	Select whether fan should be running or stopped at safety stop

7.8 I/O functions IO definition

Depending on the selections above the following IO's will be defined and needs to be assigned a physical analog or digital channel.

IO	Type	Description	Details
Main switch	DI	See P03 parameter above	
Cool status	DO	See T09 parameter above	
Def. allowed	DI	See D07 parameter above	
Defrost start	DI	See D14 parameter above	
Defrost stop	DI	See D42 parameter above	
HG valve status	DO	See D18 parameter above	
Def status	DO	See D08 parameter above	
Cool On/Off	DI	See R05 parameter above	
Forced close	DI	See R08 parameter above	
Forced cool	DI	See R09 parameter above	
Gas conc.	AI	See P25 parameter above	If concentration range is in ppm this analog input will be available
Gas conc. XL	AI	See P25 parameter above	If concentration range is in ppb this analog input will be available
Extra temperature	AI	See SS1 parameter above	
Extra pressure	AI	See SP1 parameter above	
LL feedback	AI	Feedback from ICAD of ICM valve in Liquid feed line	Only the 4 first AI's can be used for the feedback signal (the feedback signal from the ICAD is 0-20 mA or 4-20 mA)
WR/SL feedback	AI	Feedback from ICAD of ICM/CVE valve in wet return/suction line	
HG feedback	AI	Feedback from ICAD of ICM valve in hot gas defrost line	
Fan input	DI	See parameter F11 above	
Safety stop	DI	See parameter A71 above	

8 NeoCharge control

The EKE 450 controller is required for controlling the refrigerant injection into the evaporator in NeoCharge mode (NeoCharge is only supported by EKE 450, not EKE 400).

The NeoCharge control solution has been developed for controlling fin-and-tube evaporators in cold rooms. Performance of the control algorithm for other applications or evaporator types cannot be guaranteed.

Besides the EKE 450, the following equipment is required for the NeoCharge solution:

- The NeoCharge sensor
- The NeoCharge clamp (for easy installation of the NeoCharge sensor)
- The NeoCharge solid state relay with leakage current suppression to connect the NeoCharge sensor to the EKE 450
- A pressure transmitter to measure the evaporation pressure
- A temperature sensor to measure the refrigerant temperature out of the evaporator
- An electronic valve – for example, an ICM motor valve or and AKVA pulse with modulating valve, either used as control valve (CCR systems) or expansion valve (WDX systems).

The EKE 450, the NeoCharge sensor, the NeoCharge clamp, and the NeoCharge solid state relay are delivered when ordering the NeoCharge solution. The pressure transmitter, the temperature sensor and the expansion valve must be ordered separately. It is recommended to use Danfoss Coolselector®2 for selecting a suitable pressure transmitter, temperature sensor and electronic expansion or control valve.

The NeoCharge solution supports two different kind of refrigeration system designs:

1. Pump systems with Controlled Circulation Rate (CCR systems)
2. Wet Direct eXpansion (WDX systems)

8.1 CCR - Controlled Circulation Rate pump systems

A CCR system is a traditional pump circulation system where the circulation rate is controlled by the EKE 450. The EKE 450 uses the NeoCharge sensor input signal to manipulate the control valve opening degree:

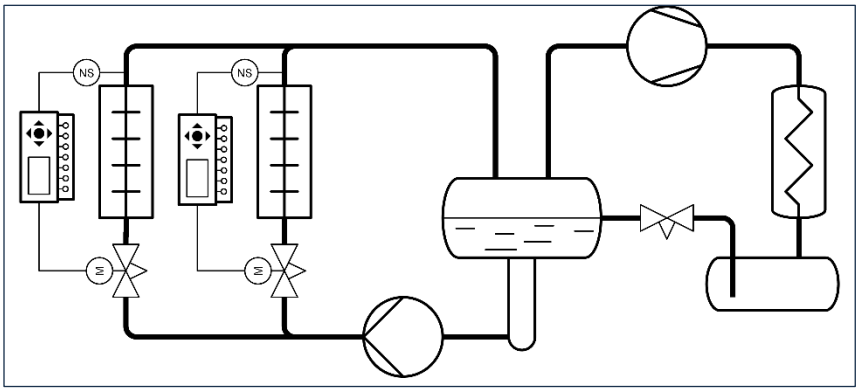


Figure 5. CCR system. EKE 450 controlling the motorized control valve using NeoCharge sensor (NS) signal

8.2 WDX – Wet Direct eXpansion systems

A WDX system is a direct expansion system, where the NeoCharge solution is used to control the injection into the evaporator so that there is no superheat at the evaporator outlet. This means that there is a small – but controlled – amount of liquid coming out of the evaporator, which needs to be managed:

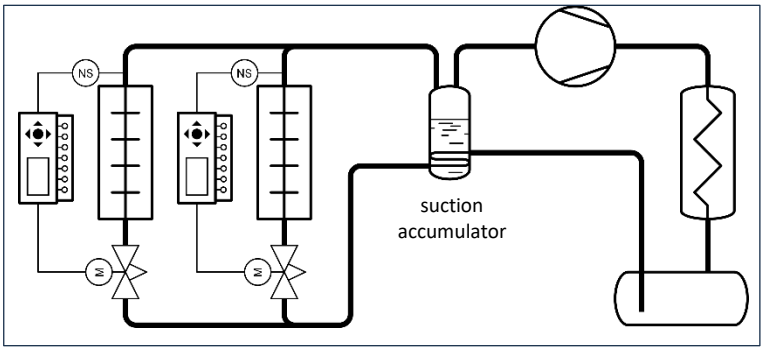


Figure 6. WDX system. EKE 450 controlling expansion valve using NeoCharge sensor (NS) signal

Note that in Figure 6 the refrigeration system has a suction accumulator with an internal heat exchanger to manage the excess liquid from the evaporator.

8.3 Control principle

Whether an evaporator in a CCR or WDX system is being controlled, the principle is the same:

1. When the controller is started, a “Setpoint Optimization” procedure is run.
2. Normal injection control based on the setpoints found.

The Setpoint Optimization procedure is used to find:

1. Power to the NeoCharge sensor heating element. The NeoCharge sensor consists of a heating element and a Pt1000 temperature sensor. The heating element is adjusted by pulsing the power using one of the solid-state relays in the EKE 450.
2. Setpoint for the NeoCharge sensor superheat. The NeoCharge sensor superheat is measured as the difference between the NeoSensor temperature and the evaporation temperature, measured using the pressure transmitter.

When the setpoint optimization is running, the EKE 450 will for a brief period, control the injection valve according to a superheat setting of default 7 K at the evaporator outlet. This is to ensure that the evaporator outlet is only gas. When the superheated outlet has been achieved, the controller will start to open the injection valve until liquid is registered at the evaporator outlet. If at some point in this process, the temperature of the NeoCharge sensor gets above default 80 °C (176 °F), then the power to the heating element is reduced, and the process is restarted.

When liquid has been detected at the evaporator outlet, the power to the heated sensor and the setpoint for the NeoCharge sensor superheat has been found, and normal control can begin.

Things to note about the Setpoint Optimization procedure:

- Cooling is provided while the setpoint optimization is running. There will be a brief period where there will be superheat at the evaporator outlet, which can reduce the evaporator capacity.
- The setpoint optimization is as default run every time the controller Main-switch parameter is changed from Off to On (i.e., also after power failure).
- The setpoint optimization can be set to run at every N number of defrosts. This process is a “fast” run, where the power to the NeoCharge sensor is reused from the previous optimization.
- If the setpoint optimization is interrupted by a defrost, a thermostat cut-out or a power failure, then the optimization will automatically restart when the system returns to normal cooling mode.

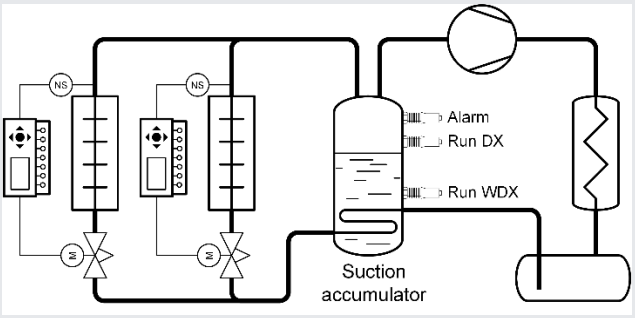
The setpoint optimization can fail under some circumstances:

- If the control valve or expansion valve is too small – then no matter the opening degree of the valve, there will not be liquid in the evaporator outlet and the NeoCharge sensor superheat setpoint cannot be found. When this happens, the opening degree of the injection valve will be close to or at 100%.
- If the NeoCharge sensor is mounted on an evaporator tube, which is not ideal (see the NeoCharge Application Manual for how to position the NeoCharge sensor). An indication of this will also be a very high opening degree of the valve, and possibly also a high amount of liquid out of the evaporator. This can happen if the evaporator has a high degree of maldistribution.

If the Setpoint Optimization fails, the process will restart as soon as possible.

8.4 Setting up NeoCharge in the EKE 450

The following parameters are related to setting up NeoCharge control:

Label	Name	Description	Details
L04	Enable NC ext	Enable NeoCharge control using external signal	Allows you to switch between normal superheat control and NeoCharge control based on a signal from a digital input or Modbus. This can for example be used in WDX control to switch to normal superheat control based on the signal from a high-level switch placed in the suction accumulator and then switch back to WDX control based on the signal from a low-level switch also installed in the suction accumulator: 
L06	NC enable	Enable NeoCharge control via Modbus. ON: NeoCharge control. OFF: DX control	If L04 is "by Modbus" and this parameter is set to On, then NeoCharge control is enabled – else controller is running DX control with a fixed superheat (see L2E parameter below). If this parameter is set to On, then it needs to be set at least every 15 minutes, else controller switches to DX mode automatically.
L2F	Forced DX ctrl.	Force DX control when running WDX or CCR.	Is selected then system will shift to standard DX control until parameter is set Off.
L2E	SH SP DX	Superheat setpoint for forced DX mode (by Modbus, DI, DX startup, or L2F parameter)	The superheat setpoint to be used when the controller is forced into DX mode – either when parameter L04 is "by Modbus" or "by DI" and DX mode is enabled, when DX startup is selected (see below) or when parameter L2F is set (see below)
L08	Num Def SPOpt	Number of defrosts between automatic Setpoint Optimization	This parameter can be used to restart the Setpoint Optimization process after every N number of defrosts. The process that will run will start with the already found power setpoint for the NeoCharge sensor, so the process will be slightly faster than the initial process. If L08 is set equal to zero, the Setpoint Optimization will not be initiated automatically after a defrost has ended.
L27	SPOpt by DI	Enable automatic setpoint optimization by Digital Input	If selected, then the setpoint optimization process can be started by setting a digital input.
L28	SPOpt start	Start automatic setpoint optimization	If selected – either on controller or from Modbus – then the setpoint optimization process will be started. The parameter will automatically be reset to false.
L34	SPOpt after MS on	Start setpoint optimization when main switch is turned On	Select between • Always • Use stored values (if no stored values are available then setpoint optimization will run) • Never, start manually or by digital input. If this is selected, you need to start setpoint optimization wither via a digital input (see parameter L27) or via Modbus (see parameter L28) If "Use stored values" is selected (and a successful setpoint optimization has been completed), then existing setpoints will be reused and a new setpoint optimization will not be initiated when main switch is turned on.
Advanced parameters			
L07	Wetness level	Wetness level	This parameter can be used to fine-tune the amount of liquid coming out of the evaporator after the Setpoint Optimization process has ended. The higher the value, the more liquid. It is recommended to leave this parameter at the default value.
L09	AKV period CCR	AKV or AKVA period time for CCR control	Only for CCR control. It defines the cycle time for a PWM (pulse width modulated) valve when used as a control valve in a CCR system. Default is 9 sec. The cycle time for a PWM valve in a WDX system is defined by the standard DX control parameters (see parameter N17).

8.5 NeoCharge DX startup

The NeoCharge DX startup function allows the controller to run standard DX controller with a fixed superheat (see parameter L2E) for a certain duration ended by either time or temperature. After the DX startup, the controller will start NeoCharge control – either going into setpoint optimization or using stored setpoints if enabled (see parameter L34).

The NeoCharge DX startup function can be useful if the startup of the system involves cooling down of products from a high temperature or if the evaporation temperature of the system varies more than approximately 5 to 8 K during startup.

The following parameters are related to setting up the NeoCharge DX startup function:

Label	Name	Description	Details
L30	NC DX startup	Run DX from Main switch On until NeoCharge startup	Select between: • Never • At first main switch On (or no setpoints found yet) • At every main switch On
L31	NC DX end	End NeoCharge DX startup process	Select between: • By time • By air temperature • By evaporation temperature
L32	NC DX end time	End time	If L31 is "By time" then enter the duration of the NeoCharge DX startup period in minutes
L33	NC DX end temp.	End temperature	If L31 is by one of the temperatures, then enter the limit temperature. When the temperature gets below this limit, the NeoCharge DX startup process stops.

8.6 NeoCharge IO definition

The following IOs might also need to be connected, depending on parameter settings:

IO	Type	Description	Details
Start SPOpt.	DI	Start setpoint optimization	See parameter L27 above
NC enable	DI	Enable WDX	If set to On, then the system is allowed to enter NeoCharge control mode. If set to Off, then the system will run in DX mode. See also parameter L04, "Enable NC ext", above.

See also chapter 6 for additional IOs related to valves used for NeoCharge.

8.7 NeoCharge connection diagram

Connections, upper level of EKE 450 **Connections, lower level of EKE 450**

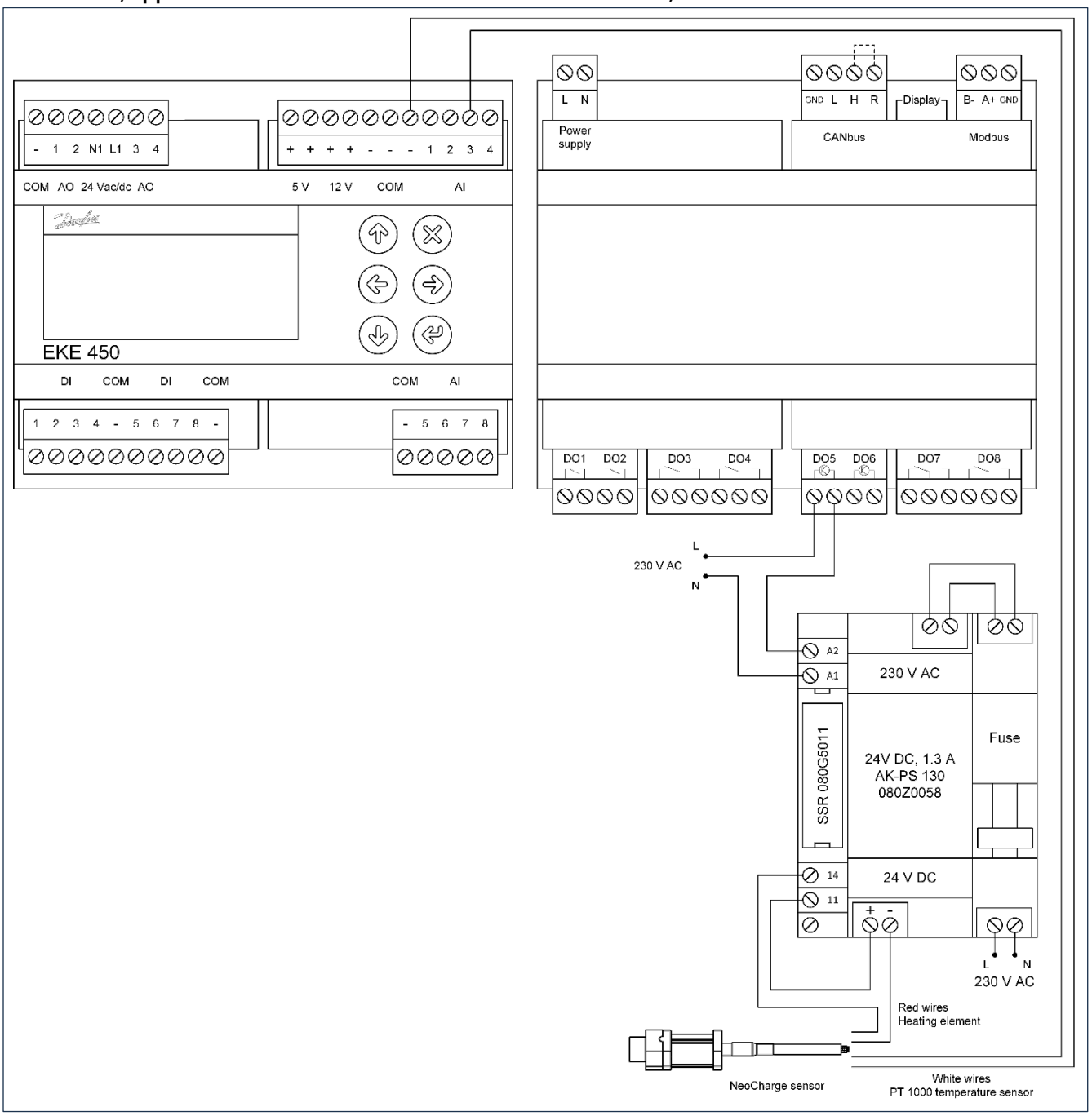


Figure 7. Electrical connection diagram for the NeoCharge solution

IMPORTANT: Always use the NeoCharge Solid State Relay supplied with the NeoCharge solution between the EKE 450 and the NeoCharge sensor as shown in Figure 7. The NeoCharge Solid State Relay has a built-in leakage current suppression circuit, which stops the relay from switching to “On” position due to the leakage current from the solid-state relay internally in the EKE 450. Using a relay without leakage current suppression circuit can leave the NeoCharge sensor heating element with continuous power regardless of the signal from the EKE 450.

Configuring the EKE 450 and the input signals for NeoCharge control can be done through the built-in display or an external display (HMI), but the easiest way to configure the EKE 450 is to use the Danfoss CoolConfig PC application.

9 Thermostat control

The EKE 400/450 includes three different methods for controlling air temperature:

1. On/off thermostat control (for all applications)
2. Modulating thermostat control (DX applications only)
3. PWM liquid control (flooded evaporator applications only)

For details on PWM liquid control and modulating thermostat see chapters 10 and 11.

9.1 Thermostat On/Off control

Thermostat On/Off control is normally used to control a solenoid valve in the liquid line to start/stop flow of refrigerant to the evaporator depending on an air temperature setpoint and a neutral zone:

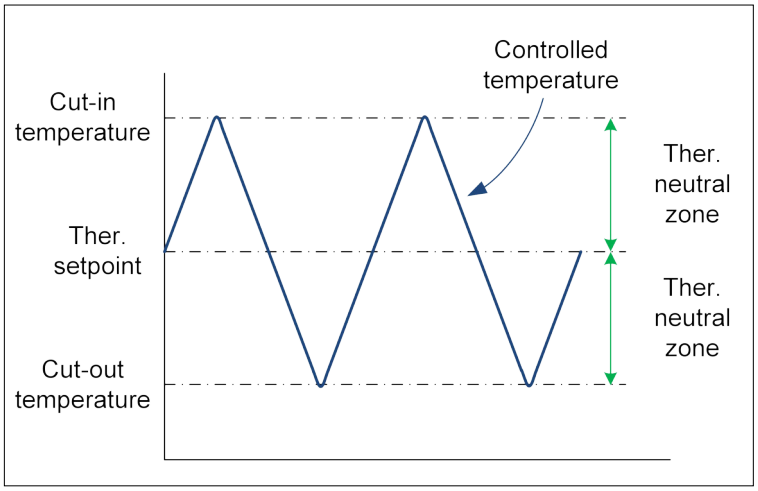


Figure 8. Thermostat On/Off control

The EKE 400/450 supports two types of On/Off thermostat modes:

1. **Individual On/Off**. In this mode each controller has its own thermostat settings, and each controller works independently of other controllers
2. **Common On/Off**. In this mode the thermostat is controlled by the primary controller in a controller group. When the main controller switch On or Off, all other controllers in that group will switch On or Off. See chapter 16 on how to define controller groups and which controller will be primary in a group.

The following parameters are used to define an On/Off thermostat:

Label	Name	Description	Details
T1A	Ther. mode	Thermostat control mode, flooded evaporator	None, Individual and Common On/Off supported
T1B	Ther. mode	Thermostat control mode, DX control	None, Individual and Common On/Off supported
T1C	Ther. mode	Thermostat control mode, evaporation pressure control by pressure	None, Individual and Common On/Off supported (pressure control mode will be covered later)
T1D	Ther. mode	Thermostat control mode, evaporation pressure control by temperature	Only None or Individual On/Off supported (pressure control mode will be covered later)
T1E	Ther. mode	Thermostat control mode, WDX or CCR	None, Individual and Common On/Off supported
T04	Ther. setpoint	Thermostat setpoint	The setpoint in °C or °F for the air temperature
T05	Ther. neutral zone	Thermostat neutral zone	Neutral zone temperature difference in K or °F. Actual cut-in = setpoint + neutral zone. Actual cut-out = setpoint - neutral zone
T02	No. of ther. sensor	Number of thermostat sensors	Up to three sensors are supported
T03	Ctrl temp. method	Calculation of control temperature for thermostat	Only available if more than one sensor is selected. You can then select if the control temperature should be the average of all sensors or the maximum value

If needed, you can define a night-setback temperature difference of the thermostat setpoint (note that similar functionality can be defined using the External reference functionality – see chapter 17).

Night setback parameters:

Label	Name	Description	Details
T06	Day/night control	Allow manual (or via network) control of Day/Night	Set this parameter to allow for day/night control
T07	Night operation	Night operation	Set this parameter to true to start night mode. Set it to false to end night mode. Setting the parameter can be done manually in the display, via Modbus or using CoolConfig
T08	Night offset	Night offset	The offset (temperature difference) to add to the thermostat setpoint when in night mode

9.2 Air temperature alarm function

A temperature alarm can be setup for the measured air temperature. The following parameters are available:

Label	Name	Description	Details
B01	Air temp. alarm	Air temperature alarm function	Select between: "None", "Separate sensor", "Thermostat temp" Note that if "Thermostat temp" is selected (default), then an analog input for will be reserved for a temperature sensor – even if thermostat control is set to "None". If separate sensor is selected, another analog input will be reserved for an air temperature sensor.
B02	High alarm limit	Upper alarm limit for the room temperature alarm function	
B03	Low alarm limit	Lower alarm limit for the room temperature alarm function	
B04	Alarm delay	Alarm delay time during normal control used for both high- and low temperature alarms	Alarm delay in minutes

9.3 Product temperature alarm function

A temperature alarm can be setup for a separate product temperature sensor. The following parameters are available:

Label	Name	Description	Details
B05	Product alarm function	Product temperature alarm	If "Yes", then a product temperature sensor needs to be connected to an analog input
B06	Prod. high alarm limit	Upper alarm limit for the product temperature alarm	
B07	Prod. low alarm limit	Lower alarm limit for the product temperature alarm	
B08	Prod. alarm delay	Alarm delay time for the product temperature alarm	Alarm delay in minutes

9.4 Thermostat IO definition

IO	Type	Description	Details
Ther. air	AI	Air temperature sensor	Can be positioned on any of the 8 analog inputs. This parameter will be visible if at least one temperature sensor has been selected or if the room temperature alarm function (B01) refers to "Thermostat temperature".
Ther. air 2	AI	Air temperature sensor	Available if 2 temperature sensors are selected (see parameter T02)
Ther. air 3	AI	Air temperature sensor	Available if 3 temperature sensors are selected (see parameter T02)
Air temp. alarm	AI	Air temperature alarm sensor	Available if parameter B01 (see above) is set to "Separate sensor"
Product temp.	AI	Product temperature alarm sensor	Available if parameter B05 is "Yes"

10 Flooded evaporator control mode

Flooded evaporator control mode can control valves (typically solenoids) and thermostat (air temperature) for a flooded evaporator in a standard pump circulation system:

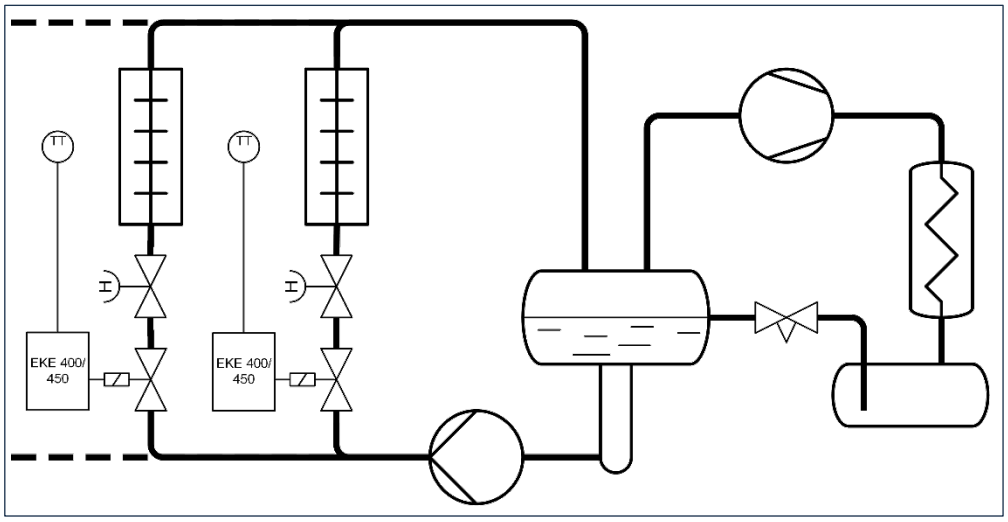


Figure 9. Standard pump circulation system with On/Off thermostat control

10.1 PWM liquid control

In Pulse Width Modulating (PWM) liquid control mode, the solenoid valve in the liquid line is used to pulse liquid injection to the flooded evaporator using the thermostat setpoint as reference.

Note that PWM liquid control requires at least one Danfoss AKV/AKVA PWM valve in the liquid feed line.

Parameters specific to PWM liquid control

Label	Name	Description	Details
T10	Pwm mod.period	Period for PWM liquid control	Period time for the AKV/AKVA valve used in the liquid feed line
T11	Pwm Max OD	Max OD for PWM valve	Maximum opening degree of the AKV/AKVA valve. Can be used to limit the amount of liquid into the evaporator (often there is a limit to the capacity of a flooded evaporator so that adding more liquid will not increase capacity, but only circulation rate)
T12	Pwm Min OD	Min OD for PWM valve	Minimum opening degree of the AKV/AKVA valve
T13	Pwm Kp	Proportional gain for PWM liquid control	Proportional gain of the PI-controller used to adjust the opening degree of the AKV/AKVA based on the difference in measured air temperature and wanted thermostat setpoint.
T14	Pwm Tn	Integration time for PWM liquid control	Integration time of the PI-controller used to adjust the opening degree of the AKV/AKVA based on the difference in measured air temperature and wanted thermostat setpoint.
T15	Desynch. Pwm	Desynchronization of PWM duty to avoid simultaneousness with other control	If selected, then the controller shifts the starting time of the valve period time based on the controller Modbus address. This will avoid synchronous start of all AKV/AKVA valves in a system with many evaporators.

The parameters for On/Off thermostat (including night setback) will also be available for flooded evaporator control even if PWM liquid control is selected, but the thermostat setpoint and the neutral zone will be used to control the PWM valve.

11 Direct expansion evaporator control mode

In direct expansion (DX) evaporator control mode, the EKE 400/450 can control injection valve according to a superheat signal:

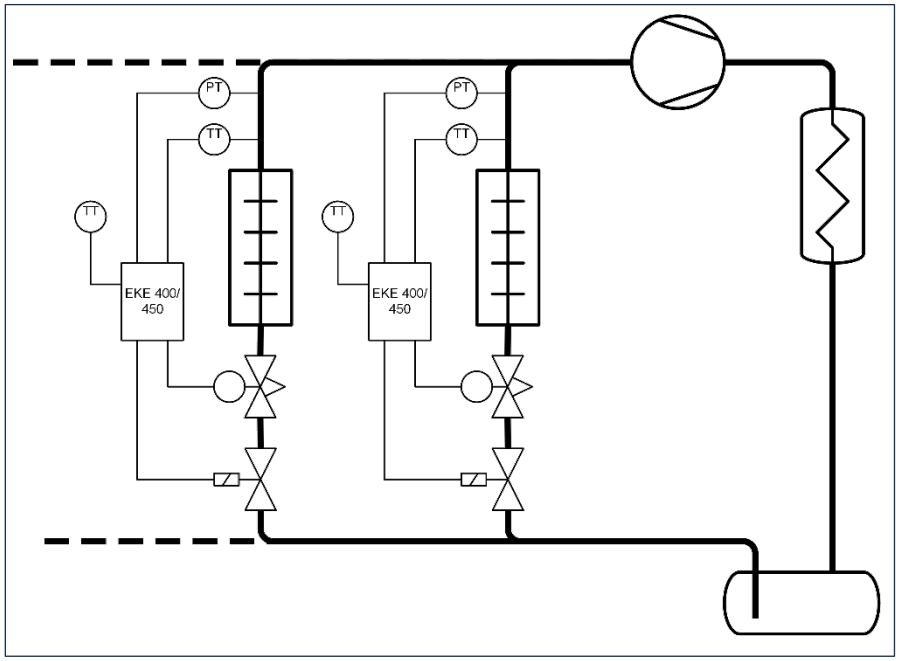


Figure 10. Direct expansion system with superheat control and On/Off thermostat

11.1 Modulating Thermostat (DX systems only)

In modulating thermostat mode, the injection to the evaporator is controlled so that the air temperature is kept close to a given setpoint. If the measured superheat gets below a threshold value, the controller automatically switch to superheat control, and when possible, the controller switch back to modulating thermostat control.

Important: Modulating thermostat is not recommended on systems with one evaporator.

When using modulating thermostat, the evaporator will in part load situations be starved – i.e., the amount of gas in the evaporator outlet will be high and the load on the evaporator will not be evenly distributed. But compared to On/Off thermostat, the evaporator will still be running, and the temperature control will be more precise.

Due to the uneven load on the evaporator in part load situations, using modulating thermostat on low temperature applications is generally not recommended. The uneven load distribution will typically lead to uneven frost formation, which can make defrosting difficult.

Parameters specific to modulating thermostat:

Label	Name	Description	Details
N36	S3 air in.temp.AI?	Air temperature sensor (S3) installed?	If yes, then an air inlet temperature (S3) sensor is installed, and this temperature is used as reference for the modulating thermostat. If no, then the thermostat setpoint temperature (T04) is used as reference for the modulating thermostat control.
Advanced parameters			
N15	MTR Tn	Integration time for the MTR algorithm	Integration time of the PI controller used to control the expansion valve according to room temperature
N16	MTR Kp	Proportional gain for the MTR algorithm	Proportional gain of the PI controller used to control the expansion valve according to room temperature

The parameters for On/Off thermostat (including night setback) will also be available if modulating thermostat is selected, but the thermostat setpoint and the neutral zone will be used to control the opening of the expansion valve.

If "N36, S3 air in.temp.AI?" id defined, then the following analog input is added to the IO's:

IO	Type	Description	Details
S3 air inlet temp.	AI	Air inlet temperature sensor	Analog input. Any of the 8 AI's can be used

11.2 Superheat control

The superheat control algorithm in the EKE 400/450 is a PI controller with advanced adjustments that will assist in controlling evaporators in DX refrigeration systems in a stable manner.

The superheat control algorithm has a dedicated startup control mode, which is used to fill the evaporator efficiently after for example a thermostat cut-out.

After the startup mode, the EKE 400/450 supports the following methods for setting the reference for the superheat control algorithm:

1. Fixed superheat reference
2. Load defined control
3. Adaptive superheat control

The startup mode and the 3 different superheat reference modes are explained in detail below, but there are a couple of common parameters when using superheat control:

Label	Name	Description	Details
N09	SH close function	Superheat close function	Close the expansion valve completely if superheat gets below a given value
N10	SH close setpoint	Superheat close limit. The valve is forced to close below this superheat value	The minimum superheat when expansion valve is closed in N09 is true.
N11	SH close Tn divide	Division factor on integration time for PI controller closing valve at low superheat (increase value to decrease integration time and close valve faster)	If N09 is selected, then a separate and more aggressive PI controller (based on the standard superheat PI controller) is used when the superheat is close to the value specified in N10. The N11 and N12 parameters are used to modify the integration time and gain inherited from the standard PI controller so that the "superheat close PI controller" becomes more aggressive (reacts faster) than the standard PI controller.
N12	SH close Kp factor	Factor on proportional gain for PI controller closing valve at low superheat (increase value to increase gain and close valve faster)	
Maximum operating pressure limit			
N13	MOP function	Maximum Operating Pressure	If selected, then the valve will start to close if the evaporation pressure is above the defined setpoint. MOP is typically used to prevent overloading the compressor motor during startup.
N14	MOP setpoint	Maximum Operating Pressure setpoint	Setpoint for the MOP function
N26	MOP Kp	MOP Kp	Proportional gain of controller when managing MOP
N27	MOP Tn	MOP Tn	Integration time of controller when managing MOP
Expansion valve settings			
N17	AKV period	AKV or AKVA period is seconds	The period for a pulse width modulated expansion valve. Within this period, the valve both opens and closes. 40% opening degree for example means that the valve is open 40 % of the period time and closed the rest.
N24	Minimum OD	Minimum Opening Degree	Minimum opening degree of the expansion valve. Default is 0 %, but this can be changed if needed.
N25	Maximum OD	Maximum Opening Degree	Maximum opening degree of the expansion valve. Default is 100 %, but this can be changed if needed. Can be used to limit the opening degree of an oversized expansion valve.

The PI controller controlling the superheat according to the selected reference mode has the following parameters:

Label	Name	Description	Details
N05	SH Tn	Superheat controller integration time	Superheat controller integration time. If the integration time is increased the regulation becomes slower. Lowering the integration time will create a faster superheat control. Too low value will create superheat fluctuation.
N06	SH Kp damp	Damping of gain near superheat setpoint	Damping of gain when superheat is near the wanted reference value. This setting damps the normal gain (N07, SH Kp), but only just around the reference value. A setting of 0.5 will reduce the gain to half of the defined value in N07.
N07	SH Kp	Superheat controller proportional gain	Superheat controller proportional gain. If the gain is reduced the regulation becomes slower. If the gain is increased the regulation becomes faster. Too high value will create superheat fluctuation
N08	SH KpTe	Suction pressure feedback gain	Suction pressure (temperature) feedback gain to the PI controller

11.2.1 Startup mode

Startup mode allows the controller to open the expansion valve faster at startup – for example after a thermostat cut-in, a finished defrost or when Main switch is turned On. This can be useful if the compressor pulls down the suction pressure faster than desired at startup (especially relevant in systems with few evaporators).

The startup mode parameter has the following options:

Label	Name	Description	Details
N20	Startup mode	Startup mode	Can be: Proportional control Fixed OD with protection Fixed OD without protection The different modes are explained below

11.2.1.1 Proportional control

The proportional control function can be used to quickly get close to the system's superheat reference. The controller is programmed for auto-proportional control that will quickly change the opening degree based on evaporating temperature and the superheat of the system.

Parameters for proportional control:

Label	Name	Description	Details
N23	Startup OD	Startup opening degree	Initial opening degree of the expansion valve
N21	Startup time	Startup time	Maximum time to use in startup mode
N22	Min. startup time	Minimum startup time	Minimum amount of time controller at least must spend in startup mode

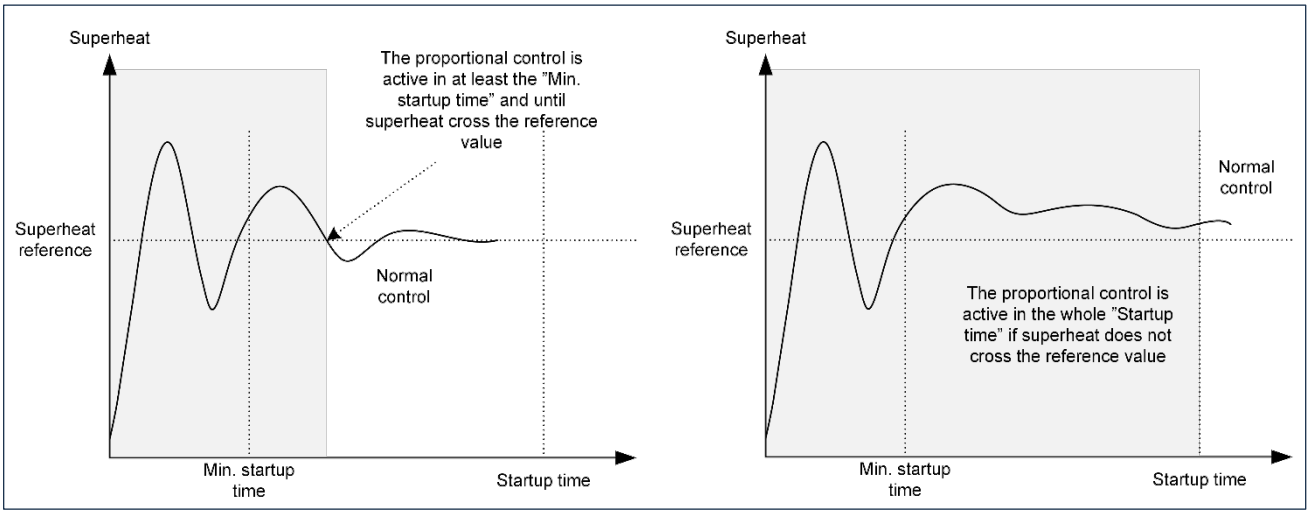


Figure 11. Proportional startup mode. Illustration of startup time settings

11.2.1.2 Fixed opening degree with and without protection

After startup (for example after cut-in of the thermostat), this function will provide an initial opening degree during a defined period.

If "fixed opening degree with protection" is defined and any of the superheat control limits (MOP, SH close function) are defined, then the controller will set the opening degree of the valve based on the fixed opening degree value and the set limits, where the limits will override the fixed opening degree:

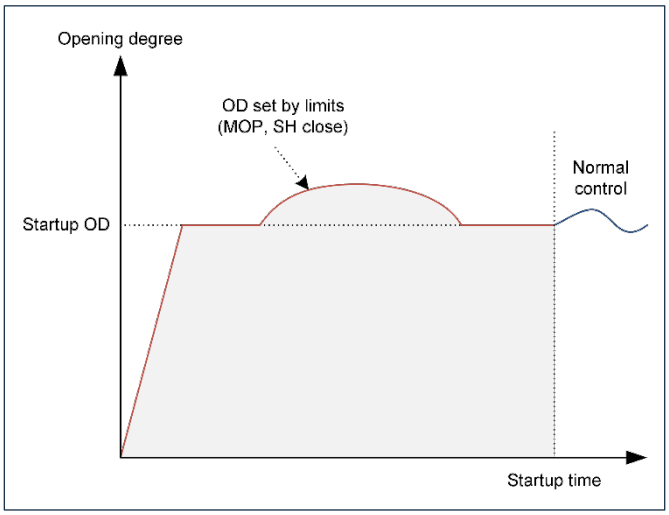


Figure 12. Fixed opening degree startup mode with protection

If "fixed opening degree without protection" is defined, then the specified valve opening degree will be set regardless of any limits:

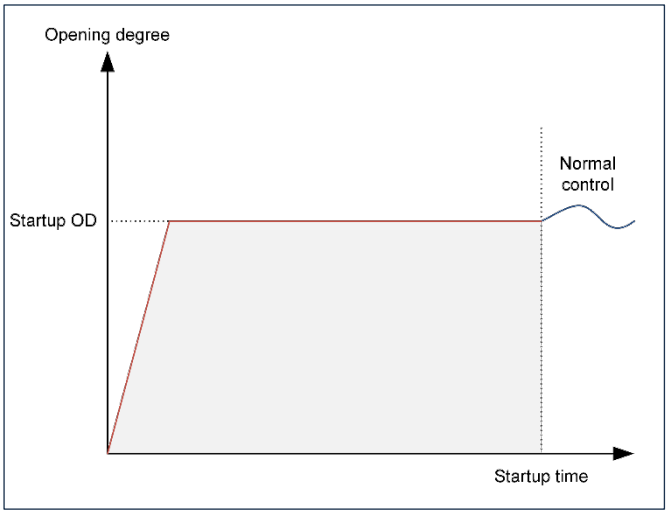


Figure 13. Fixed opening degree startup mode without protection

Parameters for fixed opening with or without protection:

Label	Name	Description	Details
N23	Startup OD	Startup opening degree	The fixed opening degree to use during startup
N21	Startup time	Startup time	Maximum time to use in startup mode

11.2.2 Superheat reference mode

The three different superheat reference modes are illustrated below:

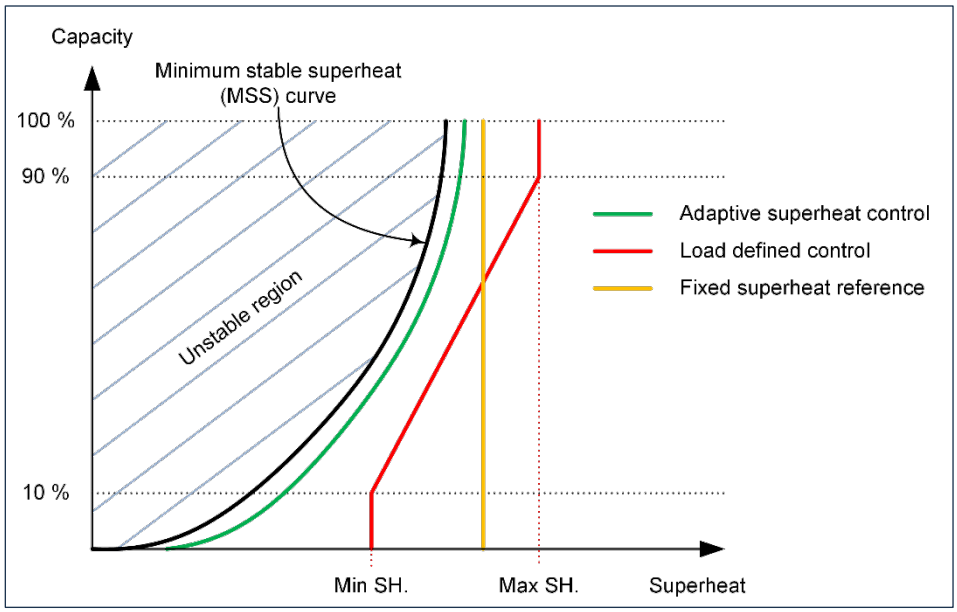


Figure 14. Superheat reference modes

Selection of the wanted reference mode is done using the parameter:

Label	Name	Description	Details
N01	SH ref. mode	Superheat reference mode	This parameter is used to select which of the 3 reference modes you want to use.

11.2.2.1 Fixed superheat reference

The “Fixed superheat reference” mode will just keep a preset and fixed reference for the superheat control. The fixed superheat control can be used in systems with stable operating conditions.

The superheat setpoint is defined using the parameter:

Label	Name	Description	Details
N02	SH Fixed setpoint	Superheat fixed setpoint	Fixed setpoint for the superheat control if “Fixed superheat reference” method is used

11.2.2.2 Load defined control

The “Load defined control” will adjust the superheat reference to be higher if the load is higher. The load is indicated by the opening degree of the expansion valve.

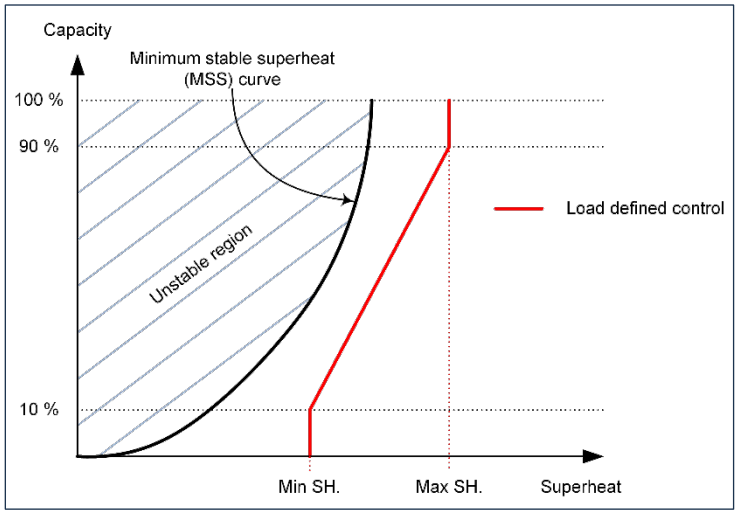


Figure 15. Load defined control of superheat reference

“Load defined control” can be seen as a preprogrammed MSS curve, defined by the minimum superheat, the maximum superheat, and 90 % opening degree, and 10% opening degree of the expansion valve as illustrated in Figure 15.

“Load defined control” will give a robust superheat reference and can in many cases be the best fit for a given system.

The parameters used to setup “Load defined control” are:

Label	Name	Description	Details
N03	SH max	Superheat maximum	Maximum allowed superheat setpoint.
N04	SH min	Superheat minimum	Minimum allowed superheat setpoint.

11.2.2.3 Adaptive superheat control

The “adaptive superheat control” will continuously try to optimize the superheat reference so that the system always will run with the minimum possible superheat. Figure 16 shows an illustration of the principle:

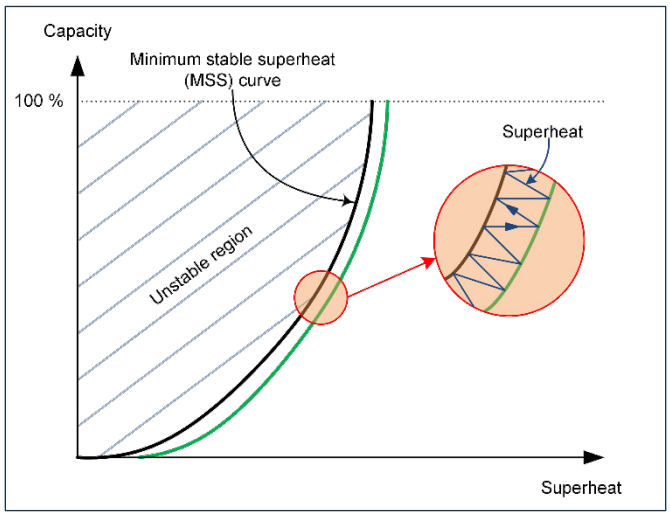


Figure 16. Adaptive superheat control

"Adaptive superheat control" is a benefit for systems with a long runtime and slow changing conditions like cold rooms, display cases and chillers. Short cycling times and system with fast changing operation condition will not benefit from "adaptive superheat control" as this feature will take time to find the optimal reference. Adaption to a new set point is approximately 15 minutes.

The "Adaptive superheat control" is configured by the following parameters:

Label	Name	Description	Details
N03	SH max	Superheat maximum	Maximum allowed superheat setpoint. Used to limit the setpoint found by adaptive algorithm.
N04	SH min	Superheat minimum	Minimum allowed superheat setpoint. Used to limit the setpoint found by adaptive algorithm.
N18	MSS stability	Minimum Stable Superheat stability	Stability factor for regulation of superheat. With a higher value the control function will allow a greater fluctuation of the superheat before the reference is changed.
N19	MSS T0 stability factor	Minimum Stable Superheat stability T0 factor	Evaporation temperature stability factor. Defines if a variation in suction pressure will influence the superheat reference or if the reference is only influenced by variation in suction temperature, S2. The evaporation temperature stability factor can be adjusted between 0 and 1: 0 = Superheat reference only influenced by S2 temperature 1 = Maximum evaporation temperature, T0, influence. In systems with frequent changes in suction pressure due to compressor start/stop, some T0 (and S2) influence on MSS stability is recommended. Default value is 0.

12 Evaporation pressure control

Evaporation pressure control is available if the evaporator control mode is either “Flooded evaporator On/Off control” or “DX control”.

Evaporation pressure control can be used to control a valve placed in the wet return line (flooded evaporator) or the suction line (DX systems) according to either a wanted evaporation pressure or a wanted room temperature:

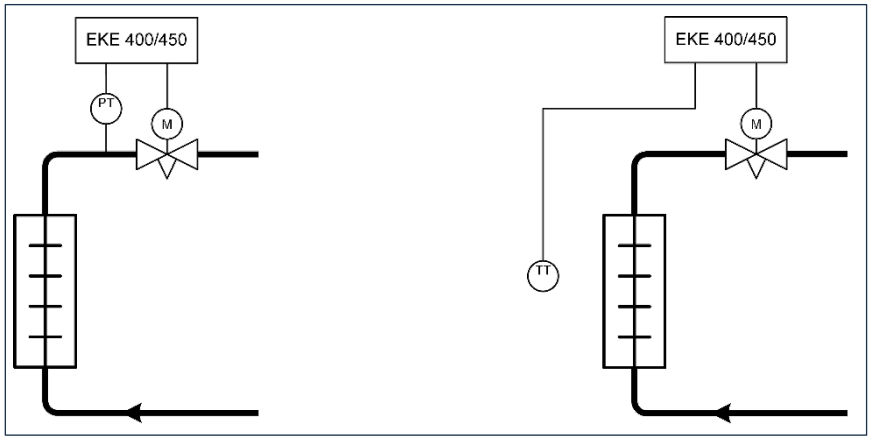


Figure 17. Evaporation pressure control - by pressure (left) or by room temperature (right)

Parameters used to configure the evaporation pressure control

Label	Name	Description	Details
T17	Evap.Pres. SP To	Evaporation Pressure Setpoint	Setpoint for evaporation pressure control if pressure is controlled “by pressure”. If evaporation pressure is controlled by “Room temperature”, then the thermostat setpoint parameter (T04) is used as setpoint.
T24	Limit LL	Closing LL when OD of WR/SL valve is below OD Limit LL	Close the valve in the liquid line (LL) when the opening degree of the evaporation pressure control valve is below limit defined in T25.
T25	OD Limit LL	Limit in percentage	Opening degree limit of evaporation pressure control valve.
T18	Evap.Pres. Kp	Proportional gain	Parameters for the PID controller used to control evaporation pressure.
T19	Evap.Pres. Tn	Integration time	
T20	Evap.Pres. Td	Derivative time	
T21	Evap.Pres. mode	Evaporation pressure control mode	Can take one of the following values: • Normal. • Min. underswing • No underswing

The different values of the T21, Evaporation pressure control mode, parameter are used to adapt the PID algorithm so that the dynamic behaviour of the controller can be optimized:

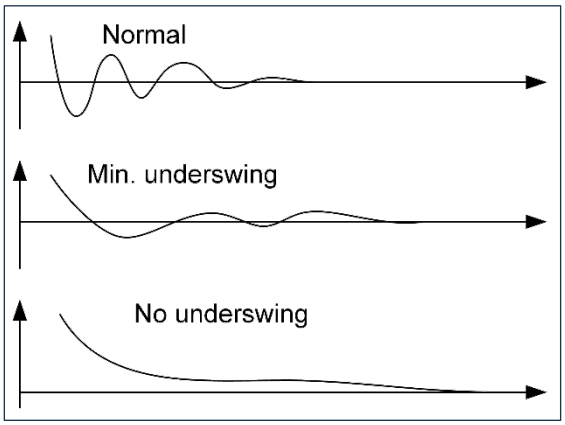


Figure 18. PID parameters for controlling underswing

The state of the selected control valve when cooling is stopped can changed by the following parameter:

Label	Name	Description	Details
D3D	State at Cool. stopped	Status of control valve when cooling is stopped	Position of control valve when cooling is stopped: • Closed • Open • User defined

If Mod (ICM) is selected as valve for controlling evaporation pressure, the following parameters are available:

Label	Name	Description	Details
D20	EPC ICM OD min	Min OD for ICM in Evaporation pressure control	Minimum opening degree of the ICM valve
D21	EPC ICM OD max	Max OD for ICM in Evaporation pressure control	Maximum opening degree of the ICM valve
D3G	ICMsafe OD at stop	ICM opening degree when cooling is stopped	If evaporation pressure control mode is "Room temperature" and D3D is "User defined", then you can specify a custom opening degree for the ICM valve when cooling is stopped.
D3F	Suc.Pres.SP T at stop	Saturation temperature setpoint when cooling is stopped	If evaporation pressure control mode is "Pressure" and D3D is "User defined", then you can specify a custom saturation temperature setpoint for the ICM valve when cooling is stopped.

If Mod (CVE) is selected as valve for controlling evaporation pressure, the following parameters are available:

Label	Name	Description	Details
D22	EPC CVE OD min	Min opening degree of CVE valve	Minimum opening degree of the CVE valve
D23	EPC CVE OD max	Max opening degree of CVE valve	Maximum opening degree of the ICM valve
D3E	CVEsafe OD at stop	CVE opening degree when cooling stopped	If D3D is "User defined", then you can specify a custom opening degree for the CVE valve when cooling is stopped.

13 Fan control

The EKE 400/450 can be used to control the fan(s) on the evaporator using one of the following methods. The fan is controlled during cooling on/off periods by the thermostat settings or by an external signal. Fan control during defrost is managed by the defrost sequence.

Control method	Description
No control	Fan is not controlled by EKE 400/EKE 450.
On-Off control (1 DO)	Fan is On/Off controlled following the thermostat (and cooling On/Off) and defrost settings / sequence. 1 digital output will be reserved for this.
On control (1 DO)	Fan is On even when cooling is stopped.

Two step control (2 DO)	Fans are controlled using 2 digital outputs:
	If cooling is On (controlled by thermostat or external signal) then
	• DO 1 = On
	• DO 2 = Off
	If cooling is Off (controlled by thermostat or external signal) then
	• DO 1 = On
	• DO 2 = On

0-10V EC fan ctrl (1 AO)	EC fan control. Using one analog 0 – 10 V output. See also parameters "F02, Fan speed high" and "F03,Fan speed low". The meaning of the 2 parameters for EC fan control are explained below
0-10V EC fan ctrl+DO (1 AO + 1 DO)	EC fan control. Using one analog 0 – 10 V output and one digital output. In addition to EC fan control, the digital output must be ON for the fan to run and OFF for the fan to stop.
0-10V VFD variable (1 AO)	Variable speed fan control using a frequency converter. Using one analog 0 – 10 V output. See also parameters "F02, Fan speed high", "F03, Fan speed low", "F04, Offset speed low", and "F05, Offset speed high". The meaning of the 4 parameters for VFD variable speed fan control are explained below
0-10V VFD var.+DO (1 AO + 1 DO)	Variable speed fan control. Using one analog 0 – 10 V output and one digital output. In addition to variable speed fan control, the digital output must be ON for the fan to run and OFF for the fan to stop.
On-Off ctrl cycling	During cooling OFF, Fan switches between ON and OFF, defined by parameter "F06, Cycling OFF time" and "F07, Cycling ON time". Used when air circulation is required during OFF periods of the thermostat.

The following parameters are used to control the fan(s):

Label	Name	Description	Details
F12	Cont. fan after cutout	Use fan cutout delay in On-Off control	Delay fan cut-out when cooling is off. Only available for On-Off control of the fan.
F13	Fan cutout delay	Cutout delay	The cut-out delay if F12 is set.
F02	Fan speed high	Fan speed high	High speed of fan in percent. Enabled if control mode is EC or variable speed fan.
F03	Fan speed low	Fan speed low	Low speed of fan in percent Enabled if control mode is EC or variable speed fan.
F04	Offset speed low	Offset speed low	Offset from thermostat setpoint in [K] where fan speed is low. Enabled if control mode is variable speed fan.
F05	Offset speed high	Offset speed high	Offset from thermostat setpoint in [K] where fan speed is high. Enabled if control mode is variable speed fan.
F06	Cycling OFF time	Cycling OFF time	Off time when "On-Off ctrl cycling" is selected as fan control mode
F07	Cycling ON time	Cycling ON time	On time when "On-Off ctrl cycling" is selected as fan control mode
F08	Fan on when DI forced closed	Set whether fan should be on when forced closed from DI or master control	Define state of fan if Forced closing is set by a digital input or master control (see also parameter R08 in chapter 7.3)

13.1 EC fan control

When EC fan control is selected, then the fan is controlled the following way:

- When cooling is Off (fan state is “off”), fan speed is set to “F03, Fan speed low”
- When cooling is On (fan state is “on”), fan speed is set to “F02, Fan speed high”
- When Main switch is off, fan is turned off.

13.2 VFD fan control

The fan speed is controlled as illustrated in Figure 19 below:

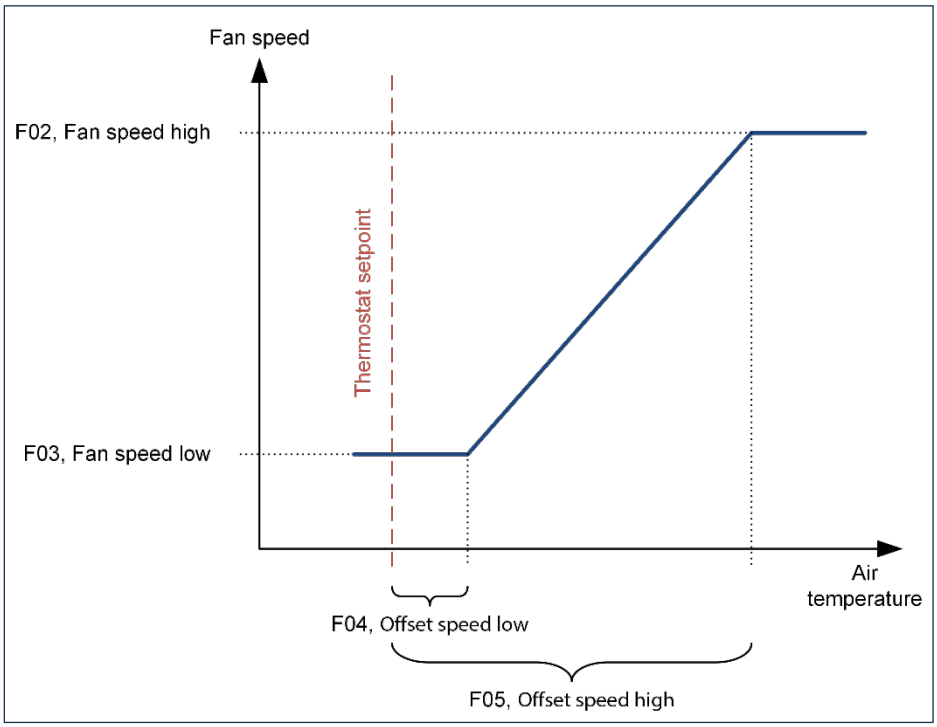


Figure 19. Fan speed control

If for example the following values are defined:

- Thermostat setpoint is -30 °C (parameter T04)
- F02, Fan speed high = 100%
- F03, Fan speed low = 60%
- F04, Offset speed low = 1 K
- F05, Offset speed high = 5 K

Then if air temperature is between -29 °C and -25 °C, the fan speed would be varied proportional from 60% to 100%.

14 Defrost control

The defrost control in the EKE 400/450 is providing a set of timing functions, which allows you to define opening and closing of valves so that the defrost in industrial sequence evaporators can be conducted in a safe manner.

The EKE 400/450 supports 3 different defrost methods:

1. Hot gas defrost, where hot refrigerant gas – typically from the compressor discharge – is used to defrost the evaporator.
2. Electrical or water defrost
    a. Electrical defrost, where the evaporator has built-in electrical heaters
    b. Water defrost where the evaporator has a separate pipe circuit for circulation of hot water/brine.
3. Externally controlled.

The Externally controlled is only relevant for NeoCharge control where the EKE 400/450 does not control defrost but relies on a defrost start and a defrost stop signal from the PLC controlling the defrost. The NeoCharge control algorithm uses the defrost start/stop to count the number of defrosts if the “L08, Number of defrosts between automatic setpoint optimization” is larger than 0. If L08 is 0, then setting Externally controlled defrost has no effect. If L08 is larger than 0, then two digital inputs (defrost start and defrost stop) are reserved and must be connected to the PLC.

See also chapter 6 for selection of defrost method and related valves.

14.1 Defrost sequence

The defrost sequence is a function of the valves that are installed in the system, as for example 2-step opening of hot gas in hot gas defrost line, and whether hot gas or electrical/water defrost is used.

The overall defrost schedule is illustrated below, where the opening and closing of valves in the different periods is shown:

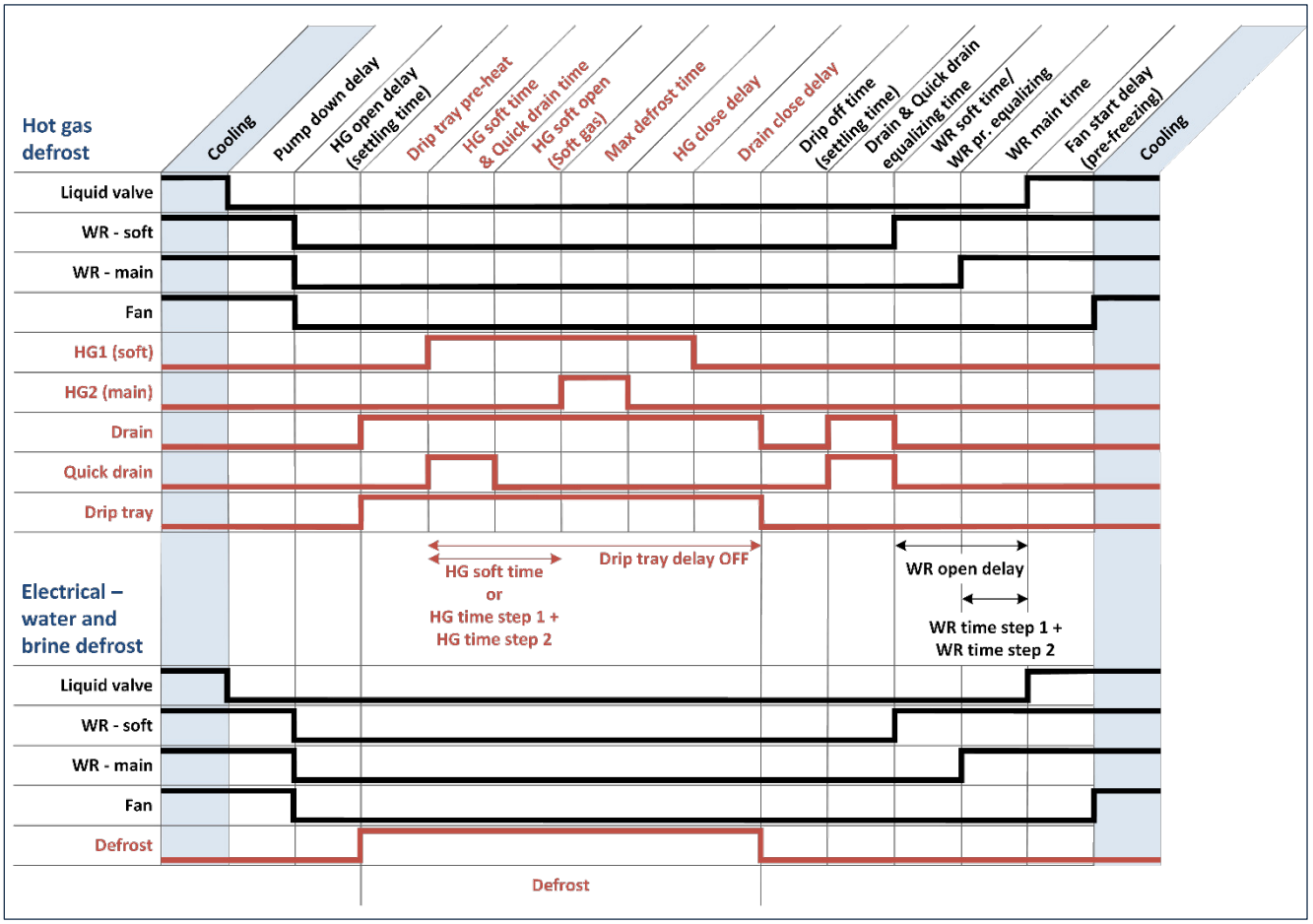


Figure 20. Defrost schedule. Liquid line and wet return/suction line valves in black. Hot gas inlet and drain valves in red

Besides the defrost schedule and the defrost method, the EKE 400/450 also contains methods for handling when to start a defrost and when to stop a defrost.

14.2 Defrost start

The start of a defrost can be controlled by the following methods:

- A fixed time interval – for example, the defrost will start every 4 hours
- After accumulated cooling time – for example, the defrost will start when there has been cooling for 4 hours. Note that periods where the thermostat has closed the cooling is not included when counting accumulated cooling time
- Defined by an external switch connected to a digital input (for example a signal from a PLC)
- Defined by a schedule. The EKE 400/450 supports 6 individual defrost start times for every day of the week.

Defrost start parameters:

Label	Name	Description	Details
D10	Man. def. start	Manual defrost start	Set this parameter to manually start a defrost. The parameter will automatically be reset after a certain time. Note that starting a defrost will start a sequence which will lock the controller state until it is safe to change it (for example by manually stopping a defrost).
D11	Def. time interval	Interval between defrost starts in hours (0 = function Off)	Set this to a value different from zero to start defrosts at a fixed time interval. This can be used as a fail-safe function to ensure a defrost is run at least at the defined interval. A defrost will be started when the timer exceeds the "Defrost time interval" setting. The timer is reset to zero when a defrost is started and the timer is disabled if Main switch is off.
D12	Def. start acc. cool time	Defrost start via accumulated cooling time. Acc. cooling time in hours between defrost starts (0 = function Off)	Set this to a value different from zero to start defrosts whenever the accumulated cooling time is larger than the defined number of hours. This can be used as a fail-safe function to ensure a defrost is run at least at the defined interval. The accumulated cooling time will be reset at each defrost.
D13	Time staggering	Defrost start time delay after power	If fixed time interval or fixed accumulated cooling time is selected, then you can use this parameter to ignore this interval for the specified number of hours after main switch is turned On.
D15	Def. start schedule	Defrost start by schedule	If selected, you can define up to 6 different defrost start times for every day of the week.
DA1…DA6	Def. Schedule Monday	Defrost start times for Monday	Define up to 6 different defrost start times for Monday.
DX1	Copy MONDAY to	Copy MONDAY schedules to another day or a weekday or all days	Allows you to copy the Monday schedule to other days.
DB1…DB6	Def. Schedule Tuesday	Defrost start times for Tuesday	Define up to 6 different defrost start times for Tuesday.
DC1…DC6	Def. Schedule Wednesday	Defrost start times for Wednesday	Define up to 6 different defrost start times for Wednesday.
DD1…DD6	Def. Schedule Thursday	Defrost start times for Thursday	Define up to 6 different defrost start times for Thursday.
DE1…DE6	Def. Schedule Friday	Defrost start times for Friday	Define up to 6 different defrost start times for Friday.
DF1…DF6	Def. Schedule Saturday	Defrost start times for Saturday	Define up to 6 different defrost start times for Saturday.
DG1…DG6	Def. Schedule Sunday	Defrost start times for Sunday	Define up to 6 different defrost start times for Sunday.

14.3 Defrost stop

The EKE 400/450 supports defrost stop either by time, a digital input or by temperature. The relevant parameters are:

Label	Name	Description	Details
D40	Defrost stop method	Defrost stop method	Values: • Stop on time. The defrost duration is entirely defined by the defrost schedule. • Stop on temperature. The defrost can stop early if the defrost temperature gets above value specified in D43. Defrost can maximum last for the duration specified in the "D58, Max defrost time" parameter. If the defrost exceeds the maximum defrost time, then an alarm is raised and the defrost is stopped. The alarm is automatically reset after 5 minutes. • Stop on 2 temperatures. The defrost will stop when both temperatures are above the value specified in D43. Defrost can maximum last for the duration specified in the "Max defrost time" parameter (D58). If the defrost exceeds the maximum defrost time, then an alarm is raised and the defrost is stopped. The alarm is automatically reset after 5 minutes. ○ If one of the sensors has an error, an alarm will be raised, and the remaining sensor will be used to stop the defrost.
D41	Man. defrost stop	Manual defrost stop	Set this parameter to manually stop a defrost. The parameter will automatically be reset after a certain time. Note that stopping a defrost will finish all defrost states after the "Max defrost time" state to end the defrost safely. When defrost is stopped this parameter will automatically be reset to "No"
D43	Def. stop temp. limit	Defrost stop temperature limit	If stop by temperature is selected, then define that temperature here. Also stop by temperature will allocate an analog input to a defrost stop temperature sensor.

14.4 Hot gas defrost

The parameters controlling the steps in a hot gas defrost sequence are explained below. Not all steps will be active depending on which valves are selected in the refrigeration system.

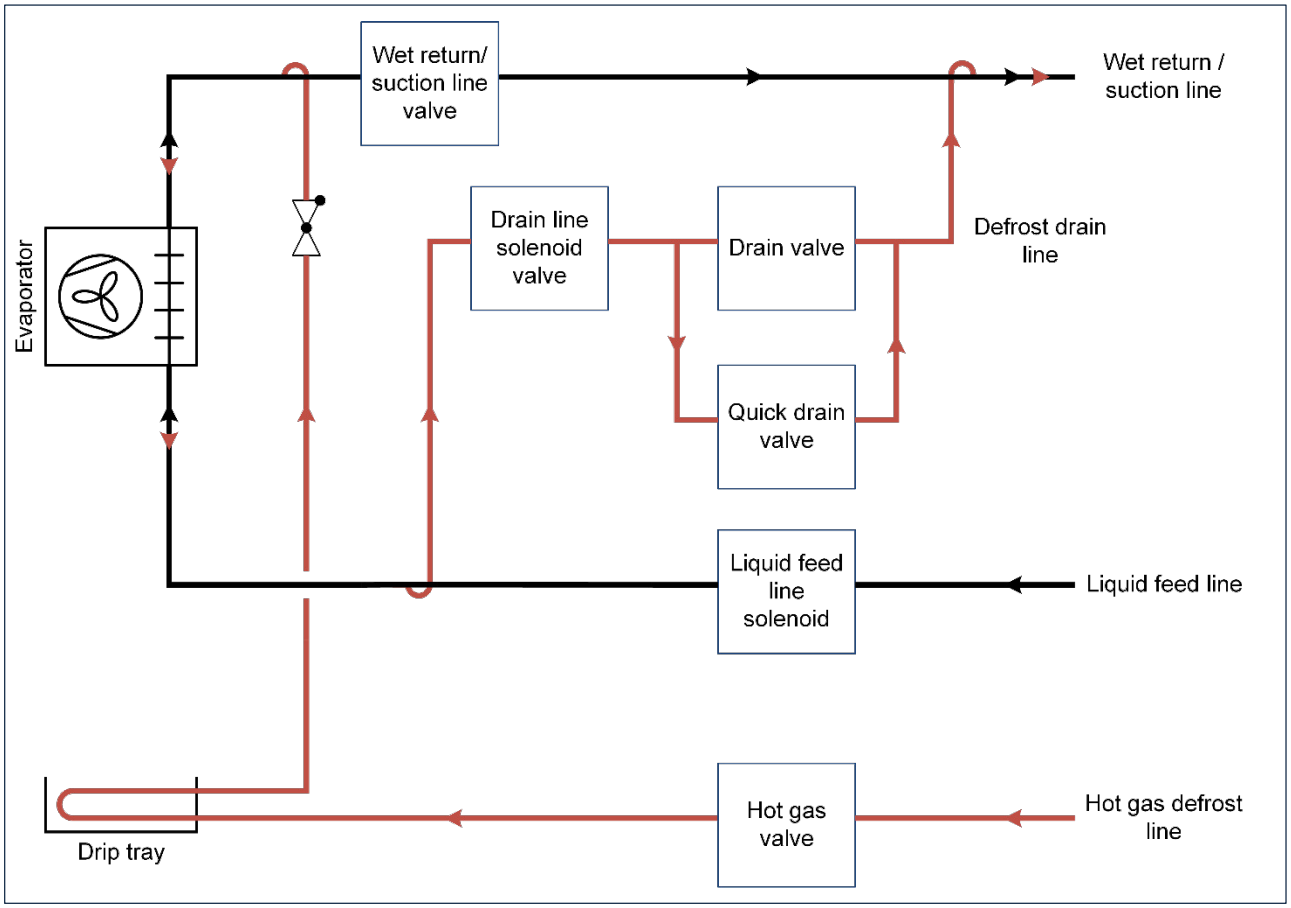


Figure 21. Principle hot gas defrost diagram

The type of valves indicated in the diagram in Figure 21 can be selected in the EKE 400/450 or by using CoolConfig.

The used valve types are typically:

- Hot gas defrost line: two-step solenoid requiring 2 digital outputs or slow opening solenoid requiring 1 analog output. Two-step or slow opening solenoids are used to ensure a controlled pressure equalization between the high-pressure hot gas line and the low-pressure evaporator at defrost start.
- Liquid feed line: one-step solenoid requiring 1 digital output.
- Defrost drain line: one-step solenoids requiring 1 digital output.
- Wet return/suction line: two-step solenoid requiring 2 digital outputs or slow opening solenoid requiring 1 analog output. Two-step or slow opening solenoids are used to ensure a controlled pressure equalization between the high-pressure hot gas in the evaporator and the low-pressure wet return/suction line at defrost end.

Besides the valves shown, there is an option to add control of two solenoid valves:

- Separate drip tray line, where a solenoid valve opens for a separate hot gas line to the drip tray
- Water spray valve, where a solenoid valve opens for hot water, which is sprayed on the evaporator to remove the ice during defrost.

The sequence for hot gas defrost can be divided into 3 parts:

1. Startup, where valves are opened/closed and appropriate settling times are added to the sequence
2. Main hot gas injection, where the main hot gas valve is open
3. End, where valves are opened/closed and appropriate settling times are added to the sequence

The hot gas defrost sequence is made according to recommendations from IIAR (International Institute of All-natural Refrigeration) and the focus is on performing a safe hot gas defrost, which minimizes the risk of for example liquid hammer or condensation shocks. The duration of the individual steps in the defrost sequence should be evaluated according to the application where the evaporator is used, the design of the evaporator, and the dimensions of the evaporator. Always consult with the evaporator manufacturer for requirements for hot gas defrost and design the system according to available standards (as for example standards published by IIAR). And note that it is always a good idea to use slow opening and closing motor valves (or alternatively 2 step valves) in the hot gas and wet return/suction lines.

If defrost is allowed, the following parameters control the startup sequence:

Label	Name	Description	Details
D50	Pump down delay	Draining the evaporator before defrosting	Always available. The liquid line valve will be closed, but valve(s) in wet return line will be open, and fans will be running. The pump down delay is used to evaporate remaining liquid in the evaporator so that risk of liquid hammer is avoided when hot gas valves are opened.
D51	HG open delay	Time delay in minutes before opening the hot gas valve (delay for the solenoid valve in the wet return/suction line to close)	Available for hot gas defrost. Fans will be turned off and valves in wet return line will be closed.
D5A	Drip tray pre-heat	Pre-heating time for hot gas to drip tray	Available if separate drip tray line is selected (parameter D2B)
D5B	Drip tray delay OFF	Continue drip tray heating some defined time	Available if separate drip tray line is selected (parameter D2B)
D57	Quick drain time	Used when 'Quick Drain valve' is selected	Available if a quick drain valve is placed in the defrost drain line. The quick drain valve will open together with the first hot gas valve that opens.
D53	HG soft time	Time between step 1 and step 2 of the hot gas valve (2 DO used).	If a two-step hot gas valve is used in the hot gas line (or two solenoid valves), then this will be the time where the first step (smallest valve) is open before main step is engaged.
D54	HG time step 1	ICM motor valve: Step 1 controlled opening "to HG OD step 1"	If a slow opening ICM valve is used in the hot gas line (controlled by an analog output), then these parameters specify the opening of the ICM: • D54 sets the time it should take to open the ICM to an opening degree specified in D55. • D56 sets the time it should take to open the ICM from D55 to 100%.
D55	HG OD step 1	ICM motor valve: Valve opening from 0% to 'HG OD step 1' inside 'HG time step 1' time	
D56	HG time step 2	ICM motor valve: Controlled opening in step 2	
D67	Water valve delay	Delay before opening the Water valve	Waiting time (in minutes) after main hot gas valve is opened before opening the water spray valve.
D68	Water valve time	Water valve “open” duration	Duration for the water spray valve to stay open. The valve is closed when main hot gas valve is closed under all circumstances.

Main hot gas injection period

Label	Name	Description	Details
D58	Max. defrost time	Max. allowed defrost duration in minutes	Maximum time spend with main hot gas valve open. Depending on the selected defrost stop method, the time can be shorter.
D78	Min defrost time	Minimum defrost time if defrost stop on temperature	Minimum time spend with hot gas valve open if defrost stop on temperature is selected (parameter D40). Regardless of the defrost temperature, the hot gas valve will remain open for at least this period.

Defrost end sequence parameters

Label	Name	Description	Details
D5C	HG close delay	Delay before closing the HG1 soft valve (only when soft gas valve used)	If a two-stage hot gas valve is used, then this will be the period where the smallest valve will be kept open after the main hot gas valve is closed.
D5D	Drain close delay	Delay before the Drain valve is closed (only when Drain valve is selected)	Only available if a drain solenoid is selected.
D59	Drip off time	Drip-off time in minutes	All valves are closed and remaining water liquid on the evaporator has a chance to drip off.
D72	Drain equalizing time	Drain and Quick Drain equalizing time after Drip Off	Drain and quick drain valves opens (if they are present) to equalize pressure in evaporator with suction pressure.
D69	WR/SL Pr. Equalizing	WR/SL Pressure Equalizing time	If evaporation pressure control is enabled, and the modulating valve is combined with a solenoid valve, then this is the opening time for the solenoid (before modulating valve is opened).
D61	WR/SL soft time	Opening time for first step (step 1) of the wet return/suction line valve	If a two-step valve is used in the wet return or suction line, this is the time for the first step.
D6A	WR/SL main time	Opening time for main step (step 2) before liquid line valve is opened	If a two-step valve is used in the wet return or suction line, this is the time for the second step.
D62	WR/SL time step 1	ICM motor valve: Step 1 controlled opening "to WR/SL OD step 1"	If a slow opening ICM valve (1 AO) is used in the wet return or suction line, this is the time it will take to reach opening degree specified in D63.
D63	WR/SL OD step 1	ICM motor valve: Valve opening from 0% to 'WR/SL OD step 1' inside 'WR/SL time step 1' time	If a slow opening ICM valve (1 AO) is used in the wet return or suction line, this is the opening degree it will reach in period specified in D62.
D64	WR/SL time step 2	ICM motor valve: Controlled opening in step 2	If a slow opening ICM valve (1 AO) is used in the wet return or suction line, this is the time it will take to open from D63 to 100%
D70	Time avg CVE OD	Time to calculate the average value of CVE opening degree	If evaporation pressure control is selected and an ICS + CVE is used as control valve, then, during cooling, an average opening degree of the CVE is calculated using this time window.
D71	Time restore CVE OD	Time to maintain the average opening degree of the CVE after defrost	If evaporation pressure control is selected and an ICS + CVE is used as control valve, then when entering “Fan start delay” state after the defrost, the CVE keeps operating at the average opening degree for this period before evaporation pressure control starts.
D73	Fan delay at main switch on	Use fan delay after Main Switch set to on or power up	When controller starts after Main Switch on, the default procedure is to run through the final stages of a defrost. This is to ensure that if a power failure happened during a defrost, the system is started up in a safe manner. This can cause issues for DX control though, where the fan often needs to run from startup. If this is the case, you can set this parameter to “No”, which will startup fan immediately when Main Switch is turned On.
D75	Fan start after defrost	Fan start after defrost	If defrost is stopped by temperature, you can choose to start fan by timer (parameter D65), or a combination of timer and temperature (whichever condition comes first)
D74	Fan start temp	Fan start temperature	If fan is started by temperature (set in parameter D75), then tis will be the value of the defrost sensor where the fan starts.
D65	Fan start delay	Delay before start of fans. The injection is started in this state, but the fans are not running	Time period where fans are not running but cooling is used to freeze and remaining water on the evaporator to prevent fans blowing liquid water into cold room.

14.5 Electrical or water defrost

The second defrost method is electrical or water defrost.

In electrical defrost the evaporator typically has built-in electrical heaters, and for water defrost the evaporator typically has a separate pipe circuit for circulation of hot water/brine. In any case, if electrical or water defrost is selected, then a digital output is reserved for a defrost On/Off signal and the EKE 400/450 only controls the liquid feed line valve and (if available) the wet return/suction line valve (see Figure 21).

The defrost sequence is shown in Figure 20 and the parameters are:

Label	Name	Description	Details
D50	Pump down delay	Draining the evaporator before defrosting	Always available. The liquid line valve will be closed, but valve(s) in wet return line will be open, and fans will be running.
D58	Max defrost time	Max. allowed defrost duration in minutes	Maximum time spend with main hot gas valve open. Depending on the selected defrost stop method, the time can be shorter.
D59	Drip off time	Drip-off time in minutes	All valves are closed and remaining water on evaporator has a chance to drip off.
D61	WR/SL soft time	Time between step 1 and step 2 for opening the wet return/suction line valve	If a two-step valve is used in the wet return or suction line, this is the time for the first step.
D6A	WR/SL main time	Delay of liquid inlet	If a two-step valve is used in the wet return or suction line, this is the time for the second step.
D62	WR/SL time step 1	ICM motor valve: Step 1 controlled opening "to WR/SL OD step 1"	If a slow opening ICM valve (1 AO) is used in the wet return or suction line, this is the time it will take to reach opening degree specified in D63.
D63	WR/SL OD step 1	ICM motor valve: Valve opening from 0% to 'WR/SL OD step 1' inside 'WR/SL time step 1' time	If a slow opening ICM valve (1 AO) is used in the wet return or suction line, this is the opening degree it will reach in period specified in D62.
D64	WR/SL time step 2	ICM motor valve: Controlled opening in step 2	If a slow opening ICM valve (1 AO) is used in the wet return or suction line, this is the time it will take to open from D63 to 100%
D65	Fan start delay	Delay before start of fans. The injection is started in this state, but the fans are not running	Time period where fans are not running but cooling is used to freeze and remaining water on the evaporator to prevent fans blowing liquid water into cold room.
D76	Fan ctrl. at defrost	Fans during defrost	Select if fans should be stopped, run at low speed or run at high speed during defrost

14.6 Defrost control IO definition

IO	Type	Description	Details
Defrost temp	AI	Temperature from defrost temperature sensor	Any of the 8 AI's can be used
Defrost temp 2	AI	Temperature from second defrost temperature sensor	Any of the 8 AI's can be used

See also chapter 6 for additional IOs related to valves and selection of defrost method.

15 Reheat function

The reheat function can be used to add heat to the air after it has passed the evaporator. In this way the evaporator can be used to remove humidity from the air, without lowering the inlet air temperature:

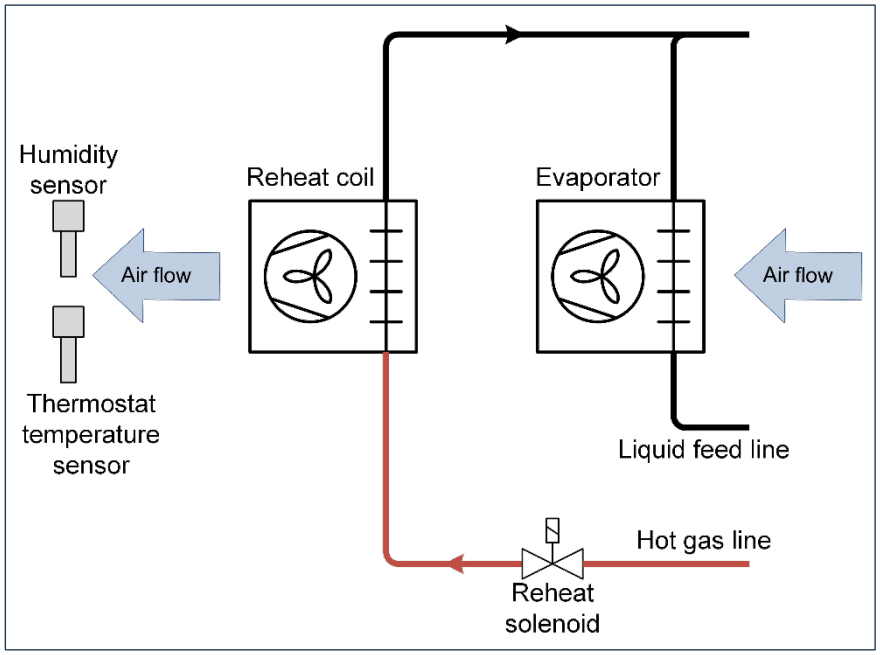


Figure 22. Reheat configuration

If the reheat function is enabled, then the EKE 400/450 will control the reheat solenoid to keep the setpoint for relative humidity out of the reheat coil.

The reheat solenoid valve is controlled like this:

- It is turned On/Off with a hysteresis of ± 5 % relative humidity or ± 1 degree of the setpoint for the thermostat.
    - It will be On when cooling is on, and the room humidity is above the humidity set-point and the room temperature is below the temperature set-point.
    - It will be Off if the room humidity falls below the humidity setpoint minus 5 %.
    - It will be Off if the room temperature rises above the temperature set-point + 1 degree, whatever the room humidity is.
- The reheat solenoid will always be off when cooling is off (due to cut-out, alarm, forced closing, etc.)

Note that the reheat function is not available when:

- Modulating thermostat is selected in DX mode
- PWM liquid control is selected for flooded evaporator mode
- Evaporation pressure control by room temperature is selected

16 Controller coordination

If several controllers are connected on the CAN bus, then these controllers can share functionality, such as:

- Common thermostat (see chapter 9)
- Common pressure transmitter
- NeoCharge and defrost coordination

A CAN bus network can consist of maximum 120 controllers. These 120 controllers can be divided into groups, and within each group, functionality can be shared.

The way to divide the controllers into groups, is to specify the number of groups (on each controller in the network). If the number of groups are set to for example 10, then there will be maximum 120 / 10 = 12 controllers in each group. (note that there does not need to be 12 controllers in each group – there can be less).

The controllers are placed in groups by the controller address (which equals the Modbus address). If there is for example 10 groups, then the controllers will be grouped like this:

Group	Modbus addresses
Group 1	1, 2, 3, …12
Group 2	13, 14, 15, … 24
Group 3	25, 26, 27, … 36
…	…
Group 10	109, 110, 111, … 120

If for example 9 groups are defined, then each group will have maximum 13 controllers – except the last group, which will maximum have the remaining number of controllers (which in the case of 9 groups will leave 120 – 8*13 = 16 controllers for the last group).

Whitin each group, the controller with the first address will be designated the “default main controller”. If for some reason the main controller changes state– for example when the controller enters defrost – the “main controller” shifts to the next controller in the group (which is not in the defrost state). When the default main controller is bac to normal state, it will automatically again be the “main controller”.

It is the main controller’s responsibility to coordinate the different functionalities that are defined.

The following parameters defines the functions to be coordinated between controllers in a group:

Label	Name	Description	Details
G17	Number of groups	Number of controller groups	See description above
Sensor sharing			
R11	Com. press transmitter	Common pressure transmitter	Select between: "No" , "Sharing on CAN-bus", "Receiving from CAN bus". If "Sharing on CAN-bus" is selected, then the pressure transmitter connected to this controller will be shared on the CAN bus. If "Receiving from CAN bus" is selected, the no pressure transmitter is connected to this controller, and it is relying on the shared pressure received from the CAN bus (will be communicated by the main controller). If more controllers are sharing a transmitter, then the main controller will calculate the average value, and if one transmitter fails, the system will continue to run using the remaining transmitters (and raise an alarm on the controller where the transmitter failed).
G18	CAN Bus sharing min. update interval	Minimum update interval for sharing values on CAN bus	Minimum update interval for sharing sensor values. Default 10 s. If this interval is exceeded a bus sharing timeout alarm is raised.
Defrost			
D05	Cool at HG defrost	Hot gas defrost coordinated locally. Start forced cooling when another controller in the group is defrosting	Start forced cooling on remaining evaporators in the group when an evaporator in the group is if defrost mode.
D77	Cool at HG open	Forced cooling only when hot gas valve is open	If D05 is selected, then select this to make sure that forced cooling is only started during the period where hot gas valve(s) are open.
D16	Coordinated defrost	Coordinates defrost between evaporators within a group	
D17	Max simultaneous defrosts	Max simultaneous defrosts in pct of number of evaporators in a group	If NeoCharge is enabled, and "L26, SPOpt independent on defrost" is false, then the "L25, Max simul. SPOpt" parameter is prioritized if a controller is running setpoint optimization.
NeoCharge			
L2A	Coord NeoCharge CCR	Coordinated NeoCharge, CCR	Enables you to set a limit on how many evaporators in a group that can run Setpoint Optimization (or defrost – see L26) at the same time. The L25 parameter sets the maximum number in percent of the total number of evaporators in a group.
L24	Coord NeoCharge WDX	Coordinated NeoCharge, WDX	
L25	Max simul. SPOpt	Max simultaneous setpoint optimizations	
L26	SPOpt independent on defrost	Allow coordinated setpoint optimization to be independent on coordinated defrost.	If selected, then the number of evaporators allowed to do setpoint optimization is independent of the number of evaporators in defrost mode. If not selected, then the number of evaporators in defrost mode is included when evaluating if "L25, Max simul. SPOpt" is exceeded.

17 External reference

The EKE 400 allows the following setpoints to be displaced by an external signal:

- Superheat setpoint – when running in DX control mode
- Thermostat setpoint – when a thermostat control function is defined, or when evaporation pressure control by room temperature is enabled
- Evaporation pressure setpoint – when evaporation pressure control by pressure is enabled

The setpoint can be displaced by:

- A current analog input
- A voltage analog input
- A Modbus input
- A digital input

If an analog input is used to displace the setpoint, the following values needs to be defined:

- Max value of offset (corresponding to max value of analog input)
- Min value of offset (corresponding to min value of analog input)
- Max value of analog input
- Min value of analog input

If a Modbus input is used, then the offset is just written to a Modbus address.

If a digital input is used, then the offset is 0 when the DI is closed and the offset for when the DI is open must be defined. The following parameters are used to define the functions:

Superheat setpoint:

Label	Name	Description
N28	Ext.Ref.DX config	Offset of superheat setpoint by external signal
N29	Ref.Offset SH Max	Offset of setpoint, max value
N30	Ref.Offset SH Min	Offset of setpoint, min value
N31	Ref.Current SH High	AI signal range - high value
N32	Ref.Current SH Low	AI signal range - low value
N33	Ref.Voltage SH High	AI signal range - high value
N34	Ref.Voltage SH Low	AI signal range - low value
N35	Re.Offset SH Modbus	Offset value via network
N38	Ref. Offset SH by DI	Offset value when DI is open, 0 K if closed

Thermostat setpoint:

Label	Name	Description
P10	Ext ref. config.	Offset of thermostat setpoint by external signal
P11	Ref. offset max	Offset of setpoint - max value
P12	Ref. offset min	Offset of setpoint - min value
P13	Ref. current high	AI signal range - high value
P14	Ref. current low	AI signal range - low value
P15	Ref. voltage high	AI signal range - high value
P16	Ref. voltage low	AI signal range - low value
P18	Ref. offset by Modbus	Offset value via network
P19	Ref. offset by DI	Offset value when DI is open, 0 K if closed
P17	Lowpass bandwidth	Lowpass bandwidth of lowpass filter applied to analog input signal

Evaporation pressure control by pressure:

Label	Name	Description
P26	Ext ref. T0 config.	Offset of saturation temperature setpoint for Evaporation pressure control by pressure
P27	Ref. offset T0 max	Offset of setpoint - max value
P28	Ref. offset T0 min	Offset of setpoint - min value
P29	Ref. current T0 high	AI signal range - high value
P30	Ref. current T0 low	AI signal range - low value
P31	Ref. voltage T0 high	AI signal range - high value
P32	Ref. voltage T0 low	AI signal range - low value
P33	Ref. offset T0 by Modbus	Offset value via network
P34	Ref. offset T0 by DI	Offset value when DI is open, 0 K if closed
P17	Lowpass bandwidth	Lowpass bandwidth of lowpass filter applied to analog input signal

Depending on the selections for external references, the following IO's will be defined:

IO	Type	Description	Details
Ext.Offset	DI	Digital input for offset of thermostat setpoint	
Ext.SH Offset	DI	Digital input for offset of superheat setpoint	
Ext.T0 Offset	DI	Digital input for offset of evaporation saturation temperature setpoint	
ExtRef cur. ther. SP	AI	Analog input for offset of thermostat setpoint by current	Only AI 1 to 4 allows current input
ExtRef vol. ther. SP	AI	Analog input for offset of thermostat setpoint by voltage	
ExtRef cur. SH	AI	Analog input for offset of superheat setpoint by current	Only AI 1 to 4 allows current input
ExtRef vol. SH	AI	Analog input for offset of superheat setpoint by voltage	
ExtRef cur. T0	AI	Analog input for offset of evaporation saturation temperature setpoint by current	Only AI 1 to 4 allows current input
ExtRef vol. T0	AI	Analog input for offset of evaporation saturation temperature setpoint by voltage	

18 Emergency cooling

If a sensor error occurs, the EKE 400/450 can enter an emergency cooling mode, where the injection valve and/or the evaporation pressure control valve is put in a fixed position.

The parameters that are used to setup emergency cooling are:

Label	Name	Description	Details
P20	Ther. sensor error	Thermostat temperature sensor error	Select either: "Close valve", "Fixed OD" or "Use average OD". When "Close valve" is selected, all valves in the liquid/liquid feed line (injection and/or solenoid valves). The OD is referring to the opening degree of the injection valve. The average OD is a moving average of the opening degree of the valve from the last 5 minutes.
P22	Fixed OD emer. cool	Fixed valve OD at emergency cooling	If "Fixed OD" is selected in P20, then this will define the opening degree.
P21	SH sensor error	S2 or Pe sensor error	Select either: "Close valve", "Fixed OD" or "Use average OD". When "Close valve" is selected, the injection valve in the liquid/liquid feed line will be closed (any solenoid in the liquid/liquid feed line will not be closed). The OD is referring to the opening degree of the injection valve. The average OD is a moving average of the opening degree of the valve from the last 5 minutes.
P2A	Fixed OD emer. cool	Fixed valve OD at emergency cooling	If "Fixed OD" is selected in P21, then this will define the opening degree.
P23	Evap.Pres.ctrl sensor error	Evaporation pressure control by pressure sensor error	Select either: "Close valve", "Fixed OD" or "Valve fully open". "Valve" is referring to the control valve in the wet return/suction line.
P24	Fixed OD emer. cool	Fixed valve OD at emergency cooling	If "Fixed OD" is selected in P23, then this will define the opening degree.

19 Alarm settings

The EKE 400/450 defines several alarms depending on the selected controller functionality.

Each alarm can be given one of the following priorities:

- Disable (alarm is ignored)
- Normal
- Severe
- Critical

The EKE 400/450 does not automatically stop controlling or take other actions depending on the alarm severity, except that there is a possibility to:

- Define that a certain priority (and higher priorities) will activate a digital output
- Define that a certain priority (and higher priorities) will activate the build in buzzer

The alarm priority settings are defined by the following parameters:

Label	Name	Description
P02	Alarm output DO	Alarm priority that will activate a digital output
cAB	Buzzer Management	Alarm priority that will activate the buzzer

The alarms, which can be given a priority, are listed below.

Evaporator control

Label	Name	Description
A48	Pressure sens.error	Pressure transmitter error
A76	S2 temp error	S2 temperature sensor error
A77	S3 temp error	S3 temperature sensor error

NeoCharge

Label	Name	Description
A92	NC sensor temp. error	NeoCharge sensor temperature sensor error
A93	NC sensor power error	NeoCharge sensor power error
A95	S2 bias alarm	S2 bias is too large
A96	NC sensor overheat alarm	NeoCharge sensor is overheated

Thermostat control

Label	Name	Description
A50	Ther. air sensor error	Thermostat temperature sensor error
A51	Ther. air 2 sensor error	Thermostat temperature sensor 2 error
A52	Ther. air 3 sensor error	Thermostat temperature sensor 3 error
A53	Air alarm sensor error	Air alarm sensor error
A61	High temp. alarm	The room temperature is too high
A62	Low temp. alarm	The room temperature is too low
A55	Product sensor error	Product temperature sensor error
A63	High product temp. alarm	The product temperature is too high
A64	Low product temp. alarm	The product temperature is too low

Defrost

Label	Name	Description
A54	Defrost sensor error	Defrost temperature sensor error
A97	Defrost 2 sensor err.	Defrost temperature sensor 2 error
A65	Max. defrost time	Max allowed defrost time is exceeded

I/O functions

Label	Name	Description
A59	Standby mode	Control is stopped by internal or external Main Switch (DI input)
A66	Output in MAN mode	An output is set in manual mode
A68	Safety stop alarm	Safety stop alarm
A69	Gas sensor err.	Gas detector error
A89	Humidity sens.error	Humidity sensor error
A91	Fan DI alarm	Fan digital input alarm

External reference

Label	Name	Description
A49	Ext.Ref. error	External reference for thermostat setpoint error
A79	Ext.Ref.SH error	External reference input for superheat setpoint error
A90	Ext.Ref.T0 error	External reference input for T0 setpoint error

Valves

Label	Name	Description	Details
A83	LL valve DI alarm	Liquid line valve alarm by DI	
A84	WR/SL valve DI alarm	Wet return/suction line valve alarm by DI	
A85	HG valve DI alarm	Hot Gas line valve alarm by DI	
A86	LL valve AI alarm	LL line ICAD input error (out of scale)	
A87	WR/SL valve AI alarm	WR/SL line ICAD input error (out of scale)	
A88	HG valve AI alarm	HG line ICAD input error (out of scale)	
A80	LL valve DI alarm	Liquid line valve digital input from ICAD	If selected a digital input is reserved for a signal from the ICAD on the ICM in the liquid/liquid feed line
A81	WR/SL valve DI alarm	Wet return/suction line valve digital input from ICAD	If selected a digital input is reserved for a signal from the ICAD on the ICM in the wet return/suction line
A82	HG valve DI alarm	Hot Gas line valve digital input from ICAD	If selected a digital input is reserved for a signal from the ICAD on the ICM in the hot gas line

Controller coordination

Label	Name	Description
A94	Bus share timeout error	Timeout error sharing pressure transmitter

Depending on the selections for alarms, the following IO's will be defined:

IO	Type	Description
LL valve alarm	DI	See parameter A80
WR/SL valve alarm	DI	See parameter A81
HG valve alarm	DI	See parameter A82
Alarm output	DO	See parameter P02

20 System settings

The system settings menu contains parameters for changing language, units, passwords etc.:

Label	Name	Description	Details
Display			
G01	Language	Set the system language	Select between: English, French, Italian, German, Dutch, Japanese, Portuguese, Spanish, Russian, Chinese and Korean
G02	Time format	Set the time format	Select between 24-hour format and 12-hour format
P01	Temperature units	Temperature unit	Select between °C and °F. Note that if °C is selected, pressure will be in bar, and if °F is selected, pressure will be in psi
G03	Screen saver time	Screen saver time	Minutes before display is dimmed
G04	User logout time	User logout time	Minutes before user is logged out
G05	Display contrast	Display contrast	
Password			
G07	Password level 1	Password level 1.	Daily tasks. Read only access. Default 100
G08	Password level 2	Password level 2.	Service task. For adjusting parameters. Default 200
G09	Password level 3	Password level 3.	Commissioning task. For configuration of system. Default 300
Network			
G11	Modbus address	Modbus address of controller	Set Modbus address between 1 and 120.
G12	Baud rate	Baud rate (default 38400)	Select between: 0 = 0 bps 12 = 1200 bps 24 = 2400 bps 48 = 4800 bps 96 = 9600 bps 144 = 14400 bps 192 = 19200 bps 288 = 28800 bps 384 = 38400 bps
G13	Serial mode	Serial Modbus mode	Select between: 8E1 = 8 bit, Even parity, 1 stop bit 8N1 = 8 bit, No parity, 1 stop bit 8N2 = 8 bit, No parity, 2 stop bits
Reset			
G14	Reset to factory	Reset all to factory settings. Alarm list will also be cleared	

21 Modbus parameter overview

The following tables give an overview of all the Modbus parameters in an EKE 400/450.

The columns have the following meaning:

Column	Meaning
Label	The label of the parameter. Short name used to uniquely define a parameter. Can be used to search for a specific parameter in CoolConfig.
Name	Short name of the parameter as seen in the display of the controller.
Description	Long description of the parameter. Also including a description of the different integer values the parameter can take if it is an enumerated parameter (see for example parameter "S1A, Control state" below).
Min	Minimum value the parameter can take.
Max	Maximum value the parameter can take.
Factory setting	Default value.
Unit	Unit (if any).
Decimals	Number of decimals the parameter has. A Modbus value is read as a Word value, so if a value of 568 is read and number of decimals is 2, then the value is 5.68.
Locked by main switch	If true then this parameter can only be changed when Main switch is off – i.e., this parameter cannot be changed when the controller is in control mode.
Read only	If true then value of the parameter can only be read – if false, the value can also be changed by writing a new value to the Modbus address.
Password level Read – Write	Password level needed to read or write a parameter. Note that CoolConfig always require password level 3 to change parameters.
Persistent	If true then the value is saved even if power to controller is switched off.
Modbus PLC address	The 1-based Modbus address of the parameter.

21.1 Control status readouts

This group of parameters contain status variables that can be read on the controller display.

Label	Name	Description	Min.	Max.	Factory setting	Unit	Decimals	Locked by main switch	Read only	Password level Read - Write	Persistent	Modbus PLC address
S1A	Control state	Control state 1: Main switch is OFF 2: Manual control 3: Pump down 4: HG open delay 5: HG Drip tray 6: HG soft opening 7: Defrosting 8: HG close delay 9: Drain close delay 10: Drip off time 11: WR open delay 12: Fan start delay 14: Forced closing 15: Forced cooling 16: Emergency control 17: Evap.Pres.Control 18: MTR control 19: Cooling 20: Cooling stopped 21: Refrig. not selected 22: Power up state 23: Safety stop 24: PWM modulation 25: IO config error 26: Drain equalising 27: Cooling WDX 28: Cooling DX 29: Cooling CCR 30: NC setpoint opt. 32: Fan safety alarm	0	0	Main switch is OFF		0	False	True	0 - 0	False	3270
S02	Cooling status	Cooling On/Off status (can be used by PLC to e.g. start/stop of pumps)	Off	Off	Off		0	False	True	0 - X	False	3165
S03	Ther. temp.	Temperature used for the thermostat function	##	200	0	°C	2	False	True	0 - X	False	3166
S05	Cut in limit	Thermostat cut in limit adjusted with night offset	0	0	0	°C	2	False	True	0 - X	False	3168
S06	Cut out limit	Thermostat cut out limit adjusted with night offset	0	0	0	°C	2	False	True	0 - X	False	3169
S04	Night status	Night operation	Off	Off	Off		0	False	True	0 - X	False	3167
S07	Alarm air temp.	Room temperature used for alarm function	0	100	0	°C	2	False	True	0 - X	False	3163

S08	Product temp.	Measured product temperature	0	0	0	°C	2	False	True	0 - X	False	3170
S17	Evap. temp. Te	Actual evaporating temperature Te converted from pressure	0	0	0	°C	2	False	True	0 - X	False	3179
S16	Evap. press Pe	Actual evaporating pressure Pe	0	0	0	bar	2	False	True	0 - X	False	3175
S18	S2 temperature	The refrigerant temperature measured at S2 sensor position	0	0	0	°C	2	False	True	0 - X	False	3180
S21	S2 superheat	Superheat (S2 temperature - Evap. Temp. Te)	0	0	0	K	1	False	True	0 - X	False	3183
S22	SH reference	Reference used for the superheat control	0	0	10	K	1	False	True	0 - X	False	3184
S29	SH set + offset	Fixed setpoint plus offset due to External reference config. For SH	0	0	0	K	1	False	True	0 - 0	False	3411
S20	Injection OD	Opening degree of injection valve in DX, CCR, WDX and PWM mode	0	0	0	%	2	False	True	0 - X	False	3182
S43	NeoCharge state	NeoCharge state 0: DX startup 1: Preparing SPOpt 2: Setpoint opt. 3: CCR control 4: WDX control 5: DX control 6: DX NC temp. 7: DX emergency ctrl 8: Emergency ctrl 9: Cooling stopped 10: NC stopped 11:	DX startup	NC stopped	DX startup		0	False	True	0 - X	False	3615
S38	NC sensor temp.	NeoCharge sensor temperature	0	100	0	°C	2	False	True	0 - X	False	3528
S39	NC sensor power%	NeoCharge power	0	100	0	%	0	False	True	0 - X	False	3529
S40	NC sensor superheat	NeoCharge superheat	0	100	0	K	1	False	True	0 - X	False	3585
S19	S3 air inlet temp	Actual air inlet temperature	0	0	0	°C	2	False	True	0 - X	False	3181
S24	Hours from Defrost	Time in hours since last defrost	0	0	0	hours	0	False	True	0 - X	False	3319
S12	Act. state time	Actual time running in the state	0	0	0	min	0	False	True	0 - X	False	3174
S11	Defrost state time	Time to spend in the current defrost state	0	0	0	min	0	False	True	0 - X	False	3173
S09	Defrosting time	Duration of the last executed defrost	0	0	0	min	0	False	True	0 - X	False	3171
S10	Def. sensor temp.	Defrost sensor temperature	0	0	0	°C	2	False	True	0 - X	False	3172
S1B	Def. sensor 2 temp.	Defrost sensor 2 temperature	0	100	0	°C	2	False	True	0 - X	False	3593
S28	Gas Conc.tra.	Gas Concentration [ppm]	0	50000	0	ppm	0	False	True	0 - X	False	3330
S37	Rel. humidity	Relative humidity	0	0	0	%	2	False	True	0 - X	False	3467
SSt	Add. temp	Additional temperature reading	0	100	0		2	False	True	0 - X	False	3510
SPp	Add. Pres	Additional pressure reading	0	200	0		2	False	True	0 - X	False	3512
S30	HG Control OD	Control OD % for slow ICM Hot Gas valves	0	0	0	%	2	False	True	0 - X	False	3453
S31	Evap. pres. ctrl OD	Opening degree of evaporation pressure control valve	0	0	0	%	2	False	True	0 - X	False	3454
S32	Evap. pres. SP	Setpoint for Evaporation pressure control	0	0	0	°C	2	False	True	0 - X	False	3434
S33	Average CVE OD%	Average value for CVE OD% valve	0	0	0	%	2	False	True	0 - X	False	3442
S34	LL valve AI Feedback	Feedback from ICAD of ICM valve in liquid line	0	0	0	%	2	False	True	0 - X	False	3455
S35	WR/SL valve AI Feedback	Feedback from ICAD of ICM/CVE valve in wet return/suction line	0	0	0	%	2	False	True	0 - X	False	3456
S36	HG valve AI Feedback	Feedback from ICAD of ICM valve in hot gas line	0	0	0	%	2	False	True	0 - X	False	3457
I01	Active alarms status	Active alarms status	##	32767	0		0	False	True	0 - X	False	3154
I02	Number of active alarms	Number of active alarms	0	32767	0		0	False	True	0 - X	False	3272
I03	Number of cleared alarms	Number of cleared alarms	0	32767	0		0	False	True	0 - X	False	3273
PAA	Active alarms	Active alarms	0	1	0		0	False	True	0 - X	False	3241
S23	Status Buzzer	Status buzzer	Off	On	Off		0	False	True	0 - X	False	3275
ST1	Thermostat mode	Thermostat mode used: if (Version <= 1.20) then T01 else (T1A, T1B, T1C, T1D or T1E)	0	0	0		0	False	True	0 - 0	False	3385
SR2	Liq.line valve	Liquid Feed valve used : if Version <=1.20 then R02 else (if T26 == 1 then (R01=2) then R2B else R2A) else if (T1A == 5) then SR2=R2C else SR2=R2A)	0	0	0		0	False	True	0 - 0	False	3387
SD3	WR/SL valves	WR/SL valves type used: if Evaporation pressure control then D03 else D3A	0	0	0		0	False	True	0 - 0	False	3389

21.2 Start/Stop controlling

Label	Name	Description	Min.	Max.	Factory setting	Unit	Decimals	Locked by main switch	Read only	Password level Read - Write	Persistent	Modbus PLC address
M01	Main switch	Start and stop controlling	Off	On	Off		0	False	False	0 - 2	True	3001
M02	Ext. Main switch	Status of the external main switch (DI)	Off	On	Off		0	True	True	0 - X	True	3002

21.3 Basic control functions

Label	Name	Description	Min.	Max.	Factory setting	Unit	Decimals	Locked by main switch	Read only	Password level Read - Write	Persistent	Modbus PLC address
Evaporator control mode												
R01	Evap. ctrl mode	Evaporator control mode -1: none 0: Flood. evap On/Off 2: DX control	none	DX control	none		0	True	False	0 - 3	True	3020
R1A	Evap. ctrl mode	Evaporator control mode -1: none 0: Flood. evap On/Off 2: DX control 3: NeoCharge CCR 4: NeoCharge WDX	none	NeoCharge WDX	none		0	True	False	0 - 3	True	3522
Evaporation pressure control												
T26	Evap.Pres.Control	Evaporation pressure control	No	Yes	No		0	True	False	0 - 3	True	3517
R04	Evap.Pres.Ctrl by	Evaporation pressure controlled by 0: Room temperature 1: Evaporation pressure	Room temperature	Evaporation pressure	Room temperature		0	True	False	0 - 3	True	3022
Refrigerant												
R20	Refrigerant	Refrigerant 0: not used 1: R12 2: R22 3: R134a 4: R502 5: R717 6: R13 7: R13B1 8: R23 9: R500 10: R503 11: R114 12: R142b 13: User 14: R32 15: R227ea 16: R401A 17: R507A 18: R402A 19: R404A 20: R407C 21: R407A 22: R407B 23: R410A 24: R170 25: R290 26: R600 27: R600a 28: R744 29: R1270 30: R417A 31: R422A 32: R413A 33: R422D 34: R427A 35: R438A 36: R513A 37: R407F 38: R1234zeE 39: R1234yf 40: R448A 41: R449A 42: R452A 43: R450A 44: R452B 45: R454B 46: R1233zdE 47: R1234zeZ 48: R449B 49: R407H	not used	R407H	not used		0	True	False	0 - 3	True	3029
R23	Refrig. fact. A1	User defined refrigerant. Factor A1	8	13	10.4		3	True	False	0 - 3	True	3032
R24	Refrig. fact. A2	User defined refrigerant. Factor A2	##	-1200	-2255		1	True	False	0 - 3	True	3033
R25	Refrig. fact. A3	User defined refrigerant. Factor	220	320	254.2		1	True	False	0 - 3	True	3034

		A3										
Fan control												
F01	Fan control mode	Fan control mode 0: No control 1: On-Off control (1 DO) 2: On control (1 DO) 3: Two step control (2 DO) 4: 0-10V EC fan ctrl (1 AO) 5: 0-10V EC fan ctrl+DO (1 AO + 1 DO) 6: 0-10V VFD variable (1 AO) 7: 0-10V VFD var.+DO (1 AO + 1 DO) 8: On-Off ctrl cycling	No control	On-Off ctrl cycling	On-Off control (1 DO)		0	True	False	0 - 3	True	3103
Thermostat control												
T1A	Ther. mode	Thermostat control mode, flooded evaporator On/Off 0: None 1: Individual On/Off 2: Common On/Off 5: PWM liquid control	None	PWM liquid control	Individual On/Off		0	True	False	0 - 3	True	3037
T1B	Ther. mode	Thermostat control mode, DX control 0: None 1: Individual On/Off 2: Common On/Off 4: MTR	None	MTR	Individual On/Off		0	True	False	0 - 3	True	3386
T1C	Ther. mode	Thermostat control mode, evaporation pressure control by pressure 0: None 1: Individual On/Off 2: Common On/Off 3:	None		None		0	True	False	0 - 3	True	3500
T1D	Ther. mode	Thermostat control mode, evaporation pressure control by temperature 0: None 1: Individual On/Off	None	None	None		0	True	False	0 - 3	True	3501
T1E	Ther. mode	Thermostat control mode, WDX or CCR 0: None 1: Individual On/Off 2: Common On/Off 3:	None	Common On/Off	None		0	True	False	0 - 3	True	3525
Defrost control												
D1A	Defrost method	Defrost method 0: No defrost 1: Hot gas 2: Electrical or water 3: Ext. controlled	No defrost	Electrical or water	Hot gas		0	True	False	0 - 3	True	3244
D2B	HG Drip tray line	Separate line for hot gas drip tray	No	Yes	No		0	True	False	0 - 3	True	3255
Reheat function												
RH0	Reheat enable?	Enable Reheat function	No	Yes	No		0	True	False	0 - 3	True	3465
RH1	Setpoint RH%	Setpoint Humidity	0	100	50	%	1	False	False	0 - 3	True	3466
Valves												

R2A	Liq. feed line valve	Valve(s) in liquid line, flooded evaporator, not PWM liquid control 1: Solenoid (ICFE) 2: Solenoid (ICS) 3: Solenoid (ICM)	Solenoid (ICFE)	Solenoid (ICM)	Solenoid (ICFE)		0	True	False	0 - 3	True	3021
R2B	Liq. line valve for DX	Valve(s) in liquid line, DX control 4: AKV 5: AKV + Solenoid 6: Mod ICM 7: Mod ICM + solenoid 8: 2 AKV 9: 2 AKV + solenoid	AKV	2 AKV + solenoid	AKV		0	True	False	0 - 3	True	3384
R2C	Liq. feed line valve PWM	Valve(s) in liquid line, flooded evaporator, PWM liquid control 4: AKV 8: 2 AKV 5: AKV + Solenoid 9: 2 AKV + Solenoid 4:	AKV	2 AKV + Solenoid	AKV		0	True	False	0 - 3	True	3380
R2D	Liq. line valve NeoCharge	Valve(s) in liquid line, NeoCharge 4: AKV 5: AKV + Solenoid 6: Mod ICM 7: Mod ICM + solenoid 4:	AKV	Mod ICM + solenoid	AKV		0	True	False	0 - 3	True	3524
D3A	WR/SL valve	Valve in wet return/suction line 0: No valve 1: Soft (ICS+EVRST) 2: Soft (ICSH) 3: Soft (ICLX) 4: Solenoid (ICS) 5: Solenoid (ICM) 6: Slow (ICM)	No valve	Slow (ICM)	Soft (ICLX)		0	True	False	0 - 3	True	3253
D03	WR/SL valve	Valve in wet return/suction line 7: Mod (ICM) 8: Mod+PE (ICM+EVRST) 9: Mod (CVE) 10: Mod+PE (CVE+EVRST) 11: Mod+PE (CVE+EVM+EVRST)	Mod (ICM)	Mod+PE (CVE+EVM+EVRST)	Mod (ICM)		0	True	False	0 - 3	True	3388
D2A	Hot gas line valve	Valve in hot gas line 0: No valve 1: Soft (ICS+EVRST) 2: Soft (ICSH) 3: Solenoid (ICFE) 4: Solenoid (ICS) 5: Solenoid (ICM) 6: Slow (ICM)	No valve	Slow (ICM)	Soft (ICSH)		0	True	False	0 - 3	True	3247
D1B	HG Drain valve	HG drain valve (no influence on SW) 0: Pressure (OFV) 1: Pressure (ICS+CVP) 2: Liquid drain (ICFD)	Pressure (OFV)	Liquid drain (ICFD)	Pressure (ICS+CVP)		0	True	False	0 - 3	True	3245
D4A	Drain solenoid?	Drain solenoid valve	No	Yes	Yes		0	True	False	0 - 3	True	3252
D4B	Quick Drain?	Quick Drain	No	Yes	No		0	True	False	0 - 3	True	3254
D09	Water valve?	Water spray on the evaporator during hot gas defrost	No	Yes	No		0	True	False	0 - 3	True	3325
Valve states												
D3B	WR/SL at Cool. stopped	State of wet return/suction line valve when cooling is stopped 0: Closed 1: Open	Closed	Open	Open		0	True	False	0 - 3	True	3323
D24	WR/SL soft at cooling	State of wet return/suction line soft valve (EVRST) when cooling is on 0: Closed 1: Open	Closed	Open	Closed		0	True	False	0 - 3	True	3463

21.4 I/O functions

Label	Name	Description	Min.	Max.	Factory setting	Unit	Decimals	Locked by main switch	Read only	Password level Read - Write	Persistent	Modbus PLC address
Cooling status												
P03	Main switch by DI	Main switch by DI. Start and stop regulating using signal from digital input	No	Yes	No		0	True	False	0 - 3	True	3117
T09	Cool. status DO	Cooling status on a digital output	No	Yes	No		0	True	False	0 - 3	True	3045
T22	Min. Cooling OD	Min Cooling OD to turn On the Cooling Status (Digital Output and info on screen)	0	20	5	%	0	True	False	0 - 3	True	3437
Defrost status												
D06	Defrost allowed	Defrost allowed signal via network	No	Yes	Yes		0	False	False	0 - 2	True	3083
D07	Defrost allowed by DI	Defrost allowed by digital input	No	Yes	No		0	True	False	0 - 3	True	3084
D14	Def. start by DI	Defrost start by digital input	No	Yes	No		0	True	False	0 - 3	True	3055
D42	Def. stop by DI	Defrost stop by digital input	No	Yes	No		0	True	False	0 - 3	True	3080
D18	Hot gas valve On/Off DO	Hot gas valve On/Off digital output	No	Yes	No		0	True	False	0 - 3	True	3604
D08	Def. status on DO	Defrost status (on/off) on a digital output	No	Yes	No		0	True	False	0 - 3	True	3085
Evaporator control												
R05	Cool On/Off by DI	Cooling on/off by digital Input	No	Yes	No		0	True	False	0 - 3	True	3024
R06	Forced closing	Forced cooling stop via network	Off	On	Off		0	False	False	0 - 2	False	3025
R07	Forced cooling	Forced cooling start via network	Off	On	Off		0	False	False	0 - 2	False	3026
R08	Forced close by DI	Forced cooling stop by digital Input	No	Yes	No		0	True	False	0 - 3	True	3027
R09	Forced cool by DI	Forced cooling start by digital Input	No	Yes	No		0	True	False	0 - 3	True	3028
Valve status												
D3H	WR/SL valve AI feedback	Feedback from ICAD of ICM valve in wet return/suction line	No	Yes	No		0	True	False	0 - 3	True	3452
D2C	HG valve AI feedback	Feedback from ICAD of ICM valve in hot gas defrost line	No	Yes	No		0	True	False	0 - 3	True	3451
R10	LL valve AI feedback	Feedback from ICAD of ICM valve in Liquid feed line	No	Yes	No		0	True	False	0 - 3	True	3446
Additional AI's												
P25	Gas Conc.tra. AI?	Gas Concentration Analog Input 0: No 1: 0-100ppm 2: 0-300ppm 3: 0-1000ppm 4: 0-2000ppm 5: 0-5000ppm 6: 0-10000ppm 7: 0-20000ppm 8: 0-50.00 ppb	No	0-50.00 ppb	No		0	True	False	0 - 3	True	3326
SS1	Temperature sensor	Additional temperature sensor	No	Yes	No		0	False	False	0 - 3	True	3509
SP1	Pressure sensor	Additional pressure sensor	No	Yes	No		0	False	False	0 - 3	True	3511
Fan status												
F11	Fan DI	Fan status digital input 0: None 1: Alarm 2: Alarm and stop	None	Alarm and stop	None		0	True	False	0 - 0	True	3515
F10	Fan DI status	Status for Fan DI	Off	On	Off		0	False	True	0 - X	False	3516
Safety stop												
A71	Safety stop by DI	Safety stop and alarm by digital input	No	Yes	No		0	True	False	0 - 3	True	3327
S70	Manual alarm reset	Require manual reset of safety stop alarm	No	Yes	No		0	True	False	0 - 2	False	3333
A72	WR/SL status	Wet return/suction line valve status at safety stop 0: Closed 1: Open	Closed	Open	Closed		0	False	False	0 - 3	True	3328
A73	Fan status	Fan status at safety stop 0: Stopped 1: Running	Stopped	Running	Stopped		0	False	False	0 - 3	True	3331

21.5 NeoCharge

Note that the NeoCharge parameters are only available in EKE 450.

Label	Name	Description	Min.	Max.	Factory setting	Unit	Decimals	Locked by main switch	Read only	Password level Read - Write	Persistent	Modbus PLC address
NeoCharge												
L04	Enable NC ext	Enable NeoCharge control by using external signal 0: not used; 1: by DI; 2: by Modbus 0: Not used 1: By DI 2: By Modbus	Not used	By Modbus	Not used		0	True	False	0 - 3	True	3534
L06	NC enable	Enable NeoCharge control via Modbus. ON: NeoCharge control. OFF: DX control. If enabled by Modbus, then this parameter needs to be set at least every 15 minutes, else controller switches to DX mode.	Off	On	Off		0	False	False	0 - 3	True	3536
L2F	Forced DX ctrl.	Force DX control when running WDX or CCR.	Off	On	Off		0	False	False	0 - 3	False	3605
L2E	SH SP DX	Superheat setpoint for forced DX mode (by Modbus, DI or L2F parameter)	0.5	40	8	K	1	False	False	0 - 3	True	3602
L08	Num Def SPOpt	Number of defrosts between automatic setpoint optimization. 0 = only initial optimization	0	100	0		0	False	False	0 - 3	True	3538
L27	SPOpt by DI	Enable automatic setpoint optimization by Digital Input	No	Yes	No		0	True	False	0 - 3	True	3582
L28	SPOpt start	Start automatic setpoint optimization	Off	On	Off		0	False	False	0 - 3	False	3583
L34	SPOpt MS on	Start setpoint optimization after main switch is turned On 0: Always 1: Use stored values (if no stored values then start SP opt) 2: Never, start manually or by digital input	Always	Never, start manually or by digital input	Always		0	False	False	0 - 3	True	3584
NeoCharge DX startup												
L30	NC DX startup	Run DX from main switch On until NeoCharge startup 0: Never 1: At first main switch On (or no setpoints found yet) 2: At every main switch On	Never	At every main switch On	Never		0	True	False	0 - 3	True	3607
L31	NC DX end	End NeoCharge DX startup process 0: By time 1: By air temperature 2: By evaporation temperature	By time	By air temperature	By time		0	True	False	0 - 3	True	3608
L32	NC DX end time	End time	1	180	10	min	0	False	False	0 - 3	True	3613
L33	NC DX end temp.	End temperature	-60	60	-20	°C	0	False	False	0 - 3	True	3614
NeoCharge advanced												
L07	Wetness level	Wetness level. 0: more dry. 10: more wet	0	10	5		0	False	False	0 - 3	True	3537
L09	AKV period CCR	AKV or AKVA period time for CCR control	6	9	9	sec	0	True	False	0 - 2	True	3546

21.6 Evaporator control

Label	Name	Description	Min.	Max.	Factory setting	Unit	Decimals	Locked by main switch	Read only	Password level Read - Write	Persistent	Modbus PLC address
Superheat control												
N01	SH ref. mode	Superheat reference mode 0: Fixed SH ref. 1: Load defined ctrl 2: Adaptive SH ctrl	Fixed SH ref.	Adaptive SH ctrl	Load defined ctrl		0	True	False	0 - 3	True	3003
N02	SH Fixed setpoint	Superheat fixed setpoint	0.5	40	8	K	1	False	False	0 - 3	True	3004
N03	SH max	Superheat maximum	0.5	40	10	K	1	False	False	0 - 2	True	3005
N04	SH min	Superheat minimum	0.5	10	4	K	1	False	False	0 - 2	True	3006
N09	SH close function	Superheat close function	No	Yes	Yes		0	True	False	0 - 2	True	3011
N10	SH close setpoint	Superheat close limit. The valve is forced to close below this superheat value	-5	20	2	K	1	False	False	0 - 3	True	3012
N11	SH close Tn divide	Division factor on integration time for PI controller closing valve at low superheat (increase value to decrease integration time and close valve faster)	1	5	3		0	False	False	0 - 3	True	3013
N12	SH close Kp factor	Factor on proportional gain for PI controller closing valve at low superheat (increase value to increase gain and close valve faster)	0.5	10	1.5		1	False	False	0 - 3	True	3014
Startup superheat control												
N20	Startup Mode	Startup mode 0: Prop.Ctrl 1: Fix OD w prot 2: Fix OD wo prot	Prop.Ctrl	Fix OD wo prot	Prop.Ctrl		0	True	False	0 - 3	True	3393
N21	Startup time	Startup time	1	600	90	sec	0	True	False	0 - 3	True	3394
N22	Min. startup time	Min. startup time	1	240	15	sec	0	True	False	0 - 3	True	3395
N23	Startup OD	Startup Opening Degree	1	100	32	%	0	True	False	0 - 3	True	3396
Expansion valve settings												
N17	AKV period	AKV or AKVA period time	3	6	6	sec	0	True	False	0 - 2	True	3019
N24	Minimum OD	Minimum Opening Degree	0	100	0	%	0	True	False	0 - 3	True	3398
N25	Maximum OD	Maximum Opening Degree	0	100	100	%	0	True	False	0 - 3	True	3399
MOP												
N13	MOP function	Maximum Operating Pressure	No	Yes	No		0	True	False	0 - 2	True	3015
N14	MOP setpoint	Maximum Operating Pressure setpoint	-70	60	0	°C	1	False	False	0 - 2	True	3016
Superheat advanced												
N05	SH Tn	Superheat controller integration time	20	900	600	sec	0	False	False	0 - 3	True	3007
N07	SH Kp	Superheat controller proportional gain	0.1	20	1.5		1	False	False	0 - 3	True	3009
N08	SH KpTe	Suction pressure feedback gain	0	20	3		1	False	False	0 - 3	True	3010
N06	SH Kp damp	Damping of gain near superheat setpoint	0.1	1	0.6		1	False	False	0 - 3	True	3008
MSS advanced												
N18	MSS stability	Minimum Stable Superheat stability	0	10	5		1	True	False	0 - 3	True	3397
N19	MSS T0 stability factor	Minimum Stable Superheat stability T0 factor	0	1	0		1	True	False	0 - 3	True	3390
MOP advanced												
N26	MOP Kp	MOP Kp	1	20	5		1	True	False	0 - 3	True	3400
N27	MOP Tn	MOP Tn	20	900	45	sec	0	True	False	0 - 3	True	3401

21.7 Evaporation pressure control

Label	Name	Description	Min.	Max.	Factory setting	Unit	Decimals	Locked by main switch	Read only	Password level Read - Write	Persistent	Modbus PLC address
Evaporation pressure control												
T17	Evap.Pres. SP To	Evaporation Pressure Setpoint	-70	160	0	°C	1	False	False	0 - 2	True	3415
T24	Limit LL	Closing LL when OD of WR/SL valve is below OD Limit LL	No	Yes	No		0	False	False	0 - 0	True	3507
T25	OD Limit LL	Limit in percentage	2	30	10	%	0	False	False	0 - 0	True	3508
T18	Evap.Pres. Kp	Proportional gain for Evaporation pressure control	0.5	50	3		1	False	False	0 - 3	True	3418
T19	Evap.Pres. Tn	Integration time for Evaporation pressure control	60	600	240	sec	0	False	False	0 - 3	True	3419
T20	Evap.Pres. Td	Derivative time for Evaporation pressure control	0	60	10	sec	0	False	False	0 - 3	True	3420
T21	Evap.Pres. mode	Evaporation pressure control mode 0: Normal 1: Min underswing 2: No underswing	Normal	No underswing	No underswing		0	False	False	0 - 3	True	3421
D3D	State at Cool. stopped	Status of control valve when cooling is stopped 0: Closed 1: Open 2: user defined	Closed	user defined	Open		0	True	False	0 - 3	True	3447
ICM valve limits												
D20	EPC ICM OD min	Min opening degree of ICM valve	0	100	0	%	0	True	False	0 - 3	True	3381
D21	EPC ICM OD max	Max opening degree of ICM valve	0	100	100	%	0	True	False	0 - 3	True	3382
D3G	ICMsafe OD at stop	ICM opening degree when cooling is stopped	0	100	50	%	0	False	False	0 - 3	True	3458
D3F	Suc.Pres.SP T at stop	Saturation temperature setpoint when cooling is stopped	-90	60	-90	°C	1	True	False	0 - 3	True	3441
CVE valve limits												
D22	EPC CVE OD min	Min opening degree of CVE valve	23	90	23	%	0	True	False	0 - 3	True	3416
D23	EPC CVE OD max	Max opening degree of CVE valve	23	90	90	%	0	True	False	0 - 3	True	3417
D3E	CVEsafe OD at stop	CVE opening degree when cooling stopped	23	90	56	%	0	True	False	0 - 3	True	3440

21.8 Thermostat control

Label	Name	Description	Min.	Max.	Factory setting	Unit	Decimals	Locked by main switch	Read only	Password level Read - Write	Persistent	Modbus PLC address
Thermostat control												
T02	No. of ther. sensor	Number of sensors connected to the controller 0: No sensor 1: One ther. sensor 2: Two ther. sensors 3: Three ther. Sensors	No sensor	Three ther. Sensors	One ther. sensor		0	True	False	0 - 2	True	3038
T03	Ctrl temp. method	Calculation of the control temperature for the thermostat 0: Highest temp. 1: Average temp.	Highest temp.	Average temp.	Highest temp.		0	False	False	0 - 2	True	3039
T04	Ther. setpoint	Thermostat set point temperature	-70	160	2	°C	1	False	False	0 - 2	True	3040
T05	Ther. neutral zone	Thermostat neutral zone (+ - to setpoint)	0.1	20	2	K	1	False	False	0 - 2	True	3041
Day/night control												
T06	Day/night control	Allow manual (or via network) control of Day/Night	No	Yes	No		0	False	False	0 - 3	True	3042
T07	Night operation	Set Night operation	No	Yes	No		0	False	False	0 - 2	True	3043
T08	Night offset	Offset of the thermostat set point temperature during night operation	-20	20	-2	K	1	False	False	0 - 2	True	3044
PWM liquid control												
T10	Pwm mod.period	Period for PWM liquid control	30	900	300	sec	0	False	False	0 - 3	True	3374
T11	Pwm Max OD	Max OD for PWM valve	0	100	100	%	0	False	False	0 - 3	True	3375
T12	Pwm Min OD	Min OD for PWM valve	0	100	0	%	0	False	False	0 - 3	True	3376
T13	Pwm Kp	Proportional gain for PWM liquid control	0.5	10	4		1	False	False	0 - 3	True	3377
T14	Pwm Tn	Integration time for PWM liquid control	60	1800	300	sec	0	False	False	0 - 3	True	3378
T15	Desynch. Pwm	Desynchronization of PWM duty to avoid simultaneousness with other control	No	Yes	No		0	True	False	0 - 3	True	3412
Modulating thermostat												
N36	S3 air in.temp.AI?	Air temperature sensor (S3) installed? 0: No use Ther.temp. 1: Yes	No use Ther.temp.	Yes	No use Ther.temp.		0	True	False	0 - 3	True	3405
N15	MTR Tn	Advanced parameter. Integration time for the MTR algorithm	20	3600	600	sec	0	False	False	0 - 3	True	3017
N16	MTR Kp	Advanced parameter. Proportional gain for the MTR algorithm	0.2	20	3		1	False	False	0 - 3	True	3018
Air temperature alarm												
B01	Air temp. alarm	Air temperature alarm function 0: None 1: Separate sensor 2: Thermostat temp.	None	Thermostat temp.	Thermostat temp.		0	True	False	0 - 3	True	3046
B02	High alarm limit	Upper alarm limit for the room temperature alarm function	-100	200	6	°C	1	True	False	0 - 2	True	3047
B03	Low alarm limit	Lower alarm limit for the room temperature alarm function	-100	200	-30	°C	1	True	False	0 - 2	True	3048
B04	Alarm delay	Alarm delay time during normal control used for both high- and low temperature alarms	0	240	120	min	0	True	False	0 - 2	True	3049
Product temperature alarm												
B05	Prod.alarm function	Product temperature alarm	No	Yes	No		0	True	False	0 - 3	True	3050
B06	Prod. high al. limit	Upper alarm limit for the product temperature alarm	-100	200	6	°C	1	True	False	0 - 2	True	3051
B07	Prod. low al. limit	Lower alarm limit for the product temperature alarm	-100	200	-30	°C	1	True	False	0 - 2	True	3052
B08	Prod. alarm delay	Alarm delay time for the product temperature alarm	0	240	120	min	0	True	False	0 - 2	True	3053

21.9 Defrost control

Label	Name	Description	Min.	Max.	Factory setting	Unit	Decimals	Locked by main switch	Read only	Password level Read - Write	Persistent	Modbus PLC address
Defrost start methods												
D10	Man. def. start	Manual defrost start	Off	On	Off		0	False	False	0 - 2	False	3054
D11	Def. time interval	Interval between defrost starts in hours (0 = function Off)	0	240	0	hours	0	True	False	0 - 2	True	3075
D12	Def. start acc. Cool	Defrost start via accumulated cooling time. Acc. cooling time in hours between defrost starts (0 = function Off)	0	240	0	hours	0	True	False	0 - 2	True	3076
D13	Time staggering	Defrost start time delay after power	0	240	0	min	0	True	False	0 - 2	True	3077
D15	Def. start schedule	Defrost start by schedule	No	Yes	No		0	True	False	0 - 3	True	3056
DA1	Def. 1 sch.MONDAY	Defrost start time for MONDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3277
DA2	Def. 2 sch.MONDAY	Defrost start time for MONDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3278
DA3	Def. 3 sch.MONDAY	Defrost start time for MONDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3279
DA4	Def. 4 sch.MONDAY	Defrost start time for MONDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3280
DA5	Def. 5 sch.MONDAY	Defrost start time for MONDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3281
DA6	Def. 6 sch.MONDAY	Defrost start time for Monday	00:00	23:59	00:00		0	False	False	0 - 2	True	3282
DX1	Copy MONDAY to	Copy MONDAY schedules to another day or a weekday or all days 0: MONDAY 1: TUESDAY 2: WEDNESDAY 3: THURSDAY 4: FRIDAY 5: SATURDAY 6: SUNDAY 7: weekdays 8: all days	MONDAY	all days	MONDAY		0	False	False	0 - 2	True	3324
DB1	Def. 1 sch.TUESDAY	Defrost start time for TUESDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3283
DB2	Def. 2 sch.TUESDAY	Defrost start time for TUESDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3284
DB3	Def. 3 sch.TUESDAY	Defrost start time for TUESDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3285
DB4	Def. 4 sch.TUESDAY	Defrost start time for TUESDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3286
DB5	Def. 5 sch.TUESDAY	Defrost start time for TUESDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3287
DB6	Def. 6 sch.TUESDAY	Defrost start time for TUESDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3288
DC1	Def. 1 sch.WEDNESDAY	Defrost start time for WEDNESDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3289
DC2	Def. 2 sch.WEDNESDAY	Defrost start time for WEDNESDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3290
DC3	Def. 3 sch.WEDNESDAY	Defrost start time for WEDNESDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3291
DC4	Def. 4 sch.WEDNESDAY	Defrost start time for WEDNESDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3292
DC5	Def. 5 sch.WEDNESDAY	Defrost start time for WEDNESDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3293
DC6	Def. 6 sch.WEDNESDAY	Defrost start time for WEDNESDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3294
DD1	Def. 1 sch.THURSDAY	Defrost start time for THURSDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3295
DD2	Def. 2 sch.THURSDAY	Defrost start time for THURSDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3296
DD3	Def. 3 sch.THURSDAY	Defrost start time for THURSDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3297
DD4	Def. 4 sch.THURSDAY	Defrost start time for THURSDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3298
DD5	Def. 5 sch.THURSDAY	Defrost start time for THURSDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3299
DD6	Def. 6 sch.THURSDAY	Defrost start time for THURSDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3300
DE1	Def. 1 sch.FRIDAY	Defrost start time for FRIDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3301
DE2	Def. 2 sch.FRIDAY	Defrost start time for FRIDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3302

DE3	Def. 3 sch.FRIDAY	Defrost start time for FRIDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3303
DE4	Def. 4 sch.FRIDAY	Defrost start time for FRIDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3304
DE5	Def. 5 sch.FRIDAY	Defrost start time for FRIDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3305
DE6	Def. 6 sch.FRIDAY	Defrost start time for FRIDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3306
DF1	Def. 1 sch.SATURDAY	Defrost start time for SATURDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3307
DF2	Def. 2 sch.SATURDAY	Defrost start time for SATURDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3308
DF3	Def. 3 sch.SATURDAY	Defrost start time for SATURDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3309
DF4	Def. 4 sch.SATURDAY	Defrost start time for SATURDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3310
DF5	Def. 5 sch.SATURDAY	Defrost start time for SATURDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3311
DF6	Def. 6 sch.SATURDAY	Defrost start time for SATURDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3312
DG1	Def. 1 sch.SUNDAY	Defrost start time for SUNDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3313
DG2	Def. 2 sch.SUNDAY	Defrost start time for SUNDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3314
DG3	Def. 3 sch.SUNDAY	Defrost start time for SUNDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3315
DG4	Def. 4 sch.SUNDAY	Defrost start time for SUNDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3316
DG5	Def. 5 sch.SUNDAY	Defrost start time for SUNDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3317
DG6	Def. 6 sch.SUNDAY	Defrost start time for SUNDAY	00:00	23:59	00:00		0	False	False	0 - 2	True	3318
Defrost stop methods												
D40	Defrost stop method	Defrost stop method 1: Stop on time 2: Stop on temperature 4: Stop on 2 temperatures	Stop on time	Stop on 2 temperatures	Stop on time		0	True	False	0 - 3	True	3078
D41	Man. def. stop	Manual defrost stop	Off	On	Off		0	False	False	0 - 2	False	3079
D43	Def. stop limit	Defrost stop temperature limit	0	25	8	°C	1	False	False	0 - 2	True	3081
Defrost sequence												
D50	Pump down delay	Draining the evaporator before defrosting	1	60	10	min	0	True	False	0 - 2	True	3086
D51	HG open delay	Time delay in minutes before opening the hot gas valve (delay for the solenoid valve in the wet return/suction line to close)	1	10	5	min	0	True	False	0 - 2	True	3087
D5A	Drip tray pre-heat	Pre-heating time for hot gas to drip tray	0	20	5	min	0	True	False	0 - 2	True	3256
D5B	Drip tray delay OFF	Continue drip tray heating some defined time	0	120	30	min	0	True	False	0 - 2	True	3257
D57	Quick drain time	Used when 'Quick Drain valve' is selected	0	300	30	sec	0	True	False	0 - 2	True	3102
D53	HG soft time	Time between step 1 and step 2 for opening the hot gas valve (2 DO used)	1	30	3	min	0	True	False	0 - 2	True	3098
D54	HG time step 1	ICM motor valve: Step 1 controlled opening "to HG OD step 1"	0	30	3	min	0	True	False	0 - 2	True	3099
D55	HG OD step 1	ICM motor valve: Valve opening from 0% to 'HG OD step 1' inside 'HG time step 1' time	0	100	20	%	0	True	False	0 - 2	True	3100
D56	HG time step 2	ICM motor valve: Controlled opening in step 2	1	30	2	min	0	True	False	0 - 2	True	3101
D58	Max defrost time	Max. allowed defrost duration in minutes	1	120	30	min	0	True	False	0 - 2	True	3089
D78	Min defrost time	Minimum defrost time if defrost stop on temperature	0	120	0	min	0	False	False	0 - 2	True	3619
D67	Water valve delay	Delay before opening the Water valve	0	240	15	min	0	True	False	0 - 2	True	3334
D68	Water valve time	Water valve “open” duration	1	120	15	min	0	True	False	0 - 2	True	3335
D5C	HG close delay	Delay before closing the HG1 soft valve (only when soft gas valve used)	0	120	15	sec	0	True	False	0 - 2	True	3258
D5D	Drain close delay	Delay before the Drain valve is closed (only when Drain valve is selected)	0	10	2	min	0	True	False	0 - 2	True	3259
D59	Drip off time	Drip-off time in minutes	1	15	5	min	0	True	False	0 - 2	True	3090

D72	Drain equalizing time	Drain and Quick Drain equalizing time after Drip Off	0	600	0	sec	0	True	False	0 - 2	True	3464
D69	WR/SL pr. equalising	WR/SL pressure equalizing time	1	10	5	min	0	True	False	0 - 2	True	3414
D61	WR/SL soft time	Opening time for first step (step 1) of the wet return/suction line valve	1	30	2	min	0	True	False	0 - 2	True	3094
D6A	WR/SL main time	Opening time for main step (step 2) before liquid line valve is opened	1	30	2	min	0	True	False	0 - 2	True	3260
D62	WR/SL time step 1	ICM motor valve: Step 1 controlled opening "to WR/SL OD step 1"	0	30	3	min	0	True	False	0 - 2	True	3095
D63	WR/SL OD step 1	ICM motor valve: Valve opening from 0% to 'WR/SL OD step 1' inside 'WR/SL time step 1' time	0	100	20	%	0	True	False	0 - 2	True	3096
D64	WR/SL time step 2	ICM motor valve: Controlled opening in step 2	1	30	2	min	0	True	False	0 - 2	True	3097
D70	Time avg CVE OD	Time to calculate the average value of CVE opening degree	0	120	30	min	0	True	False	0 - 2	True	3438
D71	Time restore CVE OD	Time to maintain the average opening degree of the CVE after defrost	0	120	10	min	0	True	False	0 - 2	True	3439
D73	Fan delay at main switch on	Fan delay after main switch set to on or power up	No	Yes	Yes		0	True	False	0 - 3	True	3595
D75	Fan start after defrost	Fan start after defrost 0: 0=Timer 1: 1=Timer or temperature	0=Timer	1=Timer or temperature	0=Timer		0	True	False	0 - 3	True	3599
D65	Fan start delay	Delay before start of fans. The injection is started in this state, but the fans are not running	0	30	2	min	0	True	False	0 - 2	True	3092
D74	Fan start temp	Fan start temperature	-60	10	-5	°C	1	False	False	0 - 3	True	3596
D76	Fan ctrl. in defrost	Fans during defrost 0: Stopped 1: Low speed 2: High speed	Stopped	High speed	Stopped		0	True	False	0 - 3	True	3093

21.10 Fan control

Label	Name	Description	Min.	Max.	Factory setting	Unit	Decimals	Locked by main switch	Read only	Password level Read - Write	Persistent	Modbus PLC address
F12	Cont. fan after cutout	Use fan cutout delay in On-Off control	No	Yes	No		0	True	False	0 - 3	True	3600
F13	Fan cutout delay	Cutout delay	1	30	5	min	0	False	False	0 - 3	True	3601
F02	Fan speed high	Fan speed high	0	100	100	%	0	True	False	0 - 2	True	3104
F03	Fan speed low	Fan speed low	0	100	50	%	0	True	False	0 - 2	True	3105
F04	Offset speed low	Offset speed low	-20	20	0	K	1	False	False	0 - 3	True	3459
F05	Offset speed high	Offset speed high	-20	20	5	K	1	False	False	0 - 3	True	3460
F06	Cycling OFF time	Cycling OFF time	1	120	5	min	0	False	False	0 - 3	True	3461
F07	Cycling ON time	Cycling ON time	1	120	5	min	0	False	False	0 - 3	True	3462
F08	Fan on when forced closed	Set whether fan should be on when forced closed from DI or master control	No	Yes	No		0	False	False	0 - 3	True	3513

21.11 Controller coordination

Label	Name	Description	Min.	Max.	Factory setting	Unit	Decimals	Locked by main switch	Read only	Password level Read - Write	Persistent	Modbus PLC address
Controller groups												
G17	Number of groups	Number of evaporator groups. There are 120 CAN-bus addresses, so if there is 10 groups, there is maximum 12 controllers in each group	1	60	4		0	False	False	1 - 3	True	3579
Sensor sharing												
R11	Com. press transmitter	Common pressure transmitter 0: No 1: Sharing on CAN-bus 2: Receiving from CAN-bus	No	Receiving from CAN-bus	No		0	True	False	0 - 3	True	3573

G18	CAN Bus sharing min. update interval	Min update interval for sharing values on CAN bus	5	60	10	s	0	False	False	1 - 1	True	3580
Defrost												
D05	Cool at HG defrost	Hot gas defrost coordinated locally, start forced cooling when another controller in the group is defrosting	No	Yes	No		0	True	False	0 - 3	True	3082
D77	Cool at HG open	Forced cooling only when hot gas valve is open	No	Yes	No		0	True	False	0 - 3	True	3618
D16	Coordinated defrost	Coordinate defrost between evaporators within a group	No	Yes	No		0	True	False	0 - 3	True	3577
D17	Max simultaneous defrosts	Max simultaneous defrosts in pct of number of evaporators in a group	0	100	33	%	0	True	False	0 - 3	True	3578
NeoCharge												
L2A	Coord NeoCharge CCR	Coordinated NeoCharge, CCR	No	Yes	No		0	False	False	0 - 3	True	3586
L24	Coord NeoCharge WDX	Coordinated NeoCharge, WDX	No	Yes	Yes		0	False	False	0 - 3	True	3574
L25	Max simul. SPOpt	Max simultaneous setpoint optimizations in pct of number of evaporators in a group	0	100	33	%	0	False	False	0 - 3	True	3575
L26	SPOpt independent on defrost	Allow coordinated setpoint optimization to be independent on coordinated defrost.	No	Yes	No		0	False	False	0 - 3	True	3576

21.12 External reference

Label	Name	Description	Min.	Max.	Factory setting	Unit	Decimals	Locked by main switch	Read only	Password level Read - Write	Persistent	Modbus PLC address
Superheat setpoint												
N28	Ext.Ref.DX config	Offset of superheat setpoint by external signal 0: Not used 1: Displaced by current 2: Displaced by voltage 3: Displaced by modbus 4: Displaced by DI	Not used	Displaced by DI	Not used		0	True	False	0 - 3	True	3402
N29	Ref.Offset SH Max	Offset of setpoint, max value	0	50	0	K	1	False	False	0 - 3	True	3410
N30	Ref.Offset SH Min	Offset of setpoint, min value	-70	0	0	K	1	False	False	0 - 3	True	3409
N31	Ref.Current SH High	AI signal range - high value	0	20	20	mA	1	False	False	0 - 3	True	3354
N32	Ref.Current SH Low	AI signal range - low value	0	20	4	mA	1	False	False	0 - 3	True	3355
N33	Ref.Voltage SH High	AI signal range - high value	0	10	10	V	1	False	False	0 - 3	True	3356
N34	Ref.Voltage SH Low	AI signal range - low value	0	10	0	V	1	False	False	0 - 3	True	3357
N35	Ref.Offset SH Modbus	Offset value send via network	-70	50	0	K	1	False	False	0 - 3	True	3358
N38	Ref. Offset SH by DI	Offset value when DI is open, 0 K if closed	-70	50	0	K	1	False	False	0 - 3	True	3470
Thermostat setpoint												
P10	Ext. ref. config.	Offset of thermostat setpoint by external signal 0: Not used 1: Displace by current 2: Displace by voltage 3: Displace by modbus 4: Displace by DI	Not used	Displace by DI	Not used		0	True	False	0 - 3	True	3118
P11	Ref. offset max	Offset of setpoint - max value	0	160	0	K	1	False	False	0 - 3	True	3119
P12	Ref. offset min	Offset of setpoint - min value	-70	0	0	K	1	False	False	0 - 3	True	3120
P13	Ref. current high	AI signal range - high value	0	20	20	mA	1	False	False	0 - 3	True	3121
P14	Ref. current low	AI signal range - low value	0	20	4	mA	1	False	False	0 - 3	True	3122
P15	Ref. voltage high	AI signal range - high value	0	10	10	V	1	False	False	0 - 3	True	3123
P16	Ref. voltage low	AI signal range - low value	0	10	0	V	1	False	False	0 - 3	True	3124
P18	Ref. offset by modbus	Offset value send via network	-70	160	0	K	1	False	False	0 - 3	True	3126
P19	Ref. offset by DI	Offset value when DI is open, 0 K if closed	-70	160	0	K	1	False	False	0 - 3	True	3469
Evaporation pressure setpoint												
P26	Ext ref. T0 config.	Offset of saturation temperature setpoint for Evaporation pressure control by pressure 0: Not used 1: Displace by current 2: Displace by voltage 3: Displace by modbus 4: Displace by DI	Not used	Displace by DI	Not used		0	True	False	0 - 3	True	3486

P27	Ref. offset T0 max	Offset of setpoint - max value	0	50	0	K	1	False	False	0 - 3	True	3487
P28	Ref. offset T0 min	Offset of setpoint - min value	-70	0	0	K	1	False	False	0 - 3	True	3488
P29	Ref. current T0 high	AI signal range - high value	0	20	20	mA	1	False	False	0 - 3	True	3489
P30	Ref. current T0 low	AI signal range - low value	0	20	4	mA	1	False	False	0 - 3	True	3490
P31	Ref. voltage T0 high	AI signal range - high value	0	10	10	V	1	False	False	0 - 3	True	3491
P32	Ref. voltage T0 low	AI signal range - low value	0	10	0	V	1	False	False	0 - 3	True	3492
P33	Ref. offset T0 by modbus	Offset value send via network	-70	50	0	K	1	False	False	0 - 3	True	3493
P34	Ref. offset T0 by DI	Offset value when DI is open, 0 K if closed	-70	50	0	K	1	False	False	0 - 3	True	3494
AI filter												
P17	Lowpass bandwidth	Filtering of the analog input signal 0: None 1: 4 Hz 2: 2 Hz 3: 1 Hz 4: 0.5 Hz 5: 0.2 Hz	None	0.2 Hz	0.2 Hz		0	False	False	0 - 3	True	3125

21.13 Emergency cooling

Label	Name	Description	Min.	Max.	Factory setting	Unit	Decimals	Locked by main switch	Read only	Password level Read - Write	Persistent	Modbus PLC address
P20	Ther. sensor error	Thermostat sensor error. Emergency cooling operation 0: Close valve 1: Fixed OD 2: Use average OD	Close valve	Use average OD	Close valve		0	True	False	0 - 3	True	3127
P22	Fixed OD emer. cool	Fixed valve OD at emergency cooling	0	100	0	%	0	True	False	0 - 3	True	3129
P21	SH sensor error	S2 or Pe sensor error. Emergency cooling operation 0: Close valve 1: Fixed OD 2: Use average OD	Close valve	Use average OD	Close valve		0	True	False	0 - 3	True	3128
P2A	Fixed OD emer. cool	Fixed valve OD at emergency cooling	0	100	0	%	0	True	False	0 - 3	True	3404
P23	Evap.Pres.ctrl sensor error	Evaporation pressure control by pressure sensor error. Emergency cooling operation 0: Close valve 1: Fixed OD 2: Valve fully open	Close valve	Valve fully open	Valve fully open		0	True	False	0 - 3	True	3130
P24	Fixed OD emer. cool	Fixed valve OD at emergency cooling	0	100	0	%	0	True	False	0 - 3	True	3131

21.14 Alarm setting

Label	Name	Description	Min.	Max.	Factory setting	Unit	Decimals	Locked by main switch	Read only	Password level Read - Write	Persistent	Modbus PLC address
Alarm priority settings												
P02	Alarm output DO	Alarm priority that will activate a digital output 0: No relay 1: Critical alarms 2: Severe alarms 3: All alarms	No relay	All alarms	No relay		0	True	False	0 - 3	True	3116
cAB	Buzzer Management	Alarm priority that will activate the buzzer 0: No buzzer 1: Critical alarms 2: Severe alarms 3: All alarms	No buzzer	All alarms	No buzzer		0	False	False	0 - 3	True	3274
Evaporator control												
A48	Pressure sens.error	Pressure transmitter error 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3506
A76	S2 temp error	S2 temperature sensor error 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3359

A77	S3 temp error	S3 temperature sensor error 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3360
NeoCharge												
A92	NC sensor temp. error	NeoCharge sensor temperature sensor error 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3526
A93	NC sensor power error	NeoCharge sensor power error 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3527
A95	S2 bias alarm	S2 bias is too large 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3588
A96	NC sensor overheat alarm	NeoCharge sensor is overheated 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3589
A98	NC AI wiring error	Wrong wiring of NeoCharge sensor and S2 sensor 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Severe		0	False	False	0 - 2	True	3606
Thermostat control												
A50	Ther. air sensor error	Thermostat temperature sensor error 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3132
A51	Ther. air 2 sensor error	Thermostat temperature sensor 2 error 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3133
A52	Ther. air 3 sensor error	Thermostat temperature sensor 3 error 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3134
A53	Air alarm sensor error	Air alarm sensor error 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3135
A61	High temp. alarm	The room temperature is too high 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Critical		0	False	False	0 - 2	True	3143
A62	Low temp. alarm	The room temperature is too low 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Critical		0	False	False	0 - 2	True	3144
A55	Product sensor error	Product temperature sensor error 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3137
A63	High product temp. alarm	The product temperature is too high 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Severe		0	False	False	0 - 2	True	3145
A64	Low product temp. alarm	The product temperature is too low 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Severe		0	False	False	0 - 2	True	3146
Defrost												

A54	Defrost sensor error	Defrost temperature sensor error 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3136
A97	Defrost sensor 2 err.	Defrost temperature sensor 2 error 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3594
A65	Max. defrost time	Max allowed defrost time is exceeded 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3147
I/O functions												
A59	Standby mode	Control is stopped by internal or external Main Switch (DI input) 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3141
A66	Output in MAN mode	An output is set in manual mode 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3148
A68	Safety stop alarm	Safety stop alarm 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Critical		0	False	False	0 - 2	True	3332
A69	Gas detector err.	Gas detector error 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3352
A89	Humidity sens.error	Humidity sensor error 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3498
A91	Fan DI alarm	Fan digital input alarm 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3514
External reference												
A49	Ext.Ref.Ther error	External reference for thermostat setpoint error 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3353
A79	Ext.Ref.SH error	External reference input for superheat setpoint error 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3408
A90	Ext.Ref.T0 error	External reference input for T0 setpoint error 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3499
Valves												
A83	LL valve DI alarm	Liquid line valve alarm by DI 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3448
A84	WR/SL valve DI alarm	Wet return/suction line valve alarm by DI 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3449
A85	HG valve DI alarm	Hot Gas line valve alarm by DI 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3450

A86	LL valve AI alarm	LL line ICAD input error (out of scale) 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3495
A87	WR/SL valve AI alarm	WR/SL line ICAD input error (out of scale) 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3496
A88	HG valve AI alarm	HG line ICAD input error (out of scale) 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3497
A80	LL valve DI alarm	Liquid line valve digital input from ICAD	No	Yes	No		0	True	False	0 - 3	True	3443
A81	WR/SL valve DI alarm	Wet return/suction line valve digital input from ICAD	No	Yes	No		0	True	False	0 - 3	True	3444
A82	HG valve DI alarm	Hot Gas line valve digital input from ICAD	No	Yes	No		0	True	False	0 - 3	True	3445
Controller coordination												
A94	Bus share timeout error	Timeout error sharing pressure transmitter 0: Critical 1: Severe 2: Normal 3: Disable	Critical	Disable	Normal		0	False	False	0 - 2	True	3581
Alarm messages												
AlarmE01	Ext.Ref.Ther error	External reference for thermostat setpoint error	0	0	0		0	False	True	0 - 0	False	1901
AlarmA50	Ther. air sensor error	Thermostat temperature sensor error	0	0	0		0	False	True	0 - 0	False	1901
AlarmA51	Ther. air 2 sensor error	Thermostat temperature sensor 2 error	0	0	0		0	False	True	0 - 0	False	1901
AlarmA52	Ther. air 3 sensor error	Thermostat temperature sensor 3 error	0	0	0		0	False	True	0 - 0	False	1901
AlarmA53	Air alarm sensor error	Air alarm sensor error	0	0	0		0	False	True	0 - 0	False	1901
AlarmA54	Defrost sensor error	Defrost temperature sensor error	0	0	0		0	False	True	0 - 0	False	1901
AlarmA55	Product sensor error	Product temperature sensor error	0	0	0		0	False	True	0 - 0	False	1901
AlarmA56	Evap. inlet sensor error	Evaporator inlet temperature sensor error	0	0	0		0	False	True	0 - 0	False	1901
AlarmA57	Evap. outlet sensor error	Evaporator outlet temperature sensor error	0	0	0		0	False	True	0 - 0	False	1901
AlarmA58	Evap. air outlet sensor error	Evaporator air outlet temperature sensor error	0	0	0		0	False	True	0 - 0	False	1901
AlarmA59	Standby mode	Control is stopped by internal or external Main Switch (DI input)	0	0	0		0	False	True	0 - 0	False	1901
AlarmA60	Refrigerant not set	No refrigerant has been selected	0	0	0		0	False	True	0 - 0	False	1901
AlarmA61	High temp. alarm	The room temperature is too high	0	0	0		0	False	True	0 - 0	False	1901
AlarmA62	Low temp. alarm	The room temperature is too low	0	0	0		0	False	True	0 - 0	False	1901
AlarmA63	High product temp. alarm	The product temperature is too high	0	0	0		0	False	True	0 - 0	False	1902
AlarmA64	Low product temp. alarm	The product temperature is too low	0	0	0		0	False	True	0 - 0	False	1902
AlarmA65	Max. defrost time	Max allowed defrost time is exceeded	0	0	0		0	False	True	0 - 0	False	1902

AlarmA66	Output in MAN mode	An output is set in manual mode	0	0	0		0	False	True	0 - 0	False	1902
AlarmA67	IO config. error	Not all inputs and output functions have been assigned to hardware inputs or outputs	0	0	0		0	False	True	0 - 0	False	1902
AlarmA68	Safety stop alarm	Safety stop by digital input, need a manual reset to remove it	0	0	0		0	False	True	0 - 0	False	1902
AlarmA69	Gas detector err.	Gas detector error	0	0	0		0	False	True	0 - 0	False	1902
AlarmA76	S2 temp error	S2 temperature sensor error	0	0	0		0	False	True	0 - 0	False	1902
AlarmA77	S3 temp error	S3 temperature sensor error	0	0	0		0	False	True	0 - 0	False	1902
AlarmA78	High pressure MOP	High pressure in MOP control	0	0	0		0	False	True	0 - 0	False	1902
AlarmA79	Ext.Ref.SH error	External reference input for superheat setpoint error	0	0	0		0	False	True	0 - 0	False	1902
AlarmA83	LL valve DI alarm	Liquid line valve alarm by DI	0	0	0		0	False	True	0 - 0	False	1902
AlarmA84	WR/SL valve DI alarm	Wet return/suction line valve alarm by DI	0	0	0		0	False	True	0 - 0	False	1902
AlarmA85	HG valve DI alarm	Hot Gas line valve alarm by DI	0	0	0		0	False	True	0 - 0	False	1902
AlarmA86	LL valve AI alarm	LL line ICAD input error (out of scale)	0	0	0		0	False	True	0 - 0	False	1902
AlarmA87	WR/SL valve AI alarm	WR/SL line ICAD input error (out of scale)	0	0	0		0	False	True	0 - 0	False	1902
AlarmA88	HG valve AI alarm	HG line ICAD input error (out of scale)	0	0	0		0	False	True	0 - 0	False	1903
AlarmA89	Humidity sens.error	Humidity sensor error	0	0	0		0	False	True	0 - 0	False	1903
AlarmA90	Ext.Ref.T0 error	External reference input for T0 setpoint error	0	0	0		0	False	True	0 - 0	False	1903
AlarmA91	Fan DI alarm	Fan digital input alarm	0	0	0		0	False	True	0 - 0	False	1903
AlarmA92	NC sensor temp. error	NeoCharge sensor temperature sensor error	0	0	0		0	False	True	0 - 0	False	1903
AlarmA93	NC sensor power error	NeoCharge sensor power error	0	0	0		0	False	True	0 - 0	False	1903
AlarmA94	Bus share timeout error	Timeout error sharing pressure transmitter	0	0	0		0	False	True	0 - 0	False	1903
AlarmA95	S2 bias alarm	S2 bias is too large	0	0	0		0	False	True	0 - 0	False	1903
AlarmA96	NC sensor overheat alarm	NeoCharge sensor is overheated	0	0	0		0	False	True	0 - 0	False	1903

21.15 System settings

Label	Name	Description	Min.	Max.	Factory setting	Unit	Decimals	Locked by main switch	Read only	Password level Read - Write	Persistent	Modbus PLC address
Display												

G01	Language	Language 0: English 5: French 3: Italian 4: German 16: Dutch 17: Japan 13: Portoguese 6: Spanish 9: Russian 14: Chinese 18: Korean	English	Korean	English		0	True	False	0 - 2	True	3106
G02	Time format	Time format 0: 24-hour format 1: 12-hour format.	24-hour format	12-hour format.	24-hour format		0	False	False	0 - 2	True	3107
P01	Temperature units	Temperature unit 0: °C 1: °F	°C	°F	°C		0	False	False	0 - 2	True	3115
G03	Screen saver time	Screen saver time (minutes before display is dimmed)	1	60	2	min	0	False	False	0 - 2	True	3189
G04	User logout time	User logout time (minutes before display is dimmed)	1	60	2	min	0	False	False	0 - 2	True	3191
G05	Display contrast	Display contrast	0	100	30	%	0	False	False	0 - 2	True	3190
Network												
G11	Modbus address	Modbus address of controller	1	120	1		0	True	False	1 - 3	True	3111
G12	Baudrate	Baudrate (default 38.400) 0: 0 1: 1200 2: 2400 3: 4800 4: 9600 5: 14400 6: 19200 7: 28800 8: 38400	0	38400	38400		0	True	False	1 - 3	True	3112
G13	Serial mode	Serial modbus mode 0: 8N1 (8 bit, No parity, 1 stop bit) 1: 8E1 (8 bit, Even parity, 1 stop bit) 2: 8N2 (8 bit, No parity, 2 stop bit)	8N1 (8 bit, No parity, 1 stop bit)	8N2 (8 bit, No parity, 2 stop bit)	8E1 (8 bit, Even parity, 1 stop bit)		0	True	False	1 - 3	True	3113
Reset to factory												
G14	Reset to factory	If this function is selected, all settings will be returned to factory settings, and the alarm list will be cleared.	Off	On	Off		0	True	False	3 - 3	True	3114

21.15.1 Setting the Real time clock

The real time clock value in EKE 400/450 is a 32-bit integer value holding the seconds passed since 1/1-1970.

To read the real time clock in the EKE 400/450 read value at address 1807 and 1808.

To change the time, write to address 1810 and 1811.

Note that the value is using big endian.

21.16 IO status

Reading the status of the 8 digital output channels is done by reading the value (a 16-bit unsigned integer) on Modbus register 1003. The On/Off value of the digital output channel 1 to 8 is in bit 8 to 15 or the value read.

Reading the status of the 8 digital input channels is done by reading the value (a 16-bit unsigned integer)on Modbus register 1001. The On/Off value of the digital input channels 1 to 8 is in bit 8 to 15 or the value read.

The values of the analog outputs 1 to 4 can be read on Modbus addresses 1037 to 1040.

The values of the analog inputs 1 to 8 can be read on Modbus addresses 1005 to 1012.

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CoolConfig – configuring electronic controller

The CoolConfig tool allows the project engineer to generate the settings for the EKE 400/450 evaporator controller offline, and hand over the file to the commissioning engineer at the appropriate time for the installation on one or multiple EKE 400/450 evaporator controllers. It also allows the commissioning engineer to download the settings from an EKE 400/450 evaporator controller already installed at a job- site and modify and store these on a PC. Can also be used to update EKE 400/450 to latest released software.

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