



Application Guide

Heat Recovery Unit





Application Guide | Heat Recovery Unit

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1. Introduction

Refrigeration systems with transcritical CO_2 have been taking market shares in recent years. Transcritical systems are now everyday business and the technology is mature. The application guideline contains a short background on the theory behind heat reclaim in transcritical systems and how to correctly select the Danfoss Heat Recovery Unit to get the highest overall system efficiency. It also covers setup procedures for the Danfoss Heat Recovery Unit (HRU), dedicated configuration settings related to interactions with the Danfoss Pack Controller AK-PC 782A and integration with the Danfoss Front End system AKSM 800A as well.





1.1 Properties of carbon dioxide

Carbon dioxide CO_2 is a natural substance that plays an important role in many natural and industrial processes. In nature, carbon dioxide plays a role in photosynthesis in plants and is one of the most important contributors to the global warming effect. In industry, carbon dioxide is used as dry ice for transport cooling, to generate the sparkling effect in some beverages, and as a protection.

It is odorless, non-flammable, and non-toxic, but if the concentration of carbon dioxide rises above the natural level in atmospheric air, it will cause the human breathing rate to increase. It is heavier than air, so if large quantities escape in a closed room the highest concentrations will typically be found close to the floor.

When carbon dioxide is used as a refrigerant it is often referred to by its refrigerant number R744.

Figure 1. shows a phase diagram of R744. The three well-known phases: solid, liquid and vapor are shown as colored areas. A phase change occurs when a process crosses a boundary between areas like evaporation or condensation for a process crossing the boundary between liquid and vapor phases. At the boundaries, the two phases exist in equilibrium, and properties, such as temperature and pressure, become dependent. The boundary line between liquid and vapor are often referred to as the vapor pressure curve. Two important state points are marked in the figure: the triple point and the critical point. The triple point represents the condition where all three phases can co-exist in equilibrium. At temperatures below the triple point temperature, liquid cannot exist - in other words the triple point temperature sets the lower temperature limit for any heat transfer process based on evaporation or condensation. At the other end of the vapor pressure curve, the critical point marks the upper limit for heat transfer processes based on evaporation or condensation.

At temperatures and pressures higher than those at the critical point, no clear distinction can be drawn between what is called liquid and what is called vapor. Thus, there is a region extending indefinitely upward from, and indefinitely to the right of, the critical point - and this region is called the fluid region. The fluid region is bounded by lines that do not represent phase changes, but which conform to arbitrary definitions of what is considered a liquid and what is considered vapor. A condition in the fluid region is referred to as a supercritical condition or very often also as a gas condition.

All substances have a triple point and a critical point, but for most of the substances used as refrigerants, the triple point and critical point are found for conditions that lie outside the region where they are normally used.





1.2 Heat recovery in CO₂ transcritical systems

In normal systems with condensing refrigerants, pressure and temperature are tied together, but in transcritical systems pressure and temperature can be controlled individually. This gives some possibilities regarding heat reclaim.

During normal operation without heat reclaim, the high pressure is kept at a level where the optimum COP is obtained. Please observe the red line in Figure 2. The pressure in the gas cooler is controlled by the Vhp valve. Regulation must have inputs from both a pressure transmitter Pgc and a temperature sensor out of gas cooler Sgc. Both must be fitted in the outlet and it is very important to install sensor Sgc immediately after the gas cooler.



Figure 2.: Optimum COP line with dependency upon temperature out of gas cooler





If the gas can be routed outside of the gas cooler by V3gc valve, a Shp sensor must be installed. If the Shp sensor measures too high a temperature, the gases will be routed through the gas cooler again. This is done automatically by a pack controller AK-PC 782A. During cold periods, if ambient temperatures allow, the pressure is typically kept at minimum 48 bar ~ 9 °C or higher. At this pressure there is very limited potential for heat reclaim. If the pressure is raised, the amount of heat that can be reclaimed and the achieved water temperature increase.



Example: In a heating system, there is a request to heat recirculating water from return temperature 27°C to supply temperature 55°C. The ambient temperature is below 5°C, enabling a low temperature out of the gas cooler. Heat load on the system needs to be reclaimed with the lowest possible energy consumption. The

temperature difference of the heat reclaim HX is set to 5 K at the outlet. The temperature out of the gas cooler is kept at 9°C in all modes where the gas cooler is active. By getting more heat recovery request, the temperature out of the gas cooler will be increased up to the optimum COP line, reaching Maximum Heat Recovery operation mode.



Under these conditions, the discharge temperature from the compressors is approx. 50°C and therefore it is not possible to produce 55°C hot water. To make the system able to deliver 55°C, the discharge pressure needs to be higher and therefore the pressure needs to be raised.

At 50 bar high pressure, the discharge temperature is around 55°C and therefore it is possible to start reclaiming heat from the system, but there is not enough temperature difference on the heat exchanger. By increasing the pressure further, the amount of heat taken out of the system increases.

Further increasing pressure in the gas cooler, the heat reclaim ratio and discharge temperature increase.







Keeping the same temperature out of the gas cooler and 80 bar in the gas cooler, approximately 73% of the heat is reclaimed at a cooling COP of 3.3.

To increase the heat reclaim ratio, the temperature out of the gas cooler can be increased by slowing down the fan speed. As the last stage, the gas cooler can be completely bypassed. By doing this, the ratio will go to 100% because there is no heat loss to the ambient, and all heat is reclaimed.

This process will engage more compressors in operation to compensate lower refrigeration efficiency as a result of a higher gas fraction in the receiver. By performing this mode, more heat can be transferred to the water system.

Since the heat output from the system varies with the pressure, it is interesting to look at how heating COP changes.

In normal operation, the system operates with highest efficiency following an optimal COP pressure curve (in this example: 48 bar). This means that no matter how much heat we pull out of the system, it will consume energy for keeping cooling demand. Therefore, the heating COP of the system is calculated taking heat recovery capacity divided with the extra energy consumed by the compressors. This is done because then it is possible to compare the heating COP with alternative heating sources.









The heat recovery ratio is the ratio between the maximum heat available and the heat used.

The heating COP varies with the ambient temperature. At high ambient temperatures, the compressor work used for refrigeration is higher and therefore the compressor work for heating is less. At lower ambient temperatures, the pressure cannot be decreased, and therefore this will not affect the heating COP.

This analysis was done with ambient temperatures below approximately 5°C. In normal operation, temperature out of the gas cooler is 9°C and pressure in the gas cooler 48 bar(a).

Sgc ¹⁾ °C	Shr2 ²⁾ °C	Pgc ³⁾ bar(a)	COP ⁴⁾ Cooling	COP ⁵⁾ Heating Standard	COP ⁶⁾ Heating	COP 7) System	HR ratio %
9	32	48	6,9				8
9	32	50	6,4				10
9	32	55	5,5	1,0	4,9	6,5	16
9	32	60	4,8	1,3	4,1	6,1	21
9	32	65	4,3	1,5	4,0	5,8	27
9	32	70	4,0	1,8	4,1	5,8	35
9	32	75	3,7	2,4	5,1	6,1	50
9	32	80	3,4	3,3	6,5	6,7	73
31,4	32	80	2,3	3,3	4,9	5,6	98
32	32	80	2,2	3,3	4,9	5,5	100

1) Sgc – temperature out of gas cooler

2) Shr2 – temperature out of heat recovery exchanger

3) Pgc – pressure in the gas cooler

4) COP Cooling – cooling capacity divided by total electrical energy for compressors

5) COP Heating Standard – heating capacity divided by total electrical energy for compressors

6) COP Heating – heating capacity divided by additional electrical energy for compressors because of heat recovery operation mode

7) COP system = COP Cooling + COP Heating Standard



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2. Precondition for installing HRU	Installation of the HRU requires fulfilment of different preconditions in cooling and heating systems.
2.1 Mandatory preconditions for installation	 To install HRU, some conditions must be met: The CO₂/water heat recovery heat exchanger must be installed on refrigeration rack Motorized 3-way valve must be installed on refrigeration system to bypass CO₂ heat exchanger when there is no need for heat recovery. A 0-10 VDC circuit must be established between the HRU and the refrigeration controller. Safety valve must be installed on heat recovery circuit – as close as possible to CO₂ heat exchanger. 4 sensors on the CO₂ heat exchanger must be mounted. Main heating pump P1 size must be determined in relation to the system's peak effect/power and must be able to supply entire installation, and the HRU. If P1 is an existing pump, it must be checked if it can deliver the flow when the HRU's pressure loss is added to the system. In central heating systems, the volume of the expansion tank must include HRU. A 2-tank solution requires approx. 401 extra volume. In an existing installation, it is important to check whether the expansion tank volume is sufficient. A manometer and safety valve must also be fitted. Cooling pack must be set to heat recovery.
2.2 Important preconditions for optimal operation	 To ensure stable and efficient operation of HRU and refrigeration system, the below conditions should be fulfilled: The CO₂ heat exchanger should be sized for nominal operating parameters of the heat recovery circuit The CO₂ heat exchanger and high-pressure piping from the compressor must be insulated Vibration dampers should be fitted between the CO₂ heat exchanger and the fixed plumbing installation Balancing valve on heat reclaim circuit should be mounted

- Heating, ventilation, and domestic hot water systems must be configured to ensure lowest possible return temperature.
- It should be ensured that operation of the cooling system is optimized to avoid excessive starting and stopping of the cooling compressors.



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2.3 CO₂ heat exchanger sizing

Sizing of a CO_2 heat exchanger is crucial for an efficient heat recovery process. If too small, a heat exchanger will not recover all the available energy during peak load condition for a refrigeration system.

Danfoss recommendation is to use in calculation max. pressure and temperature of the CO2 in transcritical operation mode. CO2 mass flow should be equal to max. winter condition for stores without heat resale and maximum compressors capacity for stores with heat resale. For the water side, the inlet temperature should be equal to the design return temperature from the heating system. To store more energy in buffer tanks, the water outlet temperature should be at least 40°C higher than the inlet temperature, but not higher than 85°C. For the highest efficiency, the temperature difference between water inlet and CO₂ outlet should not be higher than 5°C.



- To ensure the highest possible heat recovery, the return temperature from the heating system should be as low as possible. This can be achieved by sizing heat consumers' circuits with recommended temperatures (based on heat consumer type) or by using return temp. limitation valves (enough heat needs to be ensured in peak load conditions).
- 2.4 Recommended dimensioning temperatures in heating system

2.4.1 Recommended dimensioning temperatures In new heating installations, recommended design parameters should be max:

Heat consumer circuit:	Flow temperature:	Return temperature:
Radiators	60	30
Floor heating	45	25
Ventilation	60	30
Domestic hot water	65	25

Lowering the heating return temperature increases efficiency, but will require more heating surfaces. In existing buildings, it is important to optimize heating systems with regard to water flow, and settings in electronic controllers for heating, ventilation, and domestic hot water systems. The return temperature should be lowered as much as possible, while ensuring that enough heat will be delivered to consumers in peak load condition.

2.4.2 Return temperature
limitation valveInstallation of the return temperature limitation valve, like Danfoss NovoCon[®]/ AB-QM, can increase
heating system efficiency. By extending the delta T of the heat consumer, less flow is required to
deliver the same amount of energy.

Larger temperature span requires more heating surface, so before installation of a return temperature limitation valve, the heating system must be checked to ensure that enough energy will be available in peak load condition if new operating parameters apply.



3. How to control the heat recovery process in CO₂ transcritical systems?

In CO_2 systems, the higher pressure and temperature makes it possible to recover heat for tap water and heating. Regulation is carried out during transcritical and subcritical states and the controller will control the gas pressure/condensing pressure so that the system achieves the optimum COP when the recovered heat is taken into account.

The Heat Recovery circuit will take the energy it needs. If there is then any excess energy, this is removed via the gas cooler. There must be a cooling requirement in order to supply for heat recovery.



There are safety functions for the individual regulation functions, for example:

- Boiling at Shr3, Shr4 and Shr8
- An Shr3 temperature must be lower than the gas temperature that can be sent into the heat exchanger. If the Shr3 temperature is higher, the heat recovery circuit is not enabled.

Shr2: CO₂ temperature after the heat recovery exchanger

Shr3: Heat exchanger cold water access temperature

Shr4: Heat exchanger hot water outlet temperature

Shr8: Hot water temperature in the tank or after the tank

Sd: Compressor CO₂ discharge temperature

Sc3: Ambient temperature

Sgc: CO₂ temperature after the gas cooler

Shp: CO₂ temperature after gas cooler bypass connection

Pc: CO₂ compressor discharge pressure

Pgc: Pressure in the gas cooler

Prec: Pressure in CO₂ receiver

V3hr: Heat recovery 3-way valve

V3gc: Gas cooler 3-way bypass valve Vhp: High pressure expansion valve

Vrec: Gas bypass expansion valve

Regulation in the pack controller AK-PC 782A/B

can be carried out using one of the following three principles when the circuit calls for heat:

1. Basic control (no HP offset).

2. Heat reclaim mode: Hp offset and temperature reference

3. Heat reclaim mode: Max. heat reclaim



In systems where a Danfoss Heat Recovery Unit (HRU) will be installed, it is mandatory to select 3rd option Maximum Heat Recovery, because the regulation is solely based on the external heat request (consumer request) on an analogue input and a start signal on a digital input. Note, there is no active thermostat control for the heat recovery mode. To prevent any boiling in the system, the heat recovery will be stopped as soon as any of the Shr3, Shr4 or Shr8 temperatures are above 95 °C. An external ECL heat controller installed on the HRU will send a heat request signal between 0 and 10 V in relation to heating demand 0 to 100%, which will be used to start the following functions in order to achieve maximum heat recovery:

- 1. Signal on DI input for heat recovery is received (mandatory, to enable the function) and the reference for the pressure Pgc is increased to "Pgc HR min."
- 2. The external voltage signal is registered (the higher the value, the greater the need for heat). The signal is converted by the controller to 0-100% capacity and will have the following impact:



- a. ON/OFF control of pump and by-pass valve V3hr The pump is released to start, when the request signal reaches the "HR start limit" and the by-pass valve V3hr opens for the heat recovery. The valve V3hr goes into "bypass" when the "HR stop limit" is reached, and the pump is stopped after 180 sec.
- b. Pressure and temperature increase The pressure is measured with the pressure transmitter Pgc and controlled with the High pressure valve Vhp. Depending on the Heat request, the pressure reference "Pgc HR ref" will be raised from "Pgc HR min" to "Pgc HR Max". After reaching the "Pgc HR max", then "Sgc ref" is raised from "Sgc min" to "Sgc max". The consequence of the increased gas cooler reference is a decrease in the fan speed. (Min. Sgc is calculated by the controller based on the receiver pressure reference that has been set).
- c1. V3gc is modulating: The controller controls the fans and the valve, to maintain energy optimized control (bypassing of the gas cooler will only be allowed when the fans are at 0% and vice versa). Shp is the control sensor when the gascooler is bypassed.
- c2. V3gc is set to an on/off valve (see illustration): the fans will be stopped and the valve V3gc routes the gas outside the gas cooler. If the HR request is between V3gc bypass stop limit & V3gc bypass start limit, the V3gc won't bypass unless Shr2 & Sgc are lower than "TC max HR".

The "Heat recovery status" picture shows the current regulation status.

Relay output (additional heat output)

A relay can be reserved that will pull in if the received signal exceeds 9.5 V (4.75 V) for more than 10 minutes. The relay will be cut out when the signal is lower than 9.3 V (4.65 V). The relay is defined in the function: "Additional heat output", and can be used to start e.g., a heat pump evaporator.



Start conditions

- The following conditions must be fulfilled in order to start the heat reclaim function:
- 1. External heat request via the digital input
- 2. Pump Control mode is set to "Auto"
- 3. At least one MT compressor must have been running for at least 2 minutes
- 4. "Sd MT" must be higher than Shr3 brine temp.
 - If "Control signal" = "S8" or "S4", then "Sd must be higher than (Shr3 +1K)
 - If "Control signal" = "Shr4 Shr3", then "Sd must be higher than (Shr3 + Delta T)
- 5. Shr2 is higher than "TC HR max" (default 27 °C)
- 6. All sensors are OK
- 7. The "Anti boiling" is not active
- When all conditions are fulfilled, the following start sequence will be carried out:
- 1. The pump will be started when the heat request is higher than "HR start limit" (if not already running)
- 2. The flow switch will report "Flow OK", if mounted
- 3. The bypass valve will switch position and the discharge gas will be looped through the heat exchanger

Stop conditions

- The heat recovery will be stopped at one of the following conditions:
- 1. The external heat request signal on the DI is stopped
- 2. The analogue heat request signal goes below "HR stop limit"
- 3. The "Pump control mode" is set to OFF
- 4. Last MT compressor stops
- 5. The "Sd MT" discharge temperature is below the "Shr3" temperature
- 6. The "Shr2" is lower than the set saturated temperatures of the set
- minimum gas cooler pressure limit "TC HR min" (default 27 °C)
- 7. Anti-boiling safety is active

8. One or more of the relevant sensors are defective

- When one of the stop conditions is active, the following stop sequence will be initiated:
- 1. The three-way valve V3hr will switch position and bypass the gas
- 2. The pump will continue to run 240 sec. in order to remove the excessive heat in the heat exchanger. If a new heat request arises within the 240 sec., the pump will keep running.

4. HRU in detail

4.1 Description

The Heat Recovery Unit is designed to utilise excess heat from CO_2 refrigeration plants in supermarkets. It prioritises heating of own plant before sales of excess energy, e.g. to a district heating network.



To balance different usage patterns (temperatures and heating requirements) on the heating side and the production of excess heat on the cooling side, the unit has been designed as a buffer charging circuit. This results in very stable and uniform charging, also ensuring a long service life for the CO₂ heat exchanger.

The flow temperature from the HRU unit is controlled by the building requirements (heating, domestic hot water, or ventilation), either by external temperature, via signals from other ECLs or via Modbus from an existing SCADA system.

In the event of possible sale of excess heat to the district heating network or other buyers, this can be managed in such a way that a constant temperature is supplied to those buyers.

The HRU unit can send a reference signal to the cooling plant indicating how much heat can be accumulated.



4.2 Control strategy

Unit can be split into 2 main circuits: heating circuit (on top) and heat recovery circuit (on bottom).



If the temperature in the tank (S6) is lower than the set point (which is visible in the bracket), ECL Controller sends 2 Volt signal to the pack controller. This is information that HRU can collect heat and 3-way valve on cooling pack needs to direct CO_2 flow through the heat exchanger. At the same time, pump P3 is started. It adjusts the flow through the HEX to achieve the right charging temperature. If on the lowest possible flow, charging temp. cannot be reached, ECL raises signal to the cooling pack to 10 V. It is information for pack controller to increase the pressure in the CO_2 circuit to boost the CO_2 temp. If both tanks will be filled with hot water, ECL will send 0V signal to pack controller. It means that 3-way valve needs to bypass the CO_2 HEX and pump P3 will be also stopped.

When hot water is stored in the tank, it can be used in heating consumers' circuits. The mixing valve M1 will adjust flow temperature to required level by mixing hot water from tanks with cold return water from heating circuits. If there is not enough heat in the tanks, HRU will add energy from auxiliary heat source. Flow temperature is then controlled by M2 valve on the primary return line. If we have more energy than needed, then M2 valve will be closed.

If more heat than is currently used for internal purposes is available, excess heat can be sold to the district heating network or local consumers. First the pump P4 on the primary side is started to overcome the pressure in the district heating network. When the flow in this circuit occurs (indicated by signal from flow switch), then pump P4 on the tank side will be started. It will adjust the right flow temperature through the heat resell heat exchanger. During export, the M2 valve must be closed (heat cannot be bought and sold at the same time).



4.3 HRU applications

4.3.1 Application A1

A1 is an indirect heating application with two tanks and heat resale option:



In this application, heat transfer from an auxiliary heat source (connections 1 and 2) to a secondary installation is realised via a plate heat exchanger. This solution ensures hydraulic system separation. Heat consumer circuit (connections 3 and 4) is controlled by an M1 3-way valve. It mixes hot water from the storage tank with cold water from the heat return piping. In case of higher demand, additional heat can be added from the auxiliary heat source. In such cases, an M2 valve controls S3 flow temperature.

Surplus heat from a CO_2 refrigeration system is reclaimed through CO_2 /water heat exchanger (part of refrigeration pack). The heat recovery process is controlled by variable speed of a P3 PWM pump, mounted on the water side of the circuit. Heat reclaimed from the CO_2 refrigeration system is stored in two 500L tanks. Usage of a buffer tank ensures continuous surplus heat reclaim independent of current heating needs. It also provides stable working conditions for the CO_2 heat exchanger.

If internal heat consumption is lower than heat reclaim, surplus heat can be exported to a district heating network through sale heat exchanger (connections 7 and 8). Sale temperature is controlled by variable speed of P4 PWM pump.



4.3.2 Application A2

A2 is an indirect heating application with 2 tanks and without heat resale option:



In this application, heat transfer from an auxiliary heat source (connections 1 and 2) to a secondary installation is realised via a plate heat exchanger. This solution ensures hydraulic system separation. The heat consumer circuit (connections 3 and 4) is controlled by an M1 3-way valve. It mixes hot water from the storage tank with cold water from the heat return piping. In case of higher demand, additional heat can be added from an auxiliary heat source. In such cases, an M2 valve controls S3 flow temperature.

Surplus heat from a CO_2 refrigeration system is reclaimed through a CO_2 /water heat exchanger (part of refrigeration pack). The heat recovery process is controlled by variable speed of a P3 PWM pump, mounted on the water side of the circuit. Heat reclaimed from the CO_2 refrigeration system is stored in two 500L tanks. Usage of a buffer tank ensures continuous surplus heat reclaim independent of current heating needs. It also provides stable working conditions for the CO_2 heat exchanger.



4.3.3 Application A3

A3 is a direct heating application with 2 tanks and heat resale option:



In this application, heat transfer from an auxiliary heat source (connections 1 and 2) to a secondary installation is realised via direct piping with bypass. This solution ensures the lowest operating condition for the auxiliary heat source.

The heat consumer circuit (connections 3 and 4) is controlled by an M1 3-way valve. It mixes hot water from the storage tank with cold water from the heat return piping. In case of higher demand, additional heat can be added from the auxiliary heat source. In such cases, the M2 valve controls S3 flow temperature.

Surplus heat from the CO₂ refrigeration system is reclaimed through a CO₂/water heat exchanger (part of refrigeration pack). The heat recovery process is controlled by variable speed of a P3 PWM pump, mounted on the water side of the circuit. Heat reclaimed from a CO₂ refrigeration system is stored in two 500L tanks. Usage of a buffer tank ensures continuous surplus heat reclaim independent of current heating needs. It also provides stable working conditions for the CO₂ heat exchanger.

If internal heat consumption is lower than heat reclaim, surplus heat can be exported to a district heating network through sale heat exchanger (connections 7 and 8). Sale temperature is controlled by variable speed of the P4 PWM pump.



4.3.4 Application A4

A4 is an indirect heating application with 2 tanks and without heat resale option:



In this application, heat transfer from an auxiliary heat source (connections 1 and 2) to a secondary installation is realised via direct piping with bypass. This solution ensures the lowest operating condition for the auxiliary heat source.

The heat consumer circuit (connections 3 and 4) is controlled by an M1 3-way valve. It mixes hot water from the storage tank with cold water from the heat return piping. In case of higher demand, additional heat can be added from the auxiliary heat source. In such cases, the M2 valve controls the S3 flow temperature.

Surplus heat from the CO_2 refrigeration system is reclaimed through the CO_2 /water heat exchanger (part of refrigeration pack). The heat recovery process is controlled by variable speed of the P3 PWM pump, mounted on the water side of the circuit. Heat reclaimed from the CO_2 refrigeration system is stored in two 500L tanks. Usage of a buffer tank ensures continuous surplus heat reclaim independent of current heating needs. It also provides stable working conditions for the CO_2 heat exchanger.



4.3.5 Application A6

A6 is an indirect heating application with 1 tank and without heat resale option:



In this application, heat transfer from an auxiliary heat source (connections 1 and 2) to a secondary installation is realised via a plate heat exchanger. This solution ensures hydraulic system separation. The heat consumer circuit (connections 3 and 4) is controlled by an M1 3-way valve. It mixes hot water from the storage tank with cold water from the heat return piping. In case of higher demand, heat can be provided by the auxiliary heat source. In such cases, the M2 valve controls S3 flow temperature. Surplus heat from the CO₂ refrigeration system is reclaimed through the CO₂ /water heat exchanger (part of refrigeration pack). The heat recovery process is controlled by variable speed of the P3 PWM pump, mounted on the water side of the circuit. Heat reclaimed from the CO₂ refrigeration system is stored in a 500L tank. Usage of a buffer tank ensures continuous surplus heat reclaim independent of current heating needs. It also provides stable working conditions for the CO₂ heat exchanger.



4.3.6 Application A7

A7 is a direct heating application with 1 tank and without heat resale option:



In this application, heat transfer from an auxiliary heat source (connections 1 and 2) to a secondary installation is realised via direct piping with bypass. This solution ensures the lowest operating condition for the auxiliary heat source.

The heat consumer circuit (connections 3 and 4) is controlled by an M1 3-way valve. It mixes hot water from the storage tank with cold water from heat return piping. In case of higher demand, heat can be provided by the auxiliary heat source. In such cases, the M2 valve controls S3 flow temperature.

Surplus heat from the CO₂ refrigeration system is reclaimed through the CO₂/water heat exchanger (part of refrigeration pack). The heat recovery process is controlled by variable speed of the P3 PWM pump, mounted on the water side of the circuit. Heat reclaimed from the CO₂ refrigeration system is stored in a 500L tank. Usage of a buffer tank ensures continuous surplus heat reclaim independent of current heating needs. It also provides stable working conditions for the CO₂ heat exchanger.



4.4 Heat consumers

applications – examples

To control heat consumers' circuits, an additional ECL controller can be used in master-slave configuration. Those secondary side controllers can send the required flow temperature to the ECL mounted in the HRU. By doing so, optimal efficiency of the whole system can be achieved by precise flow temperature control and reducing the return temperature from the heat consumer circuit.



For more information regarding ECL controllers and applications, please visit the Danfoss web page: <u>ECL controllers | Danfoss</u>

4.4.1 Heating application - example

Application A230 is a weather-compensated control of flow temperature in a heating circuit. Room temperature and wind speed compensation is also available. Return temperature limitation can be set up. An alarm function in relation to flow temperature is available. It can be used for direct and indirect heating applications.





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4.4.2 Ventilation

application – example

Application A314 can control temperature of ventilation systems with heating or cooling or a combination of these. Weather-based compensation, return temperature limitation, frost, and fire protection are available. Optional analogue control of crossflow or rotary heat exchanger. Alarm function can be related to duct / flow temperature, fire, and frost.





4.4.3 Domestic Hot Water application - example Application A217 is advanced temperature control of a DHW circuit with storage tank, directly heated or with charging system. Return temperature limitation can be set up. An alarm function related to flow temperature is available.





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5. Commissioning steps	Before system start-up, the mandatory steps listed below should be taken.			
5.1 Connection tightening	After completion of installation, retighten all pipe unions in the HRU.			
5.2 External sensor connection	 Connect all required external sensors and ensure that they are mounted in the right location: The S4 sensor should be performed as a submersed sensor and sense completely into the heat exchanger. 			
	 For parallel operation of 2 CO₂ heat exchangers, the S4 must be placed so that it measures the common outlet temperature and as close to the heat exchangers as possible. 			
	 The submersed sensor must be in counterflow and in large pipe dimensions. Constriction (measuring blind) should be made for the S4 sensor. If the S4 is outside the heat exchanger, a min. flow must be ensured at the measuring point. 			
	 The S10 is designed as a surface sensor and is placed close to the CO₂ heat exchanger and, as far as possible, on the upper side of a horizontal pipe. 			
	 S11 & S2 are made with sensors that are heat-resistant (such as AKS 21 A 084N2007) with steel clamps/straps. 			
	 S11 (Hot gas sensor): mount close to the CO₂ heat exchanger and preferably on the upper side of a horizontal pipe. 			
	 S2 mounted outside of the CO₂ heat exchanger is to be mounted after the CO₂ 3-way valve on the common outlet pipe to the gas cooler (thereby any bypass of the CO₂ exchanger can be registered via the ECL 310 Portal / log) 			
5.3 HRU boost signal connection	Check the 0-10 Vdc signal at the end of the galvanic separation via manual operation of ECL 310 V1 from 0 to 100%.			
	If the expected voltage is not measured, the DIP switch must be checked. If they are correct, but an incorrect value is still measured, it may be a wrong connection in the cooling control. Check the output with disconnected connection to Pack.			
5.4 Location of safety valve on water side	Safety valve must be placed close to the CO_2 heat exchanger and it must lead to a drain (risk of injuries from high temperature).			
5.5 Location of balancing valves	If there is only one CO_2 heat exchanger, the balancing valve should be placed on the return circuit close to the HRU (possibly on the inlet from CO_2 heat exchanger).			
	If CO ₂ heat exchangers are connected in parallel, a balancing valve must be fitted to the inlet of each of them separately, to have the right flow in both heat exchangers.			
	The balancing valve(s) on the heat recovery circuit are adjusted in relation to P3 min (15%) to ensure that we can regulate down by small effects on the CO_2 heat exchanger.			
5.6 Water filling and ventilation	If possible, establish a fixed water connection so that it can be refilled without the need to establish a connection every time.			
	The system should be equipped with automatic air dischargers at the highest point of the system, places where there are natural air pockets (installations with inverted u piping) and on the accumula- tion tanks to release trapped air in the system in connection with water filling (remember that motor valves must be open fully).			
5.7 Connection to ECL portal	The HRU should be connected to the ECL portal. After connection is established, all M-Bus energy meters and sensors S11 and S12 should be registered for future logging.			
5.8 Functional test of components	 All components listed below must be checked in manual overdrive in the ECL 310 controller: Pumps P1, P3 and P4 (if installed) Control valves M1 and M2 Sensors reading M-bus energy meters readings Boost signal to pack controller to check if 3-way bypass valve on CO₂ heat exchanger is opening and closing 			



Application Guide | Heat Recovery Unit

6. ECL configuration

6.1 Settings in controller

Danfoss recommends adjusting parameters using the ECL Portal. Before doing so, flow meters and connection to the ECL portal must be established manually in the controller.

6.1.1 Flow meter F1, F2 and F3 configuration



Common controller settings:

MENU:	
Time & Date	
Input overview	
Log	
Output override	
Key functions	

M-bus config:

MENU	
System:	
Extension	
Ethernet	
Portal config	
▶M-bus config	
Energy Meters	

Set the Baud rate to 2400 for all connected meters.

System	
M-bus config:	
State	IDLE
Command	NONE
▶ Baud	2400

System:

Home	
MENU:	
Log	
Output override	
Key functions	
• System	

All flow meters must be configured in settings. M-bus address is last 2 digits from heat meter serial number. Flow meter F1 must be configured as Energy meter 1:

System	
M-bus config:	
Energy Meter 1	
M-bus address	48
Scan time	10 s
Туре	0
ID	160448



Flow meter F2 must be configured as Energy meter 2:

System		System
M-bus config:		M-bus co
Energy Meter 2		Energy M
M-bus address	46	M-bus ad
Scan time	10 s	Scan time
Туре	0	Туре
ID	160846	ID

Flow meter F3 must be configured as Energy meter 3:

System	
M-bus config:	
Energy Meter 3	
M-bus address	21
Scan time	30 s
Туре	0
ID	174221

- 6.2 Connection to the ECL Portal
- 6.2.1 Settings in ECL Controller

Connect the network cable with the Internet connection to HRU controller. ECL Comfort 310 listens for communication on TCP port 502. For more information regarding communication with ECL controller, please check:

https://assets.danfoss.com/documents/198690/AQ074886472234en-010601.pdf

Controller menu:

System:



Home	MENU
MENU:	System:
Time & Date	ECL version
Input overview	Extension
Log	Ethernet
Output override	Portal config
Key functions	M-bus config



Activate automatic network addressing:

System	□ ⊘
Ethernet:	
Address type	DHCP
IP 1	192
IP 2	168
IP 3	1
IP 4	100

Or set up correct static IP address according to your network settings.

Portal config:

Set "ECL Portal" to "ON"



Check serial number and access code visible in Portal info:

MENU	System	
System:	Portal config:	
ECL version	ECL Destal ECL Opline	20
Extension	Serial poly 5678	90
Ethernet	Access Code: 5b	9
M-bus config		
ni bas coning		

 6.2.2 Settings in portal
 Go to ecl.portal.danfoss.com, create a user account by pressing on the 'new user' link and follow the instructions on screen.
You only need to do this the first time you register a controller to the ECL Portal.

 6.2.3 Adding controller to a portal
 ECL -> Register new ECL:
Register new ECL using the serial number and access code:

 Preconditions to register new ECL
• Activate
• Connect
 Activate
• Connect

Enter serial number and access code to register your ECL

Serial number

Access code

 $\hfill \square$ I have the consent from the owner of the private data

Insert ECL master data

Cancel

Next



6.2.4 Sensor S11 configuration

- ECL -> Configurable input -> Configure new sensor input:
- Set name of the sensor. Choose:
- Sensor ID to S11
- Type to Pt 1000
- Sensor Option to None

Sensor ID		
S7		~
Туре		
Pt 1000		~
Sensor Option		
None		~

Click next. Check mark Data logging. Click create.

6.2.5 Heat meters configuration

Meters -> Register new meter: Set meter name and M-bus address

M-bus address		
	Novt	Canco

Click next. Check mark Data logging. Click create.

6.2.6 Circuit 1

Here all heating circuit parameters should be set.

6.2.6.1 Primary settings:

Settings -> Circuit 1 -> Primary settings

Mode Scheduled op	Scheduled operation	Des. T comfort 20.0 °C 5.0 °C 40.0 °C	20.0 °C	Des. T saving 18.0 °C 5.0 °C 40.0 °C	18.0
	_		_		_

Choose Scheduled operation.

Set T comfort and T saving according to need.



6.2.6.2 Flow temperature

Settings -> Circuit 1 -> Flow temperature



The weather-compensated flow temperature can be configured here. Temperature should be adjusted according to heat consumer type.

"Frost protection T" is the minimum temperature for S3.

"Desired T": if external override has been created for an available input, the desired fixed flow temperature (R3) from the HRU unit can be configured here.

The minimum and maximum flow temperature (R3) can be configured here.



6.2.6.3 Return Limit

Settings -> Circuit 1 -> Settings -> Return temp. limit



Here you configure the highest permitted temperature desired at S5.

When this limit is exceeded, the "Infl. - max." setting can be adjusted to determine the impact on R3.



6.2.6.4 Optimization

Settings -> Circuit 1 -> Settings -> Optimization

Auto saving -12 °C -30 °C 10 °C	-12 °C	Ramp 0 m 99 m	OFF	Optimizer 9 59	OFF
Pre-stop	Save	Total stop	Save	Summer, cut-out	Save
ON OFF		O ON OFF		0 °C 50 °C	off

If an external signal indicating the desired flow temperature (R3) is not received, these settings will apply together with the "Flow temperature" settings.

If a schedule has been configured for comfort/saving mode:

"Auto-save" will gradually reduce flow temperature

"Ramp" change from saving to comfort mode can take place slowly over the configured time.



6.2.6.5 Control par. 1

Settings -> Circuit 1 -> Control par. 1

Circuit 1, heating - Control p	oar. 1				×
Хр 60 к 5 к 250 к	60 K	Tn 40 s 1 s 999 s	40 s	M run 100 s 5 s 250 s	100 s
*	Save	*	Save	*	Save
Nz 2 к 1 К 9 К	2 К	Min. act. time	5	Xp 70 l/h 5 l/h 250 l/h	70 l/h
*	Save	*	Save	**	Save
Tn 70 s 1 s 999 s	70 s	Nz 25 1/h 1 1/h 200 1/h	25 l/h	Min Flow 500 l/h 0 l/h 3000 l/h	500 l/h
**	Save	**	Save	**	Save
Max. T limit 70 °C 10 °C 150 °C	70 °C				
***	Save				/

*Parameters apply to the M1 flow temperature (S3).

"Xp" (proportional band) - A higher value will result in a stable but slow control of the flow temperature.

"Tn" (integration time constant) - Set a high integration time constant (in seconds) to obtain a slow but stable reaction to deviations. A low integration time constant will make the controller react fast but with less stability.

"M run" (running time of the motorized control valve) - 75 sec for HRU<216 kW heating and 113 sec for HRU>216 kW heating

**Parameters apply to the mixing phase, i.e. when mixing of recovered heat and purchased heat takes place. Flow is associated with flow meter F2. Temperature controls (S3) are controlled by M2.

***Here, the anticipated flow temperature from auxiliary heat (district heating, boiler or other) is configured.



6.2.6.6 Control par. 2

Settings -> Circuit 1 -> Control par. 2

Хр 60 К 5 К 250 К	60 K	Tn 30 s 1 s 999 s	30 s		
M run	Save	Nz	Save 2 K	Min. act. time	5
				5	

Here, control parameters (M2) are configured for the desired flow temperature R3.

"Xp" (proportional band) - A higher value will result in a stable but slow control of the flow temperature.

"Tn" (integration time constant) - Set a high integration time constant (in seconds) to obtain a slow but stable reaction to deviations. A low integration time constant will make the controller react fast but with less stability.

"M run" (running time of the motorized control valve):

- 120 sec for HRU≤85 kW heating
- 75 sec for HRU>85 kW and ≤ 216 kW heating
- 113 sec for HRU>216 kW heating

6.2.6.7 Application

Settings -> Circuit 1 -> Application

Demand offset 4 K 0 K 20 K	4 κ	Send desired T ON OFF	OFF	exercise ON OFF	ON	M exercise ON OFF	OF
P frost T 2 °C -11 °C 20 °C	Save 2 °C 0 off	P heat T 5 °C 40 °C	Save	P post-run 0 m 99 m	Save 3 m	Ext. input OFF	Save
Ext. mode FROST PR.	FROST PR.	Operating form	1	Difference	OFF Off		Save

"Demand offset" is the temperature that is added to the highest temperature requirement that may be received from one or more ECL 310 slave regulators.

- "Operating form" Here you select the mode of operation in which the HRU unit will run
- 1: All three phases: recovered / mix / auxiliary heat 2: Phases: recovered / auxiliary heat
- 2: 100% use of recovered heat



6.2.6.8 Schedule 1

Settings -> Circuit 1 -> Schedule 1

Мо	Tu	We	Th	Fr	Sa	Su
Period		Start			End	
1	0	▼ : 0	•	24	: 0	•
2	24	▼ : 0	•	24	: 0	•
3	24	▼ : 0	•	24	: 0	•

If an external signal indicating the desired flow temperature (R3) is not received, this schedule will apply to the configured comfort and saving mode temperatures.

6.2.7 Circuit 2

Here all heat recovery and heat resale parameters can be set.

6.2.7.1 Tank temperature

Settings -> Circuit 2 -> Tank temperature

65.0 °C	65.0 °C	Start difference	-1 K
0.0 °C 150.0 °C	Save	-50 K -1 K	Sava
top difference	25 K	P post-run	0 m
25 K		0 m 0 m 99 m	
50 K 50 K			

Here, you configure the desired temperature in the buffer/charger tanks and when charging should start and stop.

"Tank temp." - required tank temperature is base for calculation of the charging temp.



6.2.7.2 Compensation T

Settings -> Circuit 2 -> Compensation T

Lower difference	2 K	Upper difference	3 К	Low X 50 °C 10 °C 150 °C	50 °(
High X 80 °C 10 °C 150 °C	Save 80 °C	Infl max. -9.9 9.9	-1.5	Adapt. time	Save OFI € Off

The permitted difference between temperatures S10 and S2 at high and low charging temperature respectively ("High X" and "Low X") can adjust the desired charging temperature (R4) with a desired amplification factor "Max. amplification".

6.2.7.3 Control heat recovery

Settings -> Circuit 2 -> Contr. heat recov.

cuit 2 - Contr. heat recov					
Charge difference 2 K 1 K 50 K	2 K	Хр 100 К 5 К 250 К	100 K	Tn 60 s 1 s 999 s	60 s
M run <u>100</u> s 5 s 250 s	Save	Nz []К 0 К 9 К	Save 2 K	Min. act. time 2 50	Save 2
V out max. 90 % 0 % 100 %	Save 90 %	V out min.	Save	Adapt. time 10 s 100 s	Save 1 s
Min. act. time 1.0] s 0.1 s 5.0 s	Save	PWM period 5.0] s 0.2 s 10.0 s	Save 5.0 s	Reverse out NO	Save NO

"Charging difference" – desired charging temperature in relation to the tank temperature.

"V out. min." – you can configure the desired minimum charging flow given by P3.

"Adapt. time" – controls how fast the actual charging temp. adapts to the desired charging temp. "Min. act. time" – min. PWM duty cycle. If "Adapt. time" setting is other than 0.

"PWM period" – PWM signal period length. Settings can be configured with "Min. act. Time" to specify how often pump will stop and start to achieve less flow.


6.2.7.4 Control par., export

Settings -> Circuit 2 -> Control par., export

Desired T	70 °C	Start T	95 °C	Start difference	ок	Stop difference	-5
10 °C 110 °C		20 °C 95 °C		-50 K 0 K	□ off	-50 K -1 K	_
DHW priority	Save	(Yn	Save		Save	NZ	Save
ON OFF	on	лр 45] К 5 К 250 К	45 K	25 s 1 s 999 s	233	СК 2 К 0 К 9 К	1
	Save		Save		Save		Save
V out max.	90 %	V out min.	30 %	Adapt. time	OFF	PWM period 7.0 s 0.2 s 10.0 s	7.0
	Save		Save		Save		Save
Reverse out	NO V	Хр 9.0 К	9.0 K	Tn 8	8		
		4.0 K 50.0 K	_	1 50	_		

"Desired T" - The desired sale/export temperature.

"Start T" – Required tank top temperature (S6) before export can be started.

"Start difference" – Required tank bottom temperature (S8) before export can start.

"Stop difference" - Required tank top temperature (S6) to end export.

Example:

Export starts when both requirements have been met:

S6 > "Start T" > 80 °C

S8 > "Start T" + "Start difference" > 80-0 = 80 °C

Export stops when:

S6 < "Start T"+ "Stop difference" < 80-5 = 75 °C

Or if domestic hot water requirements are received from another ECL 310 if the setting "DHV priority" is ON.



6.2.7.5 Boost

Settings -> Circuit 2 -> Boost

Delay	10 s	V out max.	70 %
10 s 1 s 200 s	Off	70 % 0 % 100 %	
	Save		Save
V out min.	20 %	Dep., export	OF
0 % 100 %		O ON OFF	

Boost is an expression of how much energy the HRU can reclaim. This signal (0-10VDC) ECL 310 sends to the cooling plant.

"Delay" – Time needed to change boost signal by 1%

"V out. min." - Min signal during operation

"V out max." - Max level of signal transmitted to the pack controller.

"Depended on export ON" – This setting can increase the "Boost" signal to the cooler in the event of export/sale of recovered heat. This happens if the tank temperature (S6) is lower than the desired start temperature for export "Start T," or if the current charging temperature (S4) is lower than the desired tank temperature (R6).

"Depended on export OFF" – This setting can increase the "Boost" signal to the cooler. This happens only if the current charging temperature (S4) is lower than the desired tank temperature (R6).

6.2.7.6 Schedule 2

Settings -> Circuit 2 -> Schedule 2

rcuit 2 - S	chedul	e 2					
Мо	Tu	We	Th	Fr	Sa	Su	
Period		Start			End		
1	0	❤ : 0	~	24 🔪	<pre> : 0 </pre>	~	
2	24		~	24 🕚	• : 0	~	
3	24		~	24 丶	· : 0	~	
]
					1	Save	
							5

Here, you can configure a Schedule for when you want to export excess energy.



6.3 Connection to Leanheat monitor portal

6.3.1 Settings in ECL Controller Connect the network cable with the Internet connection to your ECL Comfort 310. Next follow below steps:

Controller menu:

System:





Activate automatic network addressing:

System	
Ethernet:	
Address type	DHCP
IP 1	192
IP 2	168
IP 3	1
IP 4	100

Or set up correct static IP address according to your network settings.

Portal config:

Make sure that URL is "lcl.portal.danfoss.com", then Set "ECL Portal" to "ON"



Check serial number and access code visible in Portal info:

MENU	System	
System:	Portal config:	
ECL version Extension Ethernet Portal config	ECL Online Serial no.: 567890 Access Code: 5bv9	0 X
M-bus config		



a portal

6.3.2 Settings in portal Go to app.enspire.danfoss.com and login to your account.

6.3.3 Adding controller to Admin -> Device Administration -> Connect -> Connect ECL:

Admin - Device Administration	+				
\leftrightarrow \rightarrow C $$ app.enspi	re.danfoss.com/#/admin/devices				
Danfoss Leanhea	at [®] Monitor 🗰 Dashboa	rd 🕡 Devices 🛱 Alar	ms 🖽 Reports 🗔 Admin		
Device Administration Da	ta Relays General Settings	User Management Dashboard	Api Keys Activity		
+ Connect 🛞 Scan	Export csv				
Connect ECI					
connectice					
Sync OPC devices	Connection	Device type	Description 个	Disconnected	Locat
Connect Modbus					
	ECL	ECL	ECL310_279530		

Input the serial number and access code which you got from your device and click "connect":

	Con	nect ECL	-		
Serial number					
Code					
			Clos	se	Connect



6.3.4 Circuit 1

Devices -> ECL310 (HRU) -> Settings -> Circuit 1, heating Here all parameters regarding Heating circuit should be set.



6.3.4.1 Primary settings:



Choose Scheduled operation. Set T comfort and T saving according to need.







The weather compensated flow temperature can be configured here. Temperature should be adjusted according to heat consumer type.

"Frost protection T" is the minimum temperature for S3.

"Desired T" if external override has been created for an available input, the desired fixed flow temperature (R3) from the HRU unit can be configured here.

The minimum and maximum flow temperature (R3) can be configured here.





Here you configure the highest permitted temperature desired at S5.

When this limit is exceeded, the "Infl. - max." setting can be adjusted to determine the impact on R3.



6.3.4.4 Optimization

Optimization	Pre-stop
Auto saving	OFF Save
ON Auto saving	Save
Between -30 and 10 °C	Total stop
Ramp	OFF Save
ON Ramp	Save Summer, cut-out
Between 0 and 99 m	ON Summer, cut-out Save
Optimizer	Between 0 and 50 °C
Optimizer	Save
Between 9 and 59	

If an external signal indicating the desired flow temperature (R3) is not received, these settings will apply together with the "Flow temperature" settings.

If a schedule has been configured for comfort/saving mode:

"Auto-save" will gradually reduce flow temperature

"Ramp" change from saving to comfort mode can take place slowly over the configured time.

6.3.4.5 Control par. 1

Control par. 1	ſ	Maria	N	1
× _{P (K)} *	Save	5	*	Save
Between 5 and 250 K		Between 2	2 and 50	
Tn (s) 40 X	Save	Xp (l/h) 70	**	Save
Between 1 and 999 s		Between !	5 and 250 l/h	
M run (s) 🗙	Save	Tn (s) 70	**	Save
Between 5 and 250 s	l	Cohunon '	1 and 000 c	
Nz (K) 2 *	Save	between	1 910 999 2	
Between 1 and 9 K				
Nz (l/h) **	Save			
Between 1 and 200 l/h				
Min. Flow (l/h) **	Save			
Between 0 and 3000 l/h				
Max. T limit (°C) ***	Save			
Between 10 and 150 ℃				

*Parameters apply to the M1 flow temperature (S3).

"Xp" (proportional band) - A higher value will result in a stable but slow control of the flow temperature. "Tn" (integration time constant) - Set a high integration time constant (in seconds) to obtain a slow but stable reaction to deviations. A low integration time constant will make the controller react fast but with less stability.

"M run" (running time of the motorized control valve) - 75 sec for HRU<216 kW heating and 113 sec for HRU>216 kW heating

**Parameters apply to the mixing phase, i.e. when mixing of recovered heat and purchased heat takes place. Flow is associated with flow meter F2. Temperature controls (S3) are controlled by M2.

***Here, the anticipated flow temperature from auxiliary heat (district heating, boiler or other) is configured.



6.3.4.6 Control par. 2

Control	par.	2
---------	------	---

Хр (К) 60	Save
Between 5 and 250 K	
Tn (s) 30	Save
Between 1 and 999 s	
M run (s) 60	Save
Between 5 and 250 s	
Nz (K) 2	Save
Between 1 and 9 K	
Min. act. time 5	Save
Between 2 and 50	

Here, control parameters (M2) are configured for the desired flow temperature R3.

"Xp" (proportional band) - A higher value will result in a stable but slow control of the flow temperature.

"Tn" (integration time constant) - Set a high integration time constant (in seconds) to obtain a slow but stable reaction to deviations. A low integration time constant will make the controller react fast but with less stability.

"M run" (running time of the motorized control valve):

- 120 sec for HRU≤85 kW heating
- 75 sec for HRU>85 kW and \leq 216 kW heating
- 113 sec for HRU>216 kW heating



6.3.4.7 Application

Application	P frost T	
Demand offset	ON P frost T 2	Save
ON Demand offset	Save Between -11 and 20 °C	
Between 0 and 20 K	P heat T (°C) 20	Save
Send desired T	Between 5 and 40 °C	
OFF	Save P post-run (m)	Save
	Between 0 and 99 m	
P exercise	Ext. input OFF	Save
OFF	Save	
M exercise		
OFF	Save	
Ext. mode FROST PR.	Save	
Operating form 1	Save	
Between 1 and 3		
Difference		
ON Difference	Save	
Between 1 and 60 K		

"Demand offset" is the temperature that is added to the highest temperature requirement that may be received from one or more ECL 310 slave regulators.

- "Operating form" Here you select the mode of operation in which the HRU unit will run
- 1: All three phases: recovered / mix / auxiliary heat
- 2: Phases: recovered / auxiliary heat
- 3: 100% use of recovered heat



6.3.4.8 Schedule 1



If an external signal indicating the desired flow temperature (R3) is not received, this schedule will apply to the configured comfort and saving mode temperatures.



6.3.5 Circuit 2

Devices -> ECL310 (HRU) -> Settings -> Circuit 2 Here all parameters regarding Heat recovery and Heat resale can be set

6.3.5.1 Tank temperature

Tank temperature

Tank temp. (°C) 65	Save
Between 10 and 150 °C	
Start difference (K) -1	Save
Between -50 and -1 K	
Stop difference (K) 25	Save
Between -50 and 50 K	
P post-run (m) O	Save

Between 0 and 99 m

Here, you configure the desired temperature in the buffer/charger tanks and when charging should start and stop.

"Tank temp." – required tank temperature is base for calculation of the charging temp.

6.3.5.2 Compensation T

Compensation T		
Lower difference (K)	High X (°C) 80	Save
2	Between 10 and 150 °C	
Between 1 and 50 K	10 Million	
Upper difference (K)	Infl max. -1	Save
S Between 1 and 50 K	Between -9.9 and 9.9	
	Adapt. time	
50	Save ON Adapt tim	Save
Between 10 and 150 °C		IC Date
	Between 0 and 50 s	

The permitted difference between temperatures S10 and S2 at high and low charging temperature respectively ("High X" and "Low X") can adjust the desired charging temperature (R4) with a desired amplification factor "Max. amplification".



6.3.5.3 Control heat recovery

Registered recuperation		
Charge difference (K)	Save	Save
Z Patware 1 and 50 K	Between 0 and 9 K	
between 1 and 50 K	Min act time	
Xp (K) 100	Save 2	Save
Between 5 and 250 K	Between 2 and 50	
Tn (s)	Save	Save
00	Between 0 and 100 %	
Between 1 and 999 s		
M run (s) 100	Save	Save
Between 5 and 250 s	Between 0 and 100 %	
between's and 2503		
Adapt. time		
ON Adapt. time	Save	
Between 0 and 100 s		
Min. act. time (s) 1	Save	
Between 0.1 and 5 s		
PWM period (s) 10	Save	
Between 0.2 and 10 s		
Reverse out A	Save	

"Charging difference" - desired charging temperature in relation to the tank temperature.

"V out. min." - you can configure the desired minimum charging flow given by P3.

"Adapt. time" – Controls how fast the actual charging temp. adapts to the desired charging temp.

"Min. act. time" – min. PWM duty cycle. If "Adapt. time" setting is other than 0

"PWM period" – PWM signal period length. Settings can be configured with "Min. act. Time" to specify how often pump will stop and start to achieve less flow.



6.3.5.4 Control par., export

Control par.,	export			DHW priority
Desired T (°C) 75			Save	OFF
Between 10 and 1	10 ℃			Хр (К) 45
Start T (°C) 80			Save	Between 5 and 250 K
Between 20 and 9	95 °C			Tn (s) 25
Start difference	2			Between 1 and 999 s
	Start difference		Save	Nz (K) 2
Between -50 and	0 K			Between 0 and 9 K
Stop difference	(K)		Save	V out max. (%) 90
Between -50 and	-1 K			Between 0 and 100 %
				V out min. (%) 15
				Between 0 and 100 %
Adapt. time				
OFF	Adapt. time 0		Save	
Between 0 and 10	00 s		_	
PWM period (s)			Save	
Between 0.2 and	10 s			
Reverse out NO		-	Save	
Хр (К) 9			Save	
Between 4 and 50	ОК			
Tn 8			Save	
Between 1 and 50)			

"Desired T" - The desired sale/export temperature.

"Start T" - Required tank top temperature (S6) before export can be started. "Start difference" - Required tank bottom temperature (S8) before export can start "Stop difference" - Required tank top temperature (S6) to end export

Example:

Export starts when both requirements have been met:

S6 > "Start T" > 80 $^\circ\text{C}$

S8 > "Start T" + "Start difference" > 80-0 = 80 °C

Export stops when:

S6 < "Start T"+ "Stop difference" < 80-5 = 75 °C

Or if domestic hot water requirements are received from another ECL 310 if the setting "DHV priority" is ON.



6.3.5.5 Boost

Delay		
	Delay 10	Save
Between 1 and 2	00 s	
V out max. (%) 70	Save	
Between 0 and 1	00 %	
V out min. (%) 20		Save
Between 0 and 1	00 %	
Dep., export		
OFF		Sava

Boost is an expression of how much energy HRU can reclaim. This signal (0-10VDC) ECL 310 send to the cooling plant.

"Delay" - time needed to change Boost signal by 1%

"V out. min." - Min signal during operation

"V out max." - Max level of signal transmitted to the pack controller.

"Depended on export ON" - This setting can increase the "Boost" signal to the cooler in the event of export/sale of recovered heat. This happens if the tank temperature (S6) is lower than the desired start temperature for export "Start T," or if the current charging temperature (S4) is lower than the desired tank temperature (R6).

"Depended on export OFF" - This setting can increase the "Boost" signal to the cooler. This happens only if the current charging temperature (S4) is lower than the desired tank temperature (R6).

6.3.5.6 Schedule 2

Schedule 2



Here, you can configure a Schedule for when you want to export excess energy.



7. How to set up Pack Controller AK-PC 782A to operate with Danfoss Heat Recovery Unit (HRU) To set up and configure Danfoss Pack Controller AK-PC 782A, you must use the Service Tool. You can download the latest version here:

https://www.danfoss.com/en/service-and-support/downloads/dcs/adap-kool-software/ak-st-500/ Depending on selected heat recovery features, the following inputs and outputs must be configured.





Application Guide | Heat Recovery Unit

7.1 Heat recovery general settings

Setup and configuration based on AK-PC 782A software version 3.7

1 00:012 AK-PC782	▼ Overview ▼
Controller identification	n 🖸 🛛 🗩
Controller type	4K-PC 7824B
Controller type	08070202
SiAl varaian	Vor 2 70
	ver 5.70
Svv build humber	50
	D00C307
SVV build time	Nov 10 2022 11:
Address switch	12
Alarm transmission	Enabled
ID shares	
IP channel	
Host name	H0001001128A
IP address	182.168,0.195
Subnet mask	355-255,253.0
Link status	Active
Cr II C L	
Cor	nfiguration menu

Configuration menu menus necessary to set up

<mark>ි</mark> ℃	onfiguration menu
	Lock/Unlock configuration
	System setup
	IP setup
	Select plant type
	Setpoint management
	Suction group MT
	Suction group LT
	Suction group IT
→	Condenser fan control
	HP control
	Receiver control
→	Heat circuits
	<u>KPI</u>
	<u>Display setup</u>
\rightarrow	General purpose
→	I/O configuration
	I/O status and manual
	Sensor calibration
	<u>Alarm priorities</u>
	Authorisation
	Copy settings
_	
Om	



In menu **Select plant type** select an option for **Heat Recovery Unit** or **Heat recover**

🛰 00:000 AK-PC 782A	_		×	
Config: Select plan	t type			
	\langle		$ \rightarrow $	
Application selection		Boos	ter + HP	
Refrigerant type			R744	
Condenser fan control			Speed	
No. of fans			1	
Heat recover		Heat	reclaim	None
Oil receiver control			None	Ten weter
	_			Tap water
Setpoint management			Manual	Heat reclaim
O alla at avriativa atum		N. I	a la stran	Tap and heat
Select quick setup		New s	election	
				Heat Recovery Unit
(Cr)		0		
			A DI FRANCISCO	

If there is in the system Gas cooler bypass valve V3gc select menu **Condenser fan control** > **Capacity control** and V3gc valve type

G Config: Condenser	fan control	
Capacity control		
Condenser fan control	Speed	
No. of fans	1	
Fan safety	No	
Fan speed type	EC motor	
EC start capacity	5.0 %	
EC min.	10.0 %	
EC max.	80.0 %	
EC abs.max.	100.0 %	
Absolute.max Sgc	35.0 °C	
Fan control mode	PI-control	
Кр	10.0	
Tn	180 s	
Capacity limit at night	100.0 %	
V3gc valve	1 Stepper	None
Кр	2.0	ON/OFF
Tn	240 s	1 Stepper
Min OD	0 %	Voltage (AO)
Max OD	90 %	



Wiring diagram



HC1 request 0 - 10V

Signal is galvanic isolated within the HRU unit, so no need for additional isolation. All - HC 1; signal 0 - 10V General purpose HR enable function Al2 - HC 1; Voltage signal used for voltage switch to enable HR Al3=Dl3; dry contact; "HR enable" DO1 – Voltage switch



Application Guide | Heat Recovery Unit

7.2 Setup with

heat reclaim type = Heat Recovery Unit The external voltage signal is registered (the higher the value, the greater the need for heat). The signal is converted by the HRU controller to 0 – 100% capacity and will have the following impact: Here is example with on/off V3gc bypass valve but it is also possible, and preferable, to design system with V3gc modulating valve which provide very stable temperature control out of gas cooler.





Under Heat recovery menu select Heat reclaim circuit

Config: Heat recover	ry	
Heat reclaim circuit		DO Select V3hr type
V3hr output type	Stepper (On/Off)	Stepper (Un/Off)
Heat reclaim type	Max heat reclaim	Heat reclaim type = Max heat reclaim
Control mode	Auto	HRU controls the water temperature.
Heat consumers	1	Note in Max heat reclaim option there is no active thermostat control for the heat
Heat consumer filter	5 s	recovery mode. Select "Auto".
Additional heat output	No	Heat Consumer (HC1) = 1
Show advanced settings	Yes	
Flowswitch	No	
Кр	5.0	
Tn	160 s	
Tc max HR	27.0 °C	
HR end delay - MT stop	0 s	
Ref. offset low limit	25 %	With Max heat reclaim option it is possible
Ref. offset high limit	70 %	to adjust pressure ref offset limits depend-
Bypass control		ing on HC signal request.
V3gc bypass stop limit	80 %	✓ If selected V3ac ON/OFF valve type, setup
V3gc bypass start limit	95 %	for start and stop limit depending on HC
HP control		signal request.
Pgc max.	103.00 bar	
Pgc max. limit P-band	5.00 bar	
Pgc HR max	80.00 bar	The Heat Consumer (HC1) 0-10V sia-
Pgc HR min.	60.00 bar	nal from HRU will increase or decrease
Pgc min.	50.00 bar	the pressure in the gas cooler in range between
		"Pgc HR min" and "Pgc HR max".
0m		



General purpose menu

HRU doesn't have digital output to enable Heat Recovery algorithm in AK-PC 782A/B so it is necessary to setup separately following action:

HR enable DO control based on HC1 signal and wire it to HR enable DI





Under Heat recovery menu select Heat reclaim circuit

I/O configuratio	n		
Digital outputs	60		
Load	Mod Pt	Active at	
Load	wou. It	Active at	
Compressors			
Compressor 1-MT	0- 0	ON	
Compressor 1-I T	0- 0	ON	
Compressor 1-IT	0- 0	ON	
Fans	0-0	OIN	
Fan 1	0- 0	ON	
HP Control	0-0		
V3ac	0- 0	ON	If V3ac is ON/OFF
Heat recovery	0-0		in vogens on, or r
V/3hr	0- 0	ON	If V3hr is ON/OFF
Additional heat	0- 0	ON	
Gen purpose	0-0		
HR enable DI	0- 0	ON	HR enable
	0-0		Gen. purpose DO
			· · · · · · · · ·
00	CONTRACTOR OF THE OWNER	~	
	the state of the		
I/O configuratio	n		
Digital inputs	\leq		
Alarm / Function	Mod. Pt	Active at	
Ext. Main Switch	0-0	Closed	
All compressors:			
Common safety MT	0-0	Open	
Common safety LT	0-0	Open	
Compressor 1-MT:			
General safety	0-0	Open	
Compressor 1-LT:			
General safety	0-0	Open	
Compressor 1-IT:			
General safety	0-0	Open	
Heat recovery			
Hr enable	0-0	Closed	DDI to enable HR
			wired from "HR enable D
			Gen. purpose DO
			1



I/O configura	tion		
Analog outputs			
Function	Mod		
Function	WOU.	гі туре	
Speed comp_MT-1	0-	0 0_10 V	
Speed comp. I T-1		0 0-10 V	
Speed comp. LT-1	0_	0 0-10 V	
Condenser sneed	0-	0 0-10 V	
HP Control	•	0 0-101	
Vhp	0 -	0 0-10 V	
V3ac	0 -	0 CTR-20	If V3ac is Stepper
Vrec 1	0 -	0 CCMT-42	in ogensstepper
Heat recovery			
V3hr	0 -	0 CTR-20	If V3hr is Stepper
	-		
Cm	Contraction of the		
ALC: NOT HOUSE ALC: NOT			
Po-MT suction Ss-MT suction Sd-MT discharge Po-LT suction p	0 - 0 0 - 0 0 - 0 0 - 0	 AKS2050-59 Pt 1000 Pt 1000 AKS2050-59 	
Ss-LT suction gas	0 - C) Pt 1000	
Sd-LT discharge	0-0	Pt 1000	
Ss-IT suction gas	0-0	Pt 1000	
Sd-IT discharge	0-0	Pt 1000	
Pc cond. pres.	0-0	AKS2050-159	
Sc3	0-0	Pt 1000	
HP Control			
Pgc	0-0	AKS2050-159	
Prec	0- C	AKS2050-59	
Sgc temp.	0- C) Pt 1000	
Shp temp.	0- C) Pt 1000	If system have V3gc
Heat recovery			
Shr2	0- C) Pt 1000	
Shr3	0-0) Pt 1000	Protection sensors
Shr4	0-0	Pt 1000]
HC1	0-0	0 -10 V	HRU Heat consumer signal 0 – 10V
Gen. purpose			
Voltage input 1	0-0	0 -10 V	Voltage input used for Voltage switch HR enable
		•	



7.3 Setup with heat reclaim type = Max heat reclaimThe external voltage signal is registered (the higher the value, the greater the need for heat). The signal is converted by the HRU controller to 0-100% capacity and will have the following impact:





Under **Heat recovery** menu select **Heat reclaim circuit**

Config: Heat recove	ery	
Heat reclaim circuit	€	DO Select V3hr type
V3hr output type	DO	Stepper (On/Off)
Heat reclaim type	Max heat recl	Select
Control mode	Auto	HP offset
Setpoint	55.0 °C	Max heat reclaim heat reclaim
Use ext.ref.offset	No	HRU controls the water temperature.
Thermostat band	5.0 K	Note in Max heat reclaim option there is
Control signal	Shr4	recovery mode. Select "Auto".
Heat consumers	1	HRU is the
Heat consumer filter	5 s	Heat Consumer (HC1), select "1".
Additional heat output	Yes	
Show advanced settings	Yes	
Flowswitch	No	
Кр	5.0	
Tn	160 s	
Tc max HR	27.0 °C	
HR end delay - MT stop	0 s	HRU is controlling the water pump but
HR stop limit	5 %	these values are valid for V3hr valve where heat recovery start and stop is based on
HR start limit	10 %	heat consumer input signal.
Ref. offset low limit	25 %	With Max haat raclaim option it is possible
Ref. offset high limit	70 %	to adjust pressure ref offset limits depend-
Bypass control		ing on HC signal request.
V3gc bypass stop limit	80 %	If selected V3ac ON/OFE value type setup
V3gc bypass start limit	95 %	for start and stop limit depending on HC
HP control		signal request.
Pgc max.	103.00 bar	
Pgc max. limit P-band	5.00 bar	
Pgc HR max	80.00 bar	The Heat Consumer (HC1) 0-10V sia-
Pgc HR min.	60.00 bar	nal from HRU will increase or decrease
Pgc min.	50.00 bar	the pressure in the gas cooler in range between
		"Pgc HR min" and "Pgc HR max".
Om	<u> </u>	



General purpose menu

HRU doesn't have digital output to enable Heat Recovery algorithm in AK-PC 782A/B so it is necessary to setup separately following action:

HR enable DO control based on HC1 signal and wire it to HR enable DI





I/O Configuration menu setup





回 I/O configura	tion					
Analog outputs		K	C	$\overline{}$		
Function	Mor	1		ne 📃	I	
unction	WIOC	4.		pe		
Speed comp. MT-	1	0 -	0 0	-10 V		
Speed comp. LT-1		0 -	0 0	-10 V		
Speed comp. IT-1		0 -	0 0	-10 V		
Condenser speed		0 -	0 0	-10 V		
HP Control						
Vhp		0 -	0 0	-10 V		
V3gc		0 -	0 C	TR-20		If V3qc is Stepper
Vrec 1		0 -	0 CCI	MT-42		5
Heat recovery						
V3hr		0 -	0 C	TR-20 <	←	If V3hr is Stepper
Cm	104.2		2			
Charles in a stall	22		A Start	法律律师		
N					1	
I/O configura	tion					
		the second se		and the second se		
Analog inputs		\leq	\in	€		
Analog inputs Sensor N	1od.	E Pt	Тур	e		
Analog inputs Sensor N	1od.	Pt	Тур	e		
Analog inputs Sensor M Po-MT suction	1od. 0 -	Pt 0	Typ AKS20	e 150-59		
Analog inputs Sensor M Po-MT suction Ss-MT suction	1od. 0 - 0 -	Pt 0 0	Typ AKS20 Pi	e 50-59 1000		
Analog inputs Sensor M Po-MT suction Ss-MT suction Sd-MT discharge	1od. 0 - 0 - 0 -	Pt 0 0	Typ AKS20 Pi Pi	e 50-59 1000 1000		
Analog inputs Sensor M Po-MT suction Ss-MT suction Sd-MT discharge Po-LT suction p	1od. 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0	AKS20 Pi AKS20 Pi AKS20	e 50-59 t 1000 t 1000 550-59		
Analog inputs Sensor M Po-MT suction Ss-MT suction Sd-MT discharge Po-LT suction p Ss-LT suction gas	1od. 0 - 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0 0 0	AKS20 Pi AKS20 Pi AKS20 Pi	e 50-59 t 1000 t 1000 50-59 t 1000		
Analog inputs Sensor M Po-MT suction Ss-MT suction Sd-MT discharge Po-LT suction p Ss-LT suction gas Sd-LT discharge	1od. 0 - 0 - 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0 0 0 0 0 0	AKS20 Pi AKS20 Pi AKS20 Pi Pi	e 50-59 t 1000 t 1000 50-59 t 1000 t 1000		
Analog inputs Sensor M Po-MT suction Ss-MT suction Sd-MT discharge Po-LT suction p Ss-LT suction gas Sd-LT discharge Ss-IT suction gas	1od. 0 - 0 - 0 - 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0 0 0 0 0 0 0 0 0	AKS20 Pri AKS20 Pri AKS20 Pri Pri Pri	e 50-59 t 1000 t 1000 50-59 t 1000 t 1000 t 1000		
Analog inputs Sensor M Po-MT suction Ss-MT suction Sd-MT discharge Po-LT suction p Ss-LT suction gas Sd-LT discharge Ss-IT suction gas Sd-IT discharge	1od. 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	AKS20 Pri AKS20 Pri AKS20 Pri Pri Pri	e 50-59 1000 1000 50-59 1000 1000 1000 1000		
Analog inputsSensorMPo-MT suctionSs-MT suctionSd-MT dischargePo-LT suction pSs-LT suction gasSd-LT dischargeSs-IT suction gasSd-IT dischargePc cond. pres.	1od. 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	AKS20 Pi AKS20 Pi AKS20 Pi Pi AKS205	e 50-59 1000 1000 50-59 1000 1000 1000 1000 00-159		
Analog inputsSensorMPo-MT suctionSs-MT suctionSd-MT dischargePo-LT suction pSs-LT suction gasSd-LT dischargeSs-IT suction gasSd-IT dischargePc cond. pres.Sc3	10d. 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	AKS20 Pi AKS20 Pi AKS20 Pi Pi AKS205 Pi	e 50-59 t 1000 t 1000 t 1000 t 1000 t 1000 t 1000 t 1000 t 1000 t 1000 t 1000		
Analog inputs Sensor M Po-MT suction Ss-MT suction Sd-MT discharge Po-LT suction p Ss-LT suction gas Sd-LT discharge Ss-IT suction gas Sd-IT discharge Pc cond. pres. Sc3 HP Control	10d. 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	AKS20 Pi AKS20 Pi AKS20 Pi Pi AKS205 Pi	e 50-59 t 1000 t 1000 t 1000 t 1000 t 1000 t 1000 t 1000 t 1000 t 1000 t 1000		
Analog inputs Sensor M Po-MT suction Ss-MT suction Sd-MT discharge Po-LT suction p Ss-LT suction gas Sd-LT discharge Ss-IT suction gas Sd-IT discharge Pc cond. pres. Sc3 HP Control Pgc	flod. 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	AKS20 Pri AKS20 Pri AKS205 Pri AKS205	e 50-59 1000 1000 50-59 1000 1000 1000 1000 1000 1000 00-159 00-159		
Analog inputs Sensor M Po-MT suction Ss-MT suction Sd-MT discharge Po-LT suction p Ss-LT suction gas Sd-LT discharge Ss-IT suction gas Sd-IT discharge Pc cond. pres. Sc3 HP Control Pgc Prec	10d. 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	AKS20 Pri AKS20 Pri AKS205 Pri AKS205 AKS205 AKS205	e 50-59 1000 1000 50-59 1000 1000 1000 1000 1000 1000 1000 10		
Analog inputsSensorMPo-MT suctionSs-MT suctionSd-MT dischargePo-LT suction pSs-LT suction gasSd-LT dischargeSs-IT suction gasSd-IT dischargePc cond. pres.Sc3HP ControlPgcPrecSgc temp.	10d. 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	AKS20 Pri AKS20 Pri AKS205 Pri AKS205 AKS205 Pri AKS205 Pri	e 50-59 1000 1000 50-59 1000 1000 1000 1000 1000 00-159 50-59 1000		
Analog inputsSensorNPo-MT suctionSs-MT suctionSd-MT dischargePo-LT suction pSs-LT suction gasSd-LT dischargeSs-IT suction gasSd-IT dischargePc cond. pres.Sc3HP ControlPgcPrecSgc temp.Shp temp.	10d. 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	AKS20 Pri AKS20 Pri AKS205 Pri AKS205 AKS205 AKS205 Pri Pri AKS205 Pri Pri	e 50-59 1000 1000 50-59 1000 1000 1000 00-159 1000 00-159 1000 00-159 1000 00-159 1000		lf system has V3gc
Analog inputsSensorNPo-MT suctionSs-MT suctionSd-MT dischargePo-LT suction pSs-LT suction gasSd-LT dischargeSs-IT suction gasSd-IT dischargePc cond. pres.Sc3HP ControlPgcPrecSgc temp.Shp temp.Heat recovery	10d. 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	AKS20 Pi AKS20 Pi AKS205 Pi AKS205 AKS205 AKS205 Pi Pi Pi	e 50-59 1000 1000 50-59 1000 1000 1000 00-159 1000 00-159 50-59 1000 1000 4 1000 00-159 1000		lf system has V3gc
Analog inputsSensorNPo-MT suctionSs-MT suctionSd-MT dischargePo-LT suction pSs-LT suction gasSd-LT dischargeSs-IT suction gasSd-IT dischargePc cond. pres.Sc3HP ControlPgcPrecSgc temp.Shp temp.Heat recoveryShr2	10d. 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	AKS20 Pri AKS20 Pri AKS205 Pri AKS205 AKS205 AKS205 Pri Pri Pri Pri Pri	e 50-59 1000 1000 50-59 1000 1000 1000 1000 0-159 50-59 1000 0-159 1000 1000 1000		lf system has V3gc
Analog inputsSensorMPo-MT suctionSs-MT suctionSd-MT dischargePo-LT suction pSs-LT suction gasSd-LT dischargeSs-IT suction gasSd-IT dischargePc cond. pres.Sc3HP ControlPgcPrecSgc temp.Shp temp.Heat recoveryShr2Shr3	10d. 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	AKS20 Pri AKS20 Pri AKS205 Pri AKS205 AKS205 AKS205 Pri Pri Pri Pri Pri Pri Pri Pri Pri Pri	e 50-59 1000 1000 50-59 1000 1000 1000 1000 1000 0-159 1000 0-159 1000 1000 1000 1000 1000	<	If system has V3gc Protection sensors
Analog inputsSensorMPo-MT suctionSs-MT suctionSd-MT dischargePo-LT suction pSs-LT suction gasSd-LT dischargeSs-IT suction gasSd-IT dischargePc cond. pres.Sc3HP ControlPgcPrecSgc temp.Shp temp.Heat recoveryShr2Shr4	Add. 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	AKS20 Pri AKS20 Pri AKS205 Pri AKS205 AKS205 AKS205 Pri Pri Pri Pri Pri Pri	e 50-59 1000 1000 50-59 1000 1000 1000 1000 0-159 50-59 1000 1000 1000 1000 1000 1000 1000		If system has V3gc Protection sensors
Analog inputs Sensor M Po-MT suction Ss-MT suction Sd-MT discharge Po-LT suction gas Sd-LT discharge Ss-IT suction gas Sd-LT discharge Pc cond. pres. Sc3 HP Control Pgc Prec Sgc temp. Shp temp. Heat recovery Shr2 Shr4 HC1	Aod. 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	AKS20 Pri AKS20 Pri AKS205 Pri AKS205 AKS205 AKS205 Pri Pri Pri Pri Pri Pri Pri	e 50-59 1000 1000 50-59 1000 1000 1000 0-159 50-59 1000 0-159 50-59 1000 1000 1000 1000 1000 1000		If system has V3gc Protection sensors HRU heat consumer
Analog inputs Sensor M Po-MT suction Ss-MT suction Sd-MT discharge Po-LT suction gas Sd-LT discharge Ss-IT suction gas Sd-IT discharge Pc cond. pres. Sc3 HP Control Pgc Prec Sgc temp. Shp temp. Heat recovery Shr2 Shr4 HC1 Gen. purpose	10d. 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	AKS20 Pri AKS20 Pri AKS205 Pri AKS205 AKS205 AKS205 Pri Pri Pri Pri O	e 50-59 1000 1000 50-59 1000 1000 1000 00-159 1000 00-159 1000 1000 1000 1000 1000 1000 1000		lf system has V3gc Protection sensors HRU heat consumer signal 0 – 10V
Analog inputsSensorNPo-MT suctionSs-MT suctionSd-MT dischargePo-LT suction pasSd-LT dischargeSs-IT suction gasSd-LT dischargePc cond. pres.Sc3HP ControlPgcPrecSgc temp.Shp temp.Heat recoveryShr2Shr3Shr4HC1Gen. purposeVoltage input 1	10d. 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	AKS20 Pi AKS20 Pi AKS205 Pi AKS205 AKS205 AKS205 Pi Pi Pi Pi Pi Pi 0	e 50-59 1000 1000 50-59 1000 1000 1000 0-159 1000 0-159 1000 1000 1000 1000 -10 V		If system has V3gc Protection sensors HRU heat consumer signal 0 – 10V Voltage input used for
Analog inputsSensorMPo-MT suctionSs-MT suctionSd-MT dischargePo-LT suction pSs-LT suction gasSd-LT dischargeSs-IT suction gasSd-IT dischargePc cond. pres.Sc3HP ControlPgcPrecSgc temp.Shp temp.Heat recoveryShr2Shr3Shr4HC1Gen. purposeVoltage input 1	10d. 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	AKS200 Pri AKS200 Pri AKS205 Pri AKS205 AKS205 Pri AKS205 Pri Pri Pri Pri Pri O 0	e 50-59 1000 1000 50-59 1000 1000 1000 0-159 50-59 1000 0-159 50-59 1000 1000 1000 -10 V		If system has V3gc Protection sensors HRU heat consumer signal 0 – 10V Voltage input used for Voltage switch HR enable
Analog inputs Sensor M Po-MT suction Ss-MT suction Sd-MT discharge Po-LT suction pas Sd-LT suction gas Sd-LT discharge Ss-IT suction gas Sd-IT discharge Pc cond. pres. Sc3 HP Control Pgc Prec Sgc temp. Shp temp. Heat recovery Shr2 Shr3 Shr4 HC1 Gen. purpose Voltage input 1	10d. 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	Pt 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	AKS20 Pri AKS20 Pri AKS205 AKS205 AKS205 AKS205 Pri Pri Pri Pri O 0	e 50-59 1000 1000 50-59 1000 1000 1000 0-159 50-59 1000 0-159 50-59 1000 1000 1000 -10 V		lf system has V3gc Protection sensors HRU heat consumer signal 0 – 10V Voltage input used for Voltage switch HR enable



7.4 Setup with heat reclaim type = HP offset and temperature reference The external voltage signal is registered (the higher the value, the greater the need for heat). The signal is converted by the HRU controller to 0-100% capacity and will have the following impact:







Config: Heat recove	ery
Heat reclaim circuit	
V3hr output type	DO
Heat reclaim type	HP offset
Control mode	Auto
Setpoint	55.0 °C
Use ext.ref.offset	No
Thermostat band	5.0 K
Control signal	Shr8
Variable speed	No
Heat consumers	1
Heat consumer filter	5 s
Additional heat output	Yes
Show advanced settings	Yes
Flowswitch	No
Кр	5.0
Tn	160 s
Tc max HR	27.0 °C
HR end delay - MT stop	0 s
HP control	
Pgc max.	103.00 bar
Pgc max. limit P-band	5.00 bar
Pgc HR max	80.00 bar
Pgc HR min.	60.00 bar
Pgc min.	50.00 bar
-	•



General purpose menu

With HP offset option it is necessary to setup separately following actions:

- Hot water protection based on Shr8 temperature sensor
- V3hr valve control based on HC1 signal
- HR enable DO control based on HC1 signal and wire it to HR enable DI



Boil protection is done with thermostat function by use of Shr8 temperature sensor. Thermostat DO have to close externally V3hr valve.

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Note:

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ECL on HRU will automatically decrease HC1 0 – 10V signal if temperature is too high.



Config: Voltage inp	ut 1	
	€ 🖸 🕑	
Show on overview	Yes	
Name	HR enable DI	Change name
Select sensor	Voltage input 1	
Actual value	0.0	
Actual state	OFF	
Min. Readout	0.0	Satvoltago input
Max. Readout	10.0	Min = 0V; Max = 10V
Cut out	0.5	HR disable when HC1
Cut in	1.0	is lower than 0.5V
Cut out delay	0 min.	HR enable when HC1
Cut in delay	0 min.	is higher than 1V
High alarm limit	101.0	
High alarm delay	5 min.	
High alarm text	Voltage input 1 H	
Low alarm limit	-1.0	
Low alarm delay	5 min.	
Low alarm text	Voltage input 1	
Om		
Config: Voltage in	put 2	
	€ 🕒 🖻	
Show on overview	Yes	
Name	On-Off Vhr	Change name
Select sensor	Voltage input 1	
Actual value		
Actual state		
Min. Readout	0.0	
Max. Readout	10.0	
Cut out	0.5	Gff - V3hr when HC1 is lower than 0.5V
Cut in	1.0	On - V3hr when HC1 is higher than 1V
Cut out delay	0 min.	-
Cut in delay	0 min.	
High alarm limit	101.0	
High alarm delay	5 min.	
High alarm text	Voltage input 2	
Low alarm limit	-1.0	
Low alarm delay	5 min.	
Low alarm text	Voltage input 2	
Low alarm text	Voltage input 2	





I/O Configuration menu setup

I/O configuration	on		
Digital outputs	6	Ð	
Load	Mod Pt	Active at	
Loud	NICO. I I	Active at	
Compressors			
Compressor 1-MT	0- 0	ON	
Compressor 1-I T	0-0	ON	
Compressor 1-LT	0-0	ON	
Fans			
Fan 1	0-0	ON	
HP Control			
V3ac	0-0	ON <	If V3ac is ON/OFF
Heat recovery			
V3hr	0-0	ON <	Not used: Set 0 - 0
Pump hr	0-0	ON <	Not used with HRU: Set 0 - 0
Additional heat	0-0	ON	
Gen, purpose			
HR boil protection	0-0	ON -	Boil protection
HR enable DI	0-0	ON -	HR enable Gen. purpose DO
On-Off Vhr	0-0	ON -	V3hr external control
0m		Sector	
☐ I/O configuration	n		
Digital inputs		2	
Alarm / Function	Mod. Pt	Active at	
Ext. Main Switch	0-0	Closed	
All compressors:		-	
Common safety MT	0-0	Open	
Common safety LT	0-0	Open	
Compressor 1-MT:	0 0	0	
General safety	0-0	Open	
Compressor 1-L1:	0 0	Onen	
General safety	0- 0	Open	
Compressor 1-IT:	0 0	Onen	
Heat recovery	0- 0	Open	
Heat recovery Hr enable	0_ 0	Closed	Dito angle UD Wind from
	0-0	Closed 4	"HR enable DI" Gen purpose DO
Ten	-	•	
	all services and		



L	tion		
Analog outputs	Ī	1	e II P
Function	Mod.		Pt Type
Speed comp. MT-	1 0	-	0 0-10 V
Speed comp. LT-	0	- 1	0 0 -10 V
Speed comp. IT-1	0	- 1	0 0 -10 V
Condenser speed	0	-	0 0 -10 V
HP Control			
Vhp	0		0 0 -10 V
Vrec 1	0	-	0 CCMT
D ea	1000		- Co
	-	100	
l/O configura	tion		
Analog inputs		\leq	
Sensor N	od.	Pt	Type
Po-MT suction	0 -	0	AKS2050-59
Ss-MT suction	0 -	0	Pt 1000
Sd-MT discharge	0 -	0	Pt 1000
Po-LT suction p	0 -	0	AKS2050-59
Ss-LT suction das	0 -	0	Dt 1000
Sd-LT discharge	0-	_	FI IUUU
		0	Pt 1000
Ss-IT suction das	0 -	0	Pt 1000 Pt 1000 Pt 1000
Ss-IT suction gas Sd-IT discharge	0 - 0 -	0 0 0	Pt 1000 Pt 1000 Pt 1000 Pt 1000
Ss-IT suction gas Sd-IT discharge Pc cond. pres.	0 - 0 - 0 -	0 0 0	Pt 1000 Pt 1000 Pt 1000 Pt 1000 AKS2050-159
Ss-IT suction gas Sd-IT discharge Pc cond. pres. Sc3	0 - 0 - 0 - 0 -	0 0 0 0	Pt 1000 Pt 1000 Pt 1000 Pt 1000 AKS2050-159 Pt 1000
Ss-IT suction gas Sd-IT discharge Pc cond. pres. Sc3 HP Control	0 - 0 - 0 - 0 -	0 0 0 0	Pt 1000 Pt 1000 Pt 1000 Pt 1000 AKS2050-159 Pt 1000
Ss-IT suction gas Sd-IT discharge Pc cond. pres. Sc3 HP Control Pgc	0 - 0 - 0 - 0 -	0 0 0 0	Pt 1000 Pt 1000 Pt 1000 AKS2050-159 Pt 1000 AKS2050-159
Ss-IT suction gas Sd-IT discharge Pc cond. pres. Sc3 HP Control Pgc Prec	0 - 0 - 0 - 0 - 0 -	0 0 0 0 0	Pt 1000 Pt 1000 Pt 1000 AKS2050-159 Pt 1000 AKS2050-159 AKS2050-159
Ss-IT suction gas Sd-IT discharge Pc cond. pres. Sc3 HP Control Pgc Prec Sgc temp.	0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	0 0 0 0 0 0	Pt 1000 Pt 1000 Pt 1000 AKS2050-159 Pt 1000 AKS2050-159 AKS2050-59 Pt 1000
Ss-IT suction gas Sd-IT discharge Pc cond. pres. Sc3 HP Control Pgc Prec Sgc temp. Shp temp.	0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	0 0 0 0 0 0 0 0 0	Pt 1000 Pt 1000 Pt 1000 AKS2050-159 Pt 1000 AKS2050-159 AKS2050-159 Pt 1000 Pt 1000
Ss-IT suction gas Sd-IT discharge Pc cond. pres. Sc3 HP Control Pgc Prec Sgc temp. Shp temp. Heat recovery	0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	0 0 0 0 0 0 0 0 0	Pt 1000 Pt 1000 Pt 1000 AKS2050-159 Pt 1000 AKS2050-159 AKS2050-59 Pt 1000 Pt 1000
Ss-IT suction gas Sd-IT discharge Pc cond. pres. Sc3 HP Control Pgc Prec Sgc temp. Shp temp. Heat recovery Shr2	0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	0 0 0 0 0 0 0 0 0 0 0	Pt 1000 Pt 1000 Pt 1000 AKS2050-159 Pt 1000 AKS2050-159 AKS2050-59 Pt 1000 Pt 1000 Pt 1000
Ss-IT suction gas Sd-IT discharge Pc cond. pres. Sc3 HP Control Pgc Prec Sgc temp. Shp temp. Heat recovery Shr2 Shr3	0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	0 0 0 0 0 0 0 0 0 0 0 0 0	Pt 1000 Pt 1000 Pt 1000 AKS2050-159 Pt 1000 AKS2050-159 AKS2050-59 Pt 1000 Pt 1000 Pt 1000 Pt 1000 Pt 1000
Ss-IT suction gas Sd-IT discharge Pc cond. pres. Sc3 HP Control Pgc Prec Sgc temp. Shp temp. Heat recovery Shr2 Shr3 Shr4			Pt 1000 Pt 1000 Pt 1000 AKS2050-159 Pt 1000 AKS2050-159 AKS2050-59 Pt 1000 Pt 1000 Pt 1000 Pt 1000 Pt 1000 Pt 1000
Ss-IT suction gas Sd-IT discharge Pc cond. pres. Sc3 HP Control Pgc Prec Sgc temp. Shp temp. Heat recovery Shr2 Shr3 Shr4 HC1	0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -		Pt 1000 Pt 1000 Pt 1000 AKS2050-159 Pt 1000 AKS2050-159 AKS2050-59 Pt 1000 Pt 1000 Pt 1000 Pt 1000 Pt 1000 Pt 1000 Q -10 V
Ss-IT suction gas Sd-IT discharge Pc cond. pres. Sc3 HP Control Pgc Prec Sgc temp. Shp temp. Heat recovery Shr2 Shr3 Shr4 HC1 Gen, purpose	0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Pt 1000 Pt 1000 Pt 1000 AKS2050-159 Pt 1000 AKS2050-159 AKS2050-59 Pt 1000 Pt 1000 Pt 1000 Pt 1000 Pt 1000 Pt 1000 O -10 V
Ss-IT suction gas Sd-IT discharge Pc cond. pres. Sc3 HP Control Pgc Prec Sgc temp. Shp temp. Heat recovery Shr2 Shr3 Shr4 HC1 Gen. purpose Voltage input 1	0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -		Pt 1000 Pt 1000 Pt 1000 AKS2050-159 Pt 1000 AKS2050-159 AKS2050-59 Pt 1000 Pt 1000 Pt 1000 Pt 1000 Pt 1000 Pt 1000 O -10 V
Ss-IT suction gas Sd-IT discharge Pc cond. pres. Sc3 HP Control Pgc Prec Sgc temp. Shp temp. Heat recovery Shr2 Shr3 Shr4 HC1 Gen. purpose Voltage input 1	0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -		Pt 1000 Pt 1000 Pt 1000 AKS2050-159 Pt 1000 AKS2050-159 AKS2050-59 Pt 1000 Pt 1000 Pt 1000 Pt 1000 Pt 1000 O -10 V
Ss-IT suction gas Sd-IT discharge Pc cond. pres. Sc3 HP Control Pgc Prec Sgc temp. Shp temp. Heat recovery Shr2 Shr3 Shr4 HC1 Gen. purpose Voltage input 1	0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 - 0 -		Pt 1000 Pt 1000 Pt 1000 AKS2050-159 Pt 1000 AKS2050-159 AKS2050-59 Pt 1000 Pt 1000 Pt 1000 Pt 1000 Pt 1000 O -10 V



Application Guide | Heat Recovery Unit

8. Maintenance recommendations	To ensure stable and efficient operation of the HRU and Cooling Pack, Danfoss recommends connect- ing unit to ECL Portal for surveillance, regular maintenance, and service.
8.1 ECL portal surveillance	Automatic mail alarms can be set up in ECL Portal. By utilising them, failures or improper operation can be detected.
8.1.1 Examples of the monitored values	 Alarms can be set on all sensors connected to the unit together with heat meter information. Internal controller alarms can be also sent by e-mail. Monitored values can be: Heat recovery circuit "Volume Flow" or "Energy forward" to monitor if heat reclaim is working (Portal alarm) CO₂ inlet temp. to monitor if cooling pack operates in heat reclaim mode (Portal alarm) Heating flow temp. to monitor if heating is supplied to the building (ECL Alarm) Heating return temp. to monitor if heating system operates in efficient way (Portal alarm)
8.1.2 ECL portal alarms setup	 Alarms can be set on all sensors connected to the unit together with heat meter information. Internal controller alarms can be also sent by e-mail. Monitored values can be: Heat recovery circuit "Volume Flow" or "Energy forward" to monitor if heat reclaim is working (Portal alarm) CO₂ inlet temp. to monitor if cooling pack operates in heat reclaim mode (Portal alarm) Heating flow temp. to monitor if heating is supplied to the building (ECL Alarm) Heating return temp. to monitor if heating system operates in efficient way (Portal alarm)
	Recipient [MAIL] Test @danfoss.com ✓ Device P501.12 example i1 (ECL) ✓ Channel ✓ Ci 1, flow temperature ✓

In this menu, alarm can be configured.

Choose **Recipient** e-mail address, **Device** data source (application, heat meter or sensor) and monitored value in **Channel**. Click next.


Channel	Ci 1, flow temperature
Name	
Min.	
Max.	
Active	
~	
Limited pe	riod
Period	
Start	End
print and a second s	✔ 24:00 ✔
00:00	
00:00	ay 🗌 Tuesday 📄 Wednesday 📄 Thursday

In this menu, put Name, Min. and Max. value of the monitored parameter. You can also choose if monitoring should be continuous or only in required periods.



Application Guide | Heat Recovery Unit

8.2 Maintenance plan (recommendation)

The most important actions for main components and assemblies are summarized in below table. Other instructions for components not specified in this application guide can be found separately in the component's instruction attached to unit documentation.

Every 2 monthsCheck all connectionsIf necessary, re-tighten and / or replace sealsEvery 2 monthsCheck all parameters to nominal / actual values or admissibilityIf excessive, restore proper parametersClean strainersIf necessaryGeneral visual inspection of all componentsIn case of visible damage, perform a functional test and if necessary, replace the componentEvery 6 monthsPerform a functional test of the safety valveOpen the safety valve for a short period of timeEvery 6 monthsPerform a functional test of the electrical and electronic componentsManually switch the pump or open and close the actuatorEvery 12 monthsPerform a functional and usability check of all componentsTemperature monitor, sensors and / or limitersEvery 12 monthsPerform a functional and usability check of all componentsFor example, open and close the shut-off valvesEvery 12 monthsPerform a visual inspection of substation's appearanceCloor (rust), insulationEvery 12 monthsCheck the heat exchangerIn case of contamination, clean / descale as neededEvery 12 monthsPerform a visual inspection of the heat meter and water meterCheck legalization periodPerform a visual inspection of the heat meter and water meterCheck legalization periodPerform a visual inspection of the heat meter and water meterShape of vessels, tamper head, tightness of the membrane	Interval	Maintenance Comments			
Every 2 monthsCheck all parameters to nominal / actual values or admissibilityIf excessive, restore proper parametersEvery 2 monthsGeneral visual inspection of all componentsIf necessaryGeneral visual inspection of all componentsIn case of visible damage, perform a functional test and if necessary, replace the componentEvery 6 monthsPerform a functional test of the safety valveOpen the safety valve for a short period of timePerform a functional test of the electrical and electronic componentsManually switch the pump or open and close the actuatorPerform a functional and usability check of all componentsIf necessaryPerform a functional and usability check of all componentsFor example, open and close the shut-off valvesPerform a visual inspection of substation's appearanceColor (rust), insulationEvery 12 monthsCheck the heat exchangerIn case of contamination, clean / descale as neededPerform a visual inspection of the heat meter and water meterColor (rust), insulationPerform a visual inspection of the measuring devicesCheck legalization periodPerform a visual inspection of the heat meter and water meterCheck legalization periodPerform a visual inspection of the measuring devicesShape of vessels, tamper head, tiohtness of the membrane		Check all connections	If necessary, re-tighten and / or replace seals		
Every 2 monthsClean strainersIf necessaryGeneral visual inspection of all componentsIn case of visible damage, perform a functional test and if necessary, replace the componentEvery 6 monthsPerform a functional test of the safety valveOpen the safety valve for a short period of timeEvery 6 monthsPerform a functional test of the electrical and electronic componentsManually switch the pump or open and close the actuatorPerform an electrical test of the safety devicesTemperature monitor, sensors and / or limitersClean strainersIf necessaryPerform a functional and usability check of all componentsFor example, open and close the shut-off valvesPerform a visual inspection of substation's appearanceColor (rust), insulationCheck the heat exchangerIn case of contamination, clean / descale as neededPerform a visual inspection of the heat meter and water meterCheck legalization periodPerform a visual inspection of the measuring devicesManometer, thermometerPerform a visual inspection of the heat meter and water meterManometer, thermometerPerform a visual inspection of the heat meter and water meterShape of vessels, tamper head, tightness of the membrane	Every 2 months	Check all parameters to nominal / actual values or admissibility	If excessive, restore proper parameters		
General visual inspection of all componentsIn case of visible damage, perform a functional test and if necessary, replace the componentEvery 6 monthsPerform a functional test of the safety valveOpen the safety valve for a short period of timeEvery 6 monthsPerform a functional test of the electrical and electronic 	Every 2 months	Clean strainers	If necessary		
Every 6 monthsPerform a functional test of the safety valveOpen the safety valve for a short period of timeEvery 6 monthsPerform a functional test of the electrical and electronic componentsManually switch the pump or open and close the actuatorPerform an electrical test of the safety devicesTemperature monitor, sensors and / or limitersClean strainersIf necessaryPerform a functional and usability check of all componentsFor example, open and close the shut-off valvesPerform a visual inspection of substation's appearanceColor (rust), insulationCheck the heat exchangerIn case of contamination, clean / descale as neededPerform a visual inspection of the heat meter and water meterCheck legalization periodPerform a visual inspection of the measuring devicesManometer, thermometerPerform a visual inspection of the measuring devicesShape of vessels, tamper head, tightness of the membrane		General visual inspection of all components	In case of visible damage, perform a functional test and if necessary, replace the component		
Every 6 monthsPerform a functional test of the electrical and electronic componentsManually switch the pump or open and close the actuatorPerform an electrical test of the safety devicesTemperature monitor, sensors and / or limitersClean strainersIf necessaryPerform a functional and usability check of all componentsFor example, open and close the 		Perform a functional test of the safety valve	Open the safety valve for a short period of time		
Perform an electrical test of the safety devices Temperature monitor, sensors and / or limiters Clean strainers If necessary Perform a functional and usability check of all components For example, open and close the shut-off valves Perform a visual inspection of substation's appearance Color (rust), insulation Check the heat exchanger In case of contamination, clean / descale as needed Perform a visual inspection of the heat meter and water meter Check legalization period Perform a visual inspection of the heat meter and water meter Manometer, thermometer Perform a visual inspection of the measuring devices Shape of vessels, tamper head, tightness of the membrane	Every 6 months	Perform a functional test of the electrical and electronic components	Manually switch the pump or open and close the actuator		
Clean strainers If necessary Perform a functional and usability check of all components For example, open and close the shut-off valves Perform a visual inspection of substation's appearance Color (rust), insulation Check the heat exchanger In case of contamination, clean / descale as needed Perform a visual inspection of the heat meter and water meter Check legalization period Perform a visual inspection of the measuring devices Manometer, thermometer Perform a visual inspection of the measuring devices Shape of vessels, tamper head, tightness of the membrane		Perform an electrical test of the safety devices	Temperature monitor, sensors and / or limiters		
Every 12 monthsPerform a functional and usability check of all componentsFor example, open and close the shut-off valvesPerform a visual inspection of substation's appearanceColor (rust), insulationCheck the heat exchangerIn case of contamination, clean / descale as neededPerform a visual inspection of the heat meter and water meterCheck legalization periodPerform a visual inspection of the measuring devicesManometer, thermometerPerform a visual inspection of the measuring devicesShape of vessels, tamper head, tightness of the membrane		Clean strainers	If necessary		
Perform a visual inspection of substation's appearanceColor (rust), insulationEvery 12 monthsCheck the heat exchangerIn case of contamination, clean / descale as neededPerform a visual inspection of the heat meter and water meterCheck legalization periodPerform a visual inspection of the 		Perform a functional and usability check of all components	For example, open and close the shut-off valves		
Every 12 months Check the heat exchanger In case of contamination, clean / descale as needed Perform a visual inspection of the heat meter and water meter Check legalization period Perform a visual inspection of the measuring devices Manometer, thermometer Perform a visual inspection of the measuring devices Shape of vessels, tamper head, tightness of the membrane		Perform a visual inspection of substation's appearance	Color (rust), insulation		
Every 12 months Perform a visual inspection of the heat meter and water meter Check legalization period Perform a visual inspection of the measuring devices Manometer, thermometer Perform a visual inspection of the measuring devices Shape of vessels, tamper head, tightness of the membrane	Every 12 months	Check the heat exchanger	In case of contamination, clean / descale as needed		
Perform a visual inspection of the measuring devicesManometer, thermometerPerform a visual inspection of the expansion vesselsShape of vessels, tamper head, tightness of the membrane	Every 12 months	Perform a visual inspection of the heat meter and water meter	Check legalization period		
Perform a visual inspection of the Shape of vessels, tamper head, expansion vessels		Perform a visual inspection of the measuring devices	Manometer, thermometer		
		Perform a visual inspection of the expansion vessels	Shape of vessels, tamper head, tightness of the membrane		

8.3 Service recommendation

Because of seasonal changes in operation of heating and refrigeration system throughout the year, it is important to make adjustments in the system during the first heating season after commissioning. Danfoss recommend continuous monitoring of the unit in the ECL Portal (including alarms) and servicing the unit at least once per year.



9. How to select the Heat Recovery Unit For selecting HRU it is necessary to determine following conditions:

- Maximum CO2 temperature which will enter CO2/water heat exchanger in the heating season. This value depends on discharge pressure during heat recovery operation mode and system layout (are there only medium temperature compressors or there are also parallel compressors).
- Temperature difference between water return and CO2 exit temperature. Proposed value in between 2K to 5K.
- Water return (6) and supply (5) temperature on CO2/water heat exchanger.

These values are required for selecting CO2/water heat exchanger (not part of HRU). How much heat can be recovered on selected heat exchanger you will get from the manufacturer heat exchanger selection software.



- Heating supply (3) and return (4) water temperature
- Requested heating capacity (or volume flow) demand
- HRU application A1, A2, A3, A4, A6 or A7



Application A1



- 1 DH supply
- 2 DH return
- 3 Heating supply4 Heating return
- 5 Supply from cooling unit
- 6 Return to cooling unit
- 7 DH supply
- 8 DH return



Example:

During maximum heat recovery request mode, pressure in the CO2 system is controlled on 80bar. When reaching maximum condition, temperature determined by optimum COP line is around 32°C. Water return temperature from the heating system and entering into the CO2 heat exchanger is 30°C (best performance is if return temperature is between 26°C and 30°C). Temperature difference between water return and CO2 exit temperature on the heat exchanger is 5K. This will result CO2 temperature out of the heat exchanger is 35°C. Rest of the heat to 32°C will be released to the ambient via the Gas Cooler. Water supply temperature is 70°C. CO2 heat recovery capacity is 140kW. Heating demand capacity is 200 kW with supply temperature 60°C.

HRU Application A1

- Heat recovery volume flow:
- Supply from cooling unit $(5) = 70^{\circ}C$
- Return to cooling unit (6) = 30°C
- Heat recovery capacity =140 kW

$$v = \frac{Q}{\rho \times c \times \Delta T} \times 3600$$

$$v = \frac{140 \ kW}{1000 \ \frac{kg}{m^3} \times 4,181 \frac{kJ}{kgK} \times 40K} \times 3600 = 3,01 \frac{m^3}{h}$$

Heat supply volume flow:

- Supply temperature (3) = 60°C
- Return temperature (4) = 30°C
- Heating demand capacity = 200 kW.

$$v = \frac{Q}{\rho \times c \times \Delta T} \times 3600$$

$$v = \frac{200 \, kW}{1000 \, \frac{kg}{m^3} \times 4,181 \frac{kJ}{kgK} \times 30K} \times 3600 = 5,74 \frac{m^3}{h}$$

Match in selection list table max volume flow values higher than calculated.

					Heat reclaim capacity				
				up to 100	up to 150	up to 300	up to 400	kW	Capacity **
-	Capacity*	min. Flow	max. Flow	0,03	0,04	0,06	0,10	m3/h	min. Flow
Ĕ	kW	m3/h	m3/h	2,15	3,23	6,45	8,60	m3/h	max. Flow
l a	up to 22	0,20	0,62	146B9108	146E9109				
e	up to 54	0,43	1,55	146B9120	146E9121	146B9122	146B9123		
6	up to 85	0,65	2,44	146B9126	146E9127	146B9128	146B9129		
Ĩ.	up to 135	1,50	3,87	146B9132	14669133	146B9134	146B9135		
at	up to 216	2,50	6,20	146D9138	146B9139	146B9140	146B9141		
ъ Е	up to 337	4,00	9,66	146B9144	146B9145	146B9146	146B9147		
_	up to 540	4,00	15,49	146B9150	146B9151	146B9152	146B9153		
		4,00	15,49	14009130	14009131	14009132	14009133		

* Capacity based on 30K temperature difference ** Capacity based on 40K temperature difference



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Selection list tables:

A1					Heat reclaim capacity					
				up to 100	p to 100 up to 150 up to 300 up to 400 kW Capacity **					
_	Capacity*	min. Flow	max. Flow	0,03	0,04	0,06	0,10	m3/h	min. Flow	
č	kW	m3/h	m3/h	2,15	3,23	6,45	8,60	m3/h	max. Flow	
ца	up to 22	0,20	0,62	146B9108	146B9109					
ē	up to 54	0,43	1,55	146B9120	146B9121	146B9122	146B9123			
5	up to 85	0,65	2,44	146B9126	146B9127	146B9128	146B9129			
Ĩ.	up to 135	1,50	3,87	146B9132	146B9133	146B9134	146B9135			
at	up to 216	2,50	6,20	146B9138	146B9139	146B9140	146B9141			
£	up to 337	4,00	9,66	146B9144	146B9145	146B9146	146B9147			
	up to 540	4,00	15,49	146B9150	146B9151	146B9152	146B9153			

* Capacity based on 30K temperature difference ** Capacity based on 40K temperature difference

A2				Heat reclaim capacity					
				up to 100 up to 150 up to 300 up to 400 kW Capacity**					Capacity**
_	Capacity*	min. Flow	max. Flow	0,03	0,04	0,06	0,10	m3/h	min. Flow
p	kW	m3/h	m3/h	2,15	3,23	6,45	8,60	m3/h	max. Flow
na	up to 135	1,50	3,87	146B9164	146B9165				
e	up to 216	2,50	6,20	146B9168	146B9169	146B9170			
0	up to 337	4,00	9,66	146B9173	146B9174	146B9175	146B9176		
ŭ	up to 540	4,00	15,49	146B9179	146B9180	146B9181	146B9182		
Ē									

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* Capacity based on 30K temperature difference

** Capacity based on 40K temperature difference

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				up to 100	up to 150	up to 300	up to 400	kW	Capacity**
_	Capacity*	min. Flow	max. Flow	0,03	0,04	0,06	0,10	m3/h	min. Flow
	kW	m3/h	m3/h	2,15	3,23	6,45	8,60	m3/h	max. Flow
	up to 22	0,20	0,62	146B9191	146B9192				
3	up to 54	0,43	1,55	146B9203	146B9204	146B9205	146B9206		
	up to 85	0,65	2,44	146B9209	146B9210	146B9211	146B9212		
	up to 135	1,50	3,87	146B9215	146B9216	146B9217	146B9218		
1	up to 216	2,50	6,20	146B9221	146B9222	146B9223	146B9224		
S	up to 337	4,00	9,66	146B9227	146B9228	146B9229	146B9230		
	up to 540	4,00	15,49	146B9233	146B9234	146B9235	146B9236		

Heat reclaim canacity

* Capacity based on 30K temperature difference ** Capacity based on 40K temperature difference

A4					Heat reclaim capacity				
				up to 100	up to 150	up to 300	up to 400	kW	Capacity**
_	Capacity*	min. Flow	max. Flow	0,03	0,04	0,06	0,10	m3/h	min. Flow
P	kW	m3/h	m3/h	2,15	3,23	6,45	8,60	m3/h	max. Flow
na	up to 135	1,50	3,87	146B9247	146B9248				
ē	up to 216	2,50	6,20	146B9251	146B9252	146B9253			
5	up to 337	4,00	9,66	146B9256	146B9257	146B9258	146B9259		
Ĕ	up to 540	4,00	15,49	146B9262	146B9263	146B9264	146B9265		
÷									

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* Capacity based on 30K temperature difference ** Capacity based on 40K temperature difference

A6				Heat reclaim capacity				
				up to 100	kW	Capacity**		
_	Capacity*	min. Flow	max. Flow	0,03	m3/h	min. Flow		
ů	kW	m3/h	m3/h	2,15	m3/h	max. Flow		
na	up to 22	0,20	0,62	146B9400				
P	up to 54	0,43	1,55	146B9401				
5	up to 85	0,65	2,44	146B9402				
Ľ.								
at								
н								

* Capacity based on 30K temperature difference ** Capacity based on 40K temperature difference

A7				Неа	at recla	im capacity
				up to 100	kW	Capacity**
_	Capacity*	min. Flow	max. Flow	0,03	m3/h	min. Flow
pu	kW	m3/h	m3/h	2,15	m3/h	max. Flow
na	up to 22	0,20	0,62	146B9403		
e	up to 54	0,43	1,55	146B9404		
þ	up to 85	0,65	2,44	146B9405		
Ľ.						
at						
he						

* Capacity based on 30K temperature difference ** Capacity based on 40K temperature difference



Same HRU selection using Coolselector Select within Commercial applications > Heat recovery unit



Heat recovery:

- Supply from cooling unit (5) = 70°C
- Return to cooling unit $(6) = 30^{\circ}C$
- Heat recovery capacity =140 kW

Heat supply:

- Supply temperature (3) = 60°C
- Return temperature (4) = 30°C
- Heating demand capacity = 200 kW.

Indirect connection ; eg connection to the District Heating

Heat resale option





Application Guide | Heat Recovery Unit

- 10. How to set up system manager (800A) to operate with Danfoss Heat Recovery Unit (HRU)
- 10.1 Connect HRU to a system manager through Modbus

Wiring diagram ECL to the System Manager:



It is possible to use MODBUS 2 as a substitute for MODBUS 1

All devices in the network must used in the same communication settings, i.e. multiple communication are not allowed. The module can operate with

- 9600, 19200 or 38400 (default) baud rate
- 1 start bit
- 8 data bits
- even parity
- 1 stop bit
- (in total 11 bits)



10.2 Download latest EDF package

Go to AK-SM 800A series webpage:

AK-SM 800A Series | Danfoss

Locate the **Downloads** section and select **AK-SM800A Latest EDF package**.



Click on the "AK-SM800A Latest EDF package" to begin the download.



10.3 Add ECL Controller to System Manager Software

Login to the system using your username and password.

Danfoss
System Manager 800A
Version SVB501.0.153

Once logged in, you will land on the **Dashboard** where you can view the overview of the System Manager and units connected to it.

Click Menu button.

	File Dashboard	Alarms System View G	Graphic View Deta	I Schedules Info History Configuration							
A	larms			Updated 11:55:01 🔔 🕂	Refr	rigeration				Updated	1 11:55:25 🗱 🕂
U	it Device Name	Address	Alarm Type	Occurred	Unit	Name	Address	Status	Value	Setpoint	Alarm
0	AK-SM850A	0	NTP Failure	25/01/23 11:03	0	Heat Recovery Unit	6				
					0	ECL 310	6	Online	0	40.0	
					0	AK-PC 782B	11				
					0	Condenser B	11	OFF	0.0 *C	12.8 °C	
					0	HP control	11	OFF	NaN Bar	97.0 Bar	
					0	Receiver control	11	OFF	-1.0 Bar	38.0 Bar	
					0	Heat reclaim	11	OFF	NaN "C	55.0 °C	
					0	Suction MT	11	OFF	NaN °C	-8.0 °C	
L				×							







In the EDF Update section, select Local Stored File as the update method.

lome / EDF Files Update	Files Update
lease select one of the ways to update EDF files	ect one of the ways to update EDF files
Local Stored File	Local Stored File
Web Connectivity	Web Connectivity
Export Device List File	Export Device List File
Cancel	

Click on **Choose File**. Select file downloaded in step 10.2 and press open.

tome / Download Method / EDF Update Select	
inter location of EDF update file Choose File No file chosen	
Jpdate	
Description	Information
Upgrade Software:	Information

The file should now be visible in the **Upgrade Software** section.

Home / Download Method / EDF Update Select	
Enter location of EDF update file Choose File SM800A5 (1).epk	
Jpdate	
Description	Information
 Upgrade Software: 	SM800A_EDF_Package_20230105 (1).epk
Back Stage EDF Package	

Press Stage EDF Package.

Hom	Home / EDF Download Method / EDF File Selection													
Upo Si Si Shov	date EDF(elect All EDI v 10 +	(5) Fs								Search:				
		Filename	11	Size		Date								
	⊗∕	080X1205.ed3		47566		01/06/23 07:59								
	≪	080X1208.ed3		50761		01/06/23 07:59								
	∝ ∕	080X1209.ed3		47608		01/06/23 07:59								
	~	080Z0106.ed3		42509		01/06/23 07:59								
	∝ ∕	080Z0111.ed3		84226		01/06/23 07:59								
	≪	080Z0112.ed3		84226		01/06/23 07:59								
	€ ∕	080Z0116.ed3		81979		01/06/23 07:59								
	~	080Z0117.ed3		81979		01/06/23 07:59								
	☞	080Z0118.ed3		81979		01/06/23 07:59								
	≪	080Z0119.ed3		81979		01/06/23 07:59								
Show	ving 1 to 10	0 of 542 entries 542 rows selected					Previo	ous 1	2	3 4	5	. 55	Ne	≥xt

Installed EDF(s)



Scroll down and under the Installed EDF(s) section, press Install Selected EDF Files. An Attention alert will pop up, press OK.

	81919	01/06/23 07:59	
֎ 080Z0119.ed3	81979	01/06/23 07:59	
Showing 1 to 10 of 542 entries 542 rows selected			Previous 1 2 3 4 5 55 Next
Installed EDF(s) Show 10 • entries			Search:
Filename	†⊥ Size	11 Date	
080X1205.ed3	47566	01/25/23 11:01	
080X1208.ed3	50761	01/25/23 11:01	
080X1209.ed3	47608	01/25/23 11:01	
080Z0106.ed3	42509	01/25/23 11:01	
080Z0111.ed3	84226	01/25/23 11:01	
080Z0112.ed3	84226	01/25/23 11:01	
080Z0116.ed3	81979	01/25/23 11:01	
080Z0117.ed3	81979	01/25/23 11:01	
080Z0118.ed3	81979	01/25/23 11:01	
080Z0119.ed3	81979	01/25/23 11:01	
Showing 1 to 10 of 550 entries Back Install Selected EDF Files			Previous 1 2 3 4 5 55 Next

₩ 080Z0119.ed3	81979	01/06/23 07:59	
wing 1 to 10 of 542 entries 542 rows selected			Previous 1 2 3 4 5 55 Next
talled EDF(s) vv 10 • entries			Search:
ilename	1. Size	TL Date	
30X1205.ed3	Autoritan	/23 11:01	
80X1208.ed3	Attention	/23 11:01	
80X1209.ed3	By clicking OK the unit will be taken minutes. System Manager will restar	offline for approximately 3 /23 11:01 t with the 542 selected EDF	
30Z0106.ed3	files loaded. Connection will be lost after 3 minutes if the page does not	temporarily. Please reconnect /23 11:01 auto refresh.	
30Z0111.ed3		/23 11:01	
80Z0112.ed3		Cancel OK /23 11:01	
80Z0116.ed3	81979	01/25/23 11:01	
30Z0117.ed3	81979	01/25/23 11:01	
30Z0118.ed3	81979	01/25/23 11:01	
80Z0119.ed3	81979	01/25/23 11:01	
wing 1 to 10 of 550 entries Back Install Selected EDF Files			Previous 1 2 3 4 5 55 Next

If the update is successful, a page will show up. Press **Home** and then close the **Menu** to get back to the Dashboard.



*Note: HRU will be visible in the **Refrigeration** section not in HVAC.



In the top bar, click on **Configuration**.

-	7 lu	ENGINEERING	TOMORRO	w					
	Danfoss								
	File Dashboard	Alarms Syste	em View	Graphic View	Detail Sch	dules	Info Hi	tory C	onfiguration
Ala	arms						U	pdated 12:	30.23 🛕 ∓
Unit	it Device Name		Address	Alarm Type			Occurred		
N	No data to display								
									-

This page has three sections: System Setup, **Refrigeration**, HVAC. Select **Layout** in the **Refrigeration** section.

Danfoss	ENGINEERING TOMORROW		
III File Dashboard	Alarms System View Graphic View Detail	Schedules Info History Configuration	•
Location: → Config	guration		Address: 0
Wizards Time Sy:	stern Comm Alarms Control Network No	des History Schedules	
System Setup			
Preferences	Users	Licensing	
Refrigeration			
Layout	Сору		
HVAC			
Layout	Copy		

A briefing for the **Refrigeration** Configuration wizard will pop up. To move forward, click on the **arrow (Next)** in the right corner of the top bar.





Network page opens. Make sure that needed buses are *Enabled*. Press the **Next** in the top bar again to access the **Discovery** site.

		•
• X Network		• • • • • • • • •
		Updated 12:33:23
Use this wizard to select your relevant field bus type. Double-	Channel LONWORKS	Enabled
click a line to make your selection. If Modbus/RS485 is enabled you may select SLV for the Danfoss variable speed compressor here.	Channel MODBUS 1	Enabled
	Number of polls	1
lote: When selecting SNMP as a local bus, you will be equired to enter a valid IP subnet address range used by	Number of Modbus Scan Ranges	0
Danfoss SNMP controls.	SLV/CSENSE	Yes
	🧼 Channel MODBUS 2	Disabled
	Channel SMMP	Disabled
	🧼 Channel AK-IP / PI-200	Enabled
	Network Connection	ETH1
	AK-IP Status	Found 0 Devices.
	PI-200 Status	Found no Gateways.

This will allow to access online devices, in this case the System Manager. Verify that its *status* is green. Press **Rescan** to scan and verify both the Heat Recovery Unit and System Manager.

								•
X Discovery								*******
This wizard screen allows you to scan or re-scan the local bus network(s) configured on the previous screen.	1 Online devices 0 Duplicate address						Rescan	Refresh
	Status	Name	Address	Model	Туре	Code #	Version	Device Bus
		AK-PC 782B	11	AK-PC782AB-037x	PACK	080Z0192	03.7x	LON ^

All relevant data should be uploaded. To continue, press Next again to get to the Compressors page.

Danfoss Engineering tomorrow								•	1
 X Discovery 									٠
This wizard screen allows you to scan or re-scan the local bus network(s) configured on the previous screen.	2 Online devices 0 Duplicate address						Rescan	Refresh]
	Status	Name	Address	Model	Туре	Code #	Version	Device Bus	
		AK-PC 782B	11	AK-PC782AB-037x	PACK	080Z0192	03.7x	LON	*
		HT-RECOVERY-02xx 6	6	HT-RECOVERY-02xx	PACK	P501-12	02.xx	MODBUS 1	

Compressors page gives overview of Compressor Controls.

				•
 Compressors 				******* +
	Compressor Controls		Add	Copy Remove
This screen allows you to order and manage compressor controllers discovered on the local field bus network(s). Only	Name	Address	Model	#Suction Groups
Pack devices can be managed via the layout wizard, any	AK-PC 782B	11	AK-PC782AB-037x 080Z0192 AK-PC 782AB Pack control v.3.7x	1 *
RACK #O system conligured will block the use of the wizard.	HT-RECOVERY-02xx 6	6	No compressor	0
Notes: Compatible Multi-Suction Pack controllers that have been scanned will initially appear in this screen as 0 suction groups. Manually set the suction group imper via the suction group input box for that pack, matching the actual Pack configuration.				
The AK-ST 500 (service Tool) is required to configure your Pack controllers.				
Rename default suction group name per requirements.				
The ADD button supports the creation of 'No compressor' or 'single suction group Pack controls'. Do not use the ADD button for multi-suction capable devices (suction group count remains at 1).				



For a more concise view, there is an option to **rename** units by clicking twice on the current name. Then press **Next**.

Danfoss ENGINEERING TOMORROW				
← X Compressors				********
	Compressor Controls			Add Copy Remove
This screen allows you to order and manage compressor controllers discovered on the local field bus network(s). Only	Name	Address	Model	#Suction Groups
Pack devices can be managed via the layout wizard, any	AK-PC 782B	11	AK-PC782AB-037x 080Z0192 AK-PC 782AE	3 Pack control v.3.7x 1
RACK I/O system configured will block the use of the wizard.	HT-RECOVERY-02xx 6	6	No compressor	0
Notes: Compatible Multi-Suction Pack controllers that have been scanned will initially appear in this screen as 0 suction groups. Manually set the suction group number via the suction group input box for that pack, matching the actual Pack configuration.				
The AK-ST 500 (service Tool) is required to configure your Pack controllers.				
Rename default suction group name per requirements.				
The ADD button supports the creation of 'No compressor' or 'single suction group Pack controls'. Do not use the ADD button for multi-suction capable devices (suction group count remains at 1).				

Press Next again to get to the Circuits site. Press Next.

			•
Circuits			********
	Case Control		Add Copy Remove
This wizard screen allows you to manage case controllers discovered on the local bus network.	Name	Address	Model
Use the Add button to add a new offline device. Edit model, name, and address by double-clicking in the appropriate field. Note: not all device types allow editing of all fields and the addresses of I/O points are set outside this wizard.	No data to display		1
You may also add new offline devices by selecting an existing device and pressing the Copy button.			
Selecting the case type will set the relevant graphic on device detail screens.			

The next page, **Suction group mapping**, shows the mapping of Case Controls to Pack Controls, forming suction groupings. Press **Next**.

							•
Suction group mapping							
X	Allow multi-case circuit creation						
This screen allows the mapping (via drag N drop) Case	Compressor Controls			Available Cases			
controls to Pack controls, forming suction groupings. The following features are supported:	Name	Addr	Model	Name	Addr	Model	
- Drag N Drop Case devices to and from Pack/Pack suction groups	Ⅱ → 🚺 АК-РС 7828	11	AK-PC782AB-037x	No records to display			^
- Move/re-order Case devices within same suction group or move to new Pack suction group	II + Heat Recovery Unit	6	HT-RECOVERY-02xx				
- Move/re-order Pack controllers							
Tipl Use the SHIFT or CTRL keys to select and drag multiple devices.							
Tipl When moving Case controls to Pack/Suction group the target Pack/Suction group will show a full red outline, indicating acceptance of move.							
TipI Case controllers can be selected by clicking anywhere on the Case row, for Pack selection and movement use the 6-dot 'move' icon.							v

The **Summary** is a final approval step before sending the configuration to the System Manager. Press **Finish**.

				•
🔶 🗶 Summary				Finish
This screen presents your previous device manning for your	Final Refrigeration Layout			
final approval. You may set the addresses of offline controllers	Name	Address	Туре	Model
Press the finish button to send your configuration to the SM850 and close the wizard.	- Heat Recovery Unit	6	PACK	No compressor
Please wait for configuration to complete before exiting this screen.	Sensors	6	Suction	
	▼ ↓ AK-PC 7828	11	PACK	AK-PC782AB-037x 08020192 AK-PC 782AB P
	Suction MT	11	Suction	



After configuring, the **Configuration Status** will pop up. Press **OK**.



You will go back to the **Configuration** site again. In the top bar, choose **Detail**.

	Dante	9 <u>88</u>	ENGINE	ERING TOMORF	ROW						
III Fil	e Dashbo	oard /	Alarms	System View	Graphic View	Detail	Schedules	Info	History	Configuration	٩
Locat	on: • C	onfigu	ration								Address: 0

To view data for each sensor, choose **Sensors** in the section above **Status**.

	MORROW		
III File Dashboard Alarms System	View Graphic View Detail Schedules Info Histo	bry Configuration	
🛞 Refrigeration	Overview Alarm History Log Status/Settings	Schedules	Status/Settings : Sensors #0 🛞 🏾
	Status Online Alarm OK Address 6 Septonint 40.0 *C Current Value 45.05 *C Model HT-RECOVERY-020X	No history configured	•
	Sensors V Status S1 Sensor	Updated 13 22 57 Settings 45.07 °C Ho data (or not authorized)	Updated 13:22:58
	S2 Sensor	44.84 °C	
	S3 Sensor	192.00 °C	
	54 Sensor	44.83 °C	
	S5 Sensor	45.05 °C	
	S6 Sensor	44.83 °C	
	S7 Sensor	45.23 °C	
S Lighting	S8 Sensor	44.91 °C	
4 Energy	S9 Sensor	192.00 °C	
& Miscellaneous	Device Alarms No alarms detected.		

10.4 Present live readings from HRU

Click Menu button.

ENGINEERING TOMORROW

 ENGINEERING TOMORROW

 File
 File
 Alarma System View Oraphic View Detail Schedules Info History Configuration

Choose Graphic Editor.

Danfoss	ENGINEERING TOMORROW					
×						
AK-SM800A S	Series	⊅ [""]			K 🔒	HACCP
Information	Diagnostic Log Software	e Upgrade Operating System EC	DF Update Export Database	Import Database Graphic Editor	Cleared Alarm Log Browser certificate	
(i) Information	Q Diagnostic Log	Cperating System	DF Updule Expert Database	Import Distribuse	Cleared Alarm Log	HACCP

Press Manage Graphics.

De	<u>foss</u>						Ð
Home / Graphic Editor							
New	Open	Save	Import	Export	Manage Graphics	c	lose

In the **Graphic Project Tool**, choose the file in the **Web screens graphics file count**. The file should be in the *jpeg*, *jpg*, or *flp* format.



Change the **Local screen graphics file** Count *from 0 to 1*, and then **Save** it. (*Note: you can upload up to 5 files*)

<u>Danfoss</u>	ſ	Graphic Project Tool - Add or delete graphic files: Unit 0	e
Home / Graphic Editor		Graphic Project root - Add of delete graphic riles. Onit o	
New Open Save Import Export Mar SM datapoints	nage Graphics	This wizard will help you to manage graphic project files. To add files entre the total number of files with the file count boxes. Click the X beside an existing filename to delete. Local screen graphics file count:	Close Browser View
Search	Unit 0	zitath trub	•
Analog Sensors Digital Inputs Relays Outputs Variable Outputs Devices	Edit imi	City Save	
			Version GE01.002.042

Click on Browser View.

Under SM Datapoint in the left section, click on Device and choose the IP address.



This will display an overview of the *sensors* in the system. To place **Sensors** into the chart, grab them and place them in the desired location. The same principle applies for **Controllers**.







Each sensor has its **Datapoint** setting, which can be accessed by clicking on sesnor in the chart

Once the sensors are placed, press **Save** in the left corner of the top bar.

Zanghu	Ð
Home / Graphic Editor	
New Open Save Import Export Manage Graphics	Close

A confirmation message will pop up, click Yes.



From this moment readings from HRU will be displayed in Graphic View.









HRU Application A1

Application A1 is indirect heating application with 2 buffer tanks and heat resale option. Waste heat from CO₂ can be used internally or sold back to district heating network.

HRU Application A2

Application A2 is indirect heating application with 2 buffer tanks and without heat resale option. Waste heat from CO₂ can be used only internally.

HRU Application A3

Application A3 is direct heating application with 2 buffer tanks and heat resale option. Waste heat from CO_2 can be used internally or sold back to district heating network.

HRU Application A4

Application A4 is indirect heating application with 2 buffer tanks and without heat resale option. Waste heat from CO₂ can be used only internally.

HRU Application A6

Application A6 is indirect heating application with 1 buffer tank and without heat resale option. Waste heat from CO₂ can be used only internally.

HRU Application A7

Application A7 is indirect heating application with 1 buffer tank and without heat resale option. Waste heat from CO₂ can be used only internally.



HRU controller – ECL 310

Pack controller – AK-PC 782A/B

Danfoss electronic controllers (ECL) are intelligent temperature regulators for district heating and domestic hot water systems. By means of weather compensation and application keys, they can be adapted to a variety of district heating systems, ensuring a high level of comfort and optimum energy utilization.

Being the flagship and best-in-class controller for transcritical CO₂ pack controls, the

AK-PC 782A/B offers the highest possible efficiency with the Multi Ejector.





Coolselector®2 – Transcritical High-Pressure Application

Helps you optimize energy consumption and increase efficiency in any system. Run unbiased calculations based on a set of operating conditions — such as cooling capacity, refrigerant, evaporation, and condensation temperature — and then select the best components for your design.

Check out the new Transcritical High Pressure Application area.

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