INSTALLATION AND OPERATION MANUAL

Junior ECO
ECO Inverter+
Cube House
Cube Inverter+
RE 04

Manual version: 2020-03-02

Oilon
Heat pump installation and operation manual

Manual version: 2020-03-02

This manual is for the following products:

Model	Label	Refrigerant
Cube House 4 03	CUBEH403	R-410A
Junior ECO 4 03	JUNIORECO403	R-410A
Cube House 6 03	CUBEH603	R-410A
Junior ECO 6 03	JUNIORECO603	R-410A
Cube House 8 03	CUBEH803	R-410A
Junior ECO 8 03	JUNIORECO803	R-410A
Cube House 10 03	CUBEH1003	R-410A
Junior ECO 10 03	JUNIORECO1003	R-410A
Cube House 13 03	CUBEH1303	R-410A
Junior ECO 13 03	JUNIORECO1303	R-410A
Junior ECO 17 03	JUNIORECO1703	R-410A
Junior ECO 21 03	JUNIORECO2103	R-410A
Cube Inverter+ 2-9 03	CUBEINVERTER2-903	R-410A
Cube Inverter+ 3-12 03	CUBEINVERTER2-1203	R-410A
ECO Inverter+ 2-9 03	ECOINVERTER2-903	R-410A
ECO Inverter+ 3-12 03	ECOINVERTER3-1203	R-410A
ECO Inverter+ 7-25 03	ECOINVERTER7-2503	R-410A
RE 28 04	RE2804	R-410A
RE 28 HT 04	RE28HT04	R-134a
RE 33 04	RE3304	R-410A
RE 38 04	RE3804	R-410A
RE 42 04	RE4204	R-410A
RE 48 04	RE4804	R-410A
RE 56 04	RE5604	R-410A
RE 56 HT 04	RE56HT04	R-134a
RE 66 04	RE6604	R-410A
RE 76 04	RE7604	R-410A
RE 84 04	RE8404	R-410A
RE 96 04	RE9604	R-410A

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INSTALLATION AND COMMISSIONING

1 Handling the heat pump

1.1 Storage, transfer and transportation

- Transport and store the heat pump in vertical position.
- The transportation space must be dry.
- The storage space has to be warm and dry.
- The device must be transported and stored, protected against water and dust.
- The moisture may not condense from the air to the device parts during storage or transportation.
- Do not stack goods on the device.
- Move and lift the device using only safe methods.
- After lifting, lay the device carefully down on the floor level. Hard impact can break the device.

1.2 Junior ECO and ECO Inverter+

- Lift the device from the bottom of compressor unit´s outer casing.
- The compressor unit can be tilted up to 45° angle with respect to the horizontal plane.
  - Tilting the device to more than 45° angle may impair the compressor lubrication at startup. This may lead to compressor failure.
  - If the device is tilted to more than a 45° angle, the device must be held in vertical position for at least three hours before starting the compressor.

1.3 Cube House and Cube Inverter+

- Lift the device from the frame. Do not lift the device from the bottom of the compressor unit.
- The covering plates of the device can be removed to ease the carrying and moving.
- The device can temporarily be carried by lifting it from its side beams.
- If necessary, the compressor unit can be detached from the frame of the device before carrying and tilting the device.
- Do not lift or move the device if the service buffer tank is filled. If the tank is filled, empty it before moving the device.
- The compressor unit can be tilted up to 45° angle with respect to the horizontal plane. Remove the compressor unit from the device, if the device must be tilted more.
  - Tilting the device to more than 45° angle may impair the compressor lubrication at startup. This may lead to compressor failure.
  - If the device is tilted to more than a 45° angle, the device must be held in vertical position for at least three hours before starting the compressor.

1.4 RE 04

- Do not tilt the device.
- Lift the tower consisting of two units only from below the lower unit.
- Lift and move the device with a hand pallet truck or forklift.
- Lift and move the device only so that both forks of the lifting device extend under the whole device.
- Keep the thick covering plates of the unit closed during lifting and moving the device.
- Do not lift the device under the electric cabinet.

2 Installation

2.1 Most essential components and typical piping diagrams

2.1.1 Component markings

SEQ Taulukko * ARABIC Table 1. Most essential components of the heat pump system

BRINE CIRCUIT		**CONDENSER CIRCUIT**	
Q8	brine circuit pump	Q9	Condenser-circuit pump
B91	brine circuit's temperature sensor, brine in (brine circuit in, brine circuit return)	B71	condenser circuit's temperature sensor, return water (condenser circuit in, heating return water)
B92	brine circuit's temperature sensor, brine out (brine circuit out, brine circuit flow)	B21	condenser circuit's temperature sensor, flow water (condenser circuit out, heating flow water)
E15	brine circuit's flow meter*	E24	condenser circuit's flow meter
E26	brine circuit's pressure switch	Q3	change valve
REFRIGERANT CIRCUIT		**DHW CIRCUIT**	
E9	low pressure switch	B3	DHW storage tank temperature
K1	Compressor	B31	DHW storage tank temperature, lower section of the tank
B81	hot gas temperature sensor	**THE HEATING CIRCUIT**	
E10	high pressure switch	B4	additional storage tank (buffer storage tank) temperature
B83	liquid line temperature	B41	additional storage tank (buffer storage tank) temperature, lower section of the tank
B85	suction line temperature	B9	outdoor temperature sensor
V81	Expansion valve	Y1/Y2	heating circuit 1 control valve (open/closed)
H82	suction pressure	Q2	heating circuit 1 circulation pump**
H83	higher pressure	B1	heating circuit 1 flow temperature sensor
		RG	room temperature measurement, heating circuit 1

2.1.2 Space heating without a buffer storage tank

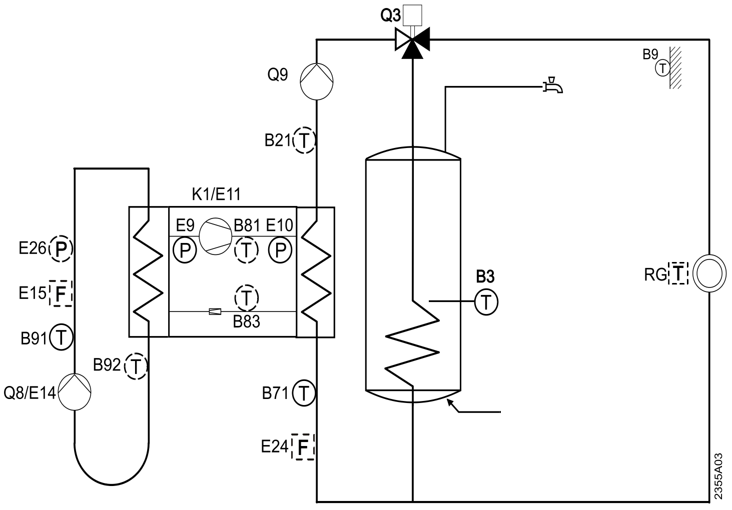


Figure 1. DHW storage tank and space heating without a buffer storage tank (additional storage tank)

2.1.3 Space heating with a regulated storage tank

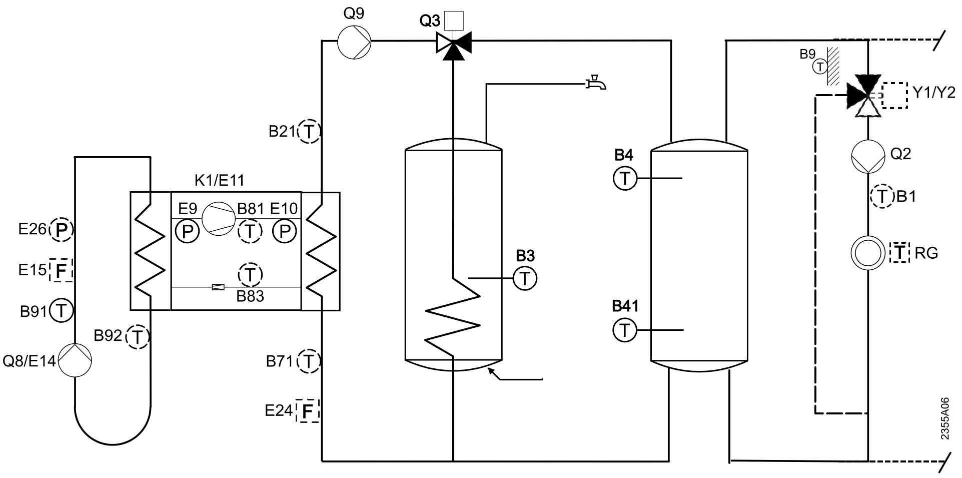


Figure 2. DHW storage tank and space heating with the buffer storage tank (additional storage tank)

2.2 Installation site

2.2.1 Site planning and selection

- The device with its equipment must be installed in a warm, dry place.
- The permissible temperature of installation site is +5…+35 °C (non-condensing).
- The moisture may not condense from the air on installation site to the device parts.
- The air of the installation site must not contain hazardous quantities of dust or other substances affecting the performance, endurance, or safety of the heat pump.
- Avoid installing the heat pump and its equipment, such as circulating pumps, in noise sensitive areas or in their vicinity.
- The heat pump and related equipment should be installed to the exterior wall. This way, noise drifting into residential premises can be eliminated.
- Soundproof the noise sensitive area from the installation site of the devices. Note that the soundproofing must suppress low sounds. Also take the structure-borne noise through the floor structures into account in soundproofing.
- If necessary, use flexible pipes (coupling hoses) in order to prevent the transmission of sound.
- An air gap has to be left between the device and the wall surfaces in order to avoid vibration and sound transmission.

2.2.2 Device base and adjustable legs

- There must be a stable and steady base under the device that withstands the weight of the device.
- The device must be mounted securely in a vertical position on its own adjustable legs.
- The device must be adjusted horizontally using the adjustable legs of the device.

2.2.3 Maintenance and free space around the device

- The device must be serviceable from the front and both sides. Serviceability has to be organized either by leaving sufficient free space around the device or by ensuring that the structures around the device can be easily disassembled and put back to their places.

2.2.4 Floor drain

- There has to be a floor drain on the istallation site of the device.
- The inclination of the floor on the istallation site has to be lead from the device to the floor drain.

2.3 Pumps

- Always check the pumps' flow dimensioning by comparing the pump performance (lifting height, flow rate) to the circuit's pressure loss calculation. Pay special attention to the dimensioning of the brine circuit pump.
- If the selected pumps deviate from the standard configuration and are connected to the heat pump switchboard, always check dimensioning of the pumps' power supply, and the power supply and cabling of the components. If necessary, change the coupling to comply with the pump's requirements.
- Note, that the pump operating sound may drift to the residential premises and other noise sensitive areas.
    - Avoid installing the pumps in noise sensitive areas or in their vicinity.
    - The pumps should be installed to the outer side of the wall. This way, noise drifting into residential premises can be eliminated.
    - Insulate the external circulation pumps of the device with absorbers from the wall and floor surfaces. For example, rubber vibration absorbers can be used for insulation.
- When selecting the pump, pay attention to a minimal electrical power consumption in the most probable point (MPP). This will keep the pumping costs as low as possible.
    - The cost is significantly influenced by the pressure loss in the piping and its equipment. If the loss is kept to a minimum, the required electrical power is drastically reduced. This may allow for a smaller pump to be used. Usually the most important factor in attaining minimal pressure loss is having sufficiently wide piping.
- Smaller pumps should be installed on a vertical line, flow direction upwards. Thus, the air can not accumulate in the pump housing. Larger pumps usually require horizontal installation. See the pump manual for the permitted installation methods.
- Wet-motor pumps (water-lubricated pumps) must be installed so that the water can lubricate and cool the pump motor. This requires that the wet-motor pump's motor and its shaft are in a horizontal position. A wet-motor pump can be installed in a horizontal or vertical line, as long as the pump shaft is in a horizontal position (the motor shaft can be at an angle of max. 7 ° in relation to the horizontal and vertical plane).
- Oilon is not responsible for the suitability of the pump in the customer's system, nor for any changes made in the installation phase.

Standard pumps are presented in the technical data section along with the flow data.

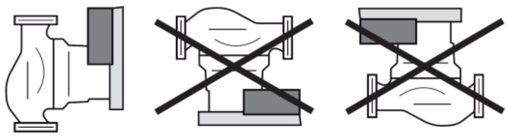


Figure 1. Installing the wet-motor pump

2.4 Brine circuit

2.4.1 Designing and implementing the system

- The brine circuit must be implemented according to the effective legislation and licence conditions set by the authorities.
- It must be heat and flow technically adequate for the heat pump's capacity.
- The pump for the brine circuit must be selected according to the circuit's pressure loss calculation (chapter **Error! Reference source not found.**).
- In a system with multiple brine circuits, the circuits must be connected in parallel and the flow of each circuit must be separately adjustable.
- In a system with multiple heat pumps, the brine circuit flow to each pump much be measurable and adjustable. The circuits must be designed to be as symmetrical as possible, and if necessary, the piping must be fitted with balancing valves and non-return valves to ensure the correct flow direction and for balancing the flows.
- If the selected pumps deviate from the standard configuration, always check dimensioning of the pumps' power supply and the heat pump's power supply.

2.4.2 Brine circuit pump

The pump for the brine circuit must always be selected according to the circuit's pressure loss calculation. The pressure loss is calculated from the brine capacity in design conditions, and the temperatures and attributes of the brine liquid in design conditions. The design conditions are the conditions where the capacity is at its peak during the device's normal operation. The brine circuit's pump must be able to produce the flow that the pressure loss calculation requires under the design conditions. The temperature difference between the circuit's flow and return sides must be at maximum 4 °C. The recommended difference is 3 °C, because it diminishes the risk of underestimation and the evaporation temperature is kept as high as possible. Note that even a carefully drafted pressure loss calculation can have a margin of error as high as +/− 20 %, and that the pressure loss usually grows as the system ages.

2.4.3 Pipe size

- The appropriate pipe size is determined by the technical functionality, pressure loss, expenses and ease of installation. When selecting the pipe size, pay attention to the brine circuit's planning and the circuit pump's performance, as well as the pipe material and equipment.
- It is usually a good idea to choose the pipe size so that the flow rate in the pipes in approximately 0.4...1.5 m/s. For practical reasons, the flow rate may exceed these values in shorter pipe segments, but typically stays at under 2.5 m/s. The flow rate must usually stay at over 0.3 m/s so the gas bubbles can be exhausted with the stream. Check the maximum permitted flow in the pipe's technical data.
- The smaller the pipe, the larger the flow rate and pressure loss will be. Using a pipe size that is too small will result in high pressure loss, inadequate flow, poor functioning of the heat pump, high electrical power consumption by the pump, high pumping expenses, noisy piping, poor functioning of the deaerators and piping cavitation.

2.4.4 Brine solution

- The liquid used in the brine circuits must be a mix of ethanol and water, or other equivalent solution that conforms to the licence conditions set by the local authorities. Note that solutions containing corrosion inhibitors are not permitted in all regions. For these cases, Naturet Geosafe by Altia is one commercially available option.
- The solution used in the brine circuits must withstand all the different conditions within the circuit and the evaporator without freezing or slushing. The solution's freezing temperature must be under −15 °C.

2.4.5 Ethanol and water solutions

The strength of ethanol and water solutions is reported in mass or volume percentages. These two differ slightly from one another. A suitable ethanol and water solution strength is 28...30 mass-%. This results in a freezing temperature of −17…−20 °C. Stronger solutions must be diluted with water to the suitable strength. Always check the correct dilution ratio from the solution supplier.

SEQ Taulukko * ARABIC Table 2. Diluting ethanol and water mix to a 28 mass-% (23 volume-%) solution

Non-diluted strength mass-%	Non-diluted strength volume-%	Dilution
28	23	• completed solution, do not dilute
60	52	• liters of solution + 1020 liters of water • cubes of solution + 1020 liters of water • kilograms of solution + 1143 kilograms of water • 1000 kg of solution requires 1143 kg of water
88	83	• liters of solution + 1814 liters of water • cubes of solution + 1814 liters of water • kilograms of solution + 2214 kilograms of water • 1000 kg of solution requires 2214 kg of water

2.4.6 Safety valve

- Install the safety valve in the highest point of the pipe extending from the brine circuit on the suction side of the circulation pump.
- Install the safety valve's discharge pipe so that it is continuously descending and reaches the floor drain in a safe manner.
- The discharge pipe's diameter must be at least as large as the safety valve's nominal diameter.
- The pipe must be self-emptying (must not be placed under the liquid level of the tank or the well, must not freeze),
- A shut-off valve must not placed between the safety valve and the circuit.
    - If an irremovable shut-off valve is placed between the safety valve and the circuit, detach the shut-off valve's handle after opening the valve and place a caution sign that forbids shutting the shut-off valve next to the valve. Finally, make sure that the shut-off valve is open.
- The safety valve's discharge side must not have a shut-off valve.
- Select the safety valve's opening pressure according to the brine circuit's largest permitted operating pressure. The opening pressure may not be higher than 3 bar. Single-family houses usually require a 1.5 bar safety valve.
- Check the safety valve's functioning by releasing the valve from the button after the pipes have been filled.

2.4.7 Shut-off valves

- Instal shut-off valves on both sides of the brine circuit's heat pump to facilitate the pump's maintenance. Make sure that in addition to the heat pump, all other components that may require maintenance or changing are also within the whole demarcated by the shut-off valves.

2.4.8 Expansion tank

- Install the expansion tank to the pipe extending from the brine circuit on the suction side of the circulation pump.
- The expansion tank can be a transparent, plastic level vessel or a diaphragm expansion vessel.
- Install the level vessel in the uppermost point of the brine circuit.
- It is not necessary to install the diaphragm expansion vessel in the highest point of the system.
- Check that the diaphragm expansion vessel's diaphragm suits the brine and temperature level.
- Equip the diaphragm expansion vessel with a maintenance valve (shut-off valve and blow-off valve) to be able to adjust the pressure level and facilitate replacing the vessel.
- Adjust the diaphragm expansion vessel's pressure to a level that suits the system.

2.4.9 Brine circuit's filter (sanitary trap)

- Install the filter to the pipe extending from the brine circuit on the suction side of the circulation pump.

- Make sure it can be emptied and cleaned easily.
- Install a shut-off valve on both sides off the filter to facilitate the emptying and cleaning.
- Use an adequately small mesh size to prevent the evaporator from getting dirty. A suitable size is 1 mm or less.

2.4.10 Pressure gauge

- Install a pressure gauge to the expansion tank.
- Equip the gauge with a shut-off valve.

2.4.11 Bleeding valve and air deaerator

- Install the bleeding valve or air deaerator to the highest point of the pipe returning from the brine circuit if the brine piping cannot be vented though the level vessel.
- Equip the bleeding valve with a shut-off valve, and the air deaerator with a bypass kit.
  - To prevent the deaerator and bleeding valve from getting dirty, close the shut-off valve and use the bypass when the system is being filled and purged.

2.4.12 Insulating the pipes and pipe equipment

- Insulate the indoor pipes and pipe equipment of the brine circuit tightly from the indoor air.
  - Uninsulated cold surfaces may gather condensed water from the indoor air.
  - Do not leave a gap between the insulant and the insulated surface. The air humidity could condense on the cold surface inside the insulant.

2.4.13 Filling and bleeding

- Make sure that the pipe couplings are valid before filling.
- Fill and bleed all pipes thoroughly before switching on the electrical supply.

2.4.14 Flushing the pipes

- If the brine circuit contains impurities, flush the circuit before installing the heat pump. When flushing, check that the flow in the piping is unobstructed.
- Do not circulate the flushing water through the heat pump or other clean components in the system, or they will get dirty. Design and fit the piping with flush connectors and shut-off valves that can be used to bypass and separate the heat pump from the rest of the system for the duration of the flushing.

2.5 Condenser circuit and heating circuit

The thermostat valves of the heating circuit and the radiators should usually be opened completely if the system does not have a buffer. You may need to regulate the heating circuit and radiator currents and balance the network again if the temperature level deviates from the original level.

If the building's heating system already has a regulating system – for example, for floor heating – the integration of the regulating systems should be designed in connection with the building's HPAC system design. Take the piping and automation into account in the integration.

2.5.1 Designing and implementing the system

- The heating circuit must be implemented according to the effective legislation.
- The heating circuit must be heat and flow technically adequate for the heat pump's capacity.
    - Take the circuit's heat accumulation and transfer properties into account when designing, especially if the system does not include a buffer storage tank in the heating circuit.
- In a system with multiple heat pumps, the condenser circuit's flow to each heat pump must be measurable and adjustable. The circuits must be designed to be as symmetrical as possible, and if necessary, the piping must be fitted with balancing valves and non-return valves to ensure the correct flow direction and for balancing the flows.

2.5.2 Pipe size

- The appropriate pipe size is determined by the technical functionality, pressure loss, expenses and ease of installation. When selecting the pipe size, pay attention to the heating circuit's planning, the condenser and heating circuits' pump's performance, as well as the pipe material and equipment.
- It is usually a good idea to choose the pipe size so that the flow rate in the pipes is approximately 0.4...1.5 m/s. For practical reasons, the flow rate may exceed these values in shorter pipe segments, but typically stays at under 2.5 m/s. The flow rate must usually stay at over 0.3 m/s so the gas bubbles can be exhausted with the stream. Check the maximum permitted flow in the pipe's technical data.
- The smaller the pipe, the larger the flow rate and pressure loss will be. Using a pipe size that is too small will result in high pressure loss, inadequate flow, poor functioning of the heat pump, high electrical power consumption by the pump, high pumping expenses, noisy piping, poor functioning of the deaerators and piping cavitation.

2.5.3 Shut-off valves

- Install shut-off valves on both sides of the condenser circuit's heat pump to facilitate the pump's maintenance. Make sure that in addition to the heat pump, all other components that may require maintenance or changing are also within the whole demarcated by the shut-off valves.

2.5.4 Heating circuit's minimum volumetric capacity in direct coupling

In a direct coupling, the heat pump's condenser is connected to the heating circuit directly, without a regulated storage tank and mixing valve (3-way valve). The circuit's volumetric capacity must be adequate for the pump's heating capacity. This means at least 20 liters / kW. If the volumetric capacity is insufficient, an instantaneous water cylinder must installed so that the system has enough volume. In this connection, the automation does not regulate the cylinder, because the its only function is to bring more volumetric capacity to the heating circuit.

2.5.5 Buffer storage tank volume in storage tank coupling

In a storage tank coupling the heating circuit's condenser is connected to a buffer storage tank that automation regulates, and the heating circuit is connected to the buffer with a mxiing valve coupling (3-way valve). The buffer storage tank's volumetric capacity must be adequate for the heat pump's heating capacity. This means at least 15...20 liters / kW. In this coupling the heat pump's automation regulates the buffer storage tank's temperature and usually the heating circuit's mixing valve as well.

2.5.6 Safety valve

- The safety valve is installed in the highest point of the pipe extending from the heating circuit on the suction side of the circulation pump.
- In storage tank systems the safety valve is installed in the tank's uppermost connector sleeve.
- Install the safety valve's discharge pipe so that it is continuously descending and reaches the floor drain in a safe manner.
- The discharge pipe's diameter must be at least as large as the safety valve's nominal diameter.
- The pipe must be self-emptying (must not be placed under the liquid level of the tank or the well, must not freeze),
- A shut-off valve must not placed between the safety valve and the circuit.
    - If an irremovable shut-off valve is placed between the safety valve and the circuit, detach the shut-off valve's handle after opening the valve and place a caution sign that forbids shutting the shut-off valve next to the valve. Finally, make sure that the shut-off valve is open.
- The safety valve's discharge side must not have a shut-off valve.
- Select the safety valve's opening pressure according to the brine circuit's largest permitted operating pressure. The opening pressure may not be higher than 3 bar. Single-family houses usually require a 1.5 bar safety valve.
- Check the safety valve's functioning by releasing the valve from the button after the pipes have been filled.

2.5.7 Expansion tank

- Install the diaphragm expansion vessel to the pipe extending from the heating circuit on the suction side of the circulation pump.
- Ensure that the diaphragm expansion vessel is suitable for the heating circuit's temperature level.

- Equip the expansion vessel with a maintenance valve (shut-off valve and blow-off valve) to be able to adjust the pressure level and facilitate replacing the vessel.
- Adjust the diaphragm expansion vessel's pressure to a level that suits the system.

2.5.8 Heating circuit's filter (sanitary trap)

- Install the filter to the pipe extending from the heating circuit on the suction side of the circulation pump.
- Make sure it can be emptied and cleaned easily.
- Install a shut-off valve on both sides of the filter to facilitate the emptying and cleaning.
- Use an adequately small mesh size in the filter to prevent the condenser from getting dirty. A suitable size is 1 mm or less.

2.5.9 Pressure gauge

- Install a pressure gauge to the expansion tank.
- Equip the gauge with a shut-off valve.

2.5.10 Change valve's running time

If the system has a change valve that is used to control the heat pump's condenser circuit's switch from DHW heating to space heating, the valve's running time must be sufficiently long. The larger the temperature difference between DHW and space heating, the longer the running time needs to be. A suitable running time is several tens of seconds. This lets the temperature of the flow the condenser receives change slowly enough. If the running time is too short, the temperature may change too quickly, which may result in underpressure, overpressure or excessive hot gas temperature, depending on the running direction and temperatures. Rapid changes may wear out the compressor prematurely.

2.5.11 Bleeding valve and air deaerator

- Install an automatic bleeding valve or air deaerator in the highest point of the pipe that runs into the heating circuit (i.e. the highest point of the hottest pipe).
- Equip the bleeding valve with a shut-off valve, and the air deaerator with a bypass kit.
    - To prevent the deaerator and bleeding valve from getting dirty, close the shut-off valve and use the bypass when the system is being filled and purged.

2.5.12 Insulating the pipes and pipe equipment

- If needed, insulate the heating circuit's piping to prevent heat loss.

2.5.13 Flushing the pipes

- If the heating circuit and storage tanks contain impurities, flush them before installing the heat pump. When flushing, check that the flow in the piping is unobstructed.
- Do not circulate the flushing water through the heat pump or other clean components in the system, or they will get dirty. Design and fit the piping with flush connectors and shut-off valves that can be used to bypass and separate the heat pump from the rest of the system for the duration of the flushing.

2.5.14 Filling and bleeding

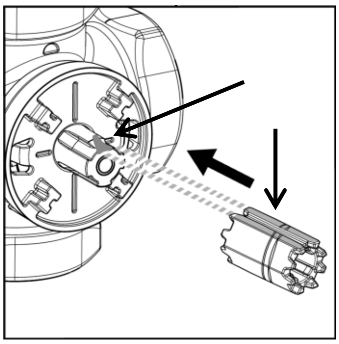
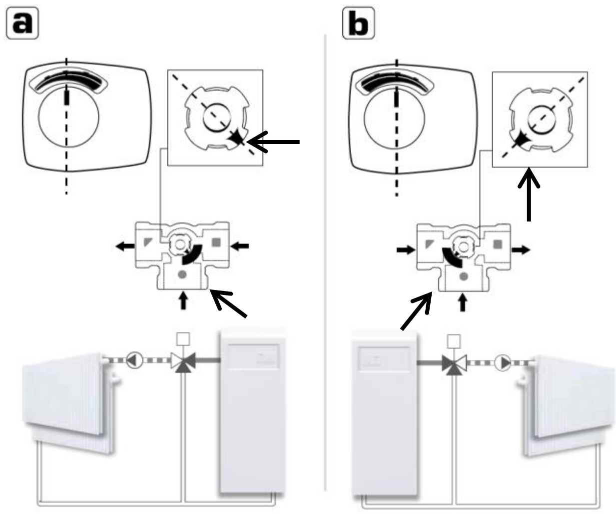
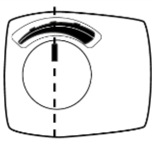
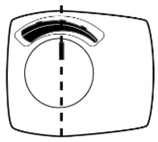
- Make sure that the pipe couplings are valid before filling.
- Fill and bleed all pipes thoroughly before switching on the electrical supply.

2.5.15 Heating circuit pump's electrical current and fuse size

- Pay attention to the heating circuit pump's required electrical current and fuse size if it is connected to the heat pump's switchboard. The selected pump may not necessarily correspond to the supposed electrical current of the heating circuit's pump.
- Pay attention to the following components during connection: fuse size and cabling of the heating circuit's pump; backup fuse and cabling of the heat pump's power supply.

2.5.16 Heating circuit's control valve

Heating circuit's control valves are delivered with a separate valve installation guide by the manufacturer. This is an outline of the installation of an Esbe VRG130 series valve and the connected Esbe ARA600 series motor. Other valves are installed in the same way. Detail-level instructions are in the guide delivered with the valve and motor.

<table>
<tr><td>Align the valve spindle's bevel and motor shaft's groove.</td><td colspan="2">Turn the valve's spindle to a position corresponding to the piping connection. Pay attention to the flow directions and the markings on the valve (triangle, circle and square). Also install the scale plate. Note that the motor's control knob must be in the middle position when the motor is being installed. The valve's installation guide presents other coupling options.</td></tr>
<tr><td></td><td colspan="2"></td></tr>
<tr><td rowspan="2">Make the electrical connections according to the electrical diagrams. Pay attention to the valve's adjustment direction, which may differ from the default coupling presented in the electrical diagrams.</td><td>Valve open clockwise (turning clockwise increases the heat from the storage tank to the heating circuit):
QX10: brown (clockwise, CW)
QX11: black (counterclockwise, CCW)</td><td>Valve open counterclockwise (turning counterclockwise increases the heat from the storage tank to the heating circuit):
QX10: black (counterclockwise, CCW)
QX11: brown (clockwise, CW)</td></tr>
<tr><td></td><td></td></tr>
</table>

2.5.17 Non-return valve

Make sure that the pressure produced by the pumps is sufficient to open the non-return valves installed in the system, if any. Increase the pump speed if needed. Ensure that the valves are also opened when possible other pumps installed in the system are on, which may increase the required pressure.

2.6 Service buffer tank

2.6.1 Designing and implementing the system

- The domestic water system must be implemented according to the effective legislation and the regulations and conditions set by the water supplier.
- The service buffer tank must be sufficiently large in comparison with the water consumption and heat pump's capacity,

2.6.2 Shut-off valves

- Install shut-off valves on both sides of the tank.
- The cold water line's shut-off valves are placed first in the flow direction, before other piping equipment, such as the safety valve, pressure reducer valve and expansion tank. This lets the piping equipment be separated from the cold water supply line during maintenance.
- The hot water line's shut-off valves are placed last, after all the other equipment in the piping. This lets the piping equipment be separated from the DHW supply line during maintenance.

2.6.3 Safety valve

- Install the safety valve in the cold water pipe running to the storage tank.
    - The safety valve is usually integrated into complete mixing valves, so there is no need for a separate component.
- Install the safety valve's discharge pipe so that it is continuously descending and reaches the floor drain in a safe manner.
- The discharge pipe's diameter must be at least as large as the safety valve's nominal diameter.
- The pipe must be self-emptying (must not be placed under the liquid level of the tank or the well, must not freeze),
- A shut-off valve must not placed between the safety valve and the circuit.
    - If an irremovable shut-off valve is placed between the safety valve and the circuit, detach the shut-off valve's handle after opening the valve and place a caution sign that forbids shutting the shut-off valve next to the valve. Finally, make sure that the shut-off valve is open.
- The safety valve's discharge side must not have a shut-off valve.
- Safety valve's opening pressure can be max. 10 bar.
- Check the safety valve's functioning by releasing the valve from the button after the pipes have been filled.

2.6.4 Thermostat mixer

- Install the thermostat mixer to the hot water pipe running from the storage tank, if the tank's temperature is able to rise above 65 °C. The mixer is usually included in mixing valve kits, so there is no need for a separate component.
- First, set the mixer to the hottest position (the + direction), then check the tap water temperature with the storage tank's maximum temperature.
- Install the mechanical mixer at least 30 cm below the storage tank's hot water connection, so that the tank's heat does not strain the mixing valve. This improves the valve's operational reliability and prolongs its service life

2.6.5 Mixing valve

- It is usually recommended to install at least one mixing valve in a domestic water system. A ready-to-use mixing valve kit usually includes all the necessary equipment needed in a domestic water pipework.
- Install the discharge pipe of the mixing valve's safety valve so that it is continuously descending and reaches the floor drain in a safe manner. Also follow all other instructions concerning the safety valve.
- First, set the mixing valve's thermostat mixer to the hottest position (the + direction), then check the tap water temperature with the storage tank's maximum temperature.
- Install the mixing valve at least 30 cm below the storage tank's hot water connection, so that the tank's heat does not strain the mixing valve. This improves the valve's operational reliability and prolongs its service life

2.6.6 Anti-siphonage valve (non-return valve) and vacuum relief valve

- Install a non-return valve (anti-siphonage valve) or a vacuum relief valve in the cold water line right after the shut-off valve. The anti-siphonage valve and vacuum relief valve prevent water from the supply network from re-entering the network when it is malfunctioning.
- The non-return valve is usually integrated into mixing valve kits.

2.6.7 Pressure gauge

- It is usually a good idea to install a pressure gauge in the cold water line running to the storage tank. The gauge facilitates filling the system and observing it (indicating the need for a pressure reducer valve, among other things).
- Equip the gauge with a shut-off valve.

2.6.8 Pressure reducer valve

- If the cold water pipework's pressure is high, install a pressure reducer valve in the cold water line running from the storage tank, if necessary.
- The pressure reducer valve can prevent the constant safety valve drip, which results from changes in the storage tank temperature.

2.6.9 Expansion tank

- The domestic water system does not usually require an expansion tank.

- If an expansion tank is installed in the system, it needs to be the kind that is approved for domestic water use, where the water flows through the tank. Water must not be still in the tank when hot water is being drawn.
- The expansion tank can also be used to prevent the safety valve from dripping.
- In a domestic water system, the expansion tank is installed in the cold water line running to the storage tank, after the pressure reducer (if installed).
- Equip the expansion vessel with a maintenance valve (shut-off valve and blow-off valve) to be able to adjust the pressure level and facilitate replacing the vessel.
- Adjust the diaphragm expansion vessel's pressure to a level that suits the system.

2.6.10 Filling and bleeding

- Make sure that the pipe couplings are valid before filling.
- Fill and bleed all pipes thoroughly before switching on the electrical supply.

2.7 Electrical connections

2.7.1 Electrical connections

- Electrical connections must be made according to the electrical diagrams.
- Fill in all the additional and change connections to the device's and building's electrical diagrams.
- Perform the needed electrical safety measurements to the connections, make sure that the connections are safe and draw up a record on the measurements.

2.7.2 Power supply's safety breaker

- A safety breaker has to be installed in the device's power supply.
- The breaker must be easily found and accessible.
- The breaker must be appropriately marked.

2.7.3 Switching the power on

- The building's power supply must not be switched on before the measurements have been performed and the connections have been confirmed safe.
- Power to the device is allowed to switch on only after the piping and storage tanks are filled and vented.
- Adhere to the commissioning instructions of each model.

2.7.4 Power supply's fuse

- The power supply's line circuit breaker (fuse, fuse link) must in accordance with the electrical diagrams.

2.7.5 Sensor and communication cables

- The distance of sensor and communication cables from the 230 V and 400 V cables must be sufficiently long. The distance has to be at least 10 cm.

2.7.6 Sensors

- Connect the outdoor sensor and other necessary sensors to the automation according to the wiring diagrams and installation instructions of this manual.

2.7.7 Room unit

- Connect the room units (chapter 2.10) if they are a part of the system.

2.8 Automation: controllers, inputs and outputs

2.8.1 Intended use of inputs and outputs

SEQ Taulukko * ARABIC Table 3. Inputs and outputs of automation

BX	Temperature input	temperature sensors	NTC 10 kOhm (outdoor sensor NTC 1 kOhm, solar collector NTC 10 kOhm or Pt1000)
EX	230 V input	control messages, voltage control, grid-power monitoring, pressure switches	120 V…230 V control messages
HX	Low voltage input	control signals, electricity meter, energy meters, pressure sensors etc.	digital, analog 0…10 V, pulse, frequency
QX	230 V output	actuators controlled by automation, additional heat source control, etc.	
UX	Low voltage output	speed of rotation for pumps, additional heat source control, etc.	0…10 V, PWM
ZX	TRIAC output	control messages	
GX	Sensor´s voltage	operating voltage for active sensors 5 V or 12 V	5 V (4.75...5.25 V) or 12 V (11.4...12.6 V), SELV, 20 mA
DB MB (M)	LPB bus	additional controllers, remote access devices, cascade connection reserved addresses: 0.5 OZW672 remote connection, 0.8 OCI700 connection cable	Copper cable, length at most 250 m. The minimum cross-sectional area for the wires is 0.5 mm^2. If the cable is pulled for several meters, use an area of at least 1.5 mm^2 The most recommended option is a twisted pair cable (instrumentation cable). Unshielded cables must be at least 150 meters away from charged conductors. DB: bus + (terminals 1 and 2 of remote access devices) MB (M): bus – (terminals 3 and 4 of remote access devices) Bus voltage is approximately +9.5 V.
CL+ (BSB) CL− (M)	BSB bus	user interfaces, remote connection	cross-sectional area at least 0.50 mm2, length at most 200 m CL+ (BSB): bus + CL− (M): bus and user interfaces backlight –
G+	User interfaces backlight	user interfaces backlight	DC +12 V 88 mA SELV user interfaces’ backlight +
BSB	BSB bus	user interfaces with a flat cable	
LBP	LPB bus	OCI 700 service cable and Siemens ACS790 program	
M	Low voltage ground	bus and temperature sensor ground	
X60	LPB bus (Equipment)	antenna for wireless devices or Modbus converter.	
X30 and X50	BSB bus (Equipment)	additional controllers and user interfaces integrated to the device	
WX21	Expansion valve	unipolar expansion valve	
GX	supply voltage 5 V or 12 V	supply voltage of pressure sensors and other sensors	
FX23	voltage input for QX23 relay		

Inputs EX5, EX6 and EX7 are always reserved for the voltage and phase control, and inputs EX9 and EX10 for pressure switches. See the detailed electrical specifications of inputs and outputs from automation and bus system manuals. Connections M, MB and CL- have been interconnected inside the controller.

2.8.2 Automation's master controller

Model-specific functions have been presented in the electrical diagrams of each model and their respective installation chapters. Outputs, marked blank, have no function. A function to those can be freely chosen. The function can be changed, if needed.

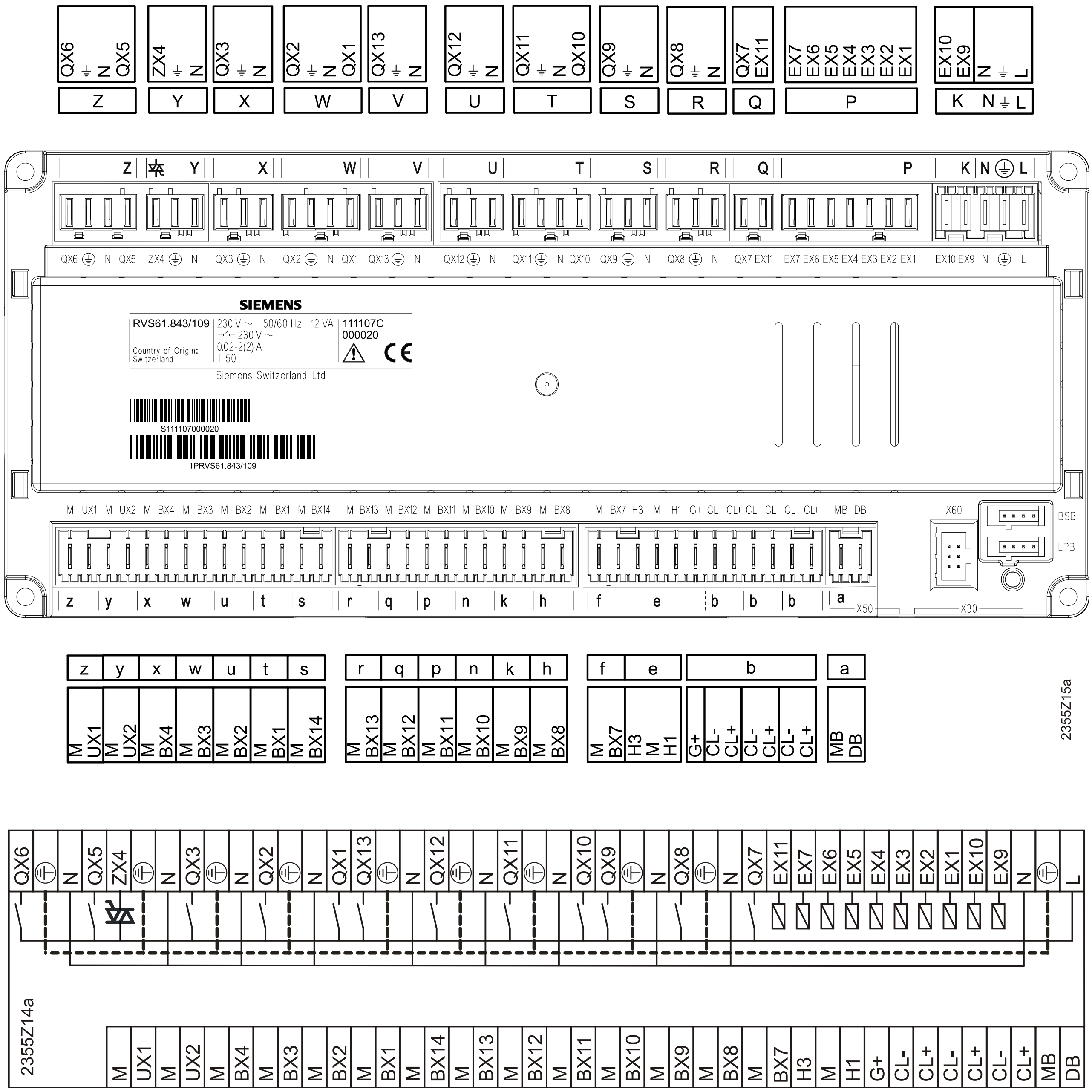
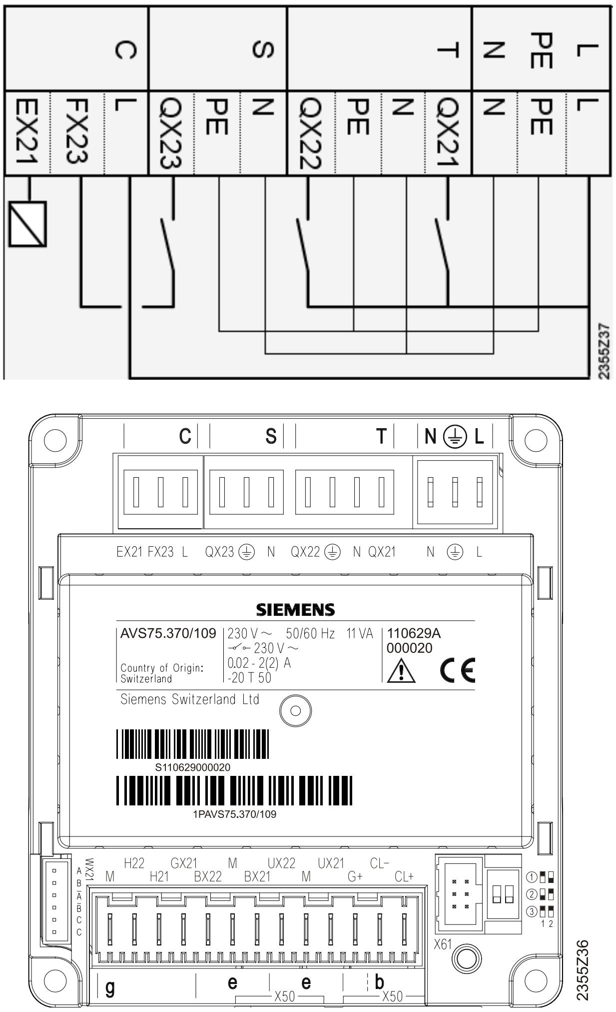


Figure 4. Automation's master controller

2.8.3 Automation's auxiliary controllers

There can be three auxiliary controllers in total. Model-specific functions have been presented in the electrical diagrams of each model and their respective installation chapters. Outputs, marked blank, have no function. A function to those can be freely chosen. The function can be changed, if needed.

The function for auxiliary controller 1 is usually selected on line 7300. This selection locks some of the controller's inputs and outputs while other connections remain freely available. Typically the auxiliary controller regulates heating circuit 2's three-way valve. The tables presented on the following page correspond to this connection.



① Address 1: Auxiliary controller 1

② Address 1: Auxiliary controller 2

③ Address 1: Auxiliary controller 3

Figure 5. Automation's auxiliary controllers

SUPPLY CURRENT OUTPUTS (CAPITAL LETTERS IN CONNECTORS)					
Line	Con-nector	Output	Action	Marking	Additional information
7301 (7300)	T	QX21	Heating circuit 2 valve open Y5	Y5	If the heating circuit has a control valve, otherwise vacant. Selected via line 7300, see chapter 25.
7302 (7300)	T	QX22	Heating circuit 2 valve closed Y6	Y6	If the heating circuit has a control valve, otherwise vacant. Selected via line 7300, see chapter 25.
7303 (7300)	S	QX23	Heating circuit 2 pump Q6	Q6	If the heating circuit contains a pump, otherwise vacant. Selected via line 7300, see chapter 25.

For outputs Q21, Q22 and Q23 is selected function on line 7300. See chapter 25.

TEMPERATURE SENSORS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
7307 (7300)	e	BX21	Heating circuit 2 supply water B12	B12	If the heating circuit has a control valve, otherwise vacant. Selected via line 7300, see chapter 25.
7308	e	BX22			

For input BX21 is selected function on line 7300.

LOW VOLTAGE INPUTS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
7321	g	H21			
7331	g	H22			

SENSOR VOLTAGE (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
7341	g	GX21			

SUPPLY CURRENT INPUTS (CAPITAL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
7342	C	EX21			

CONTROL MESSAGES (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Output	Action	Marking	Additional information
7348	e	UX21			
7355	e	UX22			

2.9 Temperature sensors

2.9.1 Outdoor temperature sensor

The heat pump’s outside temperature sensor (sensor code 89) is delivered with the pump. The sensor is mounted during the pump’s installation. It is connected, depending on the heat pump’s model, either to the master controller of heat pump’s automation, or to a cable that has already been connected to the controller. The cable can be extended if required.

The sensor connection is presented in the pump’s installation instructions and electrical diagrams. By default, the connection is to the k terminal (BX9) of the pump’s Siemens RVS61.843 controller, but the sensor can be configured for other BX sensor inputs. One wire of sensor’s cable is connected to the connector’s pole BX9 and the other to the pole M (either way). The sensor connection and cable extension are done with a regular, insulated copper twin cable. Select the cross-sectional area of the wires by consulting the table below. When you run the sensor cable into the switchboard, use an insulated cable and, if possible, a cable trough that does not contain supply cables. Peel off the cable insulation and the wire insulation right next to the controller.

Install the sensor outdoors such that the sensor-cable bushing points downward. Select the sensor position so that it measures as accurately as possible the prevailing outside-air temperature. Make sure that the sensor is not exposed to solar radiation or heat coming from the building. Sensor housing is protected against dust and water spray (IP65, if the cable connection is pointing downward), but should still be installed in a location that is covered from rain. A suitable location for the sensor is, for example, a shady place on the north wall of the building under the eaves.

SEQ Taulukko * ARABIC Table 4. Outside sensor cable

Cable length (m)	40	60	80	120
Wire cross-sectional area (mm^2)	0.50	0.75	1.0	1.5

The type of the outside sensor is NTC 1 kOhm. Its β value is 3464 K. In addition to the standard sensor, any corresponding NTC 1 kOhm sensor suited for outside conditions with a β value of 3464 K +/- 100 K can be used.

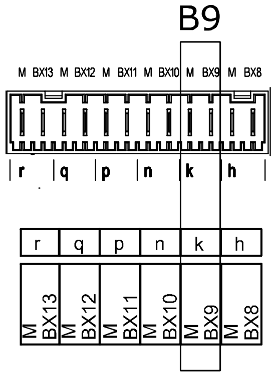


Figure 2. Outside sensor connection

2.9.2 Temperature sensor inside the pipe or on the pipe surface

Some of the external temperature sensors are installed during the heat pump's installation. The sensors fitted to the pipes have to be installed so that they measure the temperature of the fluid in the pipes as accurately as possible. The sensors must be attached on the pipe surface made of metal or to the metallic sensor pocket of the pipe. Sensors may not be connected on a pipe surface made of heat insulating material, such as plastic or rubber. Sensors installed on the pipe surface must be attached firmly along the whole length of the metal sleeve at the end of the sensor and, finally, thermally insulated from the ambient room air. If necessary, use a heat conductive paste between the sensor head and the pipe surface.

2.9.3 Temperature sensor in the storage tank

The temperature sensors for heat pump´s external storage tanks are put in place during the installation of the heat pump. The sensors must be installed so that they measure the temperature of the liquid in the storage tank as accurately as possible. The temperature sensors of storage tanks have to be installed in a metallic sensor pocket. The diameter and the depth of the sensor pocket must be sufficiently large in relation to the size of the sensor head. An air gap between the sensor head and the pocket wall must not be large. If necessary, the air gap has to be filled with heat conductive paste.

2.9.4 Temperature sensor decommissioning

To decommission a temperature sensor, first detach the sensor from the connector, then save the changes by selecting Yes on lines 6200 and 6201. For example, if sensors B4 and B1 are removed and the changes are then saved on lines 6200 and 6201, the automation will automatically decommission the buffer storage tank (B4) and the three way valve of heating circuit 1 (B1). In this way, a connection change from a buffer storage connection to a direct condenser connection of the heating circuits can be easily created.

2.9.5 Sensor type

Sensor	Sensor type	β value	Tolerance:
Outside temperature B9	NTC 1 kOhm	3464 K (25 °C / 50 °C)	+/- 100 K
Other sensors (B3, B4, B21, B71, B91, B92 etc.)	NTC 10 kOhm	3978 K (25 °C / 85 °C)	B85: +/- 10 K Other sensors: +/- 100 K

A Pt1000 sensor can also be used with the solar collector. The collector's sensor type is selected on line 6097.

2.10 QAA74.611 user interface (room unit)

2.10.1 Use and placement

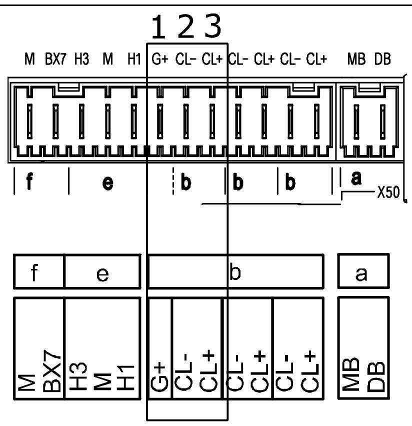
The wall-mounted user interface in the heat pump's automation is called the room unit. It can be used to measure the room temperature and to control the heat pump on the basis of measurement data. If the user interface is used for measuring the room temperature, place the interface unit in a location where the measurement result corresponds as fully as possible to the indoor air temperature of the measured space. A suitable location might, for example, be a position on a light-structured partition wall where the room unit is not exposed to heat from sunlight and radiators, or drafts from windows, doors, and ventilation systems.

2.10.2 Connecting the interface

The wall-mounted user interface is connected to the terminals of the heat pump's three-terminal connector b, as shown in the table and image below. A regular two-wire insulated copper cable can be used with the display. The minimum cross-sectional area for the cable wires is 0,50 mm^2. The maximum permitted length of the cable is 200 m. When you run the sensor cable into the switchboard, use an insulated cable and, if possible, a cable trough that does not contain supply cables. Peel off the cable insulation and the wire insulation right next to the controller.

SEQ Taulukko * ARABIC Table 5. Room unit and heat pump controller connectors

Room unit connector's terminal	Connector terminal of the heat pump's controller	
1	G+	room unit's backlight: DC +12 V, 36 mA heat pump's controller: DC +12 V, maximum 88 mA
2	CL−	bus and backlight ground (M)
3	CL+	BSB bus

Connect the user interface unit cable to pins G+, CL–, and CL+ of the three-terminal connector (b) on the low voltage side of the heat pump's main controller.		1: G+ 2: CL− 3: CL+

2.10.3 Connecting multiple room units

Multiple different interfaces can be connected to the heat pump automation. The system may contain one interface that is integrated into the heat pump, and three room units. The connection options are presented in the image below.

The interfaces utilize the automation's BSB bus. Integrated interfaces use the X30/X50 connection and room units use connectors CL+ and CL-. The room units can be connected in a line, star or tree formation, or a combination of these. Do not let the user interfaces form a closed circuit in the bus. Integrated interfaces draw their backlight power from the X30/X50 connection, and room units use connector G+. A single display's backlight uses approximately 36 mA. The X30/X50 and G+ connectors can supply a combined amount of approximately 88 mA. Thus a single heat pump controller can have at most two user interfaces. If the system requires more interfaces, the third and fourth interface are connected to the heat pump automation's auxiliary controller. A 12 V power source can be added for the backlights, or they can be left unconnected altogether.

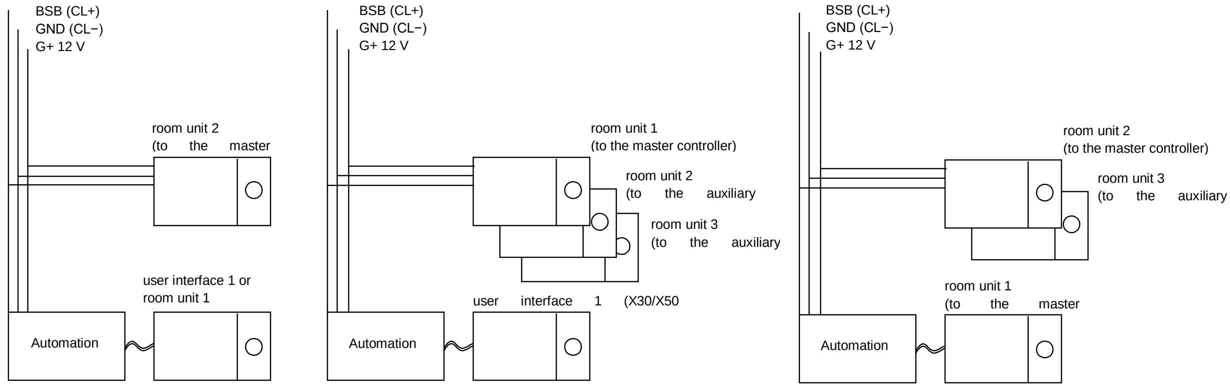


Figure 3. User interface connection options

2.11 Remote access

The remote access feature is accessed by equipping the heat pump with a Siemens OZW672 or OCI670 remote access device. Heat pump's automation can be controlled through remote connection via a local area network or the Internet. A regular Internet browser, a smartphone application, or Siemens ACS computer program (ACS790) can be used for administration. Installing the remote connection service via the cloud solution (Siemens Climatix IC) is easy and fast, and does not require network expertise or a fixed IP address. You can include the facility's piping diagram in the remote connection view and link the temperature and setpoint details to it from the automation. The remote access device can also be used to save selected values and present them in graphs automatically, and enable automatic alert messages to selected email addresses. Instructions for commissioning the remote access device can be downloaded from the Oilon website.

2.12 Modbus connection

A Modbus remote connection to the heat pump's automation can be established with a bus converter, which is sold as an accessory (Modbus RTU RS485). Modbus registers and the instructions for commissioning the device can be downloaded from the Oilon website.

2.13 Additional and change connections

Settings that correspond to the default pipe coupling are pre-configured as factory settings in the automation. Temperature sensors have also been selected according to the default pipe coupling. The pipe coupling corresponding to the factory settings is presented in each device's installation chapter. Electrical diagrams correspond to the same factory settings.

Automation settings must correspond to the pipe coupling. If necessary, change the input and output functions from the automation settings to correspond to the pipe coupling and the sensors in use. The most common connection changes are shown in the section for installation of each device. In addition, the commissioning and functioning of a variety of different additional connections are presented in the chapter Heat pump operation and automation. Detailed instructions for automation that present all functions and connections are available for download on Oilon's website. For making major changes, you should use the Siemens ACS790 computer program, because the program will automatically draw a principle pipe coupling, corresponding to the settings. Outlining the entirety by using the program is easy.

Automation recognizes the pipe coupling on the basis of the selected inputs and outputs and the connected temperature sensors. Any of the available functions can be chosen to free inputs and outputs. Remove from the controllers the additional temperature sensors, to which is not selected a function from the settings. Sensors can be removed either by disconnecting the quick coupling from the controller or the sensor wires from the quick coupling. If you disconnect the wires from the quick coupling, protect the bare wire ends so that they can not cause a short circuit. Reset and save the temperature sensors in the automation memory after the changes by choosing "yes" on lines 6200 (save the sensors) and 6201 (reset the sensors).

In addition to the heat pump, storage tanks, and heating circuits, the automation can control a solar power system; cooling; and an additional heat source, such as electric heating or an oil boiler. Additional functions of the automation (block diagrams) are enabled by selecting the inputs and outputs required by the feature, such as inputs from temperature sensors and outputs of pumps' and valves' control, as well as by connecting the devices and temperature sensors to the selected inputs and outputs. The automation is equipped with control blocks for dozens of individual connections. The controllers of two or more heat pumps can be connected together. In this way, several heat pumps and other functions connected to the system can be controlled centrally as a discrete entity. This manual presents an outline of the automation settings. More detailed instructions can be found in separate manuals for automation. All manuals and instructions can be downloaded from Oilon's website.

HEAT PUMPS

3 Junior ECO

Junior ECO is a ground source heat pump that comprises a housed compressor unit, integrated switchboard and wall-mountable user interface. The device's switchboard allows for an installation of an electric heater for additional and reserve heat. The standard configuration of the device's automation is for a service buffer tank, a heating circuit storage tank and a single heating circuit controlled with a three-way valve. For a connection corresponding to the factory settings, see chapter 3.5. The automation supports numerous other connections, systems and accessories. The most common additional and change connections are presented in chapter 3.6. Other systems are presented in the final pages of this manual, and in other, separate automation-focused manuals that are available on the Oilon website.

3.1 Dimensions, connections, and parts

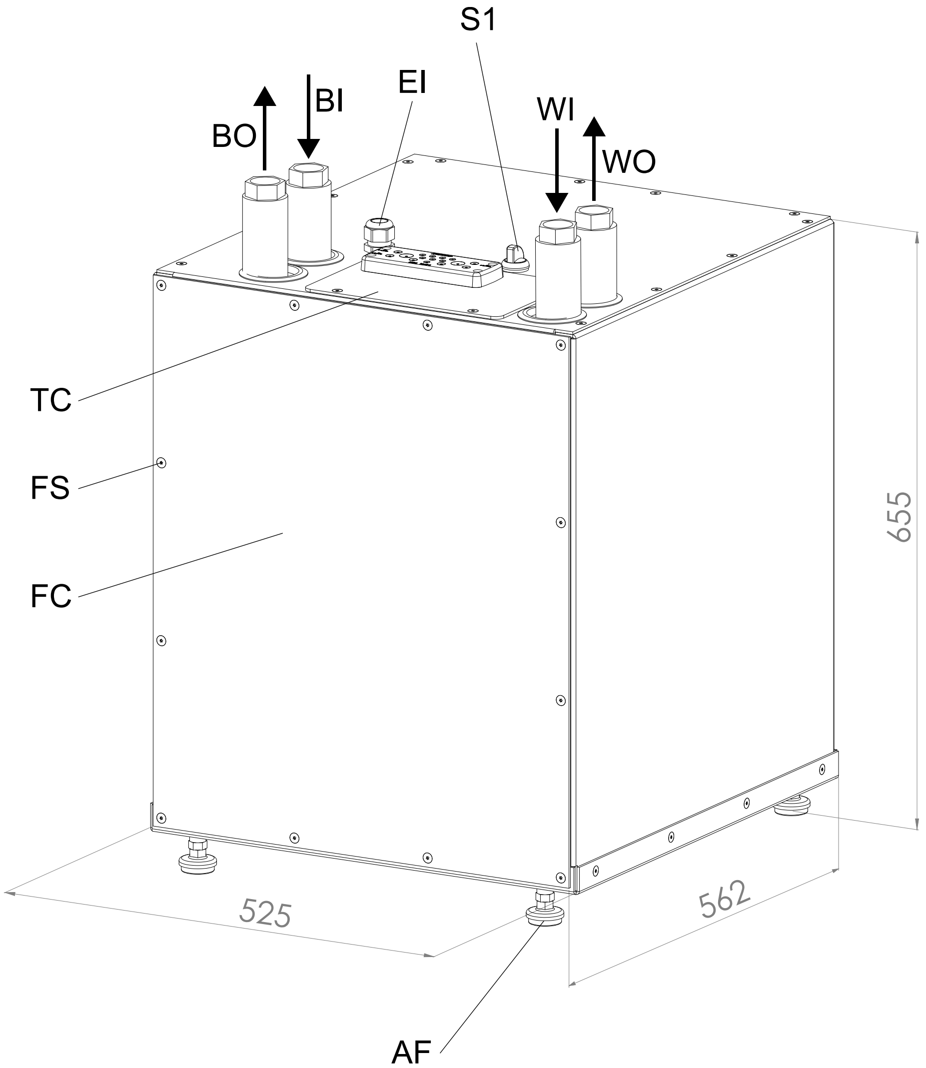


Figure 8. Junior ECO
measurements are in millimeters

WI	heating water inlet/return	1” inner thread, gasket
WO	heating water outlet/flow	
BI	brine circuit in	
BO	brine circuit out	
S1	operating switch	1/active (ON): default position 0/inactive (OFF): compressor and electric immersion heaters switched off
AF	adjustable legs	M10, DIN/ISO 17/16 mm
TC	switchboard cover panel (Torx T25) and lead-in flange to switchboard	Fuses are located under this cover.
FC	compressor unit front panel (Torx T25)	Remove the front panel when performing connections to the automation
BP	Evaporator circuit’s pump (brine circuit’s pump)	
NO	power supply	

3.2 Switches and fuses

Marking	Action	Default position	Switch position upon device delivery
S1	Operating switch	1/active (ON)	0/inactive (OFF)
F1	Compressor’s motor protection (fuse)	ON	ON
F2	Electric immersion heater’s fuse	ON	ON
F3	Control fuse (for automation and internal pumps connected to it)	ON	ON

3.2.1 Operating switch S1

The operating switch is located above the compressor unit. When the switch is in position 1/ON, the device is in the default operating mode. When the switch is in position 0/OFF, the compressor and electric immersion heaters are disabled from starting, but the heat pump’s automation stays operational. The frost protection function is an exception to this. It starts the immersion heaters and the compressor’s condenser circuit when the temperature drops below 5 °C, even if the switch S1 is set to 0/OFF.

3.3 Installation

3.3.1 Pipe joints

The pipe joints have 1” inner threads at the ends. Install shut-off valves to the joints. Use the supplied flat gasket to seal the joint.

Do not twist or turn the device’s pipes.

3.3.2 Electrical connections

Check the electrical connections in the electrical diagrams. See the outside temperature sensor’s connection in chapter 3.3.5, the installation process for the user interface in chapter 3.3.7, and instructions for installing a remote connection device in chapter 3.3.7.

3.3.3 Electric immersion heater to the condenser line

The switchboard has contactors and a fuse for installing an electric immersion heater in the condenser circuit.. An electric immersion heater (6 kW) is available as an accessory. Check the immersion heater connection from the electrical diagrams.

3.3.4 Modbus connection

A Modbus remote connection to the heat pump’s automation can be established with a bus converter (Modbus RTU RS485). Modbus registers and the instructions for commissioning the device can be downloaded from the Oilon website.

3.3.5 Outdoor temperature sensor

The heat pump's outside temperature sensor (sensor code 89) is delivered with the pump. The sensor is mounted during the pump's installation. It is connected to cable WB9. Check the cable's cross-sectional area from the table below.

Install the sensor outdoors such that the sensor-cable bushing points downward. Select the sensor position so that it measures as accurately as possible the prevailing outside-air temperature. Make sure that the sensor is not exposed to solar radiation or heat coming from the building. Sensor housing is protected against dust and water spray (IP65, if the cable connection is pointing downward), but should still be installed in a location that is covered from rain. A suitable location for the sensor is, for example, a shady place on the north wall of the building under the eaves.

SEQ Taulukko * ARABIC Table 6. Outside sensor cable

Cable length (m)	40	60	80	120
Wire cross-sectional area (mm^2)	0.50	0.75	1.0	1.5

For additional information, see chapter 2.9.

3.3.6 User interface (room unit)

The heat pump is delivered with a wall-mountable QAA74.611 user interface (room unit). It can be used for measuring the room temperature. The system may contain multiple user interfaces. For additional information, see the manual supplied with the interface and chapter 2.10.

The interface is connected to cable WA1.5. The cable can be extended if required. A regular two-wire insulated copper cable can be used with the display. The minimum cross-sectional area for the extension cable's wires is 0.50 mm^2. The maximum permitted length of the cable is 200 m.

SEQ Taulukko * ARABIC Table 7. Room unit and heat pump controller connectors

Room unit connector's terminal	Connector terminal of the heat pump's controller	
1	G+	room unit's backlight: DC +12 V, 36 mA heat pump's controller: DC +12 V, maximum 88 mA
2	CL−	bus and backlight ground (M)
3	CL+	BSB bus

3.3.7 Remote connection (accessory)

The remote connection device (OZW672 or OCI670) is connected to the cable according to the WA1.7 electrical diagrams. A basic guide to commissioning the device is presented below. If necessary, see more detailed instructions on Oilon's webpage.

- Use your internet browser to enter the ClimatixIC cloud service at www.climatixic.com
- Register the device with the registration code found in the device packaging and below the connection box cover.
- Retrieve the password from the email address that was used to register the device.
  - If you have already registered a different device with the same email address, this device is automatically added to your existing account.
- Log to the ClimatixIC cloud service.
- Enter the requested information.
- Pair the remote connection device and the heat pump's controller in the remote connection device's settings.
  - If the device is covered with a sticker that displays the heat pump's serial number, this indicates that the pairing has already been performed at the factory.
- Commissioning is finished. You can use the remote connection with an internet browser, mobile application or the Siemens ACS computer program.
  - Android application on Google Play: Siemens HomeControl IC (link)
  - iOs application on Apple's App Store: Siemens HomeControl IC (link)

3.4 Commissioning

3.4.1 Before the first start-up

- Before the first start-up check, that
    - the pipe connections are properly made and checked
    - the electrical connections connections are properly made and checked
    - all tanks and pipings are connected to a functioning safety valve
    - the necessary air supply valves are placed properly within the system
    - the expansion tanks are properly dimensioned and placed
    - all pipes and storage tanks have been carefully filled and vented
    - all necessary shut-off valves are opened
    - the general installation instructions have been followed (chapter 2)
    - the device-specific installation instructions have been followed
    - the outside sensor has been installed
    - the operating interface is installed
    - the other necessary sensors and devices have been installed.
- If the device is connected to an external electric heater, reset the heater's overheat protection before the initial start-up, if needed.

3.4.2 BASIC SETTINGS

Menu	Line	Setting
Heating circuit 1	720	Heating curve slope
Heating circuit 1	721	Heating curve displacement (parallel displacement)
Heating circuit 1	730	Summer/winter heating limit
Heating circuit 1	740	Flow temp. setpoint min. (lower limit)
Heating circuit 1	741	Flow temp. setpoint max. (upper limit)

See the standard setup for heating circuits in chapter 11.4.

3.4.3 First start-up of automation

- Move the operating switch S1 to OFF position and fuses to ON position.
    - The device is delivered with the operating switch in OFF position and the fuses in ON position.
    - This enables you to use the automation before starting the heat pump.
        - Frost protection is an exception to this. It starts the immersion heaters and the compressor's condenser circuit when the temperature drops below 5 °C even if the switch S1 is set to OFF. If the condenser circuit's temperature is below 5 °C, set the inverter and immersion heater fuses F1 and F2 to OFF, if needed.
- Go through the commissioning menus (chapter 3.4.6).
- If necessary, make the setting changes corresponding to the pipe coupling (chapter 2.13).
- Adjust the heating circuit's basic settings to fit the heating system (chapter 3.4.2)
    - Other heating circuit settings and their functioning are listed in chapter11.3.
- Continue venting the internal and external piping.
    - If necessary, use the relay test for guidance (chapter 3.4.7).
- If you have installed external actuators, such as the heating circuit's control valve, test their functionality and connections with a relay test (chapter 3.4.7).
- During device commissioning and maintenance, you can enable outside temperature simulation in the Diagnostics menu, if needed (chapter 10.4.7), This makes it possible to bypass the device's outside temperature sensor and set the outside temperature manually.

3.4.4 The first start-up of the heat pump

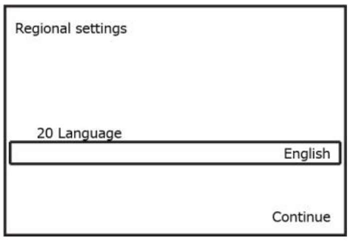
- Place the operating switch in S1 ON position.
- Reset the heat pump if needed (chapter 10.4.11).
- Wait for the compressor to start. Brine circuit's and condenser circuit's pumps start about 10...20 seconds before the compressor starts.
  - If you have to restart the compressor, wait at least 5 minutes after the last start.
- Make sure that the compressor rotates in the right direction.
  - If the compressor's rotation direction is correct, the operating sound is normal, the flow water line warms up, the hot gas pipe warms up (line 8415), the pressure in the high pressure zone increases, and that on the low pressure side falls (refrigeration gauge).
- If the compressor's direction of rotation is incorrect, stop the compressor immediately by moving its operating switch S1 to the OFF position, or by moving the motor protection switch F1 to the OFF position, or by turning off the electrical supply to the device with the external switch Q1.
  - If the compressor rotates in the wrong direction, it emits abnormal sound, the flow water or hot gas (line 8415) pipes do not warm up, and the pressure in the suction line does not fall, and the high pressure zone's pressure does not increase (refrigerant gauge).
  - If the compressor rotates in the wrong direction, make sure that the power supply is de-energized and replace the order of two phases with each other in the device's supply cable. Then go back to the beginning of this chapter and go through the start-up steps again.
  - The device is equipped with an internal phase guard that halts the compressor rotating incorrectly due to the phase order within 10 seconds of start-up.
- Check the temperature indicators to ensure that the condenser circuit warms up and the evaporator circuit cools down.

3.4.5 After the commissioning

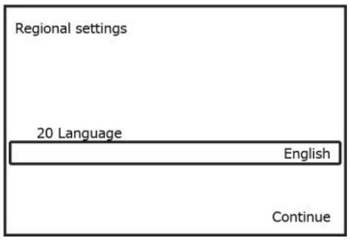
- Make sure that the heating water runs through all the required circuits.
- Make sure that the pipes and storage tanks have no residue air and the pressure level is suitable
  - Also pay attention to the inspection and adjustment of the expansion tanks' pressure.
- Ensure that the temperature sensors show sensible values during device operation.
- Check the temperature indicators to ensure that the condenser circuit warms up and the evaporator circuit cools down.
- Make sure that the heating circuit's settings are suitable for the heating system (chapter 3.4.2)
  - Other heating circuit settings and their functioning are listed in chapter11.3.
  - If the heating circuit is equipped with a separate controller, set the heat pump's and heating circuit's heating curves to correspond to one another.
- Ensure that the actuators connected to the heat pump automation, such as the mixing valve of the heating circuit, function properly when the device is turned on.
- Make sure that inspection records (electrical connections), the commissioning inspection record and other required documents have been completed and stored.
- Make sure that all changes are documented in the electrical diagrams, HVAC diagrams and operating instructions.
- Instruct the customer in the basic functionality of the device, such as
  - the line circuit breaker's location ja operation
  - adjusting the heating curve.

3.4.6 Commissioning menus

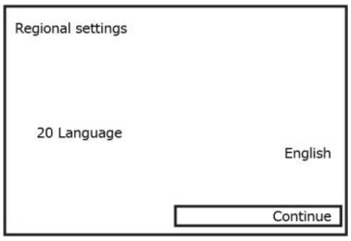
3.4.6.1 Language and time settings



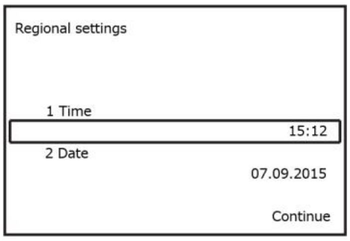
Initially, the display's language is English.



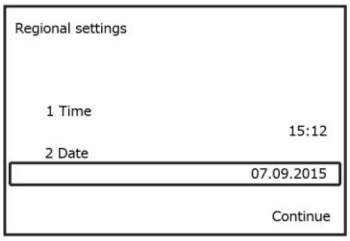
At the first screen, the interface language can be changed.



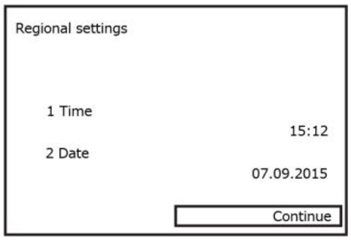
Move to the next page by pressing the button in the lower right-hand corner.



Set the time.

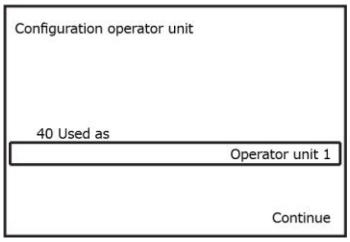


Set the date.

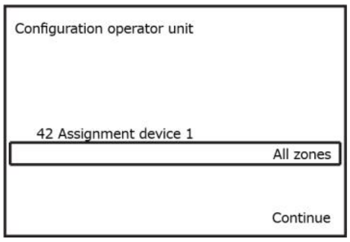


Continue to the next page.

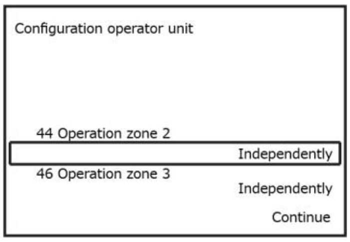
The images below show the settings that suit most situations unaltered. The commissioning menu can be accessed again from the maintenance menu (chapter 10.4.8). For a detailed overview of the settings options, see chapter 10.5.



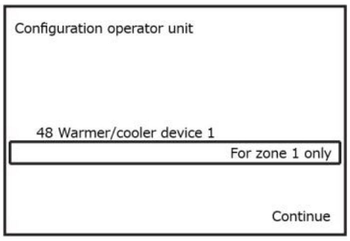
Intended use of room unit (sequence number). Select Operator unit 1.



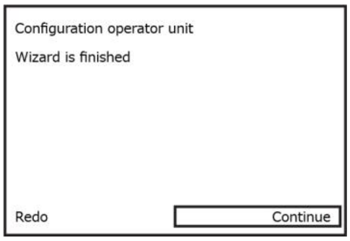
Heating circuits connected to the user terminal. Select All zones.



Autonomous settings for heating circuits 2 and 3. Select Autonomously for both.



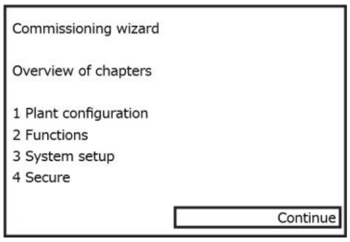
The effect of changing the temporary operating mode on other heating circuits. Select For zone 1 only.



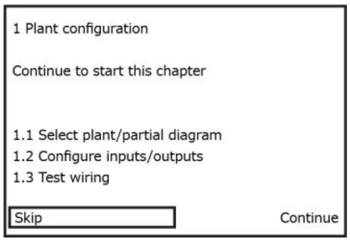
Exit the commissioning menus from the lower right-hand corner of the screen. Select "Continue". Wait for the controller to load the data. This will take a few minutes.

3.4.6.2 Configuration settings

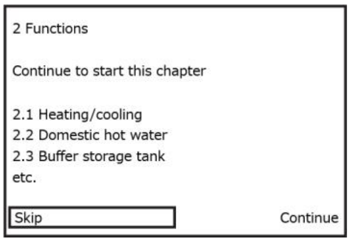
In addition to the various modes' settings, the heat pump's configuration can be changed via the commissioning wizard in the commissioning menus. The wizard is launched at the first start-up if it has not been disabled. In addition, you can launch the wizard from the settings menus later. The settings suitable for the most common cases have been preloaded in the heat pump automation at the factory, so the commissioning wizard is usually not needed. In general, any individual changes required in the default settings are easier to make later through the settings menus. You may bypass the commissioning wizard setup pages by selecting "Skip" in the lower left-hand corner of the screen. If you select "Continue" accidentally, select "Skip" in the following screens until the commissioning wizard menus have been bypassed.



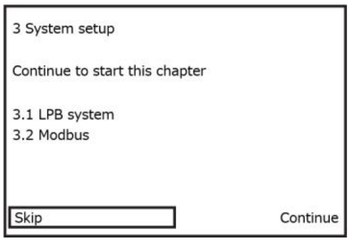
Continue to the next page.



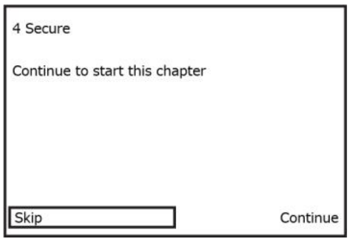
Select "Skip."



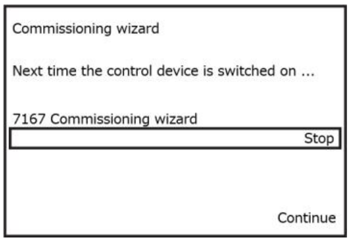
Select "Skip."



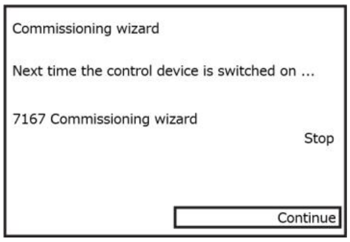
Select "Skip."



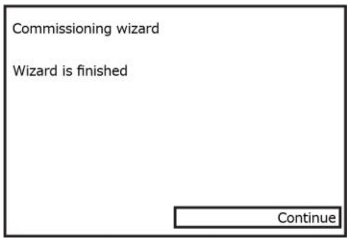
Select Skip.



Select "Stop".



Select "Continue".



Select "Continue".

3.4.7 Relay test

Test the operation of actuators with a relay test before starting the compressor if needed. The relay test is performed by selecting the desired QX output, and the UX signal output if required, and observing the operation of the actuator. The test is finished by selecting the function for relay test (line 7700) “no test”. Reset the heat pump after the relay test on line 6711 (chapter 10.4.11).

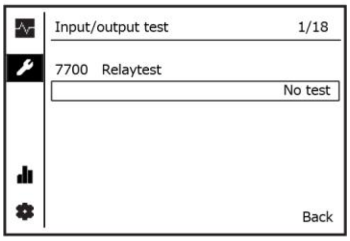
Use the relay test for venting the pipes if needed. Rotate the pump periodically for short times with the relay test and vent and fill (pressurize) the circuits between these short-term operating times. If needed, switch the positions of the change and control valves during venting.

SEQ Taulukko * ARABIC Table 8. Relay test

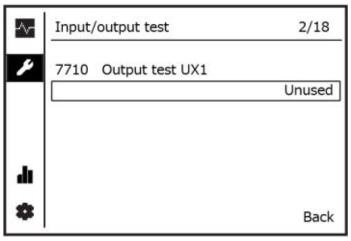
Con-nect-or	Out-put	Action	Marking	Additional information
W	QX1	Electric heater stage 1 K25	K25	Keep the fuse F2 in the position OFF. Contac-tor K2 should switch on.
W	QX2	Electric heater stage 2 K26	K26	Keep the fuse F2 in the position OFF. Contac-tor K3 should switch on.
R	QX8	Change valve Q3	Q3	Change valve is in position B (building, heating circuit) before the relay test. Switching the power on turns the valve to the position A (aq-ua, DHW storage tank). The valve returns to the position B when the relay test is turned off.
S	QX9	Heating circuit 1 pump Q2	Q2	The pump should start to rotate when the test is switched on. See further instructions for speed controlled pumps in chapter 5.4.7.1.
T	QX10	Heating circuit 1 valve open Y1	Y1	An arm from the storage tank to the heating circuit opens (heating circuit takes heat from the storage tank). After the test, the valve re-mains in the position it was in at the end of the test. If needed, see the installation instructions for the valve in chapter 2.5.16.
T	QX11	Heating circuit 1 valve closed Y2	Y2	An arm from the storage tank to the heating circuit closes (heating circuit’s internal circula-tion). After the test, the valve remains in the position it was in at the end of the test. If need-ed, see the installation instructions for the valve in chapter 2.5.16.
U	QX12	Brine circuit (evaporator-circuit) pump Q8	Q8	The pump should start to rotate when the test is switched on. See further instructions for speed controlled pumps in chapter 5.4.7.1.
V	QX13	Condenser-circuit pump Q9	Q9	. The pump should start to rotate when the test is switched on. See further instructions for speed controlled pumps in chapter 5.4.7.1.

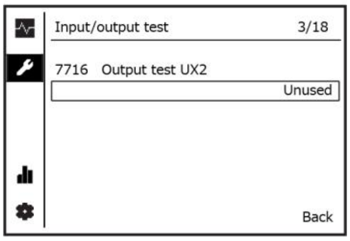
3.4.7.1 Relay test for speed controlled pumps

The test for speed controlled pumps is done by turning on the pump´s QX output and signal output test. The test is finished by selecting the function for relay test (line 7700) ”no test” and putting the test value for UX output ”---”. Other UX signal-controlled actuators are tested in the same way.



Select the QX output that is connected to the pump.





Also select the pump’s UX output test. Select the UX output that is connected to the pump (see model-specific factory settings and electrical diagrams). Select a test value, for example 100, 50 and 0 percent.

SEQ Taulukko * ARABIC Table 9. Relay test for condenser circuit speed controlled pump

Line	Con nect or	Out-put	Action	Mark-ing	Additional information
7700	V	QX13	Condenser-circuit pump Q9	Q9	The pump should start to rotate when the test is switched on and the desired speed is selected on line 7710. Try adjusting the speed by changing the setpoint on line 7710 (e.g. 100 %, 50 % and 0 %).
7710	y	UX1	Output test UX1	UX1	

SEQ Taulukko * ARABIC Table 10. Relay test for brine circuit’s speed controlled pump

Line	Con nect or	Out-put	Action	Mark-ing	Additional information
7700	U	QX12	Brine circuit pump Q8	Q8	The pump should start to rotate when the test is switched on and the desired speed is selected on line 7716. Try adjusting the speed by changing the setpoint on line 7716 (e.g. 100 %, 50 % and 0 %).
7716	y	UX2	Output test UX2	UX2	

3.5 Automation factory settings

3.5.1 Pipe connection corresponding to the factory settings

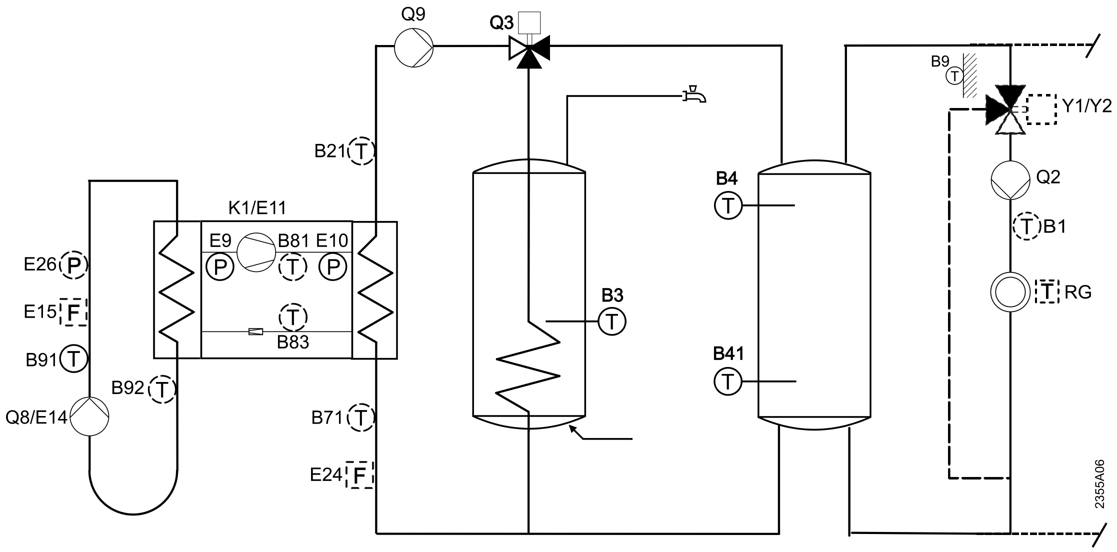


Figure 4. DHW storage tank and space heating with the buffer storage tank.
Sensor B41 is not necessary.

3.5.2 Inputs and outputs of master controller

See connections from the wiring diagrams.

SUPPLY CURRENT OUTPUTS (CAPITAL LETTERS IN CONNECTORS)					
Line	Con-nector	Output	Action	Marking	Additional information
5890	W	QX1	(Electric immersion heater stage 1 K25)	(K25)	Reserved for electric immersion heater stage K25. Contactor K2. Fuse F2.
5891	W	QX2	(Electric immersion heater stage 2 K26)	(K26)	Reserved for electric immersion heater stage K26. Contactor K3. Fuse F2.
5892	X	QX3			
5894	Y	QX4 (ZX4)			
5895	Z	QX5			
5896	Z	QX6	Alarm output K10	K10	
5897	Q	QX7	Compressor 1 K1	K1	
5898	R	QX8	Change valve Q3	Q3	
5899 (6014)	S	QX9	Heating circuit 1 pump Q2	Q2	
5900 (6014)	T	QX10	Heating circuit 1 valve open Y1	Y1	
5901 (6014)	T	QX11	Heating circuit 1 valve closed Y2	Y2	
5902	U	QX12	Brine circuit (evaporator-circuit) pump Q8	Q8	
5903	V	QX13	Condenser-circuit pump Q9	Q9	
5909	Y	ZX4 (triac)			

For outputs Q9, Q10 and Q11 is selected function on line 6014. See chapter 25.

TEMPERATURE SENSORS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5930	t	BX1	Buffer tank temperature B4	B4	Heating circuit’s storage tank
5931	u	BX2			
5932	w	BX3			
5933	x	BX4			
5936	f	BX7	Hot gas temperature B81	B81	
5937	h	BX8	DHW temperature B3	B3	
5938	k	BX9	Outside temperature B9	B9	
5939	n	BX10	Heat pump supply water (condenser out) B21	B21	
5940 (6014)	p	BX11	Heating circuit 1 supply water B1	B1	
5941	q	BX12	Return water of heat pump (condenser in) B71	B71	
5942	r	BX13	Brine circuit in (evaporator in) B91	B91	
5943	s	BX14	Brine circuit out (evaporator out) B92	B92	

For input BX11 is selected function on line 6014. See chapter 25.

SUPPLY CURRENT INPUTS (CAPITAL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5980	P	EX1	Electric utility prevention E6	E6	Operating switch S1
5981		EX1 direction			
5982	P	EX2			
5983		EX2 direction			
5984	P	EX3			
5985		EX3 direction			
5986	P	EX4			
5987		EX4 direction			
5988	P	EX5	3-ph current control		L1
5989		EX5 direction	normally closed (break contact)		
5990	P	EX6	3-ph current control		L2
5991		EX6 direction	normally closed (break contact)		
5992	P	EX7	3-ph current control		L3
5993		EX7 direction	normally closed (break contact)		
5996	K	EX9	Low pressure switch E9	E9	
5997	K	EX10	High pressure switch E10	E10	
5998	Q	EX11	Compressor´s overload E11	E11	
5999		EX9 direction	normally closed (break contact)		
6000		EX10 direc-tion	normally closed (break contact)		
6001		EX11 direc-tion	normally closed (break contact)		

Normally closed contact receives voltage, when the heat pump operates normally. Power supply of normally closed contact interrupts (break contact) under fault situations.

CONTROL MESSAGES (SMALL LETTERS IN CONNECTORS)					
Line	Con-nect-or	Output	Action	Mark-ing	Action
6070	z	UX1	Condenser-circuit pump Q9	UX1	
6071	z	UX1	Signal logic output UX1	UX1	Inverted
6072	z	UX1	Signal output UX1	UX1	PWM
6078	y	UX2	Brine circuit (evaporator circuit) pump Q8	UX2	
6079	y	UX2	Signal logic output UX2	UX2	Inverted
6080	y	UX2	Signal output UX2	UX2	PWM

LOW VOLTAGE INPUTS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5950	e	H1			
5960	e	H3			

3.5.3 Inputs and outputs of auxiliary controller

TEMPERATURE SENSORS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
7307 (7300)	e	BX21	Suction line temperature B85	B85	
7308	e	BX22	(Liquid line temperature B83)	(B83)	

For input BX21 is selected function on line 7300.

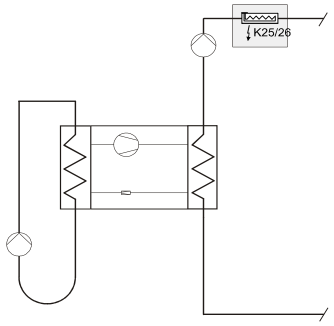
LOW VOLTAGE INPUTS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
7321	g	H21	Suction line pressure H82	H82	
7331	g	H22	(Liquid line pressure H83)	(H83)	

CONTROL MESSAGES (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Output	Action	Marking	Additional information
7362	e	WX21	Evaporator expansion valve V81	V81	

3.6 Most common additional and change connections

3.6.1 Electric immersion heater in the condenser line

The ECO Inverter+ switchboard is delivered with two contactors (K2 and K3) and a circuit breaker F2 for an eletric heater installed in condenser line. The contactors' control signals have been connected to automation controller outputs QX1 and QX2. The heater is commissioned by selecting "electric heater 1 K25" for output QX1 on line 5890, and "electric heater 2 K26" for output QX2 on line 5891. The heater must equipped with overheat protection if it is not included in the default assembly.



Settings

Configuration > line 5890, QX1: Electrical heater for flow 1 K25

Configuration > line 5891, QX2: Electrical heater for flow 2 K26

Connections to the automation

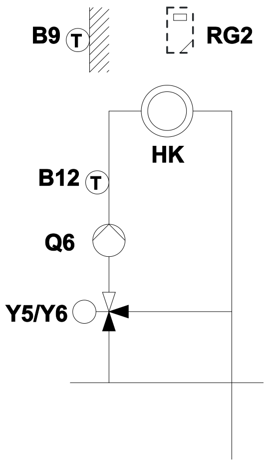
QX1: One electric heater resistor.

QX2: Two electric heater resistors.

Figure 10. The electric immersion heater in the condenser circuit of the heat pump.

3.6.2 Heating circuit 2 with a three-way valve and auxiliary controller

The ECO Inverter+ heat pump can be equipped with an optional auxiliary controller. It adds three-way valve control to heating circuit 2. Heating circuit 2 is commissioned by performing the connections presented in this manual and electrical diagrams, and by switching the circuit on according to the instructions in chapter 10.4.13.



Settings

Configuration > Line 5715 Heating circuit 2: On

Configure the expansion module > Line 7300 Operation of additional module 1: Heating circuit 2

Configuration > Line 6200 Save sensors: Yes

Connections to auxiliary controller

QX21: Y5, heating circuit 2, three-way valve open

QX22: Y6, heating circuit 2, three-way valve closed

QX23: Q6 heating circuit 2 circulation pump (via fuse F7)

BX21: B12, heating circuit 2, flow temperature

Figure 11. Heating circuit 2 with a three-way valve connected to auxiliary controller

SUPPLY CURRENT OUTPUTS (CAPITAL LETTERS IN CONNECTORS)					
Line	Con-nector	Output	Action	Marking	Additional information
7301 (7300)	T	QX21	Heating circuit 2 valve open Y5	Y5	
7302 (7300)	T	QX22	Heating circuit 2 valve closed Y6	Y6	
7303 (7300)	S	QX23	Heating circuit 2 pump Q6 (Through fuse F7)	Q6	

For outputs Q21, Q22 and Q23 is selected function on line 7300.

TEMPERATURE SENSORS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
7307 (7300)	e	BX21	Heating circuit 2 supply water B12	B12	

For input BX21 is selected function on line 7300.

CONTROL MESSAGES (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Output	Action	Marking	Additional information
7348	e	UX21	(Heating circuit 2 pump Q6)	(Q6)	On demand, if the pump is equipped with speed control.
7349	e	UX21	Signal logic output UX21		On demand, if the pump is equipped with speed control. Standard or inverse, de-pending on the pump.
7350	e	UX21	Signal output		On demand, if the pump is equipped with speed control. 0...10 V or PWM depending on the pump

3.6.3 Space heating without a buffer storage tank

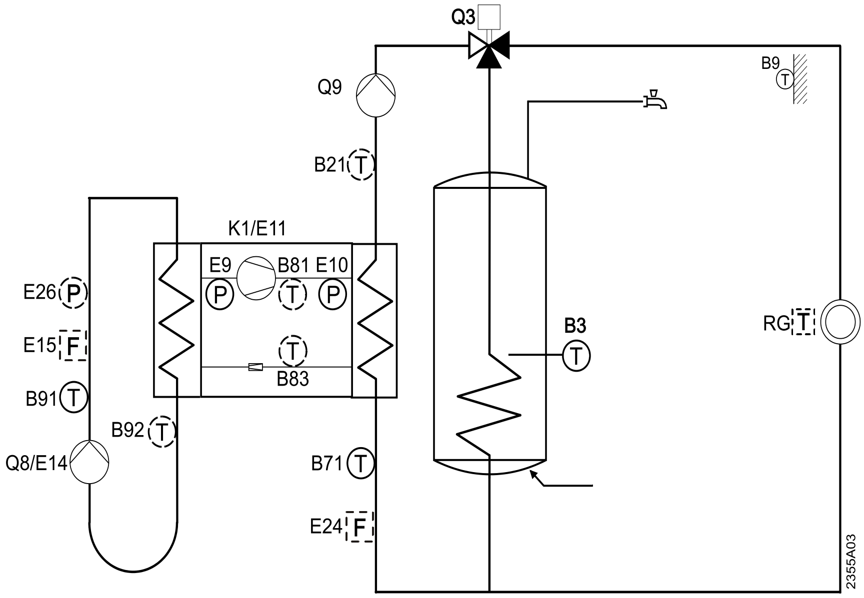


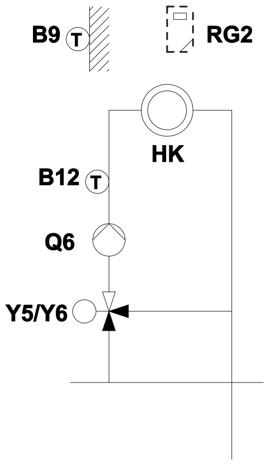
Figure 5. DHW storage tank and space heating without a buffer storage tank

3.6.3.1 Automation connection changes

Detach temperature sensors B4 and B1 from the pump's master controller. Save the changes by selecting Yes on lines 6200 and 6201.

3.6.3.2 Heating circuit 2 with a three-way valve

Heat pump's switchboard and automation are delivered with the connections and a temperature sensor for heating circuit 1 controlled with a three-way valve. In this coupling, heating circuit 1 has been connected directly to the heat pump's condenser circuit. This lets the electrical connections, temperature sensor (B1) and automation functions be used by heating circuit 2, configured and connected parallel to heating circuit 1. Make the corresponding changes to the device identifiers in the electrical diagrams manually.



Settings

Configuration > Line 5715 Heating circuit 2: On

Configuration > Line 6014 Function mixing group 1: Heating circuit 2

Configuration > Line 6200 Save sensors: Yes

Connections to the controller

QX10: Y5, heating circuit 2, three-way valve open

QX11: Y6, heating circuit 2, three-way valve closed

QX9: Q6 heating circuit 2 circulation pump (via fuse F6)

BX11: B12, heating circuit 2, flow temperature
(sensor B1's identifier changed to B12)

Figure 6. Heating circuit 2 with a three-way valve connected to master controller

4 Cube House

Cube House is a heat pump that comprises a housed compressor unit and an internal domestic hot water storage tank. In addition to the compressor unit, the device includes an internal 6 kW electric heater for additional and reserve heat production. The service buffer tank is heated with a coil heat exchanger integrated into the tank. The standard configuration of the device’s automation is for a service buffer tank and a single heating circuit. The condenser circuit’s internal pump operates as the heating circuit’s pump. For a connection corresponding to the factory settings, see chapter 4.5. The automation supports numerous other connections, systems and accessories. The most common additional and change connections are presented in chapter 4.6. Other systems are presented in the final pages of this manual, and in other, separate automation-focused manuals that are available on the Oilon website.

4.1 Dimensions, connections, and parts

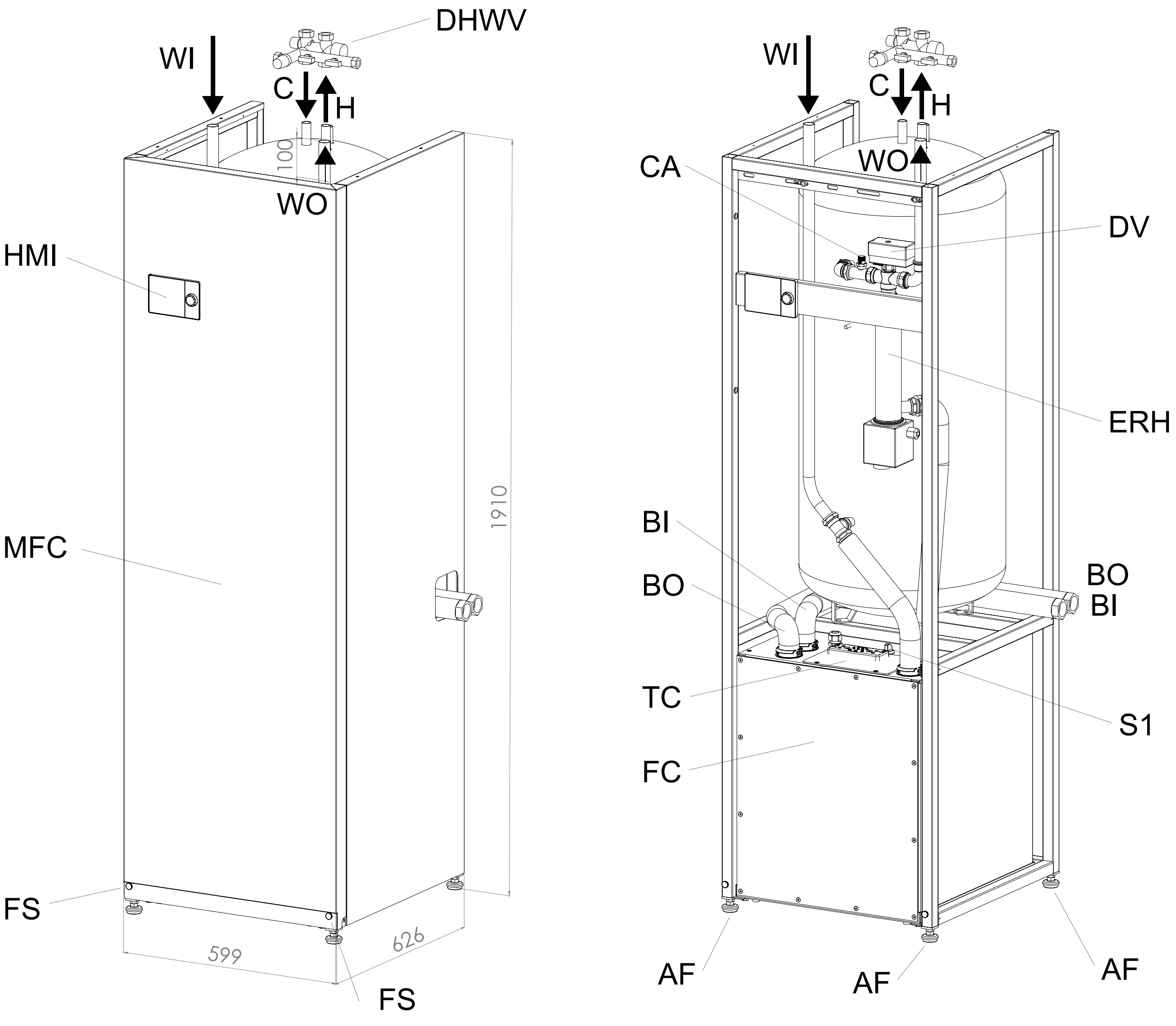


Figure 14. Cube House
measurements are in millimeters

H	DHW from storage tank	22 mm steel pipe
C	cold DHW to storage tank	22 mm steel pipe
CA	venting the DHW coil	venting screw
WI	heating water inlet/return	28 mm copper pipe
WO	heating water outlet/flow	28 mm copper pipe
BI	brine circuit in	1” inner thread and flat gasket
BO	brine circuit out	1” inner thread and flat gasket
HMI	user interface	
B3	DHW sensor	
S1	operating switch	1/active (ON): default position 0/inactive (OFF): compressor and electric immersion heaters switched off
DHWV	mixing valve with safety valve (accessory)	Oilon label: 34034069
AF	adjustable legs	M10, DIN/ISO 17/16 mm
MFC	front panel	
FS	Front panel mounting screws	Torx T20
ERH	electric immersion heater	6 kW
DV	change valve	A: domestic hot water B: building heating
TC	switchboard cover panel (Torx T25)	Fuses are located under this cover.
FC	compressor unit front panel (Torx T25)	Remove the front panel when performing connections to the automation

4.2 Switches and fuses

Marking	Action	Default position	Switch position upon device delivery
S1	Operating switch	1/active (ON)	0/inactive (OFF)
F1	Compressor’s motor protection (fuse)	ON	ON
F2	Electric immersion heater’s fuse	ON	ON
F3	Control fuse (for automation and internal pumps connected to it)	ON	ON

4.2.1 Operating switch S1

The operating switch is located above the compressor unit. When the switch is in position 1/ON, the device is in the default operating mode. When the switch is in position 0/OFF, the compressor and electric immersion heaters are disabled from starting, but the heat pump’s automation stays operational. The frost protection function is an exception to this. It starts the immersion heaters and the compressor’s condenser circuit when the temperature drops below 5 °C, even if the switch S1 is set to 0/OFF.

4.3 Installation

4.3.1 Detaching the front plate

Unscrew the fastening screws (FS) in the lower portion of the front plate (MFC). After the screws are detached, the plate will hang by the top part. Raise the plate upward, then pull it toward yourself.

4.3.2 Brine circuit's pipe joint

The brine circuit's pipes have 1" inner threads at the ends. Install shut-off valves to the pipes. Use the supplied flat gasket to seal the joint. Make sure that the piping inside the device does not rotate when the pipe connections are tightened. This could loosen the internal hose connection.

4.3.3 Rotating the brine circuit's piping

The brine circuit's piping can be rotated to a suitable direction during installation. If the pipes are rotated to face a new direction, from left to right for example, the original bend must first be straightened before a new one is made. Otherwise the opposite end of the pipe may loosen when the pipe is being rotated. The minimum bending radius is 35 mm. Do not bend the same spot more than three times.

- Straighten the bend facing right.
- Create a new bend facing the desired direction.
- Do not fold the pipe without creating a new bend first, otherwise the thread connection at the other end of the pipe may loosen.

4.3.4 Electrical connections

Check the electrical connections in the electrical diagrams. There is no need to open the switchboard if the piping connection corresponds to factory settings. See the outside temperature sensor's connection in chapter 4.3.7 and the installation process for a remote control system in chapter 4.3.8.

4.3.5 Modbus connection

A Modbus remote connection to the heat pump's automation can be established with a bus converter (Modbus RTU RS485). Modbus registers and the instructions for commissioning the device can be downloaded from the Oilon website.

4.3.6 Venting the DHW coil

Vent the device's internal domestic hot water coil carefully during installation. Draw water through the return line (WI) and let the air out with the venting screw (CA).

The change valve's (DV) position affects the water circulation inside the device. If the change valve is in position B (facing the building's heating circuit), the water supplied to the return line will run according to the image only through the DHW coil. This is the default position when the device is shipped from the factory, and whenever domestic water is not being heated. The valve can be turned with the relay test (chapter 4.4.7) if needed, or by detaching the valve motor and carefully turning the spindle manually.

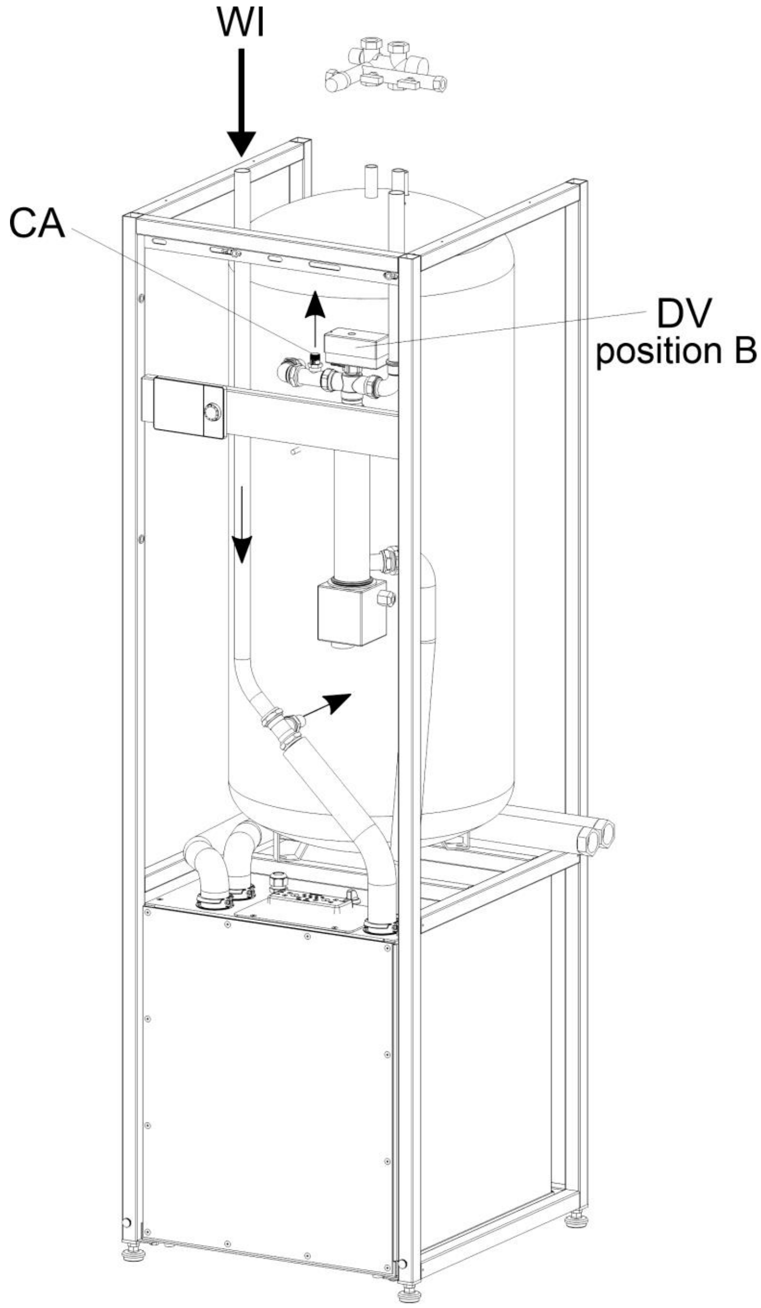


Figure 15. Venting the DHW coil, Cube House

4.3.7 Outdoor temperature sensor

The heat pump's outside temperature sensor (sensor code 89) is delivered with the pump. The sensor is mounted during the pump's installation. It is connected to cable WB9. Check the cable's cross-sectional area from the table below.

Install the sensor outdoors such that the sensor-cable bushing points downward. Select the sensor position so that it measures as accurately as possible the prevailing outside-air temperature. Make sure that the sensor is not exposed to solar radiation or heat coming from the building. Sensor housing is protected against dust and water spray (IP65, if the cable connection is pointing downward), but should still be installed in a location that is covered from rain. A suitable location for the sensor is, for example, a shady place on the north wall of the building under the eaves.

SEQ Taulukko * ARABIC Table 11. Outside sensor cable

Cable length (m)	40	60	80	120
Wire cross-sectional area (mm^2)	0.50	0.75	1.0	1.5

For additional information, see chapter 2.9.

4.3.8 Remote connection

The remote connection device (OZW672 or OCI670) is connected to the cable according to the WA1.7 electrical diagrams. A basic guide to commissioning the device is presented below. If necessary, see more detailed instructions on Oilon's webpage.

- Use your internet browser to enter the ClimatixIC cloud service at www.climatixic.com
- Register the device with the registration code found in the device packaging and below the connection box cover.
- Retrieve the password from the email address that was used to register the device.
  - If you have already registered a different device with the same email address, this device is automatically added to your existing account.
- Log to the ClimatixIC cloud service.
- Enter the requested information.
- Pair the remote connection device and the heat pump's controller in the remote connection device's settings.
  - If the device is covered with a sticker that displays the heat pump's serial number, this indicates that the pairing has already been performed at the factory.
- Commissioning is finished. You can use the remote connection with an internet browser, mobile application or the Siemens ACS computer program.
  - Android application on Google Play: Siemens HomeControl IC (link)
  - iOs application on Apple's App Store: Siemens HomeControl IC (link)

4.3.9 Electric immersion heater's overheat protection reset

Reset the overheat protection during installation. It may be triggered by blows or vibration during transport.

The electric immersion heater is equipped with an internal overheat protection system. It shuts the immersion heater’s power off when the internal temperature of the immersion heater cartridge exceeds 105 °C. The overheat protection is reset with the button on the black plastic housing located at the end of the electric immersion heater. The button is under a transparent plastic lid. The lid can be opened with a slot-head screwdriver. Before the high temperature sensor is reset, determine what caused triggering of the sensor and address the causes. The sensor may have been triggered by the vibration caused by the transportation and relocation of the device.

The thermostat in the internal electric immersion heater of the devices should not be adjusted. The thermostat in the electric immersion heater has been set to 80 °C at the factory. The immersion heater's own thermostat will shut off power to the immersion heater only if the automation or the emergency operation thermostat malfunctions. The setpoint of the electric immersion heater thermostat must be set high enough in consideration of both the building and DHW heating, because the electricity supply to the immersion heater travels through the immersion heater thermostat in all use. The internal thermostat is not used as the emergency operation thermostat for automation, nor with the operating switch position

The condenser circuit’s electric immersion heater has three 2 kW rods. The combined resistor capacity is 6 kW. The resistors are controlled in three stages. Stage 1 (K25) is connected to contactor K2. Its capacity is 2 kW. Stage 2 (K26) is connected to contactor K3. Its capacity is 4 kW. The third stage uses stages 1 and 2 simultaneously (K25 + K26).

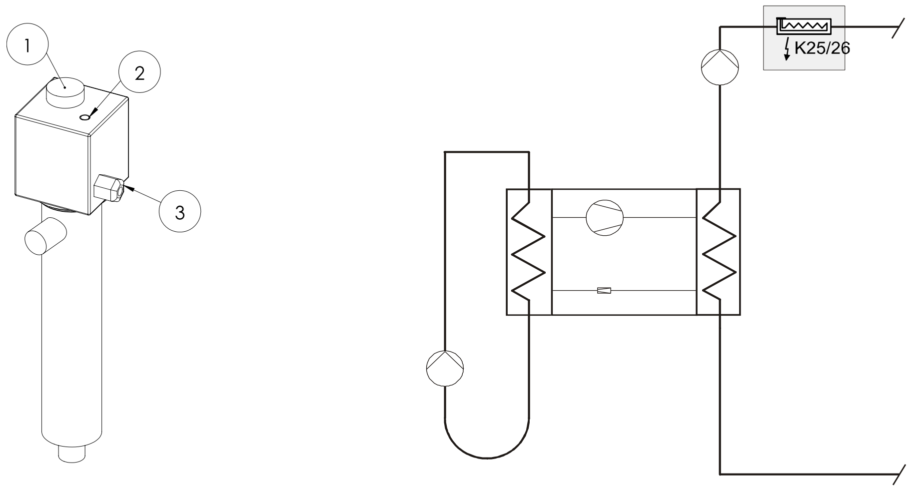


Figure 16. Electric immersion heater

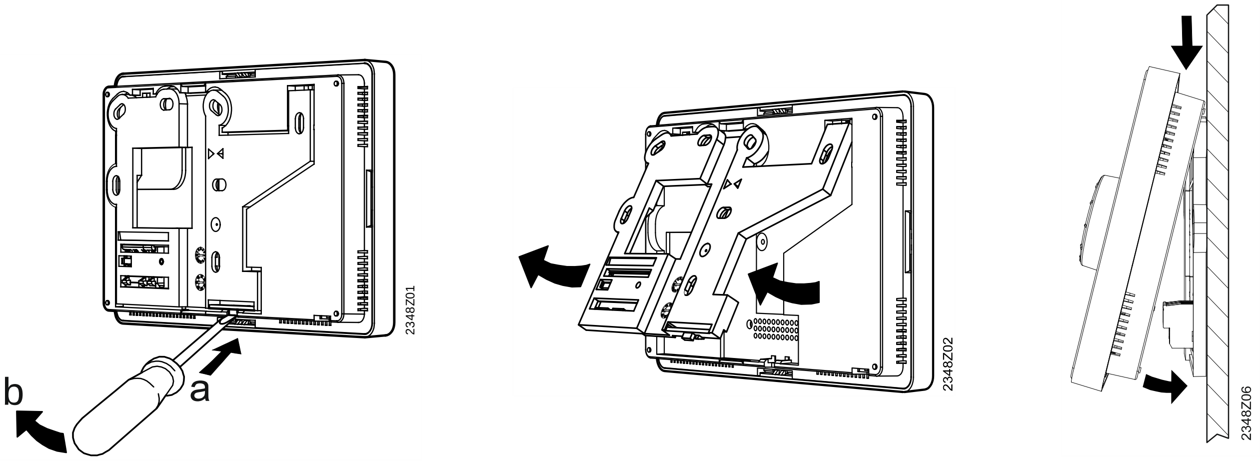
1	Electric immersion heater thermostat		QX1: electric immersion heater stage 1 K25 (contac-tor K2)
2	Electric immersion heater's overheat protection reset		QX2: electric immersion heater stage 2 K26 (contac-tor K3)
3	Electrical connection		

4.3.10 Detaching the compressor unit from the housing

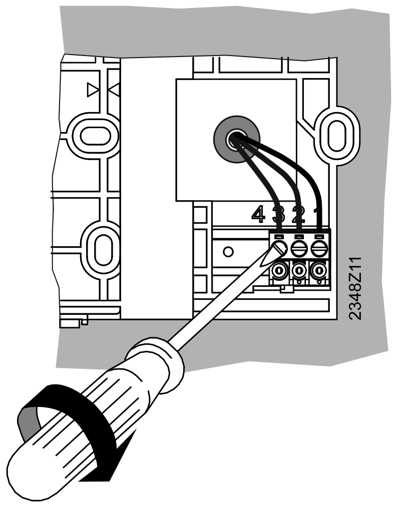
The compressor unit can be removed for easier moving, carrying, or servicing. Exercise caution when moving and carrying the unit, to avoid personal injury and damage to the device and surroundings. You may use cargo straps under the unit to make carrying easier. If the device has already been installed, make sure its electrical supply is not live, reduce the pressure of the water and brine circuits to near atmospheric pressure (gauge pressure: 0 bar), and close all external shut-off valves before removing the unit.

- Remove the device's front plate (MFC, chapter 6.3.1).
- Remove the display cable (**Error! Reference source not found.**).
- Pull the electric immersion heater's (ERH) connector (WE1) apart.
    - When detaching the connectors, grasp the body of the connector. Do not pull by the cables. The connector has a locking plate that is opened with a slot-head screwdriver.
- Detach the change valve's (DV) motor from the valve housing.
    - The motor is fastened with a pin that can be pulled out.
- Remove the DHW sensor (B3) via the pocket in the lower part of the DHW storage tank.
    - Press the gasket above the pocket with one hand and use the other hand to pull the sensor out.
- Open the thread connection in the flexible pipe leading from the unit to the change valve (DV).
    - Remove the connection by turning the freely rotating nut while applying gentle pressure from the other end of the connection. Make sure that the hose is not twisted when the connection is being removed or attached. Do not open the beaded connection.
- Open the thread connection in the flexible pipe leading from the unit to the electric immersion heater (DV).
    - Remove the connection by turning the freely rotating nut while applying gentle pressure from the other end of the connection. Make sure that the hose is not twisted when the connection is being removed or attached. Do not open the beaded connection.
- Open the front plate of the compressor unit (FC, Torx 25).
- Remove the unit's fastening screws and pull the unit out (see image).
    - Keep the brine circuit's piping attached to the unit.
- For remounting of the unit, follow the corresponding steps in the opposite sequence. While remounting it, check the seals of the water and brine connections and, if it is necessary to do so, replace the flat seal of the connections.

Press the mounting bracket with a slot-head screwdriver and detach the display. The display is mounted back by first connecting the upper part with the back plate’s brackets, and the pressing the lower part into the plate.



Detach the display cable.



Loosen the back plate’s screws slightly to be able to reach the end of the cable.

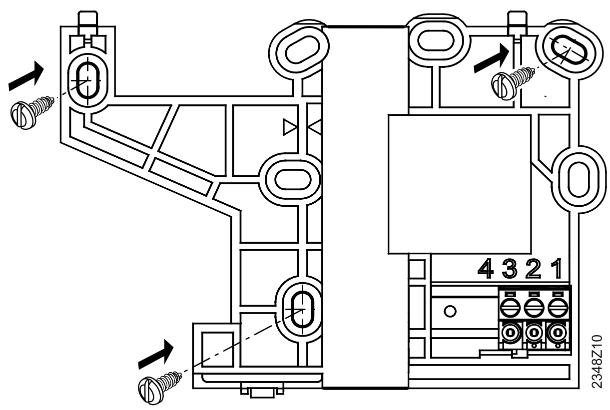
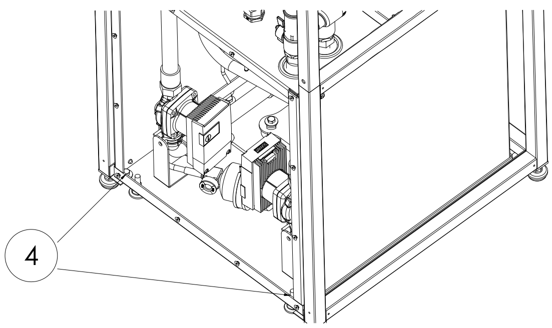


Figure 17. Unmounting the display from the housing

The unit's mounting screws (4)



Then pull out the unit.

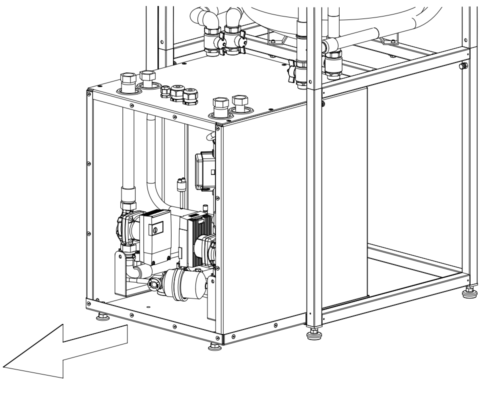


Figure 18. Unmounting the unit from the housing

4.4 Commissioning

4.4.1 Before the first start-up

- Before the first start-up check, that
    - the pipe connections are properly made and checked
    - the electrical connections connections are properly made and checked
    - all tanks and pipings are connected to a functioning safety valve
    - the necessary air supply valves are placed properly within the system
    - the expansion tanks are properly dimensioned and placed
    - all pipes and storage tanks have been carefully filled and vented
    - all necessary shut-off valves are opened
    - the general installation instructions have been followed (chapter 2)
    - the device-specific installation instructions have been followed
    - the outside sensor has been installed
    - the operating interface is installed
    - the other necessary sensors and devices have been installed.
- If necessary, reset the overheat protection before the initial start-up.

4.4.2 BASIC SETTINGS

Menu	Line	Setting
Heating circuit 1	720	Heating curve slope
Heating circuit 1	721	Heating curve displacement (parallel displacement)
Heating circuit 1	730	Summer/winter heating limit
Heating circuit 1	740	Flow temp. setpoint min. (lower limit)
Heating circuit 1	741	Flow temp. setpoint max. (upper limit)
Heat pump	2855 F	Switch-off temperature in space heating

See the standard setup for heating circuits in chapter 11.4.

4.4.3 First start-up of automation

- Move the operating switch S1 to OFF position and fuses to ON position.
    - The device is delivered with the operating switch in OFF position and the fuses in ON position.
    - This enables you to use the automation before starting the heat pump.
        - Frost protection is an exception to this. It starts the immersion heaters and the compressor's condenser circuit when the temperature drops below 5 °C even if the switch S1 is set to OFF. If the condenser circuit's temperature is below 5 °C, set the inverter and immersion heater fuses F1 and F2 to OFF, if needed.
- Wait for the user interface to update the data from the controller.
    - Go through the commissioning menus if needed (chapter 4.4.6). The commissioning menu settings are preset at the factory.
- If necessary, make the setting changes corresponding to the pipe coupling (chapter 2.13).
- Adjust the heating circuit's basic settings to fit the heating system (chapter 4.4.2)
    - Other heating circuit settings and their functioning are listed in chapter11.3.
- Continue venting the internal and external piping.
    - If necessary, use the relay test for guidance (chapter 4.4.7).
    - For instructions on venting the internal tank's coil, see chapter 4.3.6.
- If you have installed external actuators, such as the heating circuit's control valve, test their functionality and connections with a relay test (chapter 4.4.7).
- During device commissioning and maintenance, you can enable outside temperature simulation in the Diagnostics menu, if needed (chapter 10.4.7), This makes it possible to bypass the device's outside temperature sensor and set the outside temperature manually.

4.4.4 The first start-up of the heat pump

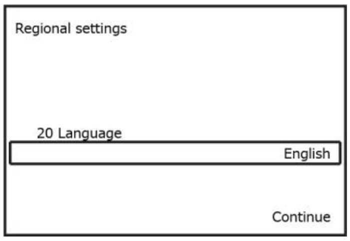
- Reset the heat pump if needed (chapter 10.4.11).
- Place the operating switch in S1 ON position.
- Wait for the compressor to start. Brine circuit's and condenser circuit's pumps start about 10...20 seconds before the compressor starts.
    - If you have to restart the compressor, wait at least 5 minutes after the last start.
- Make sure that the compressor rotates in the right direction.
    - If the compressor's rotation direction is correct, the operating sound is normal, the flow water line warms up, the hot gas pipe warms up (line 8415), the pressure in the high pressure zone increases, and that on the low pressure side falls (refrigeration gauge).
- If the compressor's direction of rotation is incorrect, stop the compressor immediately by moving its operating switch S1 to the OFF position, or by moving the motor protection switch F1 to the OFF position, or by turning off the electrical supply to the device with the external switch Q1.
    - If the compressor rotates in the wrong direction, it emits abnormal sound, the flow water or hot gas (line 8415) pipes do not warm up, and the pressure in the suction line does not fall, and the high pressure zone's pressure does not increase (refrigerant gauge).
    - If the compressor rotates in the wrong direction, make sure that the power supply is de-energized and replace the order of two phases with each other in the device's supply cable. Then go back to the beginning of this chapter and go through the start-up steps again.
    - The device is equipped with an internal phase guard that halts the compressor rotating incorrectly due to the phase order within 10 seconds of start-up.
- Check the temperature indicators to ensure that the condenser circuit warms up and the evaporator circuit cools down.

4.4.5 After the commissioning

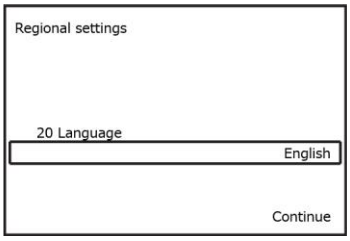
- Make sure that the heating water runs through all the required circuits.
- Make sure that the device's internal DHW storage tank spiral has been properly vented.
- Make sure that the pipes and storage tanks have no residue air and the pressure level is suitable
    - Also pay attention to the inspection and adjustment of the expansion tanks' pressure.
- Ensure that the temperature sensors show sensible values during device operation.
- Check the temperature indicators to ensure that the condenser circuit warms up and the evaporator circuit cools down.
- Make sure that the heating circuit's settings are suitable for the heating system (chapter 4.4.2)
    - Other heating circuit settings and their functioning are listed in chapter11.3.
    - If the heating circuit is equipped with a separate controller, set the heat pump's and heating circuit's heating curves to correspond to one another.
- Ensure that the actuators connected to the heat pump automation, such as the mixing valve of the heating circuit, function properly when the device is turned on.
- Make sure that inspection records (electrical connections), the commissioning inspection record and other required documents have been completed and stored.
- Make sure that all changes are documented in the electrical diagrams, HVAC diagrams and operating instructions.
- Instruct the customer in the basic functionality of the device, such as
    - the line circuit breaker's location ja operation
    - adjusting the heating curve.

4.4.6 Commissioning menus

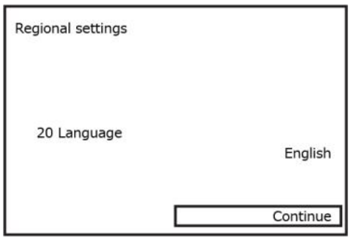
4.4.6.1 Language and time settings



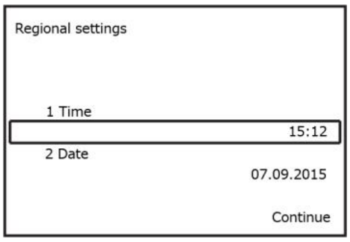
Initially, the display's language is English.



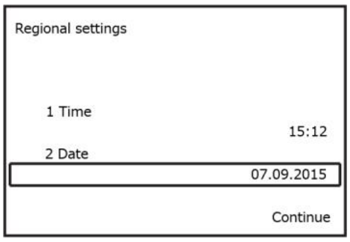
At the first screen, the interface language can be changed.



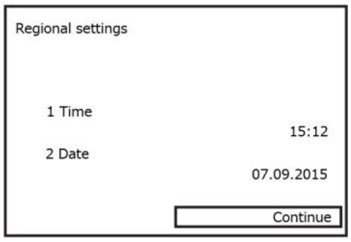
Move to the next page by pressing the button in the lower right-hand corner.



Set the time.



Set the date.



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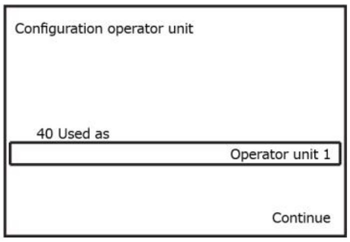
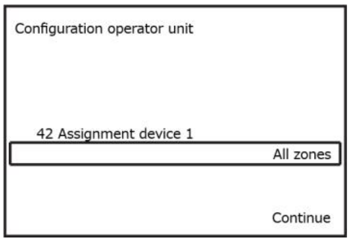
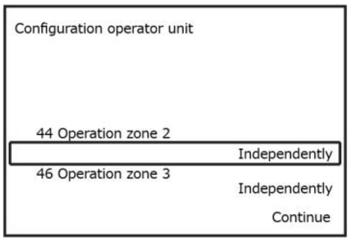
The images below show the settings that suit most situations unaltered. The menu settings are preset at the factory. The commissioning menu can be accessed again from the maintenance menu (chapter 10.4.8). For a detailed overview of the settings options, see chapter 10.5.



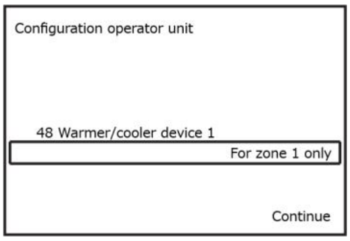
Intended use of room unit (sequence number). Select Operator unit 1.



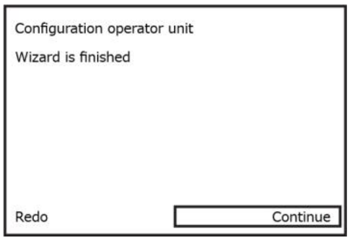
Heating circuits connected to the user terminal. Select All zones.



Autonomous settings for heating circuits 2 and 3. Select Autonomously for both.



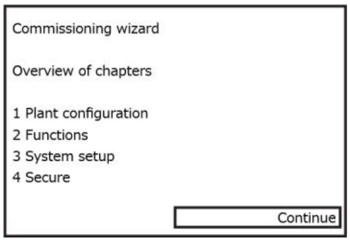
The effect of changing the temporary operating mode on other heating circuits. Select For zone 1 only.



Exit the commissioning menus from the lower right-hand corner of the screen. Select “Continue”. Wait for the controller to load the data. This will take a few minutes.

4.4.6.2 Configuration settings

In addition to the various modes' settings, the heat pump's configuration can be changed via the commissioning wizard in the commissioning menus. The wizard is launched at the first start-up if it has not been disabled. In addition, you can launch the wizard from the settings menus later. The settings suitable for the most common cases have been preloaded in the heat pump automation at the factory, so the commissioning wizard is usually not needed. In general, any individual changes required in the default settings are easier to make later through the settings menus. You may bypass the commissioning wizard setup pages by selecting "Skip" in the lower left-hand corner of the screen. If you select "Continue" accidentally, select "Skip" in the following screens until the commissioning wizard menus have been bypassed.



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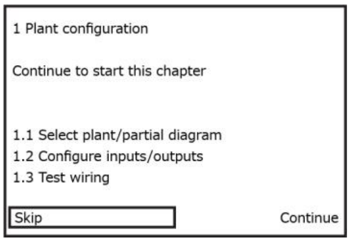
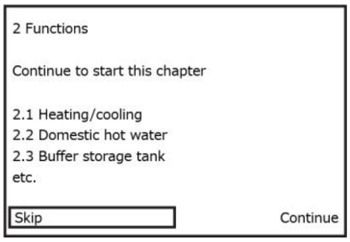
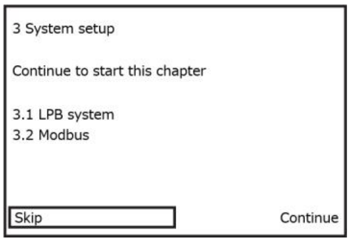


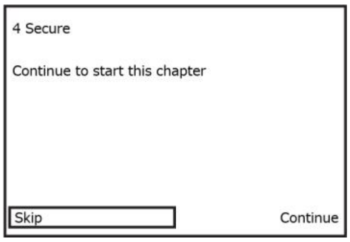
Select "Skip."



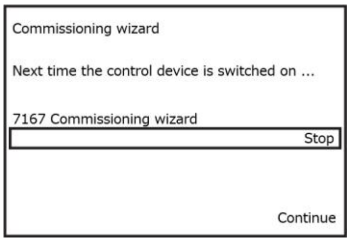
Select "Skip."



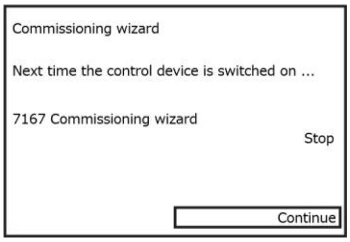
Select "Skip."



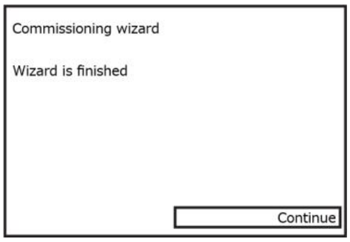
Select Skip.



Select "Stop".



Select "Continue".



Select "Continue".

4.4.7 Relay test

Test the operation of actuators with a relay test before starting the compressor if needed. The relay test is performed by selecting the desired QX output, and the UX signal output if required, and observing the operation of the actuator. The test is finished by selecting the function for relay test (line 7700) “no test”. Reset the heat pump after the relay test on line 6711 (chapter 10.4.11).

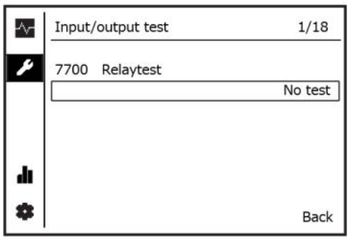
Use the relay test for venting the pipes if needed. Rotate the pump periodically for short times with the relay test and vent and fill (pressurize) the circuits between these short-term operating times. If needed, switch the positions of the change and control valves during venting.

SEQ Taulukko * ARABIC Table 12. Relay test

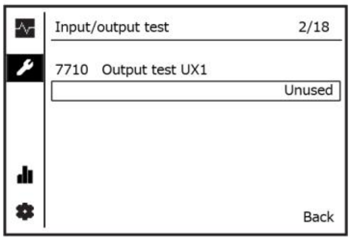
Con-nect-or	Out-put	Action	Marking	Additional information
W	QX1	Electric heater stage 1 K25	K25	Keep the fuse F2 in the position OFF. Contactor K2 should switch on.
W	QX2	Electric heater stage 2 K26	K26	Keep the fuse F2 in the position OFF. Contactor K3 should switch on.
R	QX8	Change valve Q3	Q3	Change valve is in position B (building, heating circuit) before the relay test. Switching the power on turns the valve into position A (aqua, service buffer tank’s coil). The valve returns to the position B when the relay test is turned off.
S	QX9	Heating circuit 1 pump Q2	Q2	The pump should start to rotate when the test is switched on. See further instructions for speed controlled pumps in the next chapter, if needed.
T	QX10	Heating circuit 1 valve open Y1	Y1	An arm from the storage tank to the heating circuit opens (heating circuit takes heat from the storage tank). After the test, the valve remains in the position it was in at the end of the test. If needed, see the installation instructions for the valve in chapter 2.5.16.
T	QX11	Heating circuit 1 valve closed Y2	Y2	An arm from the storage tank to the heating circuit closes (heating circuit’s internal circulation). After the test, the valve remains in the position it was in at the end of the test. If needed, see the installation instructions for the valve in chapter 2.5.16.
U	QX12	Brine circuit (evaporator-circuit) pump Q8	Q8	The pump should start to rotate when the test is switched on. See further instructions for speed controlled pumps in the next chapter.
V	QX13	Condenser-circuit pump Q9	Q9	The pump should start to rotate when the test is switched on. See further instructions for speed controlled pumps in the next chapter.

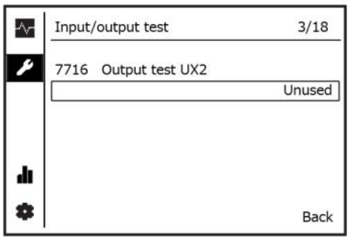
4.4.7.1 Relay test for speed controlled pumps

The test for speed controlled pumps is done by turning on the pump´s QX output and signal output test. The test is finished by selecting the function for relay test (line 7700) ”no test” and putting the test value for UX output ”---”. Other UX signal-controlled actuators are tested in the same way.



Select the QX output that is connected to the pump.





Also select the pump’s UX output test. Select the UX output that is connected to the pump (see model-specific factory settings and electrical diagrams). Select a test value, for example 100, 50 and 0 percent.

SEQ Taulukko * ARABIC Table 13. Relay test for condenser circuit speed controlled pump

Line	Connector	Out-put	Action	Mark-ing	Additional information
7700	V	QX13	Condenser-circuit pump Q9	Q9	The pump should start to rotate when the test is switched on and the desired speed is selected on line 7710. Try adjusting the speed by changing the setpoint on line 7710 (e.g. 100 %, 50 % and 0 %).
7710	y	UX1	Output test UX1	UX1	

SEQ Taulukko * ARABIC Table 14. Relay test for brine circuit’s speed controlled pump

Line	Connector	Out-put	Action	Mark-ing	Additional information
7700	U	QX12	Brine circuit pump Q8	Q8	The pump should start to rotate when the test is switched on and the desired speed is selected on line 7716. Try adjusting the speed by changing the setpoint on line 7716 (e.g. 100 %, 50 % and 0 %).
7716	y	UX2	Output test UX2	UX2	

4.5 Automation factory settings

4.5.1 Pipe connection corresponding to the factory settings

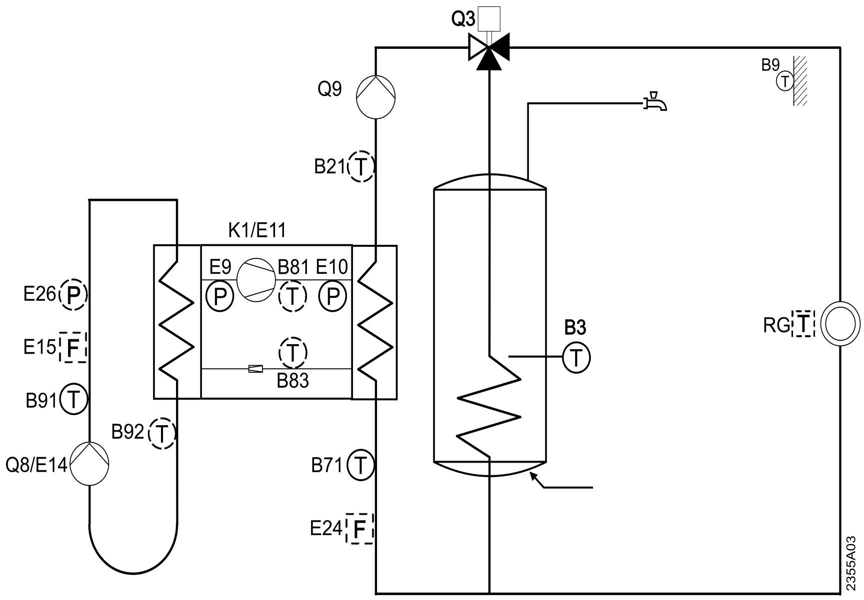


Figure 19. DHW storage tank and space heating without a buffer storage tank
DHW storage tank, valve Q3 and sensor B3 are internal to the device.

4.5.2 Inputs and outputs of master controller

See connections from the wiring diagrams.

SUPPLY CURRENT OUTPUTS (CAPITAL LETTERS IN CONNECTORS)					
Line	Con-nector	Output	Action	Marking	Additional information
5890	W	QX1	Electric heater stage 1 K25	K25	
5891	W	QX2	Electric heater stage 2 K26	K26	
5892	X	QX3			
5894	Y	QX4 (ZX4)			
5895	Z	QX5			
5896	Z	QX6	Alarm output K10	K10	
5897	Q	QX7	Compressor 1 K1	K1	
5898	R	QX8	Change valve Q3	Q3	
5899 (6014)	S	QX9			
5900 (6014)	T	QX10			
5901 (6014)	T	QX11			
5902	U	QX12	Brine circuit (evaporator-circuit) pump Q8	Q8	
5903	V	QX13	Condenser-circuit pump Q9	Q9	
5909	Y	ZX4 (triac)			

For outputs Q9, Q10 and Q11 is selected function on line 6014. See chapter 25.

TEMPERATURE SENSORS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5930	t	BX1			
5931	u	BX2			
5932	w	BX3			
5933	x	BX4			
5936	f	BX7			
5937	h	BX8	DHW temperature B3	B3	
5938	k	BX9	Outside temperature B9	B9	
5939	n	BX10	Heat pump supply water (condenser out) B21	B21	
5940 (6014)	p	BX11			
5941	q	BX12	Return water of heat pump (condenser in) B71	B71	
5942	r	BX13	Brine circuit in (evaporator in) B91	B91	
5943	s	BX14	Brine circuit out (evaporator out) B92	B92	

For input BX11 is selected function on line 6014. See chapter 25.

SUPPLY CURRENT INPUTS (CAPITAL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5980	P	EX1	Electric utility prevention E6	E6	Operating switch S1
5981		EX1 direction			
5982	P	EX2			
5983		EX2 direction			
5984	P	EX3			
5985		EX3 direction			
5986	P	EX4			
5987		EX4 direction			
5988	P	EX5	3-ph current control		L1
5989		EX5 direction	normally closed (break contact)		
5990	P	EX6	3-ph current control		L2
5991		EX6 direction	normally closed (break contact)		
5992	P	EX7	3-ph current control		L3
5993		EX7 direction	normally closed (break contact)		
5996	K	EX9	Low pressure switch E9	E9	
5997	K	EX10	High pressure switch E10	E10	
5998	Q	EX11	Compressor´s overload E11	E11	
5999		EX9 direction	normally closed (break contact)		
6000		EX10 direc-tion	normally closed (break contact)		
6001		EX11 direc-tion	normally closed (break contact)		

Normally closed contact receives voltage, when the heat pump operates normally. Power supply of normally closed contact interrupts (break contact) under fault situations.

CONTROL MESSAGES (SMALL LETTERS IN CONNECTORS)					
Line	Con-nect-or	Output	Action	Mark-ing	Action
6070	z	UX1	Condenser-circuit pump Q9	UX1	
6071	z	UX1	Signal logic output UX1	UX1	Inverted
6072	z	UX1	Signal output UX1	UX1	PWM
6078	y	UX2	Brine circuit (evaporator circuit) pump Q8	UX2	
6079	y	UX2	Signal logic output UX2	UX2	Inverted
6080	y	UX2	Signal output UX2	UX2	PWM

LOW VOLTAGE INPUTS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5950	e	H1			
5960	e	H3			

4.5.3 Inputs and outputs of auxiliary controller

TEMPERATURE SENSORS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
7307 (7300)	e	BX21	Suction line temperature B85	B85	
7308	e	BX22	(Liquid line temperature B83)	(B83)	Optional

For input BX21 is selected function on line 7300.

LOW VOLTAGE INPUTS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
7321	g	H21	Suction line pressure H82	H82	
7331	g	H22	(Liquid line pressure H83)	(H83)	Optional

CONTROL MESSAGES (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Output	Action	Marking	Additional information
7362	e	WX21	Evaporator expansion valve V81	V81	

4.6 Most common additional and change connections

4.6.1 Controlled heating circuit storage buffer tank and control valve

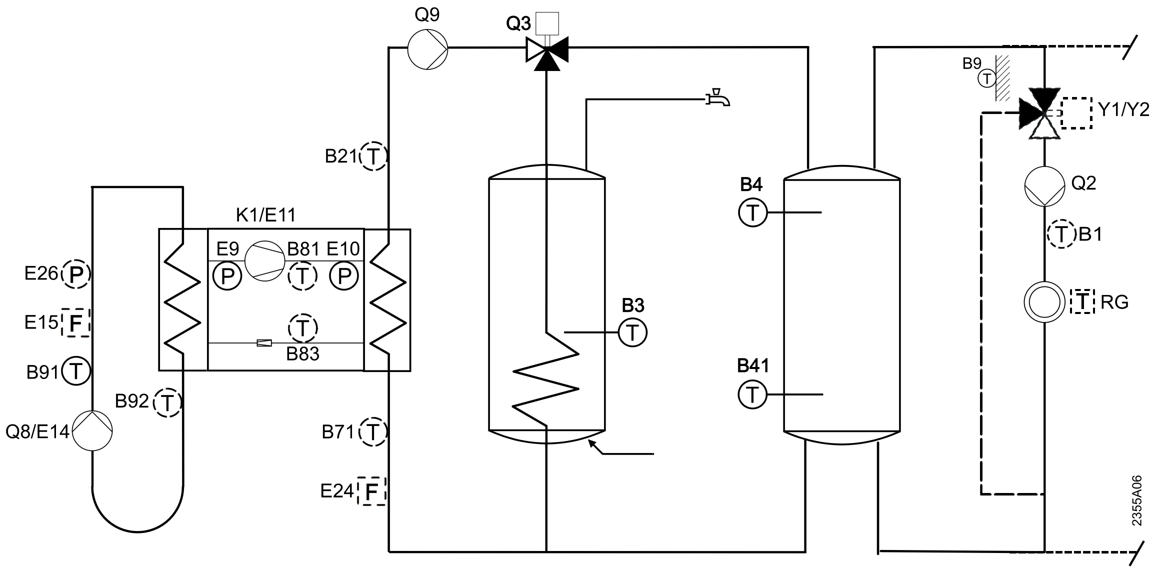


Figure 20. DHW storage tank and space heating with the buffer storage tank.
DHW storage tank, valve Q3 and sensor B3 are internal to the device. Sensor B41 is not necessary.

4.6.1.1 Changes to factory settings

Menu	Line	Line name	Setpoint
Heating circuit 1	870	With buffer	Yes
Configuration	5930	Sensor input BX1	Buffer tank temperature B4
Configuration	6014	Function of mixing group 1	Heating circuit 1

4.6.1.2 Electrical connections

TEMPERATURE SENSORS (SMALL LETTERS IN CONNECTORS)					
Line	Con nect or	Input	Action	Marking	Additional information
5930	t	BX1	Buffer tank temperature B4	B4	Space heating circuit storage tank
5940 (6014)	p	BX11	Heating circuit 1 supply water B1	B1	Supply water pipe of heating circuit 1

For input BX11 is selected function on line 6014. See chapter 25.

SUPPLY CURRENT OUTPUTS (CAPITAL LETTERS IN CONNECTORS)					
Line	Con nect or	Output	Action	Marking	Additional information
5899 (6014)	S	QX9	Heating circuit 1 pump Q2	Q2	
5900 (6014)	T	QX10	Heating circuit 1 valve open Y1	Y1	

5901 (6014)	T	QX11	Heating circuit 1 valve closed Y2	Y2	

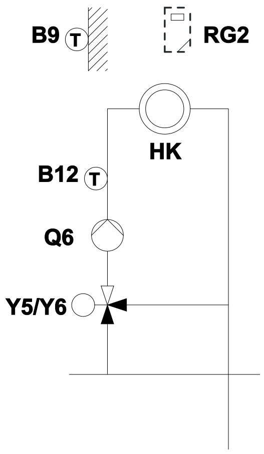
For outputs Q9, Q10 and Q11 is selected function on line 6014. See chapter 25.

4.6.1.3 Things to consider in installation

In this connection, the mixing shunt of the master controller is utilized in heating circuit 1. If another heating circuit (heating circuit 2) equipped with a mixing valve needs to be added, an auxiliary controller must to be installed.

4.6.2 Heating circuit 2 regulated by a three-way valve

The master controller has one functional block for the heating circuit's mixing valve. Cube Inverter+ heating circuit 1 is usually connected directly from the condenser to the heating circuit, leaving the mixing valve's functional block to be utilized with heating circuit 2. Heating circuit 2 is commissioned by performing the connections presented in this manual and electrical diagrams, and by switching the circuit on according to the instructions in chapter 10.4.13.



Settings

Configuration > Heating circuit 2 (line 5715): On

Configuration > Line 6014 Function mixing group 1: Heating circuit 2

Connections to the controller

QX10: Y5, heating circuit 2, three-way valve open

QX11: Y6, heating circuit 2, three-way valve closed

QX9: Q6 heating circuit 2 circulation pump (via fuse F7)

BX11: B12, heating circuit 2, flow temperature

Figure 21. Heating circuit 2 regulated by a three-way valve (with the controller)

5 ECO Inverter+

ECO Inverter+ is an inverter heat pump that comprises a housed compressor unit, integrated switchboard and wall-mountable user interface. The device's switchboard allows for an installation of an electric heater for additional and reserve heat. The standard configuration of the device's automation is for a service buffer tank, a heating circuit storage tank and a single heating circuit controlled with a three-way valve. For a connection corresponding to the factory settings, see chapter 5.5. The automation supports numerous other connections, systems and accessories. The most common additional and change connections are presented in chapter 5.5.3. Other systems are presented in the final pages of this manual, and in other, separate automation-focused manuals that are available on the Oilon website.

ECO Inverter+ models 2-9 and 3-12 have condenser and brine circuit pumps ready-fitted inside the device. The 7-25 model requires installation of external pumps when the heat pump is installed.

5.1 Dimensions, connections, and parts

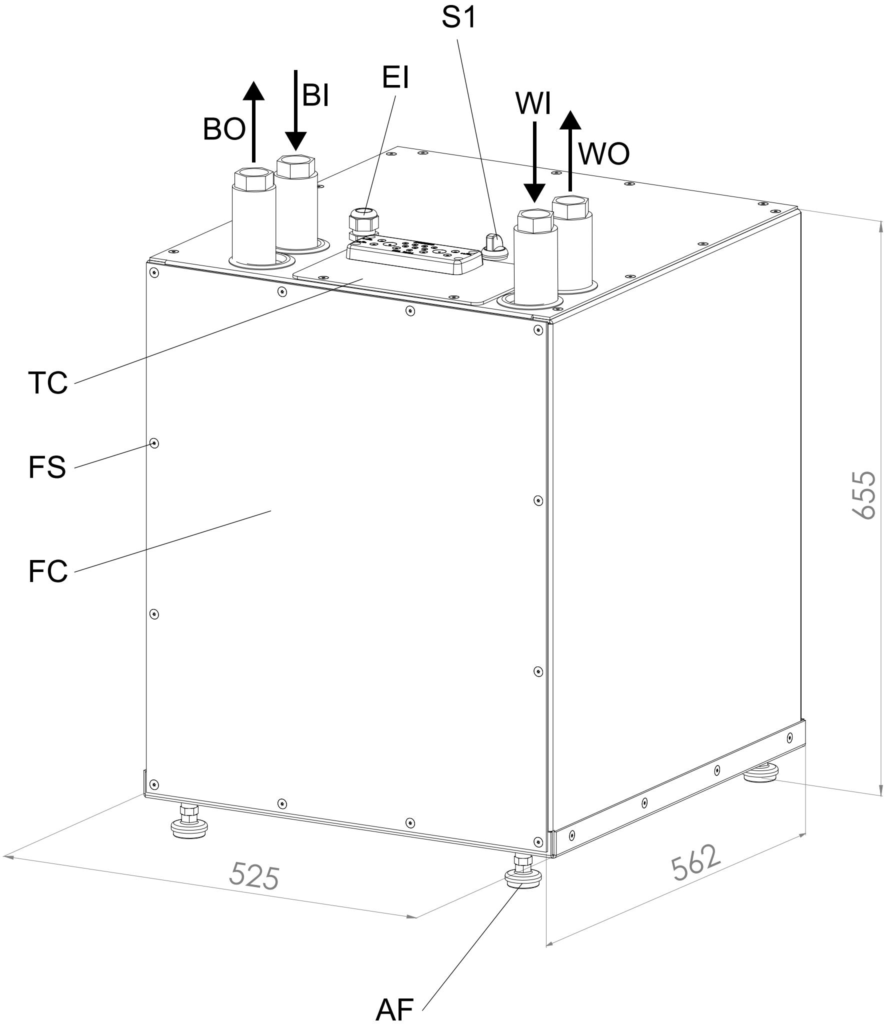


Figure 22. ECO Inverter+
measurements are in millimeters

WI	heating water inlet/return	Model: 7–25: 1 1/4" inner thread Other models: 1" inner thread Sealed with a gasket
WO	heating water outlet/flow	
BI	brine circuit in	
BO	brine circuit out	
S1	operating switch	1/active (ON): default position 0/inactive (OFF): compressor and electric immersion heaters switched off
AF	adjustable legs	M10, DIN/ISO 17/16 mm
TC	switchboard cover panel (Torx T25)	Fuses are located under this cover.
FC	compressor unit front panel (Torx T25)	Remove the front panel when performing connections to the automation
BP	Evaporator circuit's pump (brine circuit's pump)	
NO	power supply	

5.2 Switches and fuses

Marking	Action	Default position	Switch position upon device delivery
S1	Operating switch	1/active (ON)	0/inactive (OFF)
F1	Inverter fuse	ON	ON
F2	Electric immersion heater's fuse	ON	ON
F3	Control fuse (for automation and internal pumps connected to it)	ON	ON
F4*	Condenser circuit pump Q9's fuse	ON	ON
F5*	Evaporator circuit pump Q8's fuse	ON	ON

* Only ECO Inverter+ 7–25

5.2.1 Operating switch S1

The operating switch is located above the compressor unit. When the switch is in position 1/ON, the device is in the default operating mode. When the switch is in position 0/OFF, the compressor and electric immersion heaters are disabled from starting, but the heat pump's automation stays operational. The frost protection function is an exception to this. It starts the immersion heaters and the compressor's condenser circuit when the temperature drops below 5 °C, even if the switch S1 is set to 0/OFF.

5.3 Installation

5.3.1 Pipe joints

The pipe joints have 1” inner threads at the ends. Install shut-off valves to the joints. Use the supplied flat gasket to seal the joint.

Do not twist or turn the device’s pipes.

5.3.2 Electrical connections

Check the electrical connections in the electrical diagrams. See the outside temperature sensor’s connection in chapter 5.3.5, the installation process for the user interface in chapter 5.3.7, and instructions for installing a remote connection device in chapter 3.3.7.

5.3.3 Modbus connection

The Modbus connection (Modbus RTU RS485) in the heat pump’s automation operates in master mode. Data for the automation can be retrieved from external slave devices. Connecting an external master device is not possible.

5.3.4 ECO Inverter 7–25 pumps

The 7-25 model requires installation of external pumps when the heat pump is installed.

Their electrical connections are presented in the electrical diagrams. If their required current exceeds the values given in the diagrams, power is drawn directly from the building’s switchboard. In this case the pumps’ relay control can be done via the heat pump’s switchboard, from the same relay that the smaller pump would have been in direct connection with.

The pump of the condenser circuit included in the standard delivery can be regulated via the pump’s own red adjustment knob, or the control cable can be connected to the automation, which then regulates the pump’s speed.

The brine circuit’s connection depends on the selected pump. The automation also has a readiness for controlling the brine circuit’s pump speed with a 0-10 V control signal.

5.3.5 Outdoor temperature sensor

The heat pump's outside temperature sensor (sensor code 89) is delivered with the pump. The sensor is mounted during the pump's installation. It is connected to cable WB9. Check the cable's cross-sectional area from the table below.

Install the sensor outdoors such that the sensor-cable bushing points downward. Select the sensor position so that it measures as accurately as possible the prevailing outside-air temperature. Make sure that the sensor is not exposed to solar radiation or heat coming from the building. Sensor housing is protected against dust and water spray (IP65, if the cable connection is pointing downward), but should still be installed in a location that is covered from rain. A suitable location for the sensor is, for example, a shady place on the north wall of the building under the eaves.

SEQ Taulukko * ARABIC Table 15. Outside sensor cable

Cable length (m)	40	60	80	120
Wire cross-sectional area (mm^2)	0.50	0.75	1.0	1.5

For additional information, see chapter 2.9.

5.3.6 User interface (room unit)

The heat pump is delivered with a wall-mountable QAA74.611 user interface (room unit). It can be used for measuring the room temperature. The system may contain multiple user interfaces. For additional information, see the manual supplied with the interface and chapter 2.10.

The interface is connected to cable WA1.5. The cable can be extended if required. A regular two-wire insulated copper cable can be used with the display. The minimum cross-sectional area for the extension cable's wires is 0.50 mm^2. The maximum permitted length of the cable is 200 m.

Table 1. Room unit and heat pump controller connectors

Room unit con-nector's terminal	Connector terminal of the heat pump's control-ler	
1	G+	room unit's backlight: DC +12 V, 36 mA heat pump's controller: DC +12 V, maximum 88 mA
2	CL−	bus and backlight ground (M)
3	CL+	BSB bus

5.3.7 Remote connection (accessory)

The remote connection device (OZW672 or OCI670) is connected to the cable according to the WA1.7 electrical diagrams. A basic guide to commissioning the device is presented below. If necessary, see more detailed instructions on Oilon's webpage.

- Use your internet browser to enter the ClimatixIC cloud service at www.climatixic.com
- Register the device with the registration code found in the device packaging and below the connection box cover.
- Retrieve the password from the email address that was used to register the device.
    - If you have already registered a different device with the same email address, this device is automatically added to your existing account.
- Log to the ClimatixIC cloud service.
- Enter the requested information.
- Pair the remote connection device and the heat pump's controller in the remote connection device's settings.
    - If the device is covered with a sticker that displays the heat pump's serial number, this indicates that the pairing has already been performed at the factory.
- Commissioning is finished. You can use the remote connection with an internet browser, mobile application or the Siemens ACS computer program.
    - Android application on Google Play: Siemens HomeControl IC (link)
    - iOs application on Apple's App Store: Siemens HomeControl IC (link)

5.4 Commissioning

5.4.1 Before the first start-up

- Before the first start-up check, that
  - the pipe connections are properly made and checked
  - the electrical connections connections are properly made and checked
  - all tanks and pipings are connected to a functioning safety valve
  - the necessary air supply valves are placed properly within the system
  - the expansion tanks are properly dimensioned and placed
  - all pipes and storage tanks have been carefully filled and vented
  - all necessary shut-off valves are opened
  - the general installation instructions have been followed (chapter 2)
  - the device-specific installation instructions have been followed
  - the outside sensor has been installed
  - the operating interface is installed
  - the other necessary sensors and devices have been installed.
- If the device is connected to an external electric heater, reset the heater’s overheat protection before the initial start-up, if needed.

5.4.2 BASIC SETTINGS

Menu	Line	Setting
Heating circuit 1	720	Heating curve slope
Heating circuit 1	721	Heating curve displacement (parallel displacement)
Heating circuit 1	730	Summer/winter heating limit
Heating circuit 1	740	Flow temp. setpoint min. (lower limit)
Heating circuit 1	741	Flow temp. setpoint max. (upper limit)

See the standard setup for heating circuits in chapter 11.4.

5.4.3 First start-up of automation

- Move the operating switch S1 to OFF position and fuses to ON position.
    - The device is delivered with the operating switch in OFF position and the fuses in ON position.
    - This enables you to use the automation before starting the heat pump.
        - Frost protection is an exception to this. It starts the immersion heaters and the compressor's condenser circuit when the temperature drops below 5 °C even if the switch S1 is set to OFF. If the condenser circuit's temperature is below 5 °C, set the inverter and immersion heater fuses F1 and F2 to OFF, if needed.
- Go through the commissioning menus (chapter 5.4.6).
- If necessary, make the setting changes corresponding to the pipe coupling (chapter 2.13).
- Adjust the heating circuit's basic settings to fit the heating system (chapter 5.4.2)
    - Other heating circuit settings and their functioning are listed in chapter11.3.
- Continue venting the internal and external piping.
    - If necessary, use the relay test for guidance (chapter 5.4.7).
- If you have installed external actuators, such as the heating circuit's control valve, test their functionality and connections with a relay test (chapter 5.4.7).
- During device commissioning and maintenance, you can enable outside temperature simulation in the Diagnostics menu, if needed (chapter 10.4.7), This makes it possible to bypass the device's outside temperature sensor and set the outside temperature manually.

5.4.4 The first start-up of the heat pump

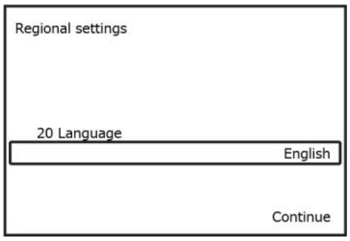
- Place the operating switch in S1 ON position.
- Reset the heat pump if needed (chapter 10.4.11).
- Wait for the compressor to start. Brine circuit's and condenser circuit's pumps start about 10...20 seconds before the compressor starts.
  - If you have to restart the compressor, wait at least 5 minutes after the last start.
- Make sure that the compressor rotates in the right direction.
  - If the compressor's rotation direction is correct, the operating sound is normal, the flow water line warms up, the hot gas pipe warms up (line 8415), the pressure in the high pressure zone increases, and that on the low pressure side falls (refrigeration gauge).
- If the compressor's direction of rotation is incorrect, stop the compressor immediately by moving its operating switch S1 to the OFF position, or by moving the motor protection switch F1 to the OFF position, or by turning off the electrical supply to the device with the external switch Q1.
  - If the compressor rotates in the wrong direction, it emits abnormal sound, the flow water or hot gas (line 8415) pipes do not warm up, and the pressure in the suction line does not fall, and the high pressure zone's pressure does not increase (refrigerant gauge).
  - If the compressor rotates in the wrong direction, make sure that the power supply is de-energized and replace the order of two phases with each other in the device's supply cable. Then go back to the beginning of this chapter and go through the start-up steps again.
  - The device is equipped with an internal phase guard that halts the compressor rotating incorrectly due to the phase order within 10 seconds of start-up.
- Check the temperature indicators to ensure that the condenser circuit warms up and the evaporator circuit cools down.

5.4.5 After the commissioning

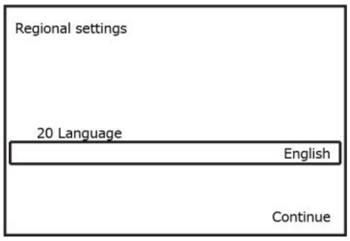
- Make sure that the heating water runs through all the required circuits.
- Make sure that the pipes and storage tanks have no residue air and the pressure level is suitable
    - Also pay attention to the inspection and adjustment of the expansion tanks' pressure.
- Ensure that the temperature sensors show sensible values during device operation.
- Check the temperature indicators to ensure that the condenser circuit warms up and the evaporator circuit cools down.
- Make sure that the heating circuit's settings are suitable for the heating system (chapter 5.4.2)
    - Other heating circuit settings and their functioning are listed in chapter11.3.
    - If the heating circuit is equipped with a separate controller, set the heat pump's and heating circuit's heating curves to correspond to one another.
- Ensure that the actuators connected to the heat pump automation, such as the mixing valve of the heating circuit, function properly when the device is turned on.
- Make sure that inspection records (electrical connections), the commissioning inspection record and other required documents have been completed and stored.
- Make sure that all changes are documented in the electrical diagrams, HVAC diagrams and operating instructions.
- Instruct the customer in the basic functionality of the device, such as
    - the line circuit breaker's location ja operation
    - adjusting the heating curve.

5.4.6 Commissioning menus

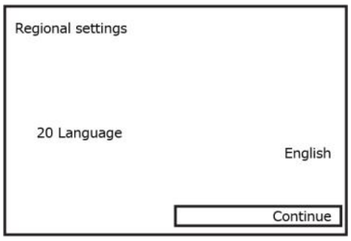
5.4.6.1 Language and time settings



Initially, the display's language is English.



At the first screen, the interface language can be changed.



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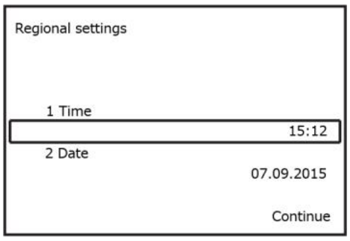
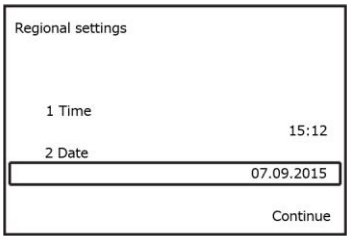
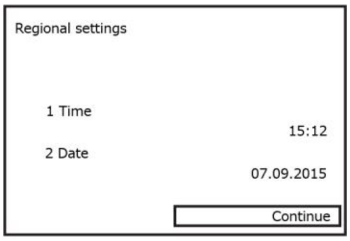


Set the time.



Set the date.



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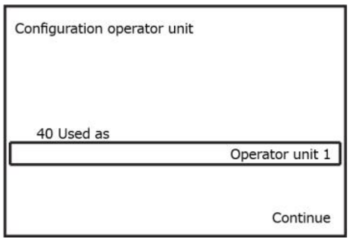
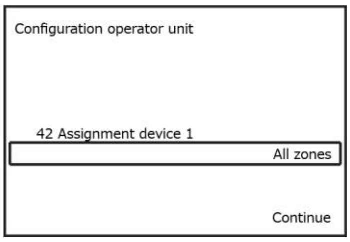
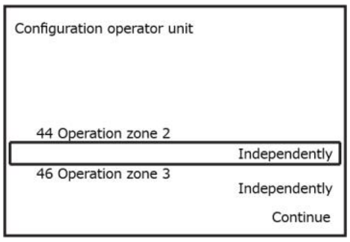
The images below show the settings that suit most situations unaltered. The commissioning menu can be accessed again from the maintenance menu (chapter 10.4.8). For a detailed overview of the settings options, see chapter 10.5.



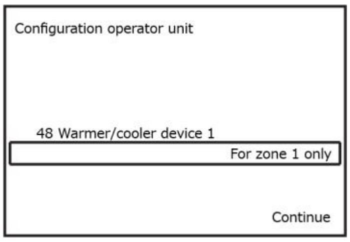
Intended use of room unit (sequence number). Select Operator unit 1.



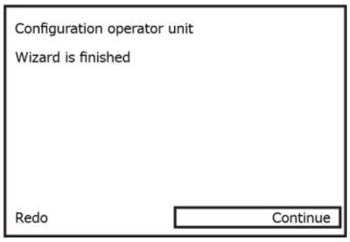
Heating circuits connected to the user terminal. Select All zones.



Autonomous settings for heating circuits 2 and 3. Select Autonomously for both.



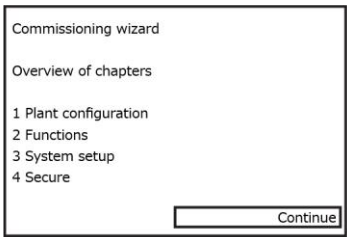
The effect of changing the temporary operating mode on other heating circuits. Select For zone 1 only.



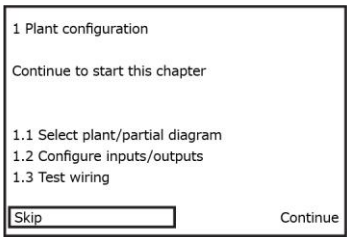
Exit the commissioning menus from the lower right-hand corner of the screen. Select "Continue". Wait for the controller to load the data. This will take a few minutes.

5.4.6.2 Configuration settings

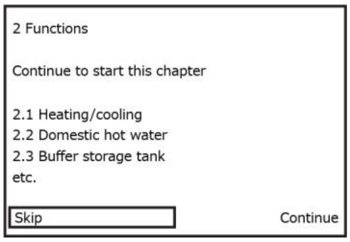
In addition to the various modes' settings, the heat pump's configuration can be changed via the commissioning wizard in the commissioning menus. The wizard is launched at the first start-up if it has not been disabled. In addition, you can launch the wizard from the settings menus later. The settings suitable for the most common cases have been preloaded in the heat pump automation at the factory, so the commissioning wizard is usually not needed. In general, any individual changes required in the default settings are easier to make later through the settings menus. You may bypass the commissioning wizard setup pages by selecting "Skip" in the lower left-hand corner of the screen. If you select "Continue" accidentally, select "Skip" in the following screens until the commissioning wizard menus have been bypassed.



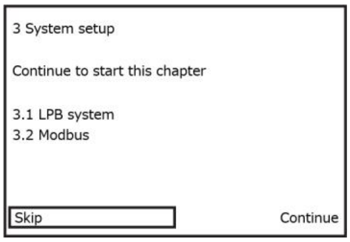
Continue to the next page.



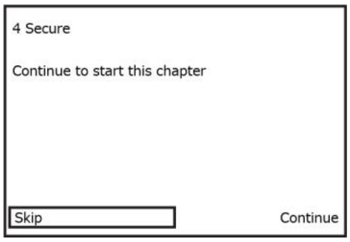
Select "Skip."



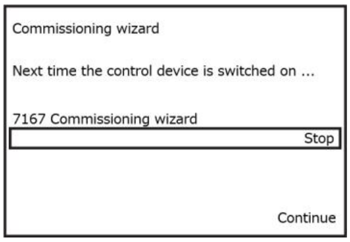
Select "Skip."



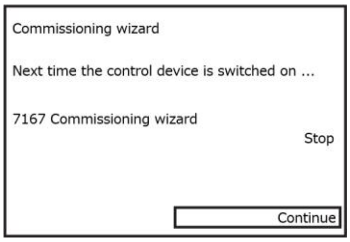
Select "Skip."



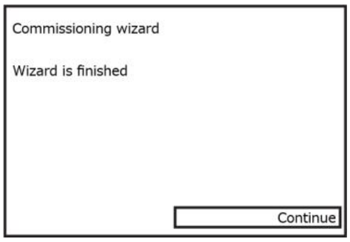
Select Skip.



Select "Stop".



Select "Continue".



Select "Continue".

5.4.7 Relay test

Test the operation of actuators with a relay test before starting the compressor if needed. The relay test is performed by selecting the desired QX output, and the UX signal output if required, and observing the operation of the actuator. The test is finished by selecting the function for relay test (line 7700) “no test”. Reset the heat pump after the relay test on line 6711 (chapter 10.4.11).

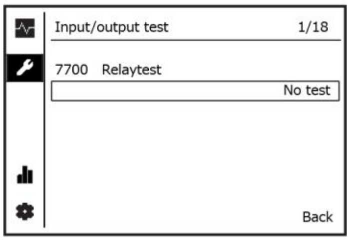
Use the relay test for venting the pipes if needed. Rotate the pump periodically for short times with the relay test and vent and fill (pressurize) the circuits between these short-term operating times. If needed, switch the positions of the change and control valves during venting.

SEQ Taulukko * ARABIC Table 17. Relay test

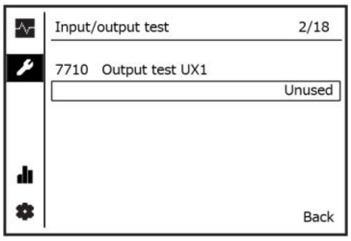
Con-nect-or	Out-put	Action	Marking	Additional information
W	QX1	Electric heater stage 1 K25	K25	Keep the fuse F2 in the position OFF. Contac-tor K2 should switch on.
W	QX2	Electric heater stage 2 K26	K26	Keep the fuse F2 in the position OFF. Contac-tor K3 should switch on.
R	QX8	Change valve Q3	Q3	Change valve is in position B (building, heating circuit) before the relay test. Switching the power on turns the valve to the position A (aq-ua, DHW storage tank). The valve returns to the position B when the relay test is turned off.
S	QX9	Heating circuit 1 pump Q2	Q2	The pump should start to rotate when the test is switched on. See further instructions for speed controlled pumps in chapter 5.4.7.1.
T	QX10	Heating circuit 1 valve open Y1	Y1	An arm from the storage tank to the heating circuit opens (heating circuit takes heat from the storage tank). After the test, the valve re-mains in the position it was in at the end of the test. If needed, see the installation instructions for the valve in chapter 2.5.16.
T	QX11	Heating circuit 1 valve closed Y2	Y2	An arm from the storage tank to the heating circuit closes (heating circuit’s internal circula-tion). After the test, the valve remains in the position it was in at the end of the test. If need-ed, see the installation instructions for the valve in chapter 2.5.16.
U	QX12	Brine circuit (evaporator-circuit) pump Q8	Q8	The pump should start to rotate when the test is switched on. See further instructions for speed controlled pumps in chapter 5.4.7.1.
V	QX13	Condenser-circuit pump Q9	Q9	. The pump should start to rotate when the test is switched on. See further instructions for speed controlled pumps in chapter 5.4.7.1.

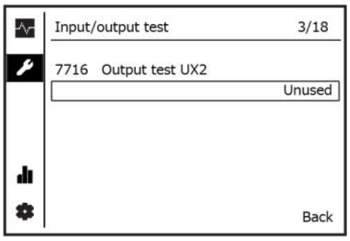
5.4.7.1 Relay test for speed controlled pumps

The test for speed controlled pumps is done by turning on the pump´s QX output and signal output test. The test is finished by selecting the function for relay test (line 7700) ”no test” and putting the test value for UX output ”---”. Other UX signal-controlled actuators are tested in the same way.



Select the QX output that is connected to the pump.





Also select the pump’s UX output test. Select the UX output that is connected to the pump (see model-specific factory settings and electrical diagrams). Select a test value, for example 100, 50 and 0 percent.

SEQ Taulukko * ARABIC Table 18. Relay test for condenser circuit speed controlled pump

Line	Connector	Out-put	Action	Mark-ing	Additional information
7700	V	QX13	Condenser-circuit pump Q9	Q9	The pump should start to rotate when the test is switched on and the desired speed is selected on line 7710. Try adjusting the speed by changing the setpoint on line 7710 (e.g. 100 %, 50 % and 0 %).
7710	y	UX1	Output test UX1	UX1	

SEQ Taulukko * ARABIC Table 19. Relay test for brine circuit’s speed controlled pump

Line	Connector	Out-put	Action	Mark-ing	Additional information
7700	U	QX12	Brine circuit pump Q8	Q8	The pump should start to rotate when the test is switched on and the desired speed is selected on line 7716. Try adjusting the speed by changing the setpoint on line 7716 (e.g. 100 %, 50 % and 0 %).
7716	y	UX2	Output test UX2	UX2	

5.5 Automation factory settings

5.5.1 Pipe connection corresponding to the factory settings

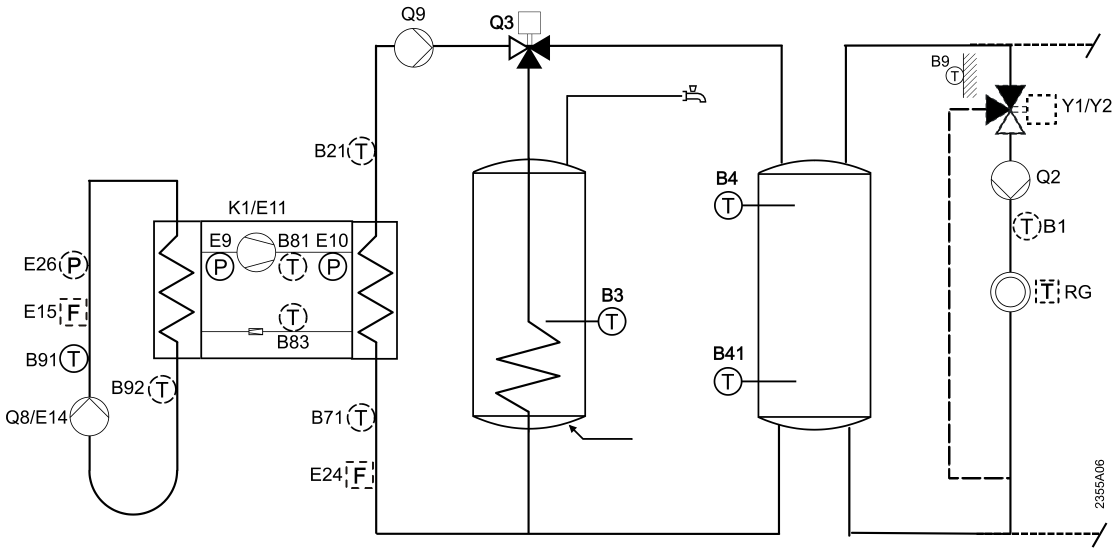


Figure 7. DHW storage tank and space heating with the buffer storage tank.
Sensor B41 is not necessary.

5.5.2 Inputs and outputs of master controller

See connections from the wiring diagrams.

SUPPLY CURRENT OUTPUTS (CAPITAL LETTERS IN CONNECTORS)					
Line	Con-nector	Output	Action	Marking	Additional information
5890	W	QX1	(Electric immersion heater stage 1 K25)	(K25)	Reserved for electric immersion heater stage K25. Contactor K2. Fuse F2.
5891	W	QX2	(Electric immersion heater stage 2 K26)	(K26)	Reserved for electric immersion heater stage K26. Contactor K3. Fuse F2.
5892	X	QX3			
5894	Y	QX4 (ZX4)			
5895	Z	QX5			
5896	Z	QX6	Alarm output K10	K10	
5897	Q	QX7	(Compressor 1 K1)	K1	Modbus connection, inverter
5898	R	QX8	Change valve Q3	Q3	
5899 (6014)	S	QX9	Heating circuit 1 pump Q2	Q2	
5900 (6014)	T	QX10	Heating circuit 1 valve open Y1	Y1	
5901 (6014)	T	QX11	Heating circuit 1 valve closed Y2	Y2	
5902	U	QX12	Brine circuit (evaporator-circuit) pump Q8	Q8	
5903	V	QX13	Condenser-circuit pump Q9	Q9	
5909	Y	ZX4 (triac)			

For outputs Q9, Q10 and Q11 is selected function on line 6014. See chapter 25.

TEMPERATURE SENSORS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5930	t	BX1	Buffer tank temperature B4	B4	Heating circuit’s storage tank
5931	u	BX2			
5932	w	BX3			
5933	x	BX4			
5936	f	BX7	(Hot gas temperature B81)	B81	Modbus connection, inverter
5937	h	BX8	DHW temperature B3	B3	
5938	k	BX9	Outside temperature B9	B9	
5939	n	BX10	Heat pump supply water (condenser out) B21	B21	
5940 (6014)	p	BX11	Heating circuit 1 supply water B1	B1	
5941	q	BX12	Return water of heat pump (condenser in) B71	B71	
5942	r	BX13	Brine circuit in (evaporator in) B91	B91	
5943	s	BX14	Brine circuit out (evaporator out) B92	B92	

For input BX11 is selected function on line 6014. See chapter 25.

SUPPLY CURRENT INPUTS (CAPITAL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5980	P	EX1	Electric utility prevention E6	E6	Operating switch S1
5981		EX1 direction			
5982	P	EX2			
5983		EX2 direction			
5984	P	EX3			
5985		EX3 direction			
5986	P	EX4			
5987		EX4 direction			
5988	P	EX5	3-ph current control		L1
5989		EX5 direction	normally closed (break contact)		
5990	P	EX6	3-ph current control		L2
5991		EX6 direction	normally closed (break contact)		
5992	P	EX7	3-ph current control		L3
5993		EX7 direction	normally closed (break contact)		
5996	K	EX9	Low pressure switch E9	E9	
5997	K	EX10	(High pressure switch E10)	E10	Modbus connection, inverter
5998	Q	EX11	(Compressor’s overload E11)	E11	Modbus connection, inverter
5999		EX9 direction	normally closed (break contact)		
6000		EX10 direc-tion	normally closed (break contact)		
6001		EX11 direc-tion	normally closed (break contact)		

Normally closed contact receives voltage, when the heat pump operates normally. Power supply of normally closed contact interrupts (break contact) under fault situations.

CONTROL MESSAGES (SMALL LETTERS IN CONNECTORS)					
Line	Con-nect-or	Output	Action	Mark-ing	Action
6070	z	UX1	Condenser-circuit pump Q9	UX1	
6071	z	UX1	Signal logic output UX1	UX1	Model 7-25: standard, other models in-verted
6072	z	UX1	Signal output UX1	UX1	Model 7–25: 0-10 V, other models PWM
6078	y	UX2	Brine circuit (evaporator circuit) pump Q8	UX2	
6079	y	UX2	Signal logic output UX2	UX2	Model 7-25: standard, other models in-verted
6080	y	UX2	Signal output UX2	UX2	Model 7–25: 0-10 V, other models PWM

LOW VOLTAGE INPUTS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5950	e	H1			
5960	e	H3			

5.5.3 Inputs and outputs of auxiliary controller

TEMPERATURE SENSORS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
7307 (7300)	e	BX21	Suction line temperature B85	B85	
7308	e	BX22	(Liquid line temperature B83)	(B83)	

For input BX21 is selected function on line 7300.

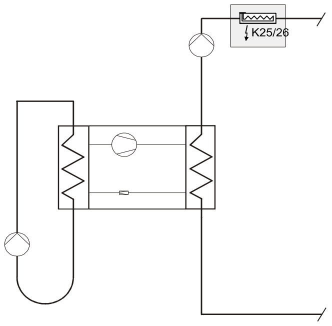
LOW VOLTAGE INPUTS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
7321	g	H21	Suction line pressure H82	H82	
7331	g	H22	(Liquid line pressure H83)	(H83)	

CONTROL MESSAGES (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Output	Action	Marking	Additional information
7362	e	WX21	Evaporator expansion valve V81	V81	

5.6 Most common additional and change connections

5.6.1 Electric immersion heater in the condenser line

The ECO Inverter+ switchboard is delivered with two contactors (K2 and K3) and a circuit breaker F2 for an eletric heater installed in condenser line. The contactors' control signals have been connected to automation controller outputs QX1 and QX2. The heater is commissioned by selecting "electric heater 1 K25" for output QX1 on line 5890, and "electric heater 2 K26" for output QX2 on line 5891. The heater must equipped with overheat protection if it is not included in the default assembly.



Settings

Configuration > line 5890, QX1: Electrical heater for flow 1 K25

Configuration > line 5891, QX2: Electrical heater for flow 2 K26

Connections to the automation

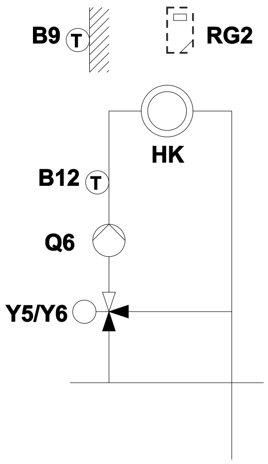
QX1: One electric heater resistor.

QX2: Two electric heater resistors.

Figure 8. The electric immersion heater in the condenser circuit of the heat pump.

5.6.2 Heating circuit 2 with a three-way valve and auxiliary controller

The ECO Inverter+ heat pump can be equipped with an optional auxiliary controller. It adds three-way valve control to heating circuit 2. Heating circuit 2 is commissioned by performing the connections presented in this manual and electrical diagrams, and by switching the circuit on according to the instructions in chapter 10.4.13.



Settings

Configuration > Line 5715 Heating circuit 2: On

Configure the expansion module > Line 7300 Operation of additional module 1: Heating circuit 2

Configuration > Line 6200 Save sensors: Yes

Connections to auxiliary controller

QX21: Y5, heating circuit 2, three-way valve open

QX22: Y6, heating circuit 2, three-way valve closed

QX23: Q6 heating circuit 2 circulation pump (via fuse F7)

BX21: B12, heating circuit 2, flow temperature

Figure 9. Heating circuit 2 with a three-way valve connected to auxiliary controller

SUPPLY CURRENT OUTPUTS (CAPITAL LETTERS IN CONNECTORS)					
Line	Con-nector	Output	Action	Marking	Additional information
7301 (7300)	T	QX21	Heating circuit 2 valve open Y5	Y5	
7302 (7300)	T	QX22	Heating circuit 2 valve closed Y6	Y6	
7303 (7300)	S	QX23	Heating circuit 2 pump Q6 (Through fuse F7)	Q6	

For outputs Q21, Q22 and Q23 is selected function on line 7300.

TEMPERATURE SENSORS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
7307 (7300)	e	BX21	Heating circuit 2 supply water B12	B12	

For input BX21 is selected function on line 7300.

CONTROL MESSAGES (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Output	Action	Marking	Additional information
7348	e	UX21	(Heating circuit 2 pump Q6)	(Q6)	On demand, if the pump is equipped with speed control.
7349	e	UX21	Signal logic output UX21		On demand, if the pump is equipped with speed control. Standard or inverse, de-pending on the pump.
7350	e	UX21	Signal output		On demand, if the pump is equipped with speed control. 0...10 V or PWM depending on the pump

5.6.3 Space heating without a buffer storage tank

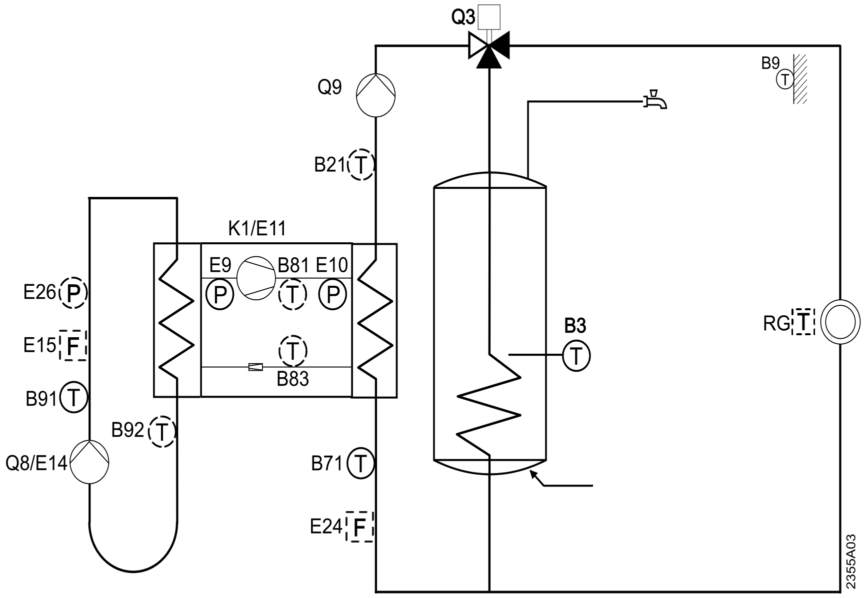


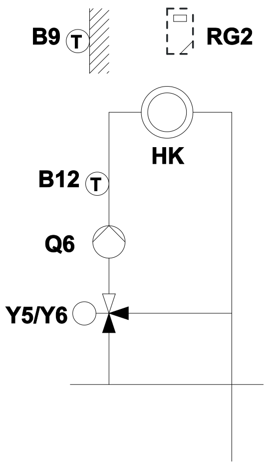
Figure 10. DHW storage tank and space heating without a buffer storage tank

5.6.3.1 Automation connection changes

Detach temperature sensors B4 and B1 from the pump's master controller. Save the changes by selecting Yes on lines 6200 and 6201.

5.6.3.2 Heating circuit 2 with a three-way valve

Heat pump's switchboard and automation are delivered with the connections and a temperature sensor for heating circuit 1 controlled with a three-way valve. In this coupling, heating circuit 1 has been connected directly to the heat pump's condenser circuit. This lets the electrical connections, temperature sensor (B1) and automation functions be used by heating circuit 2, configured and connected parallel to heating circuit 1. Make the corresponding changes to the device identifiers in the electrical diagrams manually.



Settings

Configuration > Line 5715 Heating circuit 2: On

Configuration > Line 6014 Function mixing group 1: Heating circuit 2

Configuration > Line 6200 Save sensors: Yes

Connections to the controller

QX10: Y5, heating circuit 2, three-way valve open

QX11: Y6, heating circuit 2, three-way valve closed

QX9: Q6 heating circuit 2 circulation pump (via fuse F6)

BX11: B12, heating circuit 2, flow temperature
(sensor B1’s identifier changed to B12)

Figure 11. Heating circuit 2 with a three-way valve connected to master controller

6 Cube Inverter+

Cube Inverter is an ínverter ground source heat pump that comprises a housed compressor unit and an internal domestic hot water storage tank. In addition to the compressor unit, the device includes an internal 6 kW electric heater for reserve heat production. The DHW storage tank is heated with a coil heat exchanger integrated into the tank. The standard configuration of the device’s automation is for a service buffer tank and a single heating circuit. The condenser circuit’s internal pump operates as the heating circuit’s pump. For a connection corresponding to the factory settings, see chapter 6.5. The automation supports numerous other connections, systems and accessories. The most common additional and change connections are presented in chapter 6.6. Other systems are presented in the final pages of this manual, and in other, separate automation-focused manuals that are available on the Oilon website.

6.1 Dimensions, connections, and parts

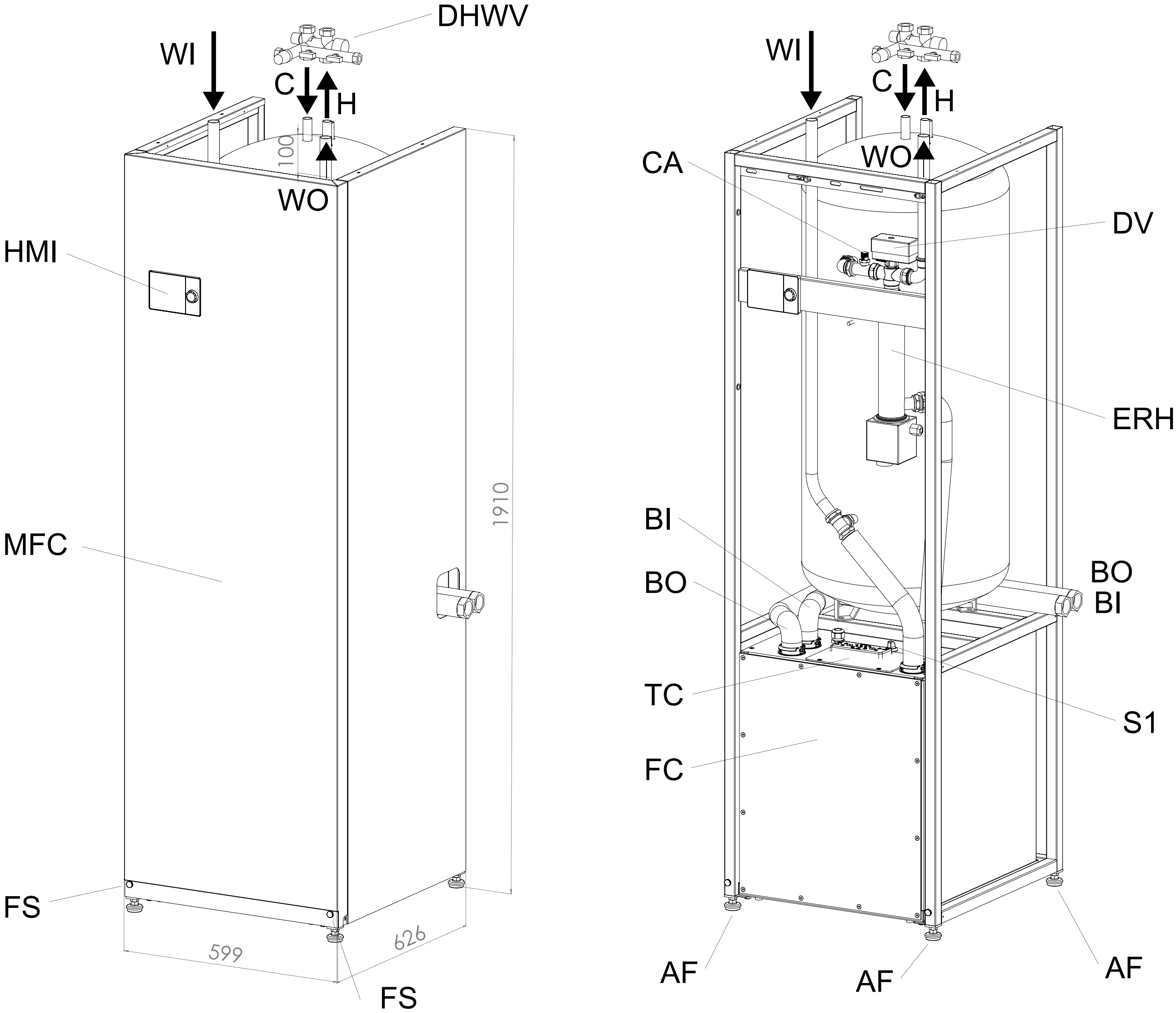


Figure 12. Cube Inverter+
measurements are in millimeters

H	DHW from storage tank	22 mm steel pipe
C	cold DHW to storage tank	22 mm steel pipe
CA	venting the DHW coil	venting screw
WI	heating water inlet/return	28 mm copper pipe
WO	heating water outlet/flow	28 mm copper pipe
BI	brine circuit in	1” inner thread and flat gasket
BO	brine circuit out	1” inner thread and flat gasket
HMI	user interface	
B3	DHW sensor	
S1	operating switch	1/active (ON): default position 0/inactive (OFF): compressor and electric immersion heaters switched off
DHWV	mixing valve with safety valve (accessory)	Oilon label: 34034069
AF	adjustable legs	M10, DIN/ISO 17/16 mm
MFC	front panel	
FS	Front panel mounting screws	Torx T20
ERH	electric immersion heater	6 kW
DV	change valve	A: domestic hot water B: building heating
TC	switchboard cover panel (Torx T25)	Fuses are located under this cover.
FC	compressor unit front panel (Torx T25)	Remove the front panel when performing connections to the automation

6.2 Switches and fuses

Marking	Action	Default position	Switch position upon device delivery
S1	Operating switch	1/active (ON)	0/inactive (OFF)
F1	Inverter fuse	ON	ON
F2	Electric immersion heater’s fuse	ON	ON
F3	Control fuse (for automation and internal pumps connected to it)	ON	ON

6.2.1 Operating switch S1

The operating switch is located above the compressor unit. When the switch is in position 1/ON, the device is in the default operating mode. When the switch is in position 0/OFF, the compressor and electric immersion heaters are disabled from starting, but the heat pump’s automation stays operational. The frost protection function is an exception to this. It starts the immersion heaters and the compressor’s condenser circuit when the temperature drops below 5 °C, even if the switch S1 is set to 0/OFF.

6.3 Installation

6.3.1 Detaching the front plate

Unscrew the fastening screws (FS) in the lower portion of the front plate (MFC). After the screws are detached, the plate will hang by the top part. Raise the plate upward, then pull it toward yourself.

6.3.2 Brine circuit's pipe joint

The brine circuit's pipes have 1" inner threads at the ends. Install shut-off valves to the pipes. Use the supplied flat gasket to seal the joint. Make sure that the piping inside the device does not rotate when the pipe connections are tightened. This could loosen the internal hose connection.

6.3.3 Rotating the brine circuit's piping

The brine circuit's piping can be rotated to a suitable direction during installation. If the pipes are rotated to face a new direction, from left to right for example, the original bend must first be straightened before a new one is made. Otherwise the opposite end of the pipe may loosen when the pipe is being rotated. The minimum bending radius is 35 mm. Do not bend the same spot more than three times.

- Straighten the bend facing right.
- Create a new bend facing the desired direction.
- Do not fold the pipe without creating a new bend first, otherwise the thread connection at the other end of the pipe may loosen.

6.3.4 Electrical connections

Check the electrical connections in the electrical diagrams. There is no need to open the switchboard if the piping connection corresponds to factory settings. See the outside temperature sensor's connection in chapter 6.3.7 and the installation process for a remote control system in chapter 6.3.8.

6.3.5 Modbus connection

The Modbus connection (Modbus RTU RS485) in the heat pump's automation operates in master mode. Data for the automation can be retrieved from external slave devices. Connecting an external master device is not possible.

6.3.6 Venting the DHW coil

Vent the device’s internal domestic hot water coil carefully during installation. Draw water through the return line (WI) and let the air out with the venting screw (CA).

The change valve’s (DV) position affects the water circulation inside the device. If the change valve is in position B (facing the building’s heating circuit), the water supplied to the return line will run according to the image only through the DHW coil. This is the default position when the device is shipped from the factory, and whenever domestic water is not being heated. The valve can be turned with the relay test (chapter 6.4.7) if needed, or by detaching the valve motor and carefully turning the spindle manually.

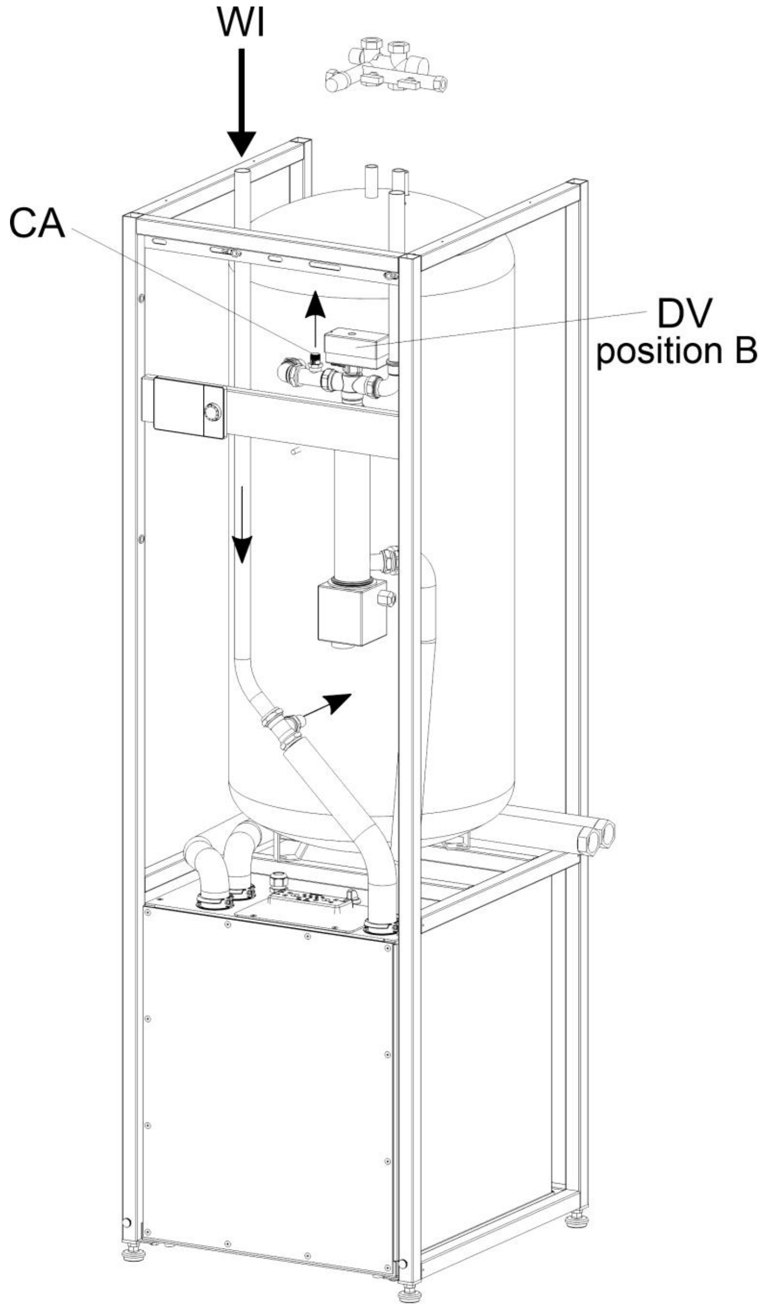


Figure 13. Venting the DHW coil, Cube Inverter+

6.3.7 Outdoor temperature sensor

The heat pump's outside temperature sensor (sensor code 89) is delivered with the pump. The sensor is mounted during the pump's installation. It is connected to cable WB9. Check the cable's cross-sectional area from the table below.

Install the sensor outdoors such that the sensor-cable bushing points downward. Select the sensor position so that it measures as accurately as possible the prevailing outside-air temperature. Make sure that the sensor is not exposed to solar radiation or heat coming from the building. Sensor housing is protected against dust and water spray (IP65, if the cable connection is pointing downward), but should still be installed in a location that is covered from rain. A suitable location for the sensor is, for example, a shady place on the north wall of the building under the eaves.

Table 20. Outside sensor cable

Cable length (m)	40	60	80	120
Wire cross-sectional area (mm^2)	0.50	0.75	1.0	1.5

For additional information, see chapter 2.9.

6.3.8 Remote connection device

The remote connection device (OZW672 or OCI670) is connected to the cable according to the WA1.7 electrical diagrams. A basic guide to commissioning the device is presented below. If necessary, see more detailed instructions on Oilon's webpage.

- Use your internet browser to enter the ClimatixIC cloud service at www.climatixic.com
- Register the device with the registration code found in the device packaging and below the connection box cover.
- Retrieve the password from the email address that was used to register the device.
    - If you have already registered a different device with the same email address, this device is automatically added to your existing account.
- Log to the ClimatixIC cloud service.
- Enter the requested information.
- Pair the remote connection device and the heat pump's controller in the remote connection device's settings.
    - If the device is covered with a sticker that displays the heat pump's serial number, this indicates that the pairing has already been performed at the factory.
- Commissioning is finished. You can use the remote connection with an internet browser, mobile application or the Siemens ACS computer program.
    - Android application on Google Play: Siemens HomeControl IC (link)
    - iOs application on Apple's App Store: Siemens HomeControl IC (link)

6.3.9 Electric immersion heater's overheat protection reset

Reset the overheat protection during installation. It may be triggered by blows or vibration during transport.

The electric immersion heater is equipped with an internal overheat protection system. It shuts the immersion heater’s power off when the internal temperature of the immersion heater cartridge exceeds 105 °C. The overheat protection is reset with the button on the black plastic housing located at the end of the electric immersion heater. The button is under a transparent plastic lid. The lid can be opened with a slot-head screwdriver. Before the high temperature sensor is reset, determine what caused triggering of the sensor and address the causes. The sensor may have been triggered by the vibration caused by the transportation and relocation of the device.

The thermostat in the internal electric immersion heater of the devices should not be adjusted. The thermostat in the electric immersion heater has been set to 80 °C at the factory. The immersion heater's own thermostat will shut off power to the immersion heater only if the automation or the emergency operation thermostat malfunctions. The setpoint of the electric immersion heater thermostat must be set high enough in consideration of both the building and DHW heating, because the electricity supply to the immersion heater travels through the immersion heater thermostat in all use. The internal thermostat is not used as the emergency operation thermostat for automation, nor with the operating switch position

The condenser circuit’s electric immersion heater has three 2 kW rods. The combined resistor capacity is 6 kW. The resistors are controlled in three stages. Stage 1 (K25) is connected to contactor K2. Its capacity is 2 kW. Stage 2 (K26) is connected to contactor K3. Its capacity is 4 kW. The third stage uses stages 1 and 2 simultaneously (K25 + K26).

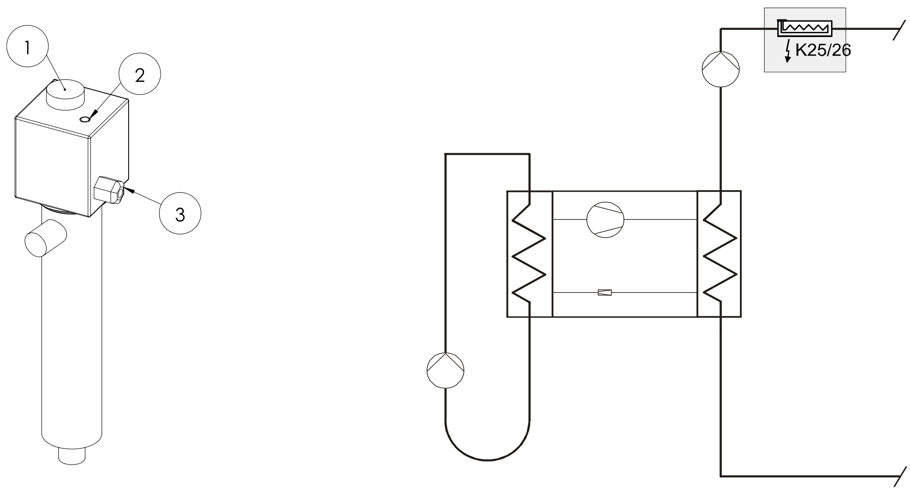


Figure 14. Electric immersion heater

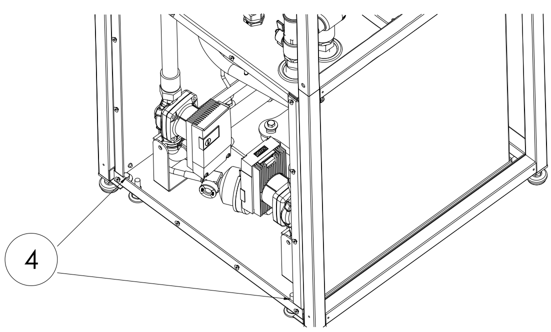
1	Electric immersion heater thermostat		QX1: electric immersion heater stage 1 K25 (contac-tor K2)
2	Electric immersion heater's overheat protection reset		QX2: electric immersion heater stage 2 K26 (contac-tor K3)
3	Electrical connection		

6.3.10 Detaching the compressor unit from the housing

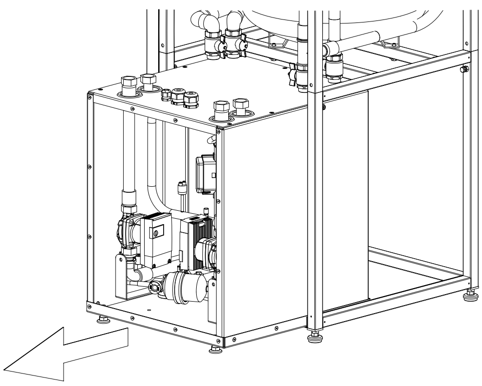
The compressor unit can be removed for easier moving, carrying, or servicing. Exercise caution when moving and carrying the unit, to avoid personal injury and damage to the device and surroundings. You may use cargo straps under the unit to make carrying easier. If the device has already been installed, make sure its electrical supply is not live, reduce the pressure of the water and brine circuits to near atmospheric pressure (gauge pressure: 0 bar), and close all external shut-off valves before removing the unit.

- Remove the front plate (MFC, chapter 6.3.1).
- Open the switchboard cover (TC, Torx T25).
- Open the front plate of the compressor unit (FC, Torx 25).
- Detach the electric heater's quick coupling, located under the switchboard cover. When detaching the connectors, grasp the body of the connector. Do not pull by the cables. The connector has a locking plate that is opened with a slot-head screwdriver.
- Detach the DHW sensor (B3) from the heat pump controller connection BX9.
- Detach the diverting valve's (DV) motor from the valve housing. The motor is fastened with a pin that can be pulled out.
- Open the thread connection in the flexible pipe leading from the unit to the diverting valve (DV).
    - Remove the connection by turning the freely rotating nut while applying gentle pressure from the other end of the connection. Make sure that the hose is not twisted when the connection is being removed or attached. Do not open the beaded connection.
- Open the thread connection in the flexible pipe leading from the unit to the electric immersion heater (DV).
    - Remove the connection by turning the freely rotating nut while applying gentle pressure from the other end of the connection. Make sure that the hose is not twisted when the connection is being removed or attached. Do not open the beaded connection.
- Remove the unit's fastening screws and pull the unit out.
    - Keep the brine circuit's piping attached to the unit.
- For remounting of the unit, follow the corresponding steps in the opposite sequence. While remounting it, check the seals of the water and brine connections and, if it is necessary to do so, replace the flat seal of the connections.

The unit's mounting screws (4)



Then pull out the unit.



6.4 Commissioning

6.4.1 Before the first start-up

- Before the first start-up check, that
  - the pipe connections are properly made and checked
  - the electrical connections connections are properly made and checked
  - all tanks and pipings are connected to a functioning safety valve
  - the necessary air supply valves are placed properly within the system
  - the expansion tanks are properly dimensioned and placed
  - all pipes and storage tanks have been carefully filled and vented
  - all necessary shut-off valves are opened
  - the general installation instructions have been followed (chapter 2)
  - the device-specific installation instructions have been followed
  - the outside sensor has been installed
  - the operating interface is installed
  - the other necessary sensors and devices have been installed.
- If necessary, reset the overheat protection before the initial start-up.

6.4.2 BASIC SETTINGS

Menu	Line	Setting
Heating circuit 1	720	Heating curve slope
Heating circuit 1	721	Heating curve displacement (parallel displacement)
Heating circuit 1	730	Summer/winter heating limit
Heating circuit 1	740	Flow temp. setpoint min. (lower limit)
Heating circuit 1	741	Flow temp. setpoint max. (upper limit)
Heat pump	2855 F	Switch-off temperature in space heating

See the standard setup for heating circuits in chapter 11.4.

6.4.3 First start-up of automation

- Move the operating switch S1 to OFF position and fuses to ON position.
  - The device is delivered with the operating switch in OFF position and the fuses in ON position.
  - This enables you to use the automation before starting the heat pump.
    - Frost protection is an exception to this. It starts the immersion heaters and the compressor’s condenser circuit when the temperature drops below 5 °C even if the switch S1 is set to OFF. If the condenser circuit’s temperature is below 5 °C, set the inverter and immersion heater fuses F1 and F2 to OFF, if needed.
- Wait for the user interface to update the data from the controller.
  - Go through the commissioning menus if needed (chapter 6.4.6). The commissioning menu settings are preset at the factory.
- If necessary, make the setting changes corresponding to the pipe coupling (chapter 2.13).
- Adjust the heating circuit’s basic settings to fit the heating system (chapter 6.4.2)
  - Other heating circuit settings and their functioning are listed in chapter11.3.
- Continue venting the internal and external piping.
  - If necessary, use the relay test for guidance (chapter 6.4.7).
  - For instructions on venting the internal tank’s coil, see chapter 6.3.6.
- If you have installed external actuators, such as the heating circuit’s control valve, test their functionality and connections with a relay test (chapter 6.4.7).
- During device commissioning and maintenance, you can enable outside temperature simulation in the Diagnostics menu, if needed (chapter 10.4.7), This makes it possible to bypass the device’s outside temperature sensor and set the outside temperature manually.

6.4.4 The first start-up of the heat pump

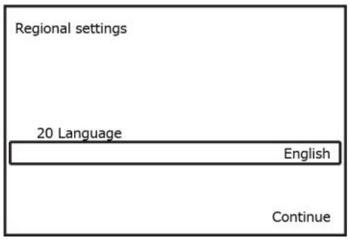
- Reset the heat pump if needed (chapter 10.4.11).
- Place the operating switch in S1 ON position.
- Wait for the compressor to start. Brine circuit's and condenser circuit's pumps start about 10...20 seconds before the compressor starts.
    - If you have to restart the compressor, wait at least 5 minutes after the last start.
- Make sure that the compressor rotates in the right direction.
    - If the compressor's rotation direction is correct, the operating sound is normal, the flow water line warms up, the hot gas pipe warms up (line 8415), the pressure in the high pressure zone increases, and that on the low pressure side falls (refrigeration gauge).
- If the compressor's direction of rotation is incorrect, stop the compressor immediately by moving its operating switch S1 to the OFF position, or by moving the motor protection switch F1 to the OFF position, or by turning off the electrical supply to the device with the external switch Q1.
    - If the compressor rotates in the wrong direction, it emits abnormal sound, the flow water or hot gas (line 8415) pipes do not warm up, and the pressure in the suction line does not fall, and the high pressure zone's pressure does not increase (refrigerant gauge).
    - If the compressor rotates in the wrong direction, make sure that the power supply is de-energized and replace the order of two phases with each other in the device's supply cable. Then go back to the beginning of this chapter and go through the start-up steps again.
    - The device is equipped with an internal phase guard that halts the compressor rotating incorrectly due to the phase order within 10 seconds of start-up.
- Check the temperature indicators to ensure that the condenser circuit warms up and the evaporator circuit cools down.

6.4.5 After the commissioning

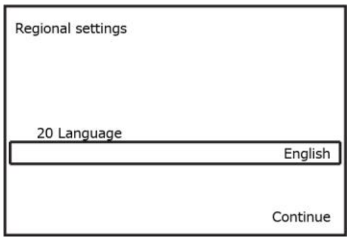
- Make sure that the heating water runs through all the required circuits.
- Make sure that the device's internal DHW storage tank spiral has been properly vented.
- Make sure that the pipes and storage tanks have no residue air and the pressure level is suitable
  - Also pay attention to the inspection and adjustment of the expansion tanks' pressure.
- Ensure that the temperature sensors show sensible values during device operation.
- Check the temperature indicators to ensure that the condenser circuit warms up and the evaporator circuit cools down.
- Make sure that the heating circuit's settings are suitable for the heating system (chapter 6.4.2)
  - Other heating circuit settings and their functioning are listed in chapter11.3.
  - If the heating circuit is equipped with a separate controller, set the heat pump's and heating circuit's heating curves to correspond to one another.
- Ensure that the actuators connected to the heat pump automation, such as the mixing valve of the heating circuit, function properly when the device is turned on.
- Make sure that inspection records (electrical connections), the commissioning inspection record and other required documents have been completed and stored.
- Make sure that all changes are documented in the electrical diagrams, HVAC diagrams and operating instructions.
- Instruct the customer in the basic functionality of the device, such as
  - the line circuit breaker's location ja operation
  - adjusting the heating curve.

6.4.6 Commissioning menus

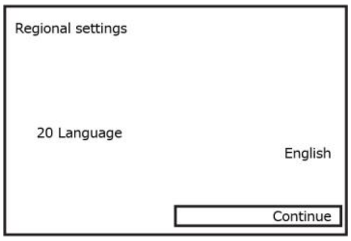
6.4.6.1 Language and time settings



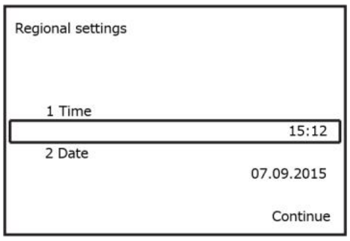
Initially, the display's language is English.



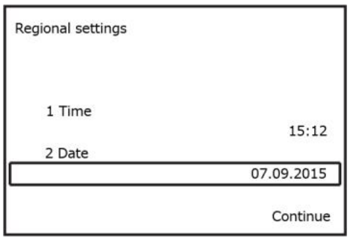
At the first screen, the interface language can be changed.



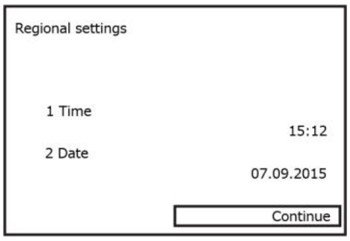
Move to the next page by pressing the button in the lower right-hand corner.



Set the time.

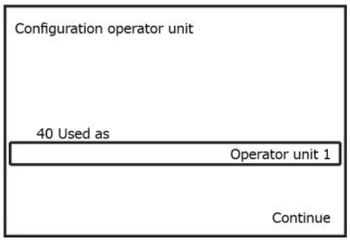


Set the date.

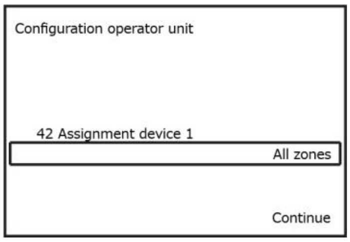


Continue to the next page.

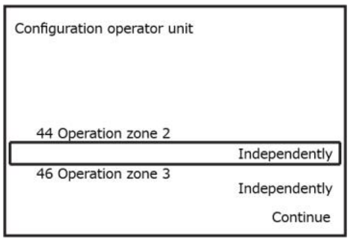
The images below show the settings that suit most situations unaltered. The menu settings are preset at the factory. The commissioning menu can be accessed again from the maintenance menu (chapter 10.4.8). For a detailed overview of the settings options, see chapter 10.5.



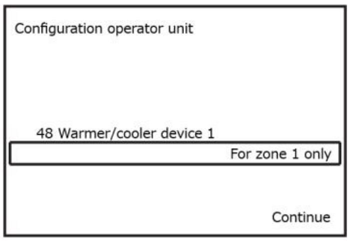
Intended use of room unit (sequence number). Select Operator unit 1.



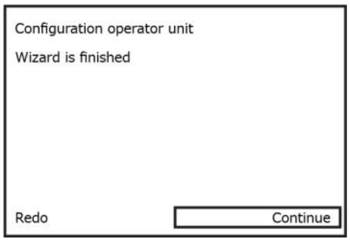
Heating circuits connected to the user terminal. Select All zones.



Autonomous settings for heating circuits 2 and 3. Select Autonomously for both.



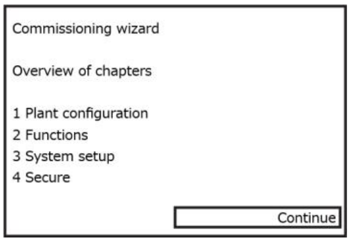
The effect of changing the temporary operating mode on other heating circuits. Select For zone 1 only.



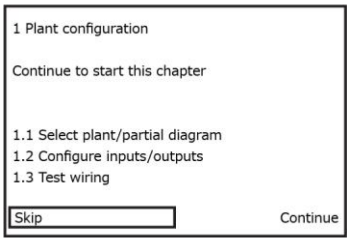
Exit the commissioning menus from the lower right-hand corner of the screen. Select "Continue". Wait for the controller to load the data. This will take a few minutes.

6.4.6.2 Configuration settings

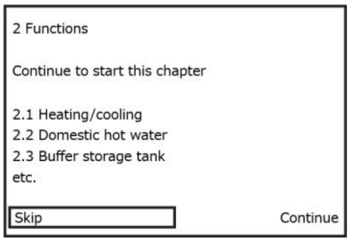
In addition to the various modes' settings, the heat pump's configuration can be changed via the commissioning wizard in the commissioning menus. The wizard is launched at the first start-up if it has not been disabled. In addition, you can launch the wizard from the settings menus later. The settings suitable for the most common cases have been preloaded in the heat pump automation at the factory, so the commissioning wizard is usually not needed. In general, any individual changes required in the default settings are easier to make later through the settings menus. You may bypass the commissioning wizard setup pages by selecting "Skip" in the lower left-hand corner of the screen. If you select "Continue" accidentally, select "Skip" in the following screens until the commissioning wizard menus have been bypassed.



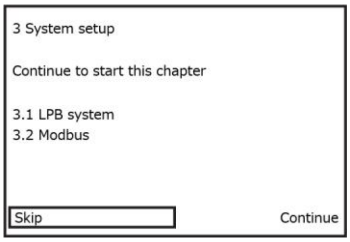
Continue to the next page.



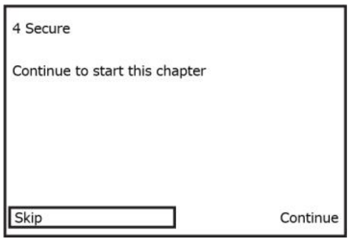
Select "Skip."



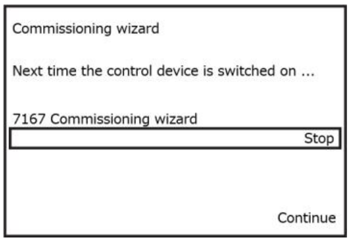
Select "Skip."



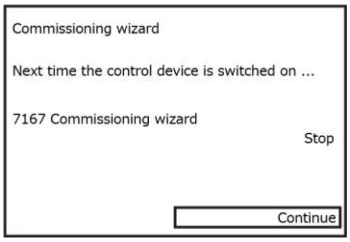
Select "Skip."



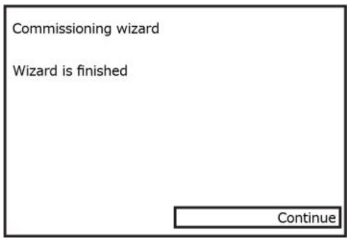
Select Skip.



Select "Stop".



Select "Continue".



Select "Continue".

6.4.7 Relay test

Test the operation of actuators with a relay test before starting the compressor if needed. The relay test is performed by selecting the desired QX output, and the UX signal output if required, and observing the operation of the actuator. The test is finished by selecting the function for relay test (line 7700) “no test”. Reset the heat pump after the relay test on line 6711 (chapter 10.4.11).

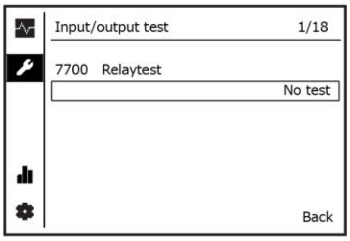
Use the relay test for venting the pipes if needed. Rotate the pump periodically for short times with the relay test and vent and fill (pressurize) the circuits between these short-term operating times. If needed, switch the positions of the change and control valves during venting.

SEQ Taulukko * ARABIC Table 21. Relay test

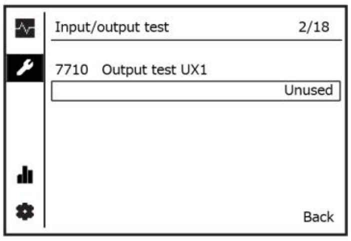
Con-nect-or	Out-put	Action	Marking	Additional information
W	QX1	Electric heater stage 1 K25	K25	Keep the fuse F2 in the position OFF. Contac-tor K2 should switch on.
W	QX2	Electric heater stage 2 K26	K26	Keep the fuse F2 in the position OFF. Contac-tor K3 should switch on.
R	QX8	Change valve Q3	Q3	Change valve is in position B (building, heating circuit) before the relay test. Switching the power on turns the valve into position A (aqua, service buffer tank’s coil). The valve returns to the position B when the relay test is turned off.
S	QX9	Heating circuit 1 pump Q2	Q2	The pump should start to rotate when the test is switched on. See further instructions for speed controlled pumps in the next chapter, if needed.
T	QX10	Heating circuit 1 valve open Y1	Y1	An arm from the storage tank to the heating circuit opens (heating circuit takes heat from the storage tank). After the test, the valve re-mains in the position it was in at the end of the test. If needed, see the installation instructions for the valve in chapter 2.5.16.
T	QX11	Heating circuit 1 valve closed Y2	Y2	An arm from the storage tank to the heating circuit closes (heating circuit’s internal circula-tion). After the test, the valve remains in the position it was in at the end of the test. If need-ed, see the installation instructions for the valve in chapter 2.5.16.
U	QX12	Brine circuit (evaporator-circuit) pump Q8	Q8	The pump should start to rotate when the test is switched on. See further instructions for speed controlled pumps in the next chapter.
V	QX13	Condenser-circuit pump Q9	Q9	The pump should start to rotate when the test is switched on. See further instructions for speed controlled pumps in the next chapter.

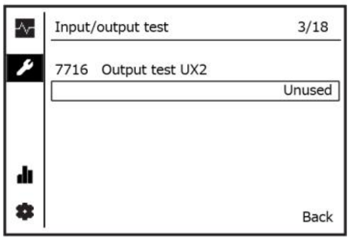
6.4.7.1 Relay test for speed controlled pumps

The test for speed controlled pumps is done by turning on the pump´s QX output and signal output test. The test is finished by selecting the function for relay test (line 7700) ”no test” and putting the test value for UX output ”---”. Other UX signal-controlled actuators are tested in the same way.



Select the QX output that is connected to the pump.





Also select the pump’s UX output test. Select the UX output that is connected to the pump (see model-specific factory settings and electrical diagrams). Select a test value, for example 100, 50 and 0 percent.

SEQ Taulukko * ARABIC Table 22. Relay test for condenser circuit speed controlled pump

Line	Con nect or	Out- put	Action	Mark- ing	Additional information
7700	V	QX13	Condenser-circuit pump Q9	Q9	The pump should start to rotate when the test is switched on and the desired speed is selected on line 7710. Try adjusting the speed by changing the setpoint on line 7710 (e.g. 100 %, 50 % and 0 %).
7710	y	UX1	Output test UX1	UX1	

SEQ Taulukko * ARABIC Table 23. Relay test for brine circuit’s speed controlled pump

Line	Con nect or	Out- put	Action	Mark- ing	Additional information
7700	U	QX12	Brine circuit pump Q8	Q8	The pump should start to rotate when the test is switched on and the desired speed is selected on line 7716. Try adjusting the speed by changing the setpoint on line 7716 (e.g. 100 %, 50 % and 0 %).
7716	y	UX2	Output test UX2	UX2	

6.5 Automation factory settings

6.5.1 Pipe connection corresponding to the factory settings

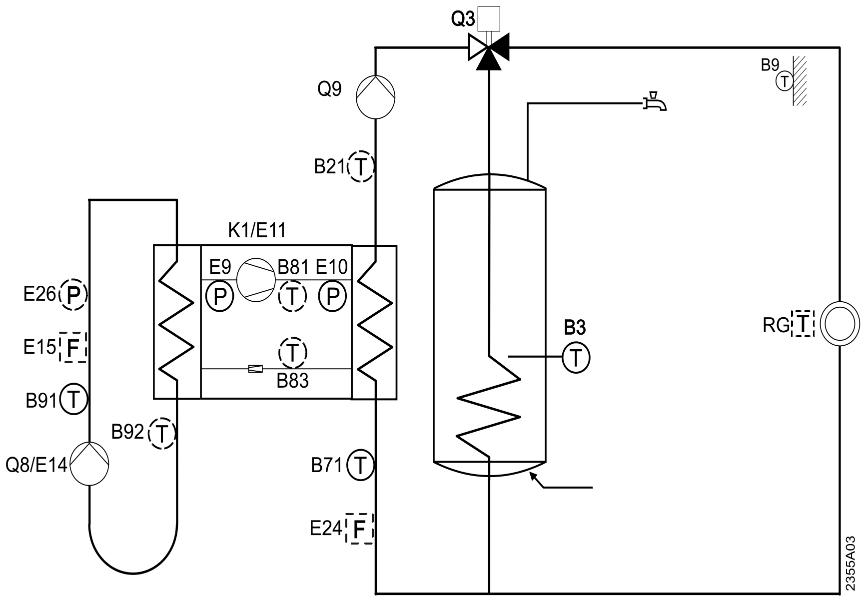


Figure 15. DHW storage tank and space heating without a buffer storage tank
DHW storage tank, valve Q3 and sensor B3 are internal to the device.

6.5.2 Inputs and outputs of master controller

See connections from the wiring diagrams.

SUPPLY CURRENT OUTPUTS (CAPITAL LETTERS IN CONNECTORS)					
Line	Con-nector	Output	Action	Marking	Additional information
5890	W	QX1	Electric heater stage 1 K25	K25	
5891	W	QX2	Electric heater stage 2 K26	K26	
5892	X	QX3			
5894	Y	QX4 (ZX4)			
5895	Z	QX5			
5896	Z	QX6	Alarm output K10	K10	
5897	Q	QX7	(Compressor 1 K1)	K1	Modbus connection, inverter
5898	R	QX8	Change valve Q3	Q3	
5899 (6014)	S	QX9			
5900 (6014)	T	QX10			
5901 (6014)	T	QX11			
5902	U	QX12	Brine circuit (evaporator-circuit) pump Q8	Q8	
5903	V	QX13	Condenser-circuit pump Q9	Q9	
5909	Y	ZX4 (triac)			

For outputs Q9, Q10 and Q11 is selected function on line 6014. See chapter 25.

TEMPERATURE SENSORS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5930	t	BX1			
5931	u	BX2			
5932	w	BX3			
5933	x	BX4			
5936	f	BX7	(Hot gas temperature B81)	B81	Modbus connection, inverter
5937	h	BX8	DHW temperature B3	B3	
5938	k	BX9	Outside temperature B9	B9	
5939	n	BX10	Heat pump supply water (condenser out) B21	B21	
5940 (6014)	p	BX11			
5941	q	BX12	Return water of heat pump (condenser in) B71	B71	
5942	r	BX13	Brine circuit in (evaporator in) B91	B91	
5943	s	BX14	Brine circuit out (evaporator out) B92	B92	

For input BX11 is selected function on line 6014. See chapter 25.

SUPPLY CURRENT INPUTS (CAPITAL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5980	P	EX1	Electric utility prevention E6	E6	Operating switch S1
5981		EX1 direction			
5982	P	EX2			
5983		EX2 direction			
5984	P	EX3			
5985		EX3 direction			
5986	P	EX4			
5987		EX4 direction			
5988	P	EX5	3-ph current control		L1
5989		EX5 direction	normally closed (break contact)		
5990	P	EX6	3-ph current control		L2
5991		EX6 direction	normally closed (break contact)		
5992	P	EX7	3-ph current control		L3
5993		EX7 direction	normally closed (break contact)		
5996	K	EX9	Low pressure switch E9	E9	
5997	K	EX10	(High pressure switch E10)	E10	Modbus connection, inverter
5998	Q	EX11	(Compressor's overload E11)	E11	Modbus connection, inverter
5999		EX9 direction	normally closed (break contact)		
6000		EX10 direc-tion	normally closed (break contact)		
6001		EX11 direc-tion	normally closed (break contact)		

Normally closed contact receives voltage, when the heat pump operates normally. Power supply of normally closed contact interrupts (break contact) under fault situations.

CONTROL MESSAGES (SMALL LETTERS IN CONNECTORS)					
Line	Con-nect-or	Output	Action	Mark-ing	Action
6070	z	UX1	Condenser-circuit pump Q9	UX1	
6071	z	UX1	Signal logic output UX1	UX1	Inverted
6072	z	UX1	Signal output UX1	UX1	PWM
6078	y	UX2	Brine circuit (evaporator circuit) pump Q8	UX2	
6079	y	UX2	Signal logic output UX2	UX2	Inverted
6080	y	UX2	Signal output UX2	UX2	PWM

LOW VOLTAGE INPUTS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5950	e	H1			
5960	e	H3			

6.5.3 Inputs and outputs of auxiliary controller

TEMPERATURE SENSORS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
7307 (7300)	e	BX21	Suction line temperature B85	B85	
7308	e	BX22	(Liquid line temperature B83)	(B83)	Optional

For input BX21 is selected function on line 7300.

LOW VOLTAGE INPUTS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
7321	g	H21	Suction line pressure H82	H82	
7331	g	H22	(Liquid line pressure H83)	(H83)	Optional

CONTROL MESSAGES (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Output	Action	Marking	Additional information
7362	e	WX21	Evaporator expansion valve V81	V81	

6.6 Most common additional and change connections

6.6.1 Controlled heating circuit storage buffer tank and control valve

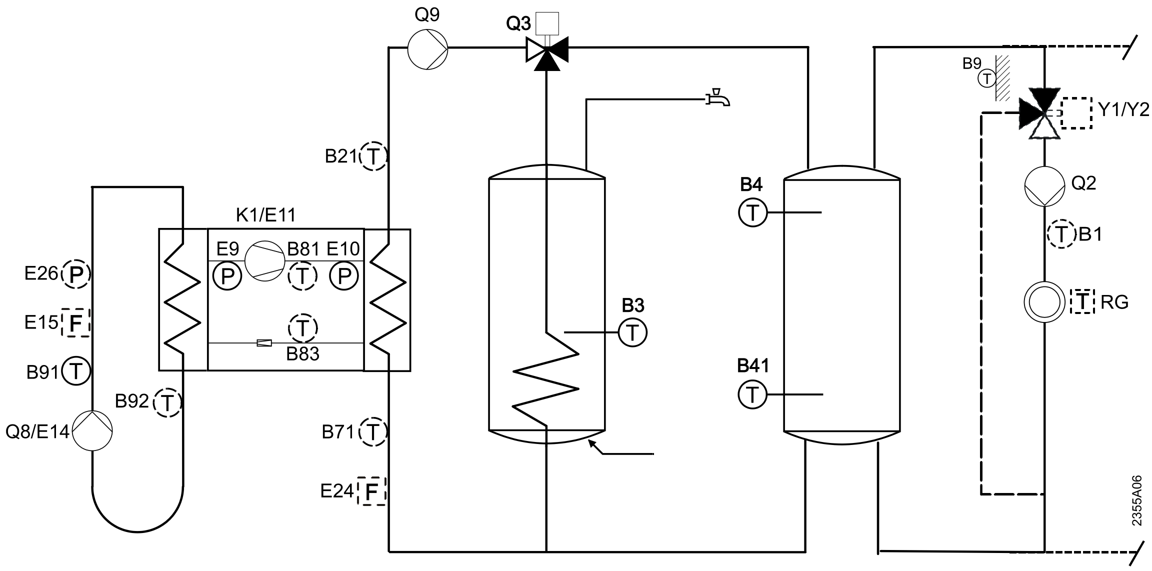


Figure 16. DHW storage tank and space heating with the buffer storage tank.
DHW storage tank, valve Q3 and sensor B3 are internal to the device. Sensor B41 is not necessary.

6.6.1.1 Changes to factory settings

Menu	Line	Line name	Setpoint
Heating circuit 1	870	With buffer	Yes
Configuration	5930	Sensor input BX1	Buffer tank temperature B4
Configuration	6014	Function of mixing group 1	Heating circuit 1

6.6.1.2 Electrical connections

TEMPERATURE SENSORS (SMALL LETTERS IN CONNECTORS)					
Line	Connector	Input	Action	Marking	Additional information
5930	t	BX1	Buffer tank temperature B4	B4	Space heating circuit storage tank
5940 (6014)	p	BX11	Heating circuit 1 supply water B1	B1	Supply water pipe of heating circuit 1

For input BX11 is selected function on line 6014. See chapter 25.

SUPPLY CURRENT OUTPUTS (CAPITAL LETTERS IN CONNECTORS)					
Line	Connector	Output	Action	Marking	Additional information
5899 (6014)	S	QX9	Heating circuit 1 pump Q2	Q2	
5900 (6014)	T	QX10	Heating circuit 1 valve open Y1	Y1	

5901 (6014)	T	QX11	Heating circuit 1 valve closed Y2	Y2	

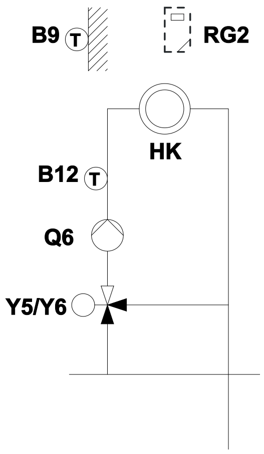
For outputs Q9, Q10 and Q11 is selected function on line 6014. See chapter 25.

6.6.1.3 Things to consider in installation

In this connection, the mixing shunt of the master controller is utilized in heating circuit 1. If another heating circuit (heating circuit 2) equipped with a mixing valve needs to be added, an auxiliary controller must to be installed.

6.6.2 Heating circuit 2 regulated by a three-way valve

The master controller has one functional block for the heating circuit's mixing valve. Cube Inverter+ heating circuit 1 is usually connected directly from the condenser to the heating circuit, leaving the mixing valve's functional block to be utilized with heating circuit 2. Heating circuit 2 is commissioned by performing the connections presented in this manual and electrical diagrams, and by switching the circuit on according to the instructions in chapter 10.4.13.



Settings

Configuration > Heating circuit 2 (line 5715): On

Configuration > Line 6014 Function mixing group 1: Heating circuit 2

Connections to the controller

QX10: Y5, heating circuit 2, three-way valve open

QX11: Y6, heating circuit 2, three-way valve closed

QX9: Q6 heating circuit 2 circulation pump (via fuse F7)

BX11: B12, heating circuit 2, flow temperature

Figure 17. Heating circuit 2 regulated by a three-way valve (with the controller)

7 RE 04 28–48

RE 04 is a ground source heat pump comprising a compressor unit and a switchboard. The standard position of the switchboard is on the device's left side, but it can be moved to the right side if needed. The standard configuration of the device's automation is for a service buffer tank, a heating circuit storage tank and a single heating circuit controlled with a three-way valve. For a connection corresponding to the factory settings, see chapter 7.5. The automation supports numerous other connections, systems and accessories. Other systems are presented in the final pages of this manual, and in other, separate automation-focused manuals that are available on the Oilon website.

7.1 Dimensions, connections, and parts

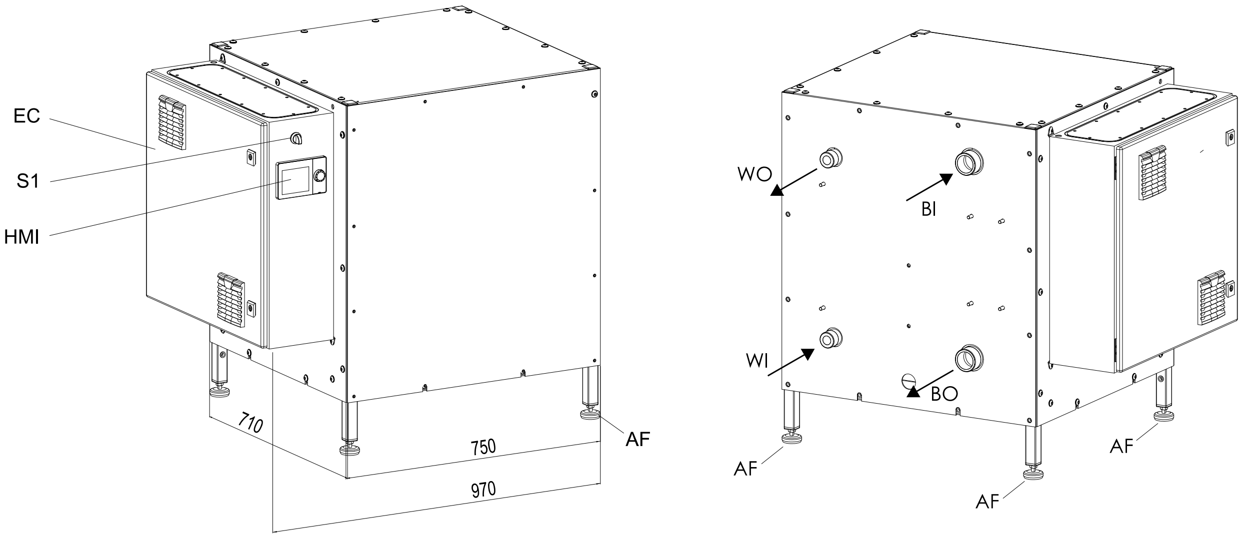


Figure 18. RE 04 with single unit 28–48
measurements are in millimeters

EC	switchboard
HMI	user interface
S1	operating switch ON/OFF
AF	adjustable legs (M10, DIN/ISO 17/16 mm)
BI	brine circuit in (evaporator circuit in)*
BO	brine circuit out (evaporator circuit out)*
WO	condenser circuit out, heating water flow*
WI	condenser circuit in, heating water return*
COMP	Compressor
HEC	Condenser
ESUC	economizer’s suction line
PSH	high pressure switch
SLV	service nipple (1/4” SAE 45 °)**
FILDR	Filter dryer and sight glass
EXVE	economizer’s expansion valve
EXV	evaporator’s expansion valve
HOT	Hot gas line
PSL	low pressure switch
TEMP.	flow and return currents’ temperature sensors
HEE	Evaporator
TS	transportation supports (M8, hex head 13 mm)

* ISO 228 - G 1 1/2 B or ISO 228 - G 2 B gas-pipe thread i.e. standard 1 1/4” or 2” outer thread. Thread size depends on the model. See more detailed information in the technical data.

**suction line from evaporator, suction line from economizer, liquid line after condenser, liquid line after economizer

7.2 Switches and fuses

Marking	Action	Default position
1S1	Operating switch ON/OFF	ON
1F1	Compressor motor protection	ON
F3	Control fuse (automation’s fuse)	ON
1F4	Condenser circuit pump Q9’s fuse	ON
1F5	Evaporator circuit pump Q8’s fuse	ON
F6	Heating circuit 1 pump Q2’s fuse	ON
F7 (optional)	Heating circuit 2 pump Q6’s fuse	ON

All fuses are in the OFF position when delivered from the factory.

7.2.1 Operating switch S1

When the switch is in position 1/ON, the device is in the default operating mode. When the switch is in position 0/OFF, the compressor is disabled from starting, but the heat pump’s automation stays operational. The frost protection function is an exception to this. It starts the compressor’s condenser circuit when the temperature drops below 5 °C, even if the switch S1 is set to 0/OFF. If the condenser circuit’s temperature is below 5 °C, set the compressor motor protection 1F1 to OFF, if needed.

7.3 Installation

7.3.1 Electrical connections

Check the electrical connections in the electrical diagrams. See the outside temperature sensor's connection in chapter 7.3.4.

7.3.2 Compressor plate's transportation supports

The compressor plate has two screws for transportation support. They go through the bottom plate, into the compressor frame. The locations have been marked in the device image with TS. The supports are removed by unscrewing them from the bottom of the device. Remove them before starting the device. The supports have an M8 thread and a 13 mm hexagonal head.

7.3.3 Brine and condenser circuit connections and pumps

Brine and condenser circuits' pumps are installed outside the device. It is a good idea to connect the heat pump's evaporator and condenser to the network with flexible connection hoses, if needed. The hoses can be ordered as an equipment package.

7.3.4 Outdoor temperature sensor

The heat pump's outside temperature sensor (sensor code 89) is delivered with the pump. The sensor connection is presented in the pump's electrical diagrams.

The sensor is connected to the k terminal in the pump's Siemens RVS61.843 controller. One wire of sensor´s cable is connected to the connector´s pole BX9 and the other to the pole M (either way). The sensor connection and cable extension are done with a regular, insulated copper twin cable. Select the cross-sectional area of the wires by consulting the table below. When you run the sensor cable into the switchboard, use an insulated cable and, if possible, a cable trough that does not contain supply cables. Peel off the cable insulation and the wire insulation right next to the controller.

Install the sensor outdoors such that the sensor-cable bushing points downward. Select the sensor position so that it measures as accurately as possible the prevailing outside-air temperature. Make sure that the sensor is not exposed to solar radiation or heat coming from the building. Sensor housing is protected against dust and water spray (IP65, if the cable connection is pointing downward), but should still be installed in a location that is covered from rain. A suitable location for the sensor is, for example, a shady place on the north wall of the building under the eaves.

SEQ Taulukko * ARABIC Table 24. Outside sensor cable

Cable length (m)	40	60	80	120
Wire cross-sectional area (mm^2)	0.50	0.75	1.0	1.5

For additional information, see chapter 2.9.

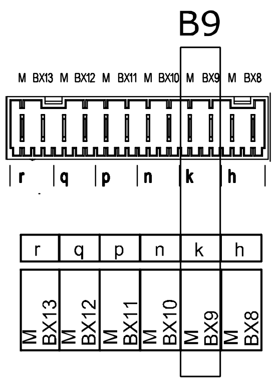


Figure 19. Outside sensor connection

7.3.5 Remote connection (accessory)

The remote connection device (OZW672 or OCI670) is connected to the LPB bus (MB/DB) according to the electrical diagrams. A basic guide to commissioning the device is presented below. If necessary, see more detailed instructions on Oilon's webpage.

- Use your internet browser to enter the ClimatixIC cloud service at www.climatixic.com
- Register the device with the registration code found in the device packaging and below the connection box cover.
- Retrieve the password from the email address that was used to register the device.
    - If you have already registered a different device with the same email address, this device is automatically added to your existing account.
- Log to the ClimatixIC cloud service.
- Enter the requested information.
- Pair the remote connection device and the heat pump's controller in the remote connection device's settings.
    - If the device is covered with a sticker that displays the heat pump's serial number, this indicates that the pairing has already been performed at the factory.
- Commissioning is finished. You can use the remote connection with an internet browser, mobile application or the Siemens ACS computer program.
    - Android application on Google Play: Siemens HomeControl IC (link)
    - iOs application on Apple's App Store: Siemens HomeControl IC (link)

7.3.6 Modbus connection

A Modbus remote connection to the heat pump's automation can be established with a bus converter (Modbus RTU RS485). Modbus registers and the instructions for commissioning the device can be downloaded from the Oilon website.

7.4 Commissioning

7.4.1 Before the first start-up

- Before the first start-up check, that
  - the pipe connections are properly made and checked
  - the electrical connections connections are properly made and checked
  - all tanks and pipings are connected to a functioning safety valve
  - the necessary air supply valves are placed properly within the system
  - the expansion tanks are properly dimensioned and placed
  - all pipes and storage tanks have been carefully filled and vented
  - all necessary shut-off valves are opened
  - the general installation instructions have been followed (chapter 2)
  - the device-specific installation instructions have been followed
  - the outside sensor has been installed
  - the operating interface is installed
  - the other necessary sensors and devices have been installed.
- Turn all switches, motor protections and fuses to the OFF position.

7.4.2 BASIC SETTINGS

Menu	Line	Setting
Heating circuit 1	720	Heating curve slope
Heating circuit 1	721	Heating curve displacement (parallel displacement)
Heating circuit 1	730	Summer/winter heating limit
Heating circuit 1	740	Flow temp. setpoint min. (lower limit)
Heating circuit 1	741	Flow temp. setpoint max. (upper limit)

See the standard setup for heating circuits in chapter 11.4.

7.4.3 First start-up of automation

- Turn all switches, motor protections and fuses to the OFF position.
- Turn the control fuse to the F3 ON position.
  - Keep the operating switch S1, motor protections and other fuses in the ON position. This enables you to use the automation without starting the compressor and other equipment.
- Wait for the user interface to update the data from the controller.
  - Go through the commissioning menus if needed (chapter 7.4.6). The commissioning menu settings are preset at the factory.
- If necessary, make the setting changes corresponding to the pipe coupling (chapter 2.13).
- Adjust the heating circuit's basic settings to fit the heating system (chapter 7.4.2)
  - Other heating circuit settings and their functioning are listed in chapter11.3.
- Continue venting the piping.
  - If necessary, use the relay test for guidance (chapter 7.4.7).
- If you have installed external actuators, such as the heating circuit's control valve, test their functionality and connections with a relay test (chapter 7.4.7).
- During device commissioning and maintenance, you can enable outside temperature simulation in the Diagnostics menu, if needed (chapter 10.4.7), This makes it possible to bypass the device's outside temperature sensor and set the outside temperature manually.

7.4.4 The first start-up of the heat pump

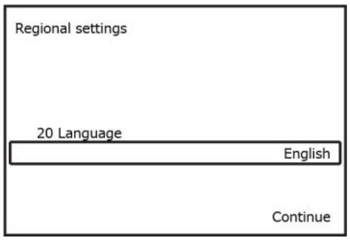
- Turn all motor protections and fuses to ON position. Keep the operating switch S1 in the OFF position.
    - First switch the pump fuses 1F4 and 1F5 on, then the control fuse F3, and finally the compressor's motor protection 1F1. This ensures that the pumps are running when the compressor starts.
    - Also switch fuses F6 and F7 on, if needed.
- Reset the heat pump if needed (chapter 10.4.11).
- Place the operating switch in S1 ON position.
- Wait for the compressor to start. Brine circuit's and condenser circuit's pumps start about 10...20 seconds before the compressor starts.
    - If you have to restart the compressor, wait at least 5 minutes after the last start. Starting up too frequently may break the soft starter.
- Make sure that the compressor rotates in the right direction.
    - If the compressor's rotation direction is correct, the operating sound is normal, the hot gas pipe warms up (line 8415), the pressure in the high pressure zone increases, and that on the low pressure side decreases (refrigeration gauge).
- If the compressor's rotation direction is incorrect, stop the compressor immediately by moving its motor protection switch (1F1) to the OFF position or by turning the operating switch 1S1 to the OFF position.
    - If the compressor rotates in the wrong direction, it emits abnormal sound, the flow water or hot gas (line 8415) pipes do not warm up, and the pressure in the suction line does not decrease, and the high pressure zone's pressure does not increase (refrigerant gauge).
    - If the compressor rotates in the wrong direction, make sure that the power supply is de-energized and replace the order of two phases with each other in the device's supply cable. Then go back to the beginning of this chapter and go through the start-up steps again.
    - The device is equipped with an internal phase guard that halts the compressor rotating incorrectly due to the phase order within 10 seconds of start-up.
- Check the temperature indicators to ensure that the condenser circuit warms up and the evaporator circuit cools down.

7.4.5 After the commissioning

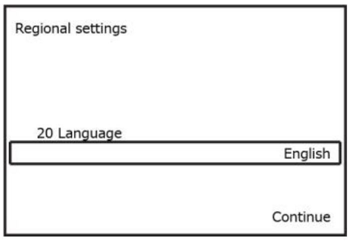
- Make sure that the heating water runs through all the required circuits.
- Make sure that the pipes and storage tanks have no residue air and the pressure level is suitable
    - Also pay attention to the inspection and adjustment of the expansion tanks' pressure.
- Ensure that the temperature sensors show sensible values during device operation.
- Check the temperature indicators to ensure that the condenser circuit warms up and the evaporator circuit cools down.
- Make sure that the heating circuit's settings are suitable for the heating system (chapter 7.4.2)
    - Other heating circuit settings and their functioning are listed in chapter11.3.
    - If the heating circuit is equipped with a separate controller, set the heat pump's and heating circuit's heating curves to correspond to one another.
- Ensure that the actuators connected to the heat pump automation, such as the mixing valve of the heating circuit, function properly when the device is turned on.
- Make sure that inspection records (electrical connections), the commissioning inspection record and other required documents have been completed and stored.
- Make sure that all changes are documented in the electrical diagrams, HVAC diagrams and operating instructions.
- Instruct the customer in the basic functionality of the device, such as
    - the line circuit breaker's location ja operation
    - adjusting the heating curve.

7.4.6 Commissioning menus

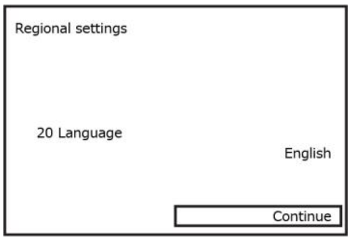
7.4.6.1 Language and time settings



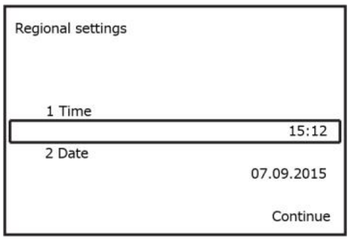
Initially, the display's language is English.



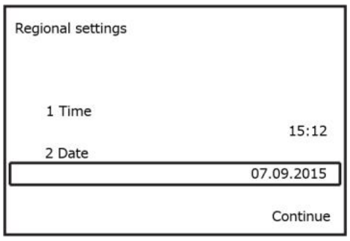
At the first screen, the interface language can be changed.



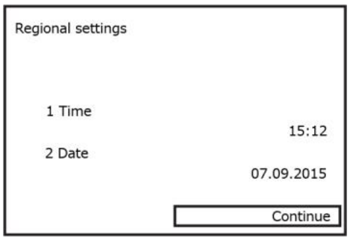
Move to the next page by pressing the button in the lower right-hand corner.



Set the time.

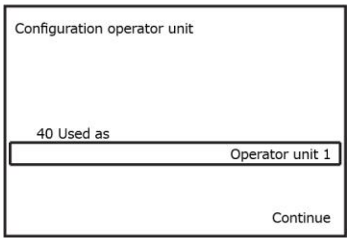


Set the date.

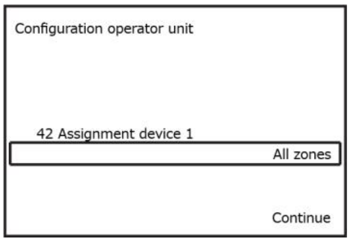


Continue to the next page.

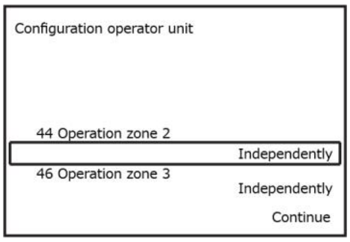
The images below show the settings that suit most situations unaltered. The menu settings are preset at the factory. The commissioning menu can be accessed again from the maintenance menu (chapter 10.4.8). For a detailed overview of the settings options, see chapter 10.5.



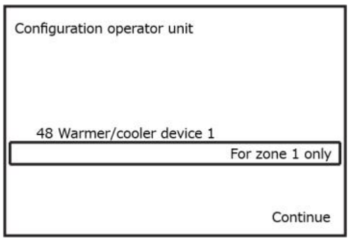
Intended use of room unit (sequence number). Select Operator unit 1.



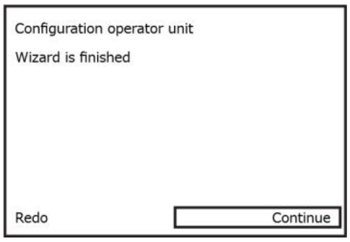
Heating circuits connected to the user terminal. Select All zones.



Autonomous settings for heating circuits 2 and 3. Select Autonomously for both.



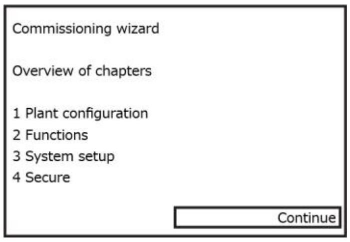
The effect of changing the temporary operating mode on other heating circuits. Select For zone 1 only.



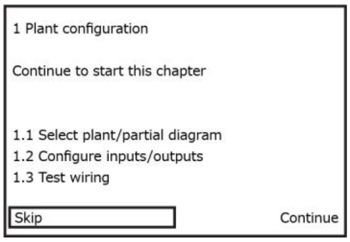
Exit the commissioning menus from the lower right-hand corner of the screen. Select "Continue". Wait for the controller to load the data. This will take a few minutes.

7.4.6.2 Configuration settings

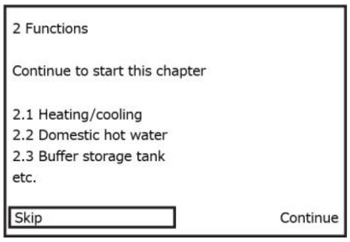
In addition to the various modes' settings, the heat pump's configuration can be changed via the commissioning wizard in the commissioning menus. The wizard is launched at the first start-up if it has not been disabled. In addition, you can launch the wizard from the settings menus later. The settings suitable for the most common cases have been preloaded in the heat pump automation at the factory, so the commissioning wizard is usually not needed. In general, any individual changes required in the default settings are easier to make later through the settings menus. You may bypass the commissioning wizard setup pages by selecting "Skip" in the lower left-hand corner of the screen. If you select "Continue" accidentally, select "Skip" in the following screens until the commissioning wizard menus have been bypassed.



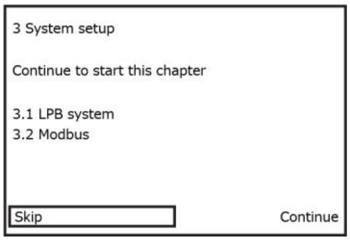
Continue to the next page.



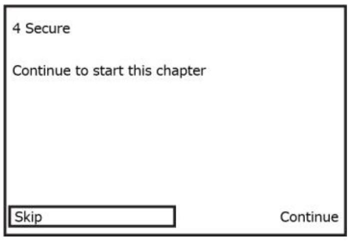
Select "Skip."



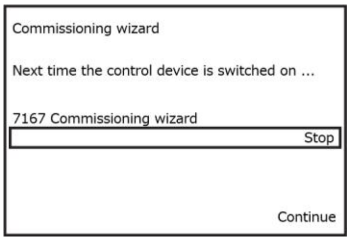
Select "Skip."



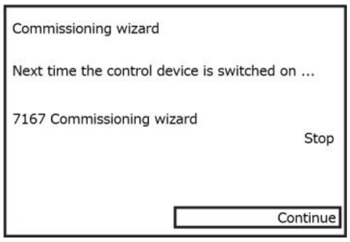
Select "Skip."



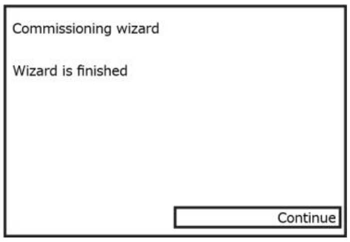
Select Skip.



Select "Stop".



Select "Continue".



Select "Continue".

7.4.7 Relay test

Test the operation of actuators with a relay test before starting the compressor if needed. The relay test is performed by selecting the desired QX output, and the UX signal output if required, and observing the operation of the actuator. The test is finished by selecting the function for relay test (line 7700) “no test”. Reset the heat pump after the relay test on line 6711 (chapter 10.4.11).

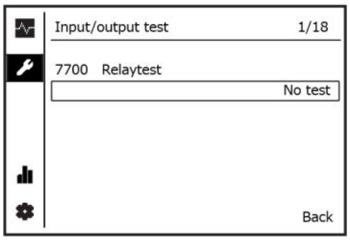
Use the relay test for venting the pipes if needed. Rotate the pump periodically for short times with the relay test and vent and fill (pressurize) the circuits between these short-term operating times. If needed, switch the positions of the change and control valves during venting.

SEQ Taulukko * ARABIC Table 25. Relay test

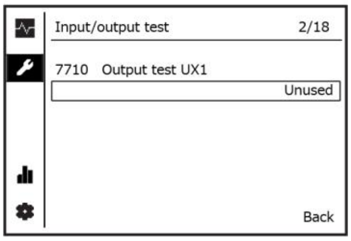
Con-nect-or	Out-put	Action	Marking	Additional information
W	QX1	Electric heater stage 1 K25	K25	Keep the fuse F2 in the position OFF. Contactor K2 should switch on.
W	QX2	Electric heater stage 2 K26	K26	Keep the fuse F2 in the position OFF. Contactor K3 should switch on.
R	QX8	Change valve Q3	Q3	Change valve is in position B (building, heating circuit) before the relay test. Switching the power on turns the valve to the position A (aqua, DHW storage tank). The valve returns to the position B when the relay test is turned off.
S	QX9	Heating circuit 1 pump Q2	Q2	The pump should start to rotate when the test is switched on. See further instructions for speed controlled pumps in the next chapter, if needed.
T	QX10	Heating circuit 1 valve open Y1	Y1	An arm from the storage tank to the heating circuit opens (heating circuit takes heat from the storage tank). After the test, the valve remains in the position it was in at the end of the test. If needed, see the installation instructions for the valve in chapter 2.5.16.
T	QX11	Heating circuit 1 valve closed Y2	Y2	An arm from the storage tank to the heating circuit closes (heating circuit’s internal circulation). After the test, the valve remains in the position it was in at the end of the test. If needed, see the installation instructions for the valve in chapter 2.5.16.
U	QX12	Brine circuit (evaporator-circuit) pump Q8	Q8	The pump should start to rotate when the test is switched on. See further instructions for speed controlled pumps in the next chapter.
V	QX13	Condenser-circuit pump Q9	Q9	The pump should start to rotate when the test is switched on. See further instructions for speed controlled pumps in the next chapter.

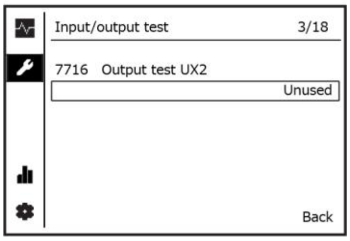
7.4.7.1 Relay test for speed controlled pumps

The test for speed controlled pumps is done by turning on the pump´s QX output and signal output test. The test is finished by selecting the function for relay test (line 7700) ”no test” and putting the test value for UX output ”---”.



Select the QX output that is connected to the pump.





Also select the pump’s UX output test. Select the UX output that is connected to the pump (see model-specific factory settings and electrical diagrams). Select a test value, for example 100, 50 and 0 percent.

SEQ Taulukko * ARABIC Table 26. Relay test for condenser circuit speed controlled pump

Line	Con nect or	Out-put	Action	Mark-ing	Additional information
7700	V	QX13	Condenser-circuit pump Q9	Q9	The pump should start to rotate when the test is switched on and the desired speed is selected on line 7710. Try adjusting the speed by changing the setpoint on line 7710 (e.g. 100 %, 50 % and 0 %).
7710	y	UX1	Output test UX1	UX1	

SEQ Taulukko * ARABIC Table 27. Relay test for brine circuit’s speed controlled pump

Line	Con nect or	Out-put	Action	Mark-ing	Additional information
7700	U	QX12	Brine circuit pump Q8	Q8	The pump should start to rotate when the test is switched on and the desired speed is selected on line 7716. Try adjusting the speed by changing the setpoint on line 7716 (e.g. 100 %, 50 % and 0 %).
7716	y	UX2	Output test UX2	UX2	

7.5 Automation factory settings

The standard configuration of the device's automation is for a service buffer tank, a heating circuit storage tank and a single heating circuit controlled with a three-way valve. The automation supports numerous other connections, systems and accessories. Other systems are presented in the final pages of this manual, and in other, separate automation-focused manuals that are available on the Oilon website.

7.5.1 Pipe connection corresponding to the factory settings

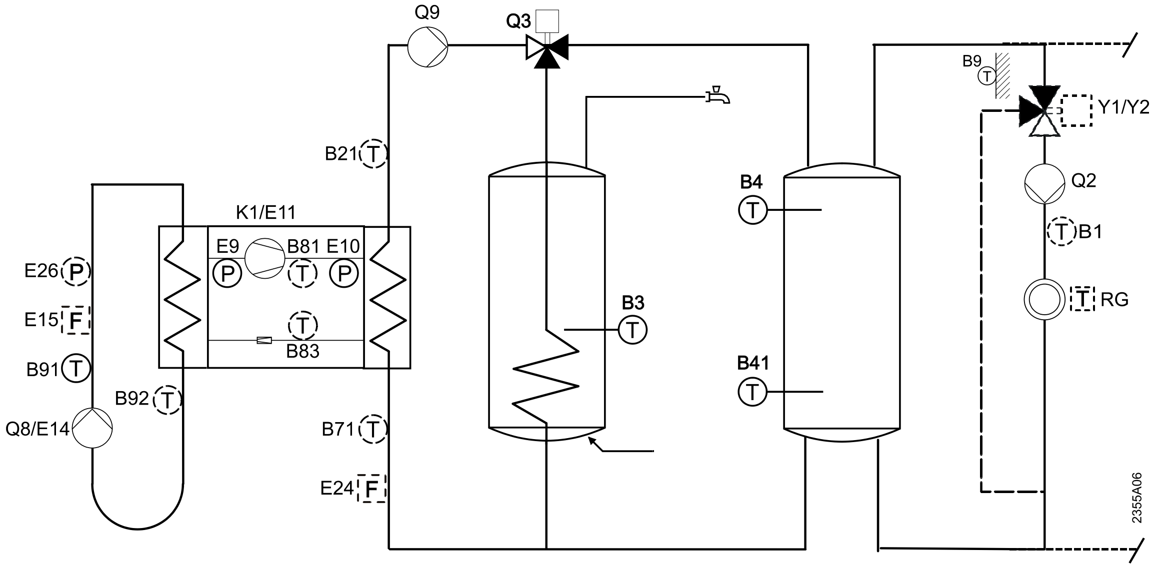


Figure 20. DHW storage tank and space heating with the buffer storage tank.
Sensor B41 is not necessary.

7.5.1.1 Inputs and outputs of master controller

SUPPLY CURRENT OUTPUTS (CAPITAL LETTERS IN CONNECTORS)					
Line	Con-nector	Output	Action	Marking	Additional information
5890	W	QX1			
5891	W	QX2			
5892	X	QX3	Crankcase heater K40	K40	
5894	Y	QX4 (ZX4)			
5895	Z	QX5			
5896	Z	QX6	Alarm output K10	K10	
5897	Q	QX7	Compressor 1 K1	K1	Fuse 1F1
5898	R	QX8	Change valve Q3	Q3	
5899 (6014)	S	QX9	Heating circuit 1 pump Q2	Q2	Fuse 1F6
5900 (6014)	T	QX10	Heating circuit 1 valve open Y1	Y1	
5901 (6014)	T	QX11	Heating circuit 1 valve closed Y2	Y2	
5902	U	QX12	Brine circuit (evaporator-circuit) pump Q8	Q8	Fuse 1F5
5903	V	QX13	Condenser-circuit pump Q9	Q9	Fuse 1F4
5909	Y	ZX4 (triac)			

For outputs Q9, Q10 and Q11 is selected function on line 6014. See chapter 25.

TEMPERATURE SENSORS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5930	t	BX1	Buffer tank temperature B4	B4	
5931	u	BX2			
5932	w	BX3			
5933	x	BX4			
5936	f	BX7	Hot gas temperature B81	B81	
5937	h	BX8	DHW temperature B3	B3	
5938	k	BX9	Outside temperature B9	B9	
5939	n	BX10	Heat pump supply water (condenser out) B21	B21	
5940 (6014)	p	BX11	Heating circuit 1 supply water B1	B1	
5941	q	BX12	Return water of heat pump (condenser in) B71	B71	
5942	r	BX13	Brine circuit in (evaporator in) B91	B91	
5943	s	BX14	Brine circuit out (evaporator out) B92	B92	

For input BX11 is selected function on line 6014. See chapter 25.

SUPPLY CURRENT INPUTS (CAPITAL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5980	P	EX1	Electric utility prevention E6	E6	Operating switch S1
5981		EX1 direction			
5982	P	EX2			
5983		EX2 direction			
5984	P	EX3			
5985		EX3 direction			
5986	P	EX4			
5987		EX4 direction			
5988	P	EX5	3-ph current control		L1
5989		EX5 direction	normally closed (break contact)		
5990	P	EX6	3-ph current control		L2
5991		EX6 direction	normally closed (break contact)		
5992	P	EX7	3-ph current control		L3
5993		EX7 direction	normally closed (break contact)		
5996	K	EX9	Low pressure switch E9	E9	
5997	K	EX10	High pressure switch E10	E10	
5998	Q	EX11	Compressor´s overload E11	E11	
5999		EX9 direction	normally closed (break contact)		
6000		EX10 direc-tion	normally closed (break contact)		
6001		EX11 direc-tion	normally closed (break contact)		

Normally closed contact receives voltage, when the heat pump operates normally. Power supply of normally closed contact interrupts (break contact) under fault situations.

CONTROL MESSAGES (SMALL LETTERS IN CONNECTORS)					
Line	Con-nect-or	Output	Action	Mark-ing	Action
6070	z	UX1	Condenser-circuit pump Q9	UX1	
6071	z	UX1	Signal logic output UX1	UX1	Standard
6072	z	UX1	Signal output UX1	UX1	0…10 V
6078	y	UX2	Brine circuit (evaporator circuit) pump Q8	UX2	
6079	y	UX2	Signal logic output UX2	UX2	Standard
6080	y	UX2	Signal output UX2	UX2	0…10 V

If needed, change the control signals to correspond to the pumps currently in use.

LOW VOLTAGE INPUTS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5950	e	H1			
5960	e	H3			

8 RE 04 56–96

RE 04 is a ground source heat pump comprising two compressor units and a switchboard. The standard position of the switchboard is on the device's left side, but it can be moved to the right side if needed.

The units can be used together or separately. The automation has a separate controller and electrical connections for each unit. If the units are used separately, they operate independent of each other. In this case both units are connected as separate units and their respective automations both have single-unit settings (chapter 5).

When used together, the automations are interconnected. Two-unit standard deliveries have the automations connected for joint use, i.e. cascaded (chapter 20). In a cascade system one of the automation controllers operates as the master, responsible for controlling the system, and the other is subordinated to a slave controller. When the units are stacked on top of one another, the top unit is the master, and the bottom one is the slave.

8.1 Dimensions, connections, and parts

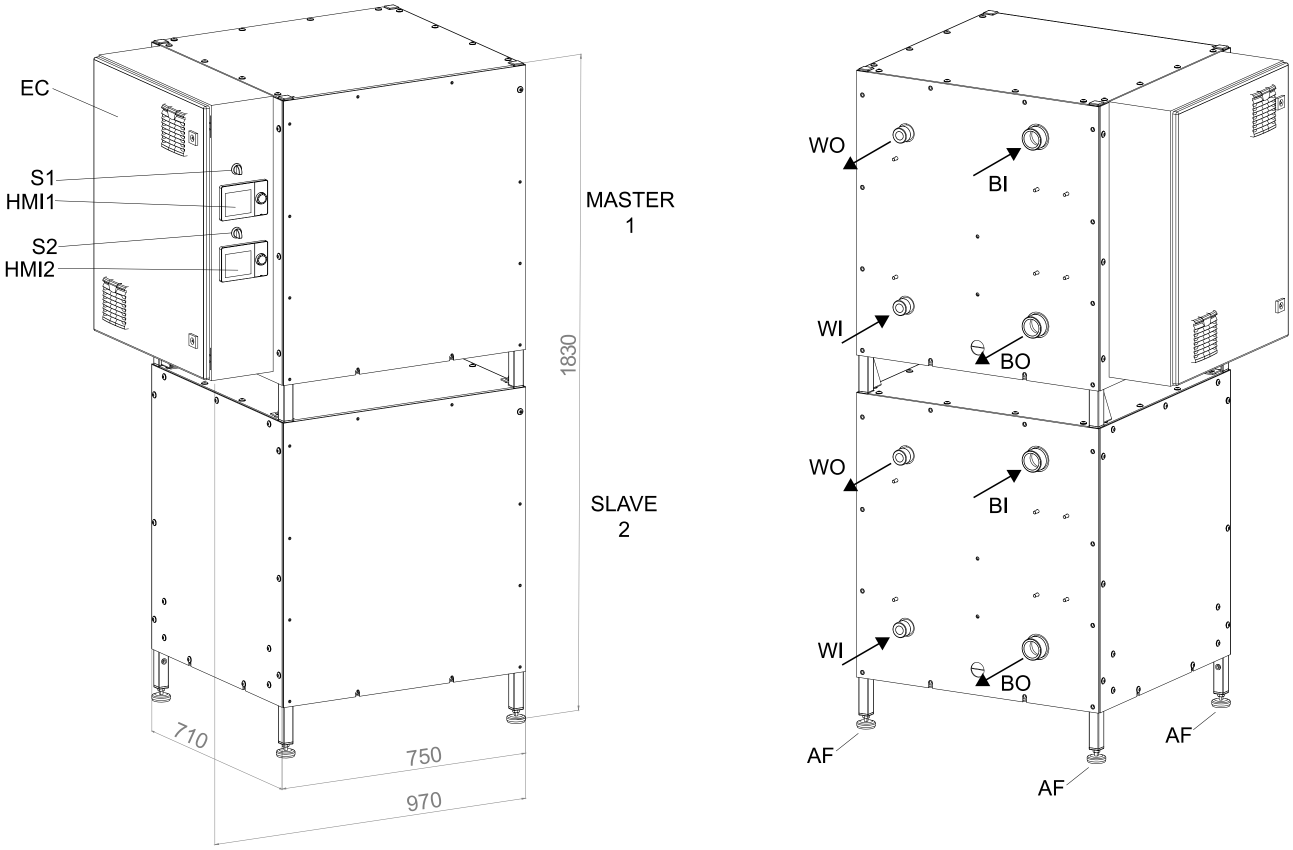


Figure 21. RE 04 with two units 56–96

See the refrigerant circuit's components in the single-unit image (**Error! Reference source not found.**).

HMI1	user interface, master
HMI2	user interface, slave
S1	upper (master) unit's operating switch (on/off)
S2	lower (slave) unit's operating switch (on/off)
EC	switchboard
AF	adjustable legs (M10, DIN/ISO 17/16 mm)
ECL	switchboard cover locking
BI	brine circuit in (evaporator circuit in)*
BO	brine circuit out (evaporator circuit out)*
WO	condenser circuit out, heating water flow*
WI	condenser circuit in, heating water return*

8.2 Switches and fuses

Marking	Action	Default position
F3	Control fuse (automation's fuse)	ON
S1	Operating switch ON/OFF, upper unit	ON
S2	Operating switch ON/OFF, lower unit	ON
1F1	Compressor's motor protection, upper unit	ON
2F1	Compressor's motor protection, lower unit	ON
1F4	Condenser circuit pump Q9's fuse, top unit	ON
1F5	Evaporator circuit pump Q8's fuse, top unit	ON
2F4	Condenser circuit pump Q9's fuse, bottom unit	ON
2F5	Evaporator circuit pump Q8's fuse, bottom unit	ON
F6	Heating circuit 1 pump Q2's fuse	ON
F7 (optional)	Heating circuit 2 pump Q6's fuse	ON

All fuses are in the OFF position when delivered from the factory.

8.2.1 Operating switch S1 and S2

When the switch is in position 1/ON, the device is in the default operating mode. When the switch is in position 0/OFF, the compressor is disabled from starting, but the heat pump's automation stays operational. The frost protection function is an exception to this. It starts the immersion heaters and the compressor's condenser circuit when the temperature drops below 5 °C, even if the is set to 0/OFF. If the condenser circuit's temperature is below 5 °C, set the compressor motor protections 1F1 and 2F1 to OFF, if needed.

Operating switch S1 halts the upper compressor unit (master) and operating switch S2 halts the lower compressor unit (slave).

8.3 Installation

8.3.1 Electrical connections

Check the electrical connections in the electrical diagrams. See the outside temperature sensor's connection in chapter 7.3.4.

8.3.2 Compressor plate's transportation supports

The compressor plate has two screws for transportation support. They go through the bottom plate, into the compressor frame. The locations have been marked in the device image with TS. The supports are removed by unscrewing them from the bottom of the device. Remove them before starting the device. The supports have an M8 thread and a 13 mm hexagonal head.

8.3.3 Brine and condenser circuit connections and pumps

Brine and condenser circuits' pumps are installed outside the device. It is a good idea to connect the heat pump's evaporator and condenser to the network with flexible connection hoses, if needed. Connection hoses can be ordered as a ready equipment package.

8.3.4 Cascade's shared flow sensor B10

The cascade system is controlled with the shared flow sensor B10. It is placed in the flow line coming from the condenser, after the last heat pump. See the correct location in the cascade connection image in chapter 8.5.2 and the chapter on cascade automation, 20. Sensor B10 is always installed in the system's master controller. Install the sensor in the piping according to the instructions in chapter 2.9.2.

8.3.5 Outdoor temperature sensor

The heat pump's outside temperature sensor (sensor code 89) is delivered with the pump. The sensor connection is presented in the pump's electrical diagrams.

The sensor is connected to the k terminal in the pump's Siemens RVS61.843 controller. One wire of sensor´s cable is connected to the connector´s pole BX9 and the other to the pole M (either way). In a cascade system the sensor is connected to the master controller by default.

The sensor connection and cable extension are done with a regular, insulated copper twin cable. Select the cross-sectional area of the wires by consulting the table below. When you run the sensor cable into the switchboard, use an insulated cable and, if possible, a cable trough that does not contain supply cables. Peel off the cable insulation and the wire insulation right next to the controller.

Install the sensor outdoors such that the sensor-cable bushing points downward. Select the sensor position so that it measures as accurately as possible the prevailing outside-air temperature. Make sure that the sensor is not exposed to solar radiation or heat coming from the building. Sensor housing is protected against dust and water spray (IP65, if the cable connection is pointing downward), but should still be installed in a location that is covered from rain. A suitable location for the sensor is, for example, a shady place on the north wall of the building under the eaves.

SEQ Taulukko * ARABIC Table 28. Outside sensor cable

Cable length (m)	40	60	80	120
Wire cross-sectional area (mm^2)	0.50	0.75	1.0	1.5

For additional information, see chapter 2.9.

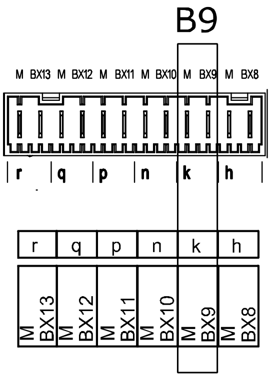


Figure 22. Outside sensor connection

8.3.6 Remote connection (accessory)

The remote connection device (OZW672 or OCI670) is connected to the LPB bus (MB/DB) according to the electrical diagrams. The heat pump controllers are connected to the same bus in a cascade connection. A basic guide to commissioning the device is presented below. If necessary, see more detailed instructions on Oilon's webpage.

- Use your internet browser to enter the ClimatixIC cloud service at www.climatixic.com
- Register the device with the registration code found in the device packaging and below the connection box cover.
- Retrieve the password from the email address that was used to register the device.
  - If you have already registered a different device with the same email address, this device is automatically added to your existing account.
- Log to the ClimatixIC cloud service.
- Enter the requested information.
- Pair the remote connection device and the heat pump's controller in the remote connection device's settings.
  - If the device is covered with a sticker that displays the heat pump's serial number, this indicates that the pairing has already been performed at the factory.
- Commissioning is finished. You can use the remote connection with an internet browser, mobile application or the Siemens ACS computer program.
  - Android application on Google Play: Siemens HomeControl IC (link)
  - iOs application on Apple's App Store: Siemens HomeControl IC (link)

8.3.7 Modbus connection

A Modbus remote connection to the heat pump's automation can be established with a bus converter (Modbus RTU RS485). Modbus registers and the instructions for commissioning the device can be downloaded from the Oilon website. The bus converter is installed to both controllers (master and slave).

8.4 Commissioning

8.4.1 Before the first start-up

- Before the first start-up check, that
  - the pipe connections are properly made and checked
  - the electrical connections connections are properly made and checked
  - all tanks and pipings are connected to a functioning safety valve
  - the necessary air supply valves are placed properly within the system
  - the expansion tanks are properly dimensioned and placed
  - all pipes and storage tanks have been carefully filled and vented
  - all necessary shut-off valves are opened
  - the general installation instructions have been followed (chapter 2)
  - the device-specific installation instructions have been followed
  - the outside sensor has been installed
  - the operating interface is installed
  - the other necessary sensors and devices have been installed.
- Turn all switches, motor protections and fuses to the OFF position.

8.4.2 BASIC SETTINGS

Menu	Line	Setting
Heating circuit 1	721	Heating curve displacement (parallel displacement)
Heating circuit 1	730	Summer/winter heating limit
Heating circuit 1	740	Flow temp. setpoint min. (lower limit)
Heating circuit 1	741	Flow temp. setpoint max. (upper limit)

See the standard setup for heating circuits in chapter 11.4.

8.4.3 First start-up of automation

- Turn all switches, motor protections and fuses to the OFF position.
- Turn the control fuse to the F3 ON position.
    - Keep the operating switches, motor protections and other fuses in the OFF position. This enables you to use the automation without starting the compressor and other equipment.
- Wait for the user interfaces (displays) to update the data from the controller.
    - Go through the commissioning menus if needed (chapter 8.4.6). The commissioning menu settings are preset at the factory.
- If necessary, make the setting changes corresponding to the pipe coupling (chapter 2.13).
- Adjust the heating circuit’s basic settings to fit the heating system (chapter 8.4.2)
    - Other heating circuit settings and their functioning are listed in chapter11.3.
- Continue venting the piping.
    - If necessary, use the relay test for guidance (chapter 8.4.7).
- If you have installed external actuators, such as the heating circuit’s control valve, test their functionality and connections with a relay test (chapter 8.4.7).
- During device commissioning and maintenance, you can enable outside temperature simulation in the Diagnostics menu, if needed (chapter 10.4.7), This makes it possible to bypass the device’s outside temperature sensor and set the outside temperature manually.

8.4.4 The first start-up of the heat pump

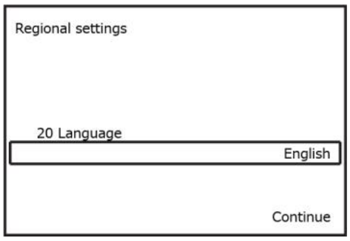
- Turn all motor protections and fuses to ON position. Keep the operating switches in the OFF position.
  - First switch the pump fuses on, then the control fuse F3, and finally the compressor's motor protections. This ensures that the pumps are running when the compressor starts.
  - Also switch fuses F6 and F7 on, if needed.
- Reset the heat pump (see Subsection 10.4.11).
- Place the upper compressor unit's operating switch S1 in the ON position.
- Wait for the compressor to start. Brine circuit's and condenser circuit's pumps start about 10...20 seconds before the compressor starts.
  - If you have to restart the compressor, wait at least 5 minutes after the last start. Starting up too frequently may break the soft starter.
- Make sure that the compressor rotates in the right direction.
  - If the compressor's rotation direction is correct, the operating sound is normal, the hot gas pipe warms up (line 8415), the pressure in the high pressure zone increases, and that on the low pressure side decreases (refrigeration gauge).
- If the compressor's rotation direction is incorrect, stop the compressor immediately by moving its motor protection switch (1F1) to the OFF position or by turning the operating switch S1 to the OFF position.
  - If the compressor rotates in the wrong direction, it emits abnormal sound, the flow water or hot gas (line 8415) pipes do not warm up, and the pressure in the suction line does not decrease, and the high pressure zone's pressure does not increase (refrigerant gauge).
  - If the compressor rotates in the wrong direction, make sure that the power supply is de-energized and replace the order of two phases with each other in the device's supply cable. Then go back to the beginning of this chapter and go through the start-up steps again.
  - The device is equipped with an internal phase guard that halts the compressor rotating incorrectly due to the phase order within 10 seconds of start-up.
- Check the temperature indicators to ensure that the condenser circuit warms up and the evaporator circuit cools down.
- Next, place the lower unit's operating switch S2 in the ON position.
- Wait for the lower compressor to start.
  - It starts with a delay depending on the system's heat demand. If needed, use the outside temperature simulation and decrease the cascade's delay time and degree minues to speed up the compressor's start-up. Restore the settings after the commissioning.
- Ensure that the rotating direction is correct as described above.

8.4.5 After the commissioning

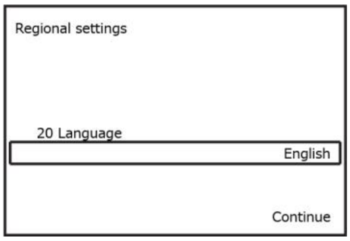
- Make sure that the heating water runs through all the required circuits.
- Make sure that the pipes and storage tanks have no residue air and the pressure level is suitable
    - Also pay attention to the inspection and adjustment of the expansion tanks' pressure.
- Ensure that the temperature sensors show sensible values during device operation.
- Check the temperature indicators to ensure that the condenser circuit warms up and the evaporator circuit cools down.
- Make sure that the heating circuit's settings are suitable for the heating system (chapter 8.4.2)
    - Other heating circuit settings and their functioning are listed in chapter11.3.
    - If the heating circuit is equipped with a separate controller, set the heat pump's and heating circuit's heating curves to correspond to one another.
- Ensure that the actuators connected to the heat pump automation, such as the mixing valve of the heating circuit, function properly when the device is turned on.
- Make sure that inspection records (electrical connections), the commissioning inspection record and other required documents have been completed and stored.
- Make sure that all changes are documented in the electrical diagrams, HVAC diagrams and operating instructions.
- Instruct the customer in the basic functionality of the device, such as
    - the line circuit breaker's location ja operation
    - adjusting the heating curve.

8.4.6 Commissioning menus

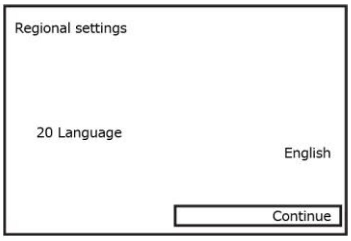
8.4.6.1 Language and time settings



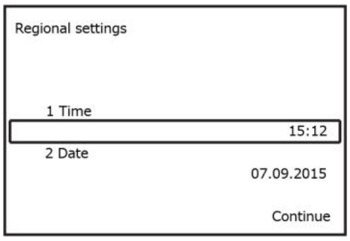
Initially, the display's language is English.



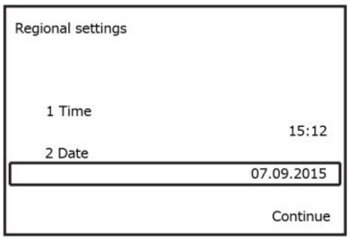
At the first screen, the interface language can be changed.



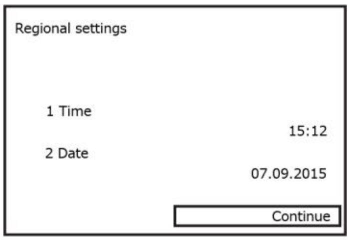
Move to the next page by pressing the button in the lower right-hand corner.



Set the time.

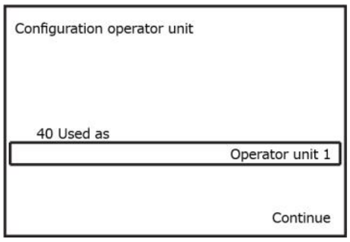


Set the date.

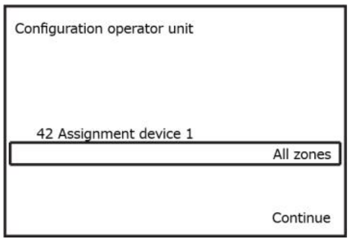


Continue to the next page.

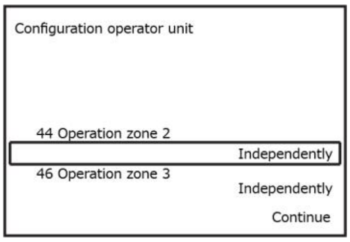
The images below show the settings that suit most situations unaltered. The menu settings are preset at the factory. The commissioning menu can be accessed again from the maintenance menu (chapter 10.4.8). For a detailed overview of the settings options, see chapter 10.5.



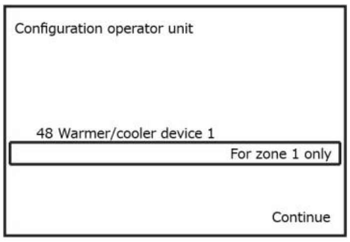
Intended use of room unit (sequence number). Select Operator unit 1.



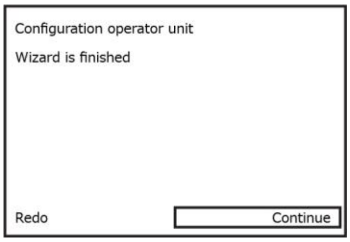
Heating circuits connected to the user terminal. Select All zones.



Autonomous settings for heating circuits 2 and 3. Select Autonomously for both.



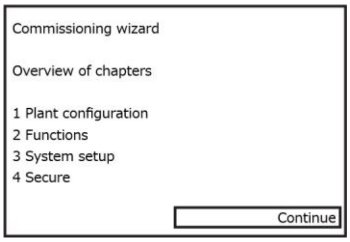
The effect of changing the temporary operating mode on other heating circuits. Select For zone 1 only.



Exit the commissioning menus from the lower right-hand corner of the screen. Select "Continue". Wait for the controller to load the data. This will take a few minutes.

8.4.6.2 Configuration settings

In addition to the various modes' settings, the heat pump's configuration can be changed via the commissioning wizard in the commissioning menus. The wizard is launched at the first start-up if it has not been disabled. In addition, you can launch the wizard from the settings menus later. The settings suitable for the most common cases have been preloaded in the heat pump automation at the factory, so the commissioning wizard is usually not needed. In general, any individual changes required in the default settings are easier to make later through the settings menus. You may bypass the commissioning wizard setup pages by selecting "Skip" in the lower left-hand corner of the screen. If you select "Continue" accidentally, select "Skip" in the following screens until the commissioning wizard menus have been bypassed.



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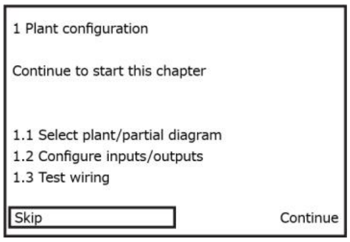
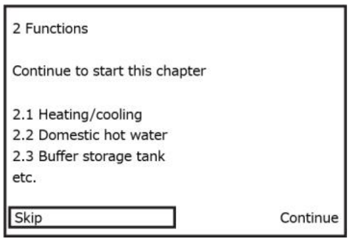
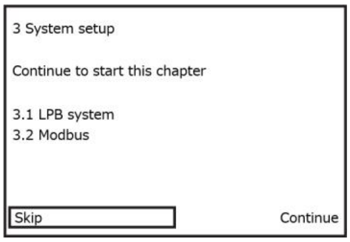


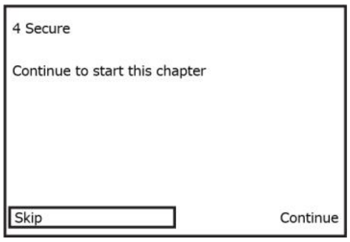
Select "Skip."



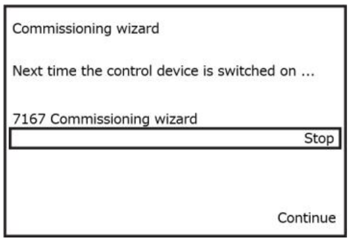
Select "Skip."



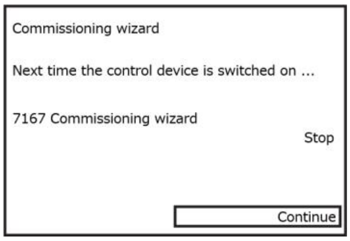
Select "Skip."



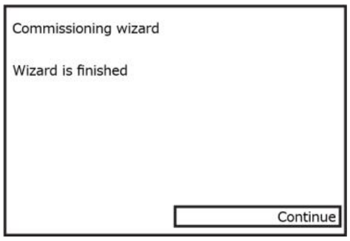
Select Skip.



Select "Stop".



Select "Continue".



Select "Continue".

8.4.7 Relay test

Test the operation of actuators with a relay test before starting the compressor if needed. The relay test is performed by selecting the desired QX output, and the UX signal output if required, and observing the operation of the actuator. The test is finished by selecting the function for relay test (line 7700) “no test”. Reset the heat pump after the relay test on line 6711 (chapter 10.4.11).

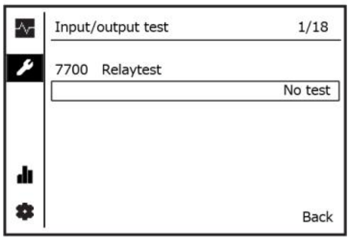
Use the relay test for venting the pipes if needed. Rotate the pump periodically for short times with the relay test and vent and fill (pressurize) the circuits between these short-term operating times. If needed, switch the positions of the change and control valves during venting.

SEQ Taulukko * ARABIC Table 29. Relay test

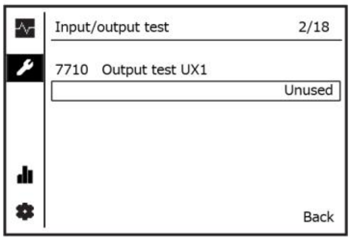
Con-nect-or	Out-put	Action	Marking	Additional information
W	QX1	Electric heater stage 1 K25	K25	Keep the fuse F2 in the position OFF. Contac-tor K2 should switch on.
W	QX2	Electric heater stage 2 K26	K26	Keep the fuse F2 in the position OFF. Contac-tor K3 should switch on.
R	QX8	Change valve Q3	Q3	Change valve is in position B (building, heating circuit) before the relay test. Switching the power on turns the valve to the position A (aq-ua, DHW storage tank). The valve returns to the position B when the relay test is turned off.
S	QX9	Heating circuit 1 pump Q2	Q2	The pump should start to rotate when the test is switched on. See further instructions for speed controlled pumps in the next chapter, if needed.
T	QX10	Heating circuit 1 valve open Y1	Y1	An arm from the storage tank to the heating circuit opens (heating circuit takes heat from the storage tank). After the test, the valve re-mains in the position it was in at the end of the test. If needed, see the installation instructions for the valve in chapter 2.5.16.
T	QX11	Heating circuit 1 valve closed Y2	Y2	An arm from the storage tank to the heating circuit closes (heating circuit’s internal circula-tion). After the test, the valve remains in the position it was in at the end of the test. If need-ed, see the installation instructions for the valve in chapter 2.5.16.
U	QX12	Brine circuit (evaporator-circuit) pump Q8	Q8	The pump should start to rotate when the test is switched on. See further instructions for speed controlled pumps in the next chapter.
V	QX13	Condenser-circuit pump Q9	Q9	The pump should start to rotate when the test is switched on. See further instructions for speed controlled pumps in the next chapter.

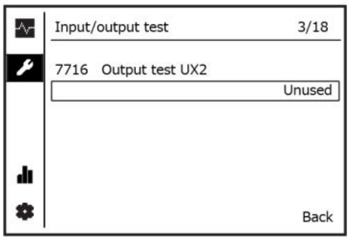
8.4.7.1 Relay test for speed controlled pumps

The test for speed controlled pumps is done by turning on the pump´s QX output and signal output test. The test is finished by selecting the function for relay test (line 7700) ”no test” and putting the test value for UX output ”---”.



Select the QX output that is connected to the pump.





Also select the pump’s UX output test. Select the UX output that is connected to the pump (see model-specific factory settings and electrical diagrams). Select a test value, for example 100, 50 and 0 percent.

SEQ Taulukko * ARABIC Table 30. Relay test for condenser circuit speed controlled pump

Line	Connector	Out-put	Action	Mark-ing	Additional information
7700	V	QX13	Condenser-circuit pump Q9	Q9	The pump should start to rotate when the test is switched on and the desired speed is selected on line 7710. Try adjusting the speed by changing the setpoint on line 7710 (e.g. 100 %, 50 % and 0 %).
7710	y	UX1	Output test UX1	UX1	

SEQ Taulukko * ARABIC Table 31. Relay test for brine circuit’s speed controlled pump

Line	Connector	Out-put	Action	Mark-ing	Additional information
7700	U	QX12	Brine circuit pump Q8	Q8	The pump should start to rotate when the test is switched on and the desired speed is selected on line 7716. Try adjusting the speed by changing the setpoint on line 7716 (e.g. 100 %, 50 % and 0 %).
7716	y	UX2	Output test UX2	UX2	

8.5 Automation factory settings

8.5.1 Pipe connection corresponding to the factory settings

Two-unit standard deliveries have the automations connected for joint use, i.e. cascaded (chapter 20). The cascade is controlled with a sensor (B10) installed in the shared supply water line. The factory setting for the cascade is one shared brine circuit pump and two condenser circuit pumps (**Error! Reference source not found.**). The installation can also be done using two brine circuit pumps, if need be (**Error! Reference source not found.**, electrical diagrams and chapter 20.4.1).

The standard configuration of the device's automation is for a service buffer tank, a heating circuit storage tank and a single heating circuit controlled with a three-way valve. In the factory settings, both machines are connected behind the same change valve (Q3) (**Error! Reference source not found.**). Then, both machines heat up at the same time either hot domestic water or buffer storage tank for space heating. The connection is principally similar to the normal single-unit connection, with the difference that there are two heating units. The system can also be piped and programmed so that one of the heat pumps heats either hot domestic water or a buffer storage tank and the other heats only a buffer storage tank (section 20.5). This way, hot domestic water and buffer storage tank can be heated at the same time.

The system may only contain a service buffer tank or a heating circuit storage tank. In this case the diverting valve and the sensors of the omitted storage tank are not included in the system. For example, in a system that only heats domestic water, the only external sensors are B3 and B10. The automation supports numerous other connections, systems and accessories. Other systems are presented in the final pages of this manual, and in other, separate automation-focused manuals that are available on the Oilon website.

8.5.2 Cascade connection principle

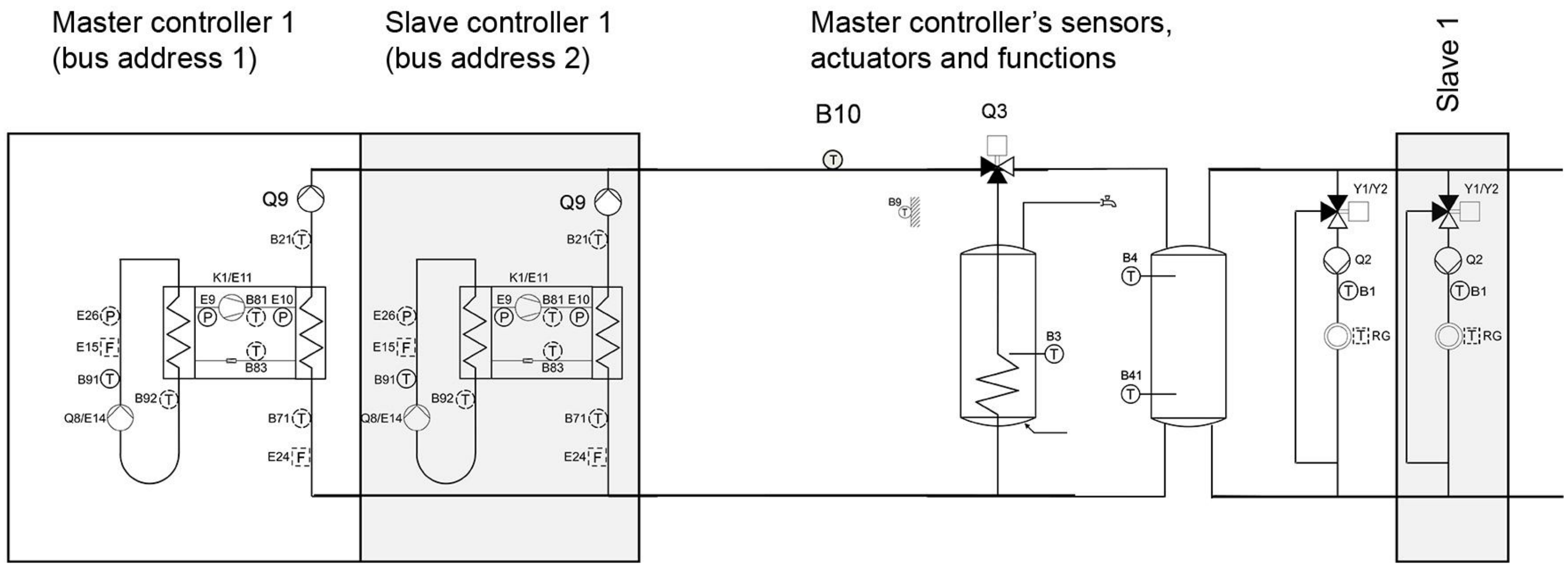


Figure 23. DHW storage tank and space heating with the buffer storage tank.

8.5.3 Cascade connection with one brine pump and two condenser pumps

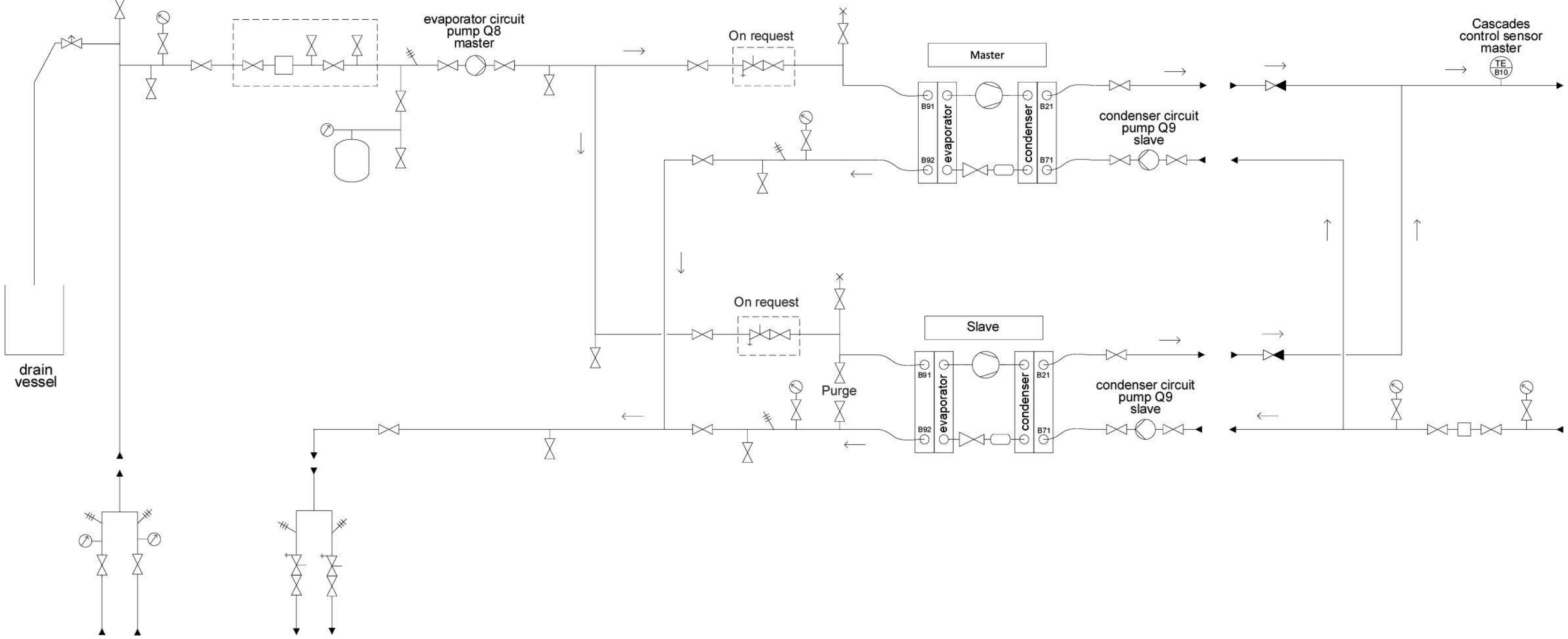


Figure 24. Cascade: One brine circuit pump, two condenser circuit pumps, both behind a diverting valve

8.5.4 Storage tank connection 1

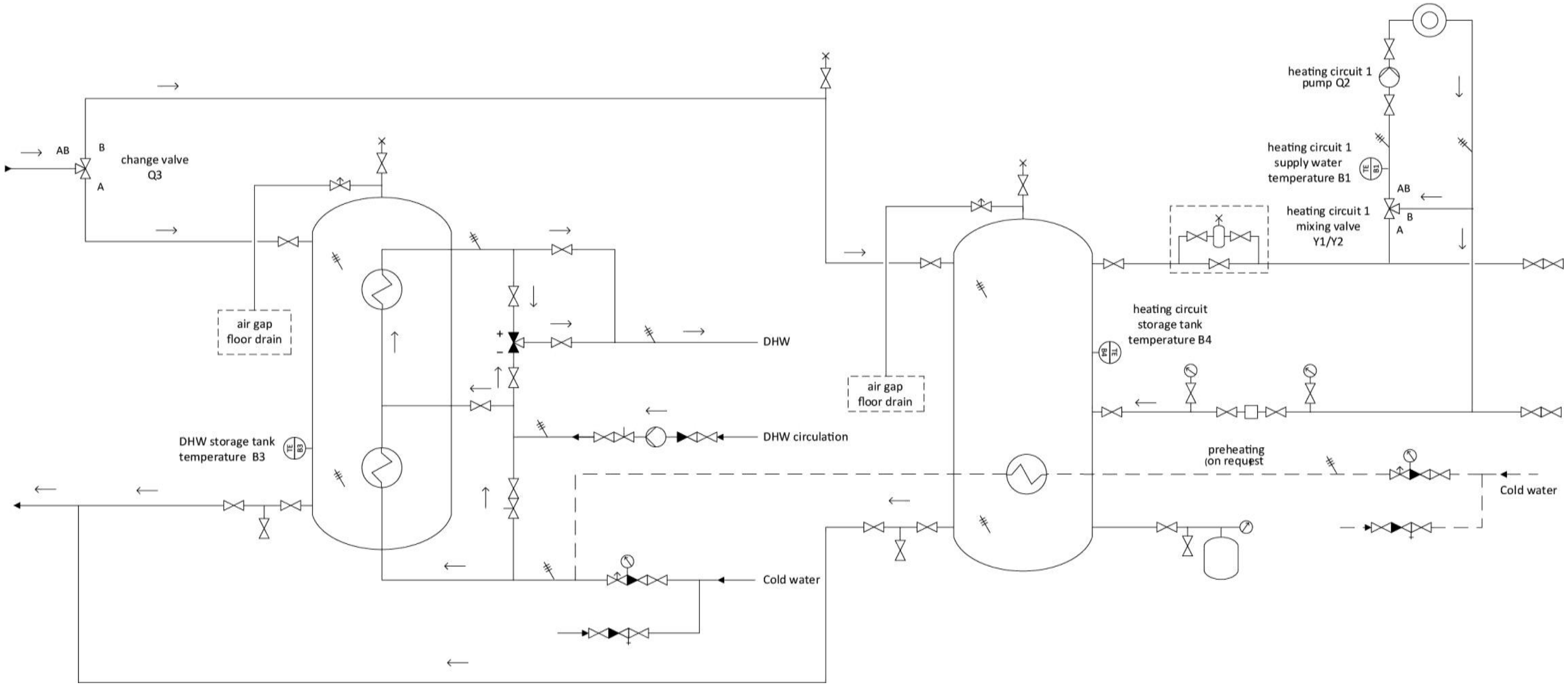


Figure 25. Service buffer tank and heating circuit's storage tank

Oilon is not liable for the functioning of the connection.

8.5.4.1 Inputs and outputs of master controller

See connections from the wiring diagrams.

SUPPLY CURRENT OUTPUTS (CAPITAL LETTERS IN CONNECTORS)					
Line	Con-nector	Output	Action	Marking	Additional information
5890	W	QX1			
5891	W	QX2			
5892	X	QX3	Crankcase heater K40	K40	
5894	Y	QX4 (ZX4)			
5895	Z	QX5			
5896	Z	QX6	Alarm output K10	K10	
5897	Q	QX7	Compressor 1 K1	K1	Fuse 1F1
5898	R	QX8	Change valve Q3	Q3	
5899 (6014)	S	QX9	Heating circuit 1 pump Q2	Q2	Fuse 1F6
5900 (6014)	T	QX10	Heating circuit 1 valve open Y1	Y1	
5901 (6014)	T	QX11	Heating circuit 1 valve closed Y2	Y2	
5902	U	QX12	Brine circuit (evaporator-circuit) pump Q8	Q8	Fuse 1F5
5903	V	QX13	Condenser-circuit pump Q9	Q9	Fuse 1F4
5909	Y	ZX4 (triac)			

For outputs Q9, Q10 and Q11 is selected function on line 6014. See chapter 25.

TEMPERATURE SENSORS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5930	t	BX1	Buffer tank temperature B4	B4	
5931	u	BX2			
5932	w	BX3			
5933	**x**	**BX4**	**Shared flow sensor B10**	**B10**	
5936	f	BX7	Hot gas temperature B81	B81	
5937	h	BX8	DHW temperature B3	B3	
5938	k	BX9	Outside temperature B9*	B9	
5939	n	BX10	Heat pump supply water (condenser out) B21	B21	
5940 (6014)	p	BX11	Heating circuit 1 supply water B1	B1	
5941	q	BX12	Return water of heat pump (condenser in) B71	B71	
5942	r	BX13	Brine circuit in (evaporator in) B91	B91	
5943	s	BX14	Brine circuit out (evaporator out) B92	B92	

For input BX11 is selected function on line 6014. See chapter 25.

SUPPLY CURRENT INPUTS (CAPITAL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5980	P	EX1	Electric utility prevention E6	E6	Operating switch S1
5981		EX1 direction			
5982	P	EX2			
5983		EX2 direction			
5984	P	EX3			
5985		EX3 direction			
5986	P	EX4			
5987		EX4 direction			
5988	P	EX5	3-ph current control		L1
5989		EX5 direction	normally closed (break contact)		
5990	P	EX6	3-ph current control		L2
5991		EX6 direction	normally closed (break contact)		
5992	P	EX7	3-ph current control		L3
5993		EX7 direction	normally closed (break contact)		
5996	K	EX9	Low pressure switch E9	E9	
5997	K	EX10	High pressure switch E10	E10	
5998	Q	EX11	Compressor´s overload E11	E11	
5999		EX9 direction	normally closed (break contact)		
6000		EX10 direc-tion	normally closed (break contact)		
6001		EX11 direc-tion	normally closed (break contact)		

Normally closed contact receives voltage, when the heat pump operates normally. Power supply of normally closed contact interrupts (break contact) under fault situations.

CONTROL MESSAGES (SMALL LETTERS IN CONNECTORS)					
Line	Con-nect-or	Output	Action	Mark-ing	Action
6070	z	UX1	Condenser-circuit pump Q9	UX1	
6071	z	UX1	Signal logic output UX1	UX1	Standard
6072	z	UX1	Signal output UX1	UX1	0…10 V
6078	y	UX2	Brine circuit (evaporator circuit) pump Q8	UX2	
6079	y	UX2	Signal logic output UX2	UX2	Standard
6080	y	UX2	Signal output UX2	UX2	0…10 V

If needed, change the control signals to correspond to the pumps currently in use.

LOW VOLTAGE INPUTS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5950	e	H1			
5960	e	H3			

8.5.4.2 Inputs and outputs of slave controller

SUPPLY CURRENT OUTPUTS (CAPITAL LETTERS IN CONNECTORS)					
Line	Con-nector	Output	Action	Marking	Additional information
5890	W	QX1			
5891	W	QX2			
5892	X	QX3	Crankcase heater K40	K40	
5894	Y	QX4 (ZX4)			
5895	Z	QX5			
5896	Z	QX6			
5897	Q	QX7	Compressor 1 K1	K1	Fuse 2F1
5898	R	QX8			
5899 (6014)	S	QX9			
5900 (6014)	T	QX10			
5901 (6014)	T	QX11			
5902	U	QX12			
5903	V	QX13	Condenser-circuit pump Q9	Q9	Fuse 2F4
5909	Y	ZX4 (triac)			

For outputs Q9, Q10 and Q11 is selected function on line 6014. See chapter 25.

TEMPERATURE SENSORS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5930	t	BX1			
5931	u	BX2			
5932	w	BX3			
5933	x	BX4			
5936	f	BX7	Hot gas temperature B81	B81	
5937	h	BX8			
5938	k	BX9			
5939	n	BX10	Heat pump supply water (condenser out) B21	B21	
5940 (6014)	p	BX11			
5941	q	BX12	Return water of heat pump (condenser in) B71	B71	
5942	r	BX13	Brine circuit in (evaporator in) B91	B91	
5943	s	BX14	Brine circuit out (evaporator out) B92	B92	

For input BX11 is selected function on line 6014. See chapter 25.

SUPPLY CURRENT INPUTS (CAPITAL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5980	P	EX1	Electric utility prevention E6	E6	Operating switch S2
5981		EX1 direction			
5982	P	EX2			
5983		EX2 direction			
5984	P	EX3			
5985		EX3 direction			
5986	P	EX4			
5987		EX4 direction			
5988	P	EX5	3-ph current control		L1
5989		EX5 direction	normally closed (break contact)		
5990	P	EX6	3-ph current control		L2
5991		EX6 direction	normally closed (break contact)		
5992	P	EX7	3-ph current control		L3
5993		EX7 direction	normally closed (break contact)		
5996	K	EX9	Low pressure switch E9	E9	
5997	K	EX10	High pressure switch E10	E10	
5998	Q	EX11	Compressor´s overload E11	E11	
5999		EX9 direction	normally closed (break contact)		
6000		EX10 direc-tion	normally closed (break contact)		
6001		EX11 direc-tion	normally closed (break contact)		

Normally closed contact receives voltage, when the heat pump operates normally. Power supply of normally closed contact interrupts (break contact) under fault situations.

LOW VOLTAGE INPUTS (SMALL LETTERS IN CONNECTORS)					
Line	Con-nector	Input	Action	Marking	Additional information
5950	e	H1			
5960	e	H3			

CONTROL MESSAGES (SMALL LETTERS IN CONNECTORS)					
Line	Con-nect-or	Output	Action	Mark-ing	Action
6070	z	UX1	Condenser-circuit pump Q9	UX1	
6071	-	-	Signal logic output UX1	-	Standard
6078	y	UX2			
6079	-	-	Signal logic output UX2	-	Standard

If needed, change the control signals to correspond to the pumps currently in use.

HEAT PUMP OPERATION AND AUTOMATION

9 Operating principle and automation

9.1 Glossary

- Evaporator: A heat exchanger that gathers heat inside a heat pump.
- Condenser: A heat exchanger that transfers heat inside a heat pump.
- Evaporator circuit: A pipe circuit that runs through a heat pump's evaporator.
    - In most contexts synonymous with brine circuit.
- Brine circuit: A pipe circuit from which the heat for the heat pump's evaporator is gathered.
    - In most contexts synonymous with evaporator circuit.
- Condenser circuit: A circuit that runs through a heat pump's condenser.
- Output circuit: The pipework where the heat pump's condenser gives out the produced heat.
    - In most contexts synonymous with condenser circuit.
- Heating circuit: A pipe circuit that heats a building's spaces.
    - If the system does not include a regulated storage tank, condenser circuit and heating circuit refer to the same circuit.
- Charging circuit: A pipework that heats the heating circuit's storage tank or the service buffer tank.
    - After the diverting valve, the condenser circuit is split into the DHW's charging circuit and heating circuit's storage tank's charging circuit.
- Brine: The liquid running inside the brine circuit (evaporator circuit).
- Heating water (water): The liquid running inside the condenser circuit.
- Buffer storage tank, buffer tank, heating storage tank: Heating circuit's storage tank.

9.2 Heat pump's operating principle

Heat pump is a device that heats a building's premises and its domestic water. It consists of a compressor; an expansion valve; an evaporator; and a condenser. Heat pump collects heat from the brine circuit (evaporator circuit) with an evaporator and transfers it to the condenser circuit (output circuit, heating circuit, charging circuit) via a condenser. The brine liquid circulates inside the brine circuit, and inside the condenser circuit, heating water. The brine circuit can be, for example, a thermal well drilled into a rock, a ground circuit dug horizontally into the ground or, for instance, a ventilation system's heat recovery. Two heating circuits are connected to the condenser circuit: the heating circuit responsible for heating the building's premises either directly or through a storage tank, and the service buffer tank's heating circuit.

The evaporator has two sides. One side is connected to the brine circuit and the other is connected to the heat pump's refrigerant circuit. These two sides are separated by a metallic wall. Heat is transferred through the wall, but the brine liquid and the refrigerant running in the refrigerant circuit stay separated. Likewise, the condenser also has two sides. One side is connected to the condenser circuit and the other to the same refrigerant circuit as the evaporator.

The compressor pumps the refrigerant that runs inside the refrigerant circuit, keeping it in motion. It sucks the refrigerant from the evaporator and feeds it to the condenser. Compressor operates on the same principle as an ordinary water pump or a cooling fan used during the summer heat. The water pump and cooling fan increase the pressure by just a tiny amount, and the temperature by a practically imperceptible amount, whereas the compressor increases the refrigerant's pressure and temperature significantly. To illustrate, refrigerant's temperature before the compressor can be –1.0 °C with a pressure of 5.6 bar, but after the compressor they have risen to 70 °C and 20 bar, respectively.

The evaporator turns the refrigerant from liquid into steam. Examples of this seen in the everyday life are water boiling in a kettle, and the evaporation of water as it contacts a hot sauna stove. The difference between water and refrigerant is the evaporation point: for water it is 100 °C, but for refrigerant it can be for example -5 °C. Having a low evaporation temperature enables the collection of heat from the brine circuit into the refrigerant even if the circuit's temperature is only 0 degrees, for example. The heat is therefore transferred from the higher temperature brine (in relation to the refrigerant) to the colder refrigerant. The brine cools down as a result. This cooling down is usually about a few degrees, for example, from 0 degrees to -3 degrees.

Like boiling water, evaporating the refrigerant requires a lot of heat. This is why the brine circuit's temperature and flow rate must be adequate. If the temperature or flow rate are insufficient, the compressor will suck the evaporator's pressure to a level that goes below the low pressure switch's minimum limit, resulting in a compressor halt due to a low pressure alert, or the brine circuit's minimum temperature alert.

The refrigerant condenses from hot vapor into liquid inside the condenser. Examples of this seen in the everyday life are water condensing on a kettle's inner surface when placed on a stove, and the condensation of steam vapor on the skin in a hot sauna. Condensation releases a lot of heat. This process heats the skin surface in a sauna, and the kettle's lid. Correspondingly, the heat released from the refrigerant in the condenser heats the condenser circuit's water. The heat is transferred from the refrigerant to the water because the compressor elevates the refrigerant's temperature level above the temperature of the water coming from the condenser circuit. The refrigerant cools when it releases its heat to the condenser circuit's water. Its pressure does not change substantially in the condenser, however. It remains highly pressurized by the compressor even after the condenser.

The compressor compresses the refrigerant to a pressure that is equivalent to the temperature of the condenser circuit's water. If the water flow is too hot, the pressure exceeds the supply water's temperature or the high pressure switch's maximum limit, which results in a compressor halt due to switch-off temperature or high pressure. This also happens when the flow is insufficient in the condenser circuit, and not enough heat is transferred from the refrigerant to the water.

The lower limit for the refrigerant's temperature is the temperature that the condenser circuit's water enters the condenser with. For example, if the water enters the condenser at 40 °C, the refrigerant can cool down to 40 degrees at maximum. The condenser does not cool below the water's temperature in the condenser. This happens when the refrigerant flows through the expansion valve into the evaporator.

The expansion valve is between the condenser and evaporator. Before entering the expansion valve the refrigerant coming from the condenser is in the high pressure produced by the compressor. The evaporator is located on the other side of the expansion valve, and has low pressure. This is because the compressor keeps sucking the refrigerant out of the evaporator. The liquid refrigerant flowing into the evaporator through the expansion valve expands when it enters the low pressure in the evaporator. Some of the refrigerant will evaporate, cooling down drastically. This natural phenomenon lowers the refrigerant's temperature by dozens of degrees, for example, from 40 degrees down to -5 degrees. The cooling process makes it possible to collect heat from the brine. After expanding, the partly evaporized refrigerant is fully evaporized with the brine's heat, and the vapor is sucked by the compressor.

The refrigerant flows into the evaporator through a small opening in the expansion valve. The flow is regulated by adjusting the size of the opening. The current is kept at a level where the heat collected from the brine is adequate for evaporizing all of the supplied refrigerant, and desuperheating it to a temperature slightly higher than the saturation point. When the refrigerant is saturated, it is in the same state as the steam rising from boiling water would be, barely transformed from liquid into gas, still "damp". If the steam is too damp it may damage the compressor, because the liquid refrigerant in the steam is not compressed inside the compressor (liquids are practically non-compressable). The refrigerant in the upper part of the evaporator is slightly hotter than this "damp" state, entering the compressor "dry". This additional heating is called refrigerant desuperheating. The expansion valve has a sensor that measures the desuperheating in the refrigerant tube running from the top part of the evaporator, and regulates the size of the refrigerant opening based on the data. If the desuperheating is not sufficient, the opening and refrigerant flow are diminished, and the heat from the brine circuit will be able to evaporate the refrigerant better. If the desuperheating is excessive, the opening and refrigerant flow are increased, and the evaporator will be able to evaporate larger quantities of refrigerant. The mechanical expansion valve has an adjustment spindle that can be used to adjust the desuperheating setpoint. In electrical expansion valves the setpoint is entered into the valve's controller. A suitable amount of desuperheating is usually around 5 °C. Not having enough desuperheating may damage the compressor (damp steam), whereas having too much weakens the heat pump's efficiency (coefficient of performance), because the compressor will have operate at a higher intensity to reach the same compressed end pressure. The desuperheating is measured by using a refrigeration gauge to check the pressure and temperature. Desuperheating has been configured during the heat pump's manufacturing process. Do not adjust the desuperheating on your own.

The refrigerant has turned into desuperheated steam in the compressor. The amount of desuperheating before the compressor is much larger. This post-compressor desuperheating can be utilized with a separate desuperheating heat exchanger placed before the condenser. This heat exchanger is sometimes also called a desuperheater. With the desuperheater, the high temperature of a hot refrigerant is recovered in a separate water current that is hotter than the condenser flow. The amount of heat extracted with a desuperheater is small compared to using a condenser, but the temperature level is significantly higher.

The refrigerant has become warm liquid after the condenser. The heat of this liquid can utilized with a subcooler installed after the condenser. The subcooler recovers heat from the liquid refrigerant, usually to a separate water current that is cooler than the condenser flow. It improves the heat pump's efficiency (coefficient of performance).

9.3 Heat pump’s automation

The heat pump automation makes use of a controller and a user interface. Extension modules (auxiliary controllers) (Siemens AVS75.370) and parallel user interfaces, along with other supplementary devices, can be installed in parallel with the controller (Siemens RVS61.843) and user interface. The extension modules offer additional inputs, outputs, and functions. Several parallel user interfaces can be used to control the automation and measure the room temperature, for fuller control of heating in the space (room unit). Other supplementary devices can be used to establish a remote connection or a Modbus link to the system, for example.

The built-in automation of the heat pump can be used to control the temperature of one DHW storage tank and one heating circuit. The maximum number of heating circuits that may be regulated by a single control valve is three. The controller can be used to control one heating circuit regulated by a control valve and two additional circuits connected directly to the heat pump. Two other regulated heating circuits can be enabled via connection of two or more extension modules in parallel with the controller.

In addition to the heat pump, storage tanks, and heating circuits, the automation can control a solar power system; cooling; and an additional heat source, such as electric heating or an oil boiler. Additional functions of the automation (block diagrams) are enabled by selecting the inputs and outputs required by the feature, such as inputs from temperature sensors and outputs of pumps’ and valves’ control, as well as by connecting the devices and temperature sensors to the selected inputs and outputs. The automation is equipped with control blocks for dozens of individual connections. The controllers of two or more heat pumps can be connected together. In this way, several heat pumps and other functions connected to the system can be controlled centrally as a discrete entity. The automation’s functions are presented in this manual and separate technical manuals. All manuals and instructions can be downloaded from Oilon’s website.

The automation setpoints can be changed as normal via the regular display mode shown on the screen. The display mode based on line numbers can be used to make more extensive changes to setpoints. Setpoints can also be changed using an Internet browser via a remote connection device or a separate computer program (Siemens ACS790). The connection via a computer program can established using a separate connection device plugged into a computer or a remote connection device. Both the computer program and a browser connection provide a direct menu-structure view of the settings. In addition, the computer program automatically presents a piping connection matching the setpoints on the screen and includes setpoints that cannot be changed otherwise. Among other things, the program can be used also to load all settings to the controller, make a backup copy of the settings, export the settings to an Excel file, and save setpoint changes as a function of time. The program and factory settings (parameters) for the automation are available for download on Oilon’s website.

Heat pump´s automation can be controlled through remote connection via a local area network or the Internet. A regular Internet browser, a smartphone application, or Siemens ACS computer program can be used for administration. Installing the remote connection service via the cloud solution (Siemens Climatix IC) is easy and fast, and does not require network expertise or a fixed IP address. You can include the facility's piping diagram in the remote connection view and link the temperature and setpoint details to it from the automation. The remote access device can also be used to save selected values and present them in graphs automatically, and enable automatic alert messages to selected email addresses.

10 Heat pump user interface

Two different interfaces can be connected to the heat pump automation. One of the interfaces is attached to the heat pump, and the other is installed on a building wall. The interface attached to the heat pump is called the “operator unit”, while the interface mounted on the wall is called the “room unit”. Both interfaces share the same functionality, except for the temperature measuring capability of the room unit and some visual differences in the operating screens. Both interfaces are referred to as “interfaces” in this manual, except for specific references to the room unit. Several interfaces can be connected to the automation. For example, each heating circuit can have its own room unit, equipped with room temperature measuring capability.

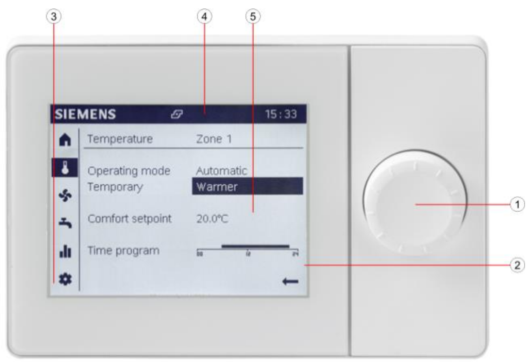


Figure 26. User interface.

Navigate the menus and settings by turning the control knob.

Select a menu or setting by pushing the control knob.

Move to the previous menu by using the arrow or text field at the bottom of the screen.

1) Control knob
2) Display
3) Navigation bar
4) Status bar
5) Work area

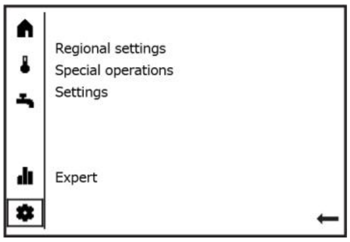
10.1 Status bar symbols

	Active alarm
	Special operations are active (e.g., outside-temperature simulation or emergency operation) or the maximum number of error notifications permitted by the settings has been reached.
	The heating-circuit status has been changed – the scheduled automatic operation does not apply. This symbol is displayed if the status of the heating circuit has been changed from automatic to Comfort mode, for example.
	User level No symbol: end-user (no password) 1: commissioning (no password) 2: expert (password 00017) 3: OEM level (password 24358)
	Heat pump compressor is on.
	Event message

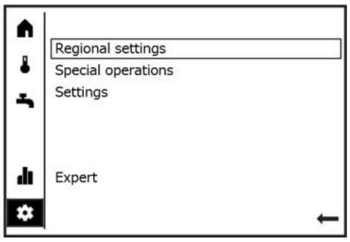
10.2 Main menu

	Start page • key temperatures • switching heating circuits on to automatic mode or off to frost protection mode
	Heating circuits • operating mode • room temperature setpoint for Comfort mode • time programs
	Domestic hot water • switching DHW heating on and off • recharging DHW to the setpoint (before the switching limit is reached) • DHW time programs
	Status bar • temperatures • operating modes • fault information and resetting the heat pump under error conditions
	Settings • time and language • changing the user level • resetting the heat pump • emergency operation mode • basic settings of the heating circuit connected to the interface
	Diagnostics menu • testing inputs and outputs • bus settings • outside temperature simulation • heat pump status • consumer-side heating details • error notification history
	Service menu • parameter list • commissioning menu (incl. connecting the interface to heating circuits) • updating operation displays of user interface (visible, if the interface needs to be updated)

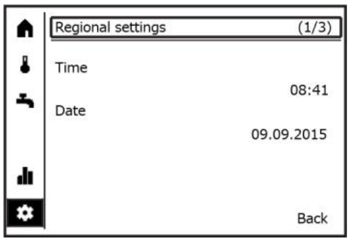
10.3 Navigation and changing setpoint values



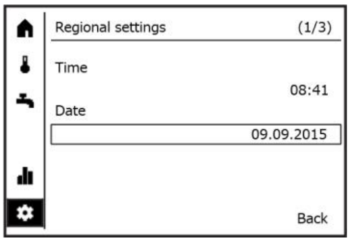
Move the selector on the left-hand side to the desired menu. Select a menu by pushing in the control knob.



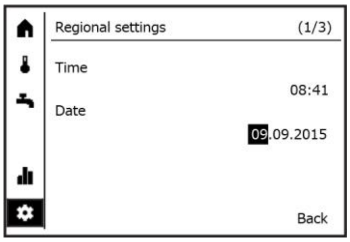
Move to the desired function by turning the control knob. Select the function by pushing the control knob in again.



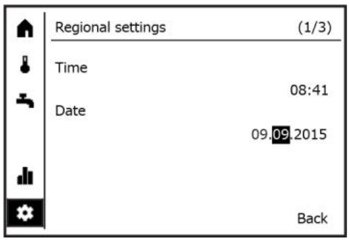
If the menu contains tabs, the cursor starts off on the status bar.



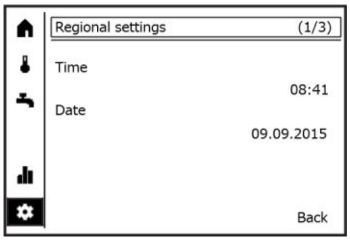
Move to the setpoints from the status bar by turning the control knob.



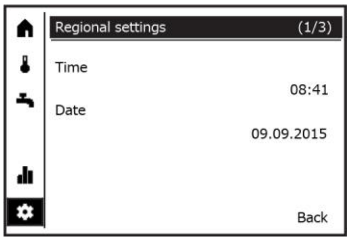
Select the setpoint to be changed by pushing in the knob. The background of the setpoint to be changed turns dark. Adjust the setpoint by turning the control knob.



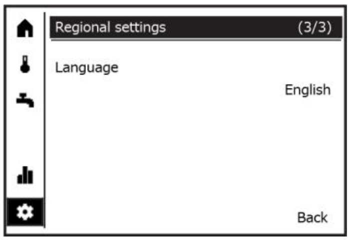
Move to the next setpoint by turning the control knob again. Proceed like this until you have gone through all the setpoints.



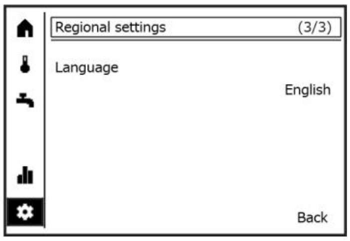
To switch tab, move to the status bar first.



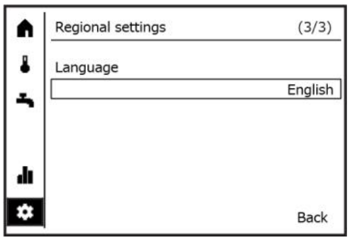
Pushing in the control knob then activates navigation between tabs.



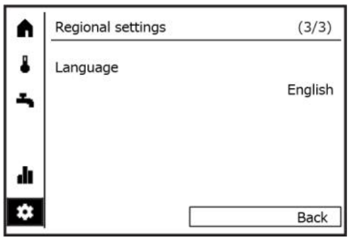
Move from one tab to another by turning the knob.

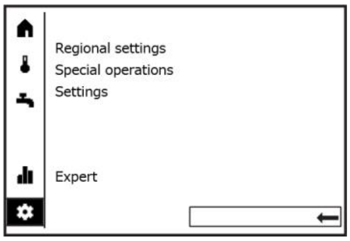


Pushing the control knob again exits tab-browsing.



Return to the setpoints from the status bar by turning the control knob.





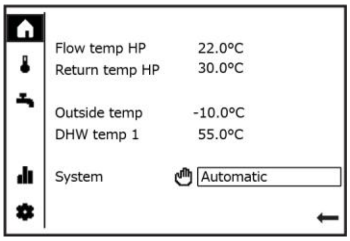
Go back by moving the cursor to the lower right-hand corner, then pushing the control knob.

10.4 Important menus and settings

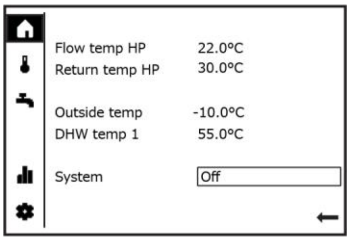
From the start page, you can also switch on or off all heating circuits connected to the relevant user interface in one go. Switching the heating circuits on from the start page places all circuits connected to the user interface in automatic mode. Switching the heating circuits off from the start page sets them to the frost protection mode. The operating mode of the individual heating circuits can be changed separately from the settings for each.

10.4.1 Start page in user interface, integrated to the heat pump

The start page of the user interface, integrated to the heat pump, shows the temperatures of the following: water flow from the condenser (sensor B21), water return to the condenser (sensor B71), DHW (sensor B3), and the outside environment (sensor B9). The use and location of the sensors is presented in chapters 13, 6 ja 23.



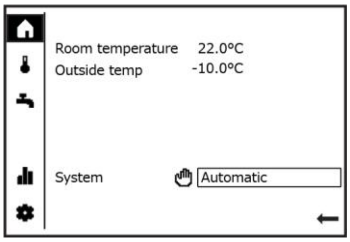
Heating circuits on and in automatic mode or placed separately in an operating mode selected later from the heating circuit settings.



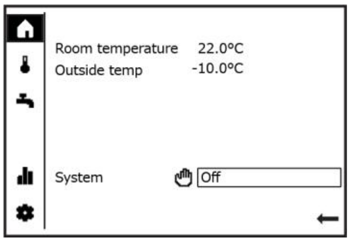
Heating circuits in frost protection mode.

10.4.2 The start page of wall-mounted user interface

The start page of wall-mounted user interface displays the room temperature measured by the unit and the outside temperature (sensor B9).



Heating circuits on and in automatic mode or placed separately in an operating mode selected later from the heating circuit settings.



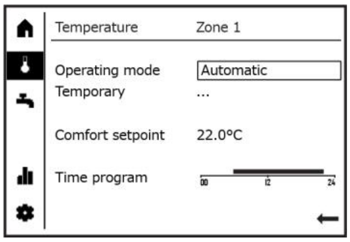
Heating circuits in frost protection mode.

10.4.3 Heating circuit menu

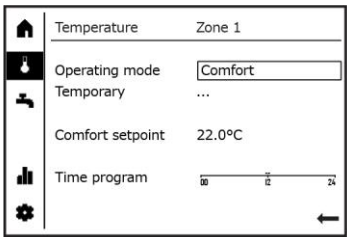
Three different room temperature setpoints can be assigned to the heating circuits. These setpoints are Comfort, Reduced and Frost protection. The Comfort setpoint can be altered directly from the heating circuit's main menu. The other setpoints can be changed in the detail-level settings for the heating circuits (chapter 10.4.10). The heating circuit settings are presented in the chapter 10.5.

When controlling the heating circuit is based on a heating curve, changing the room temperature setpoint is equal to the parallel displacement of the heating curve. When control is based on measuring the room temperature, the room temperature setpoint can be changed to alter the required room temperature directly.

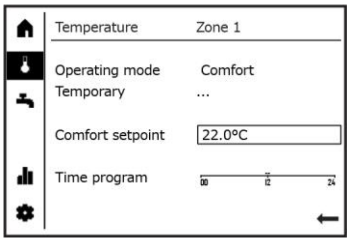
Timer programs are enabled only when the heating circuit is in automatic operating mode. A time program toggles the heating circuit's operating mode between Comfort mode and Reduced mode automatically. Comfort mode is used during the period specified in the time program. At other times, Reduced mode is used. Timer programs can be set up for each day of the week separately. Heating circuits should be kept in Automatic mode, because then they can be automatically disabled when the heating period ends (summer/winter heating limit). When using factory settings, the heat circuits have Automatic mode enabled, and the time program keeps Comfort mode on permanently. If the time program is used to switch from Comfort mode to Reduced mode, Comfort mode can be temporarily restored by selection of Temporary mode for the heater. The heating circuit's mode returns to normal the next time the time program changes the mode or operating is moved out of Automatic mode.



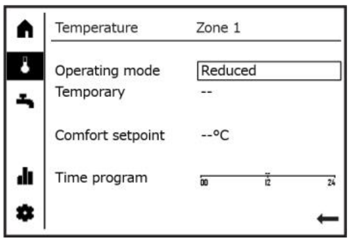
Automatic mode. Heating circuits should be kept in Automatic mode.



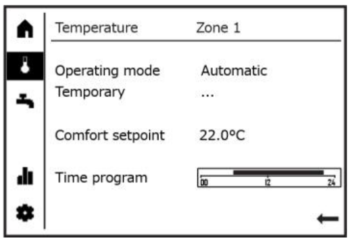
Comfort setpoint for room temperature always on.



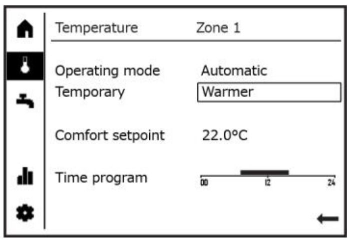
When the operating mode is set to "Comfort," the setpoint for the room temperature in Comfort mode can be changed.



The Reduced setpoint of the room temperature.



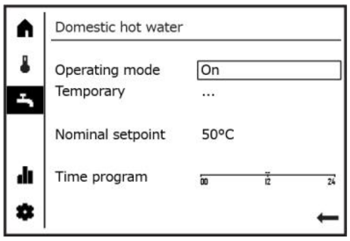
Time programs are enabled in Automatic mode only.



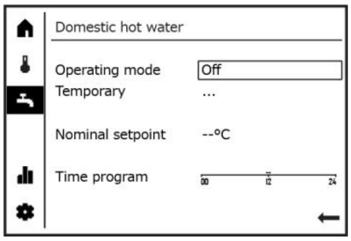
Temporary Comfort mode of the heating circuit.

10.4.4 DHW menu

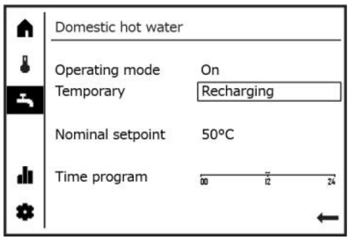
Key DHW settings can be changed in the DHW menu. Other DHW settings can be changed in the DHW and service buffer tank settings via the parameter list (chapter 10.4.9). Settings for domestic water are presented in chapter **Error! Reference source not found.**.



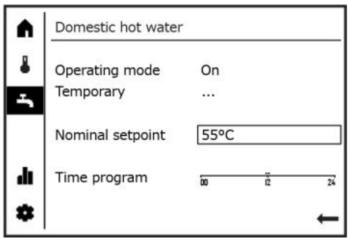
DHW heating on.



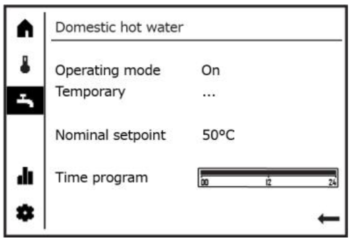
DHW heating off.



Heating the DHW to the setpoint before the temperature has fallen to the trigger threshold. The function returns to normal mode once the DHW has reached the setpoint.



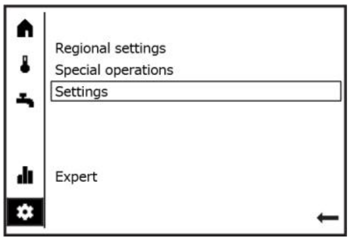
Changing the DHW temperature setpoint.



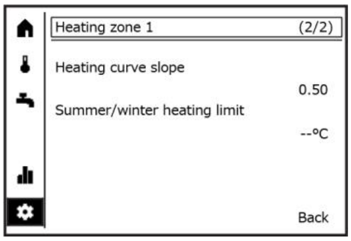
DHW time program (time program 4). Time program is switched on via line 1620.

10.4.5 Heating curve slope

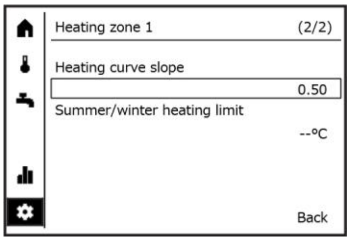
The heating curve slope of the heating circuit connected to the user interface can be adjusted in the settings menu (chapter 11.3) Other settings for that heating circuit and all heating circuits connected to the system can be changed via the parameter list (chapter 10.4.9).



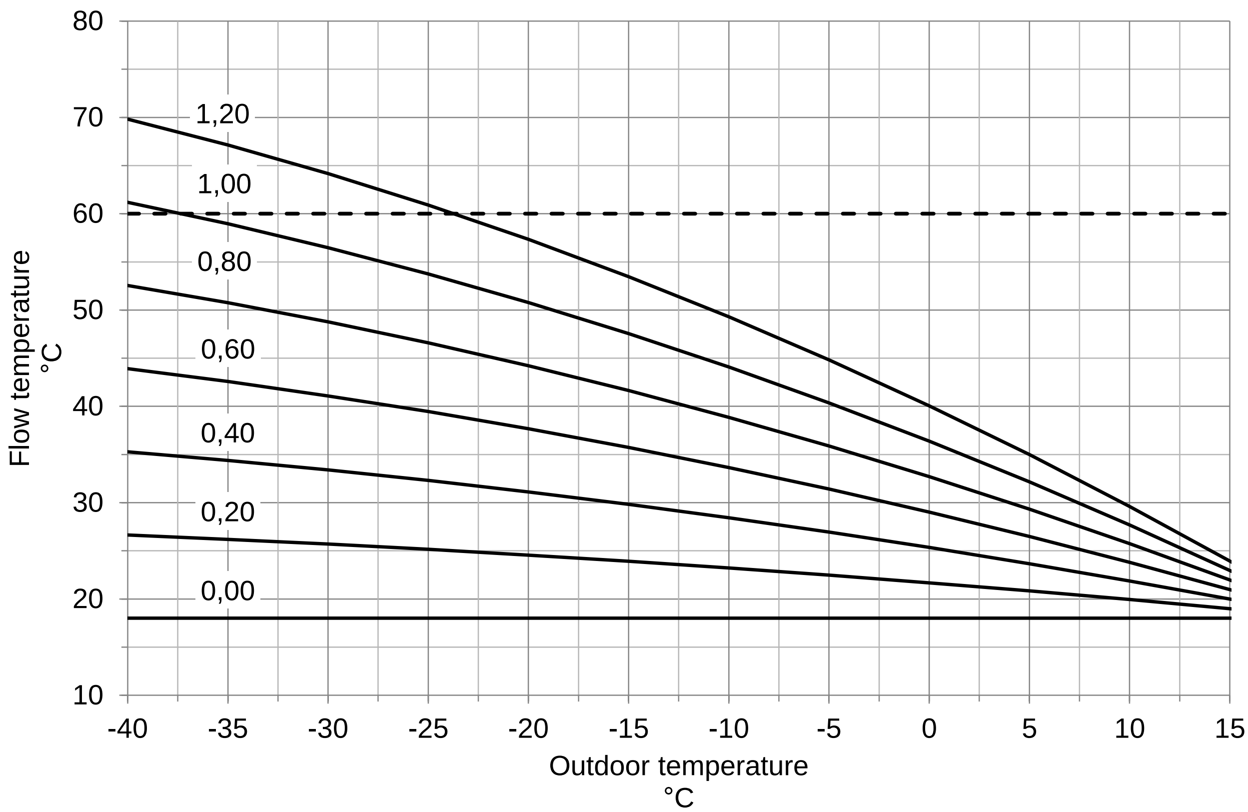
Select "Settings."



Select the sub-menu.



Specify the desired heating curve slope.

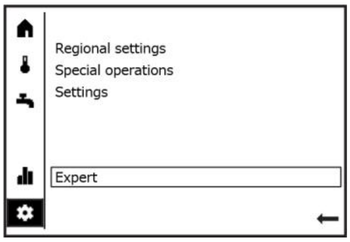


Kuva 27. Heating curves when the room temperature setpoint is 22 °C, the heating curve displacement is 0 °C, and the upper and lower limits do not restrict the heating water temperature.

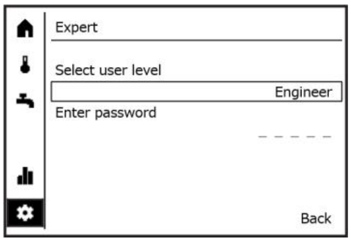
10.4.6 Changing the user level

The heat pump automation has four distinct user levels. The user level influences the menu structure and the setpoints displayed in the menus. The user levels are "end user", "commissioning", "expert", and "OEM". The end user view is the default interface view. The user level is changed from the settings menu (gear symbol). The chosen user level is indicated by a number in the status bar (see chapter 10.1). The commissioning level does not require a password, but the expert and OEM levels do require one. The end user and commissioning levels are sufficient for performing most actions.

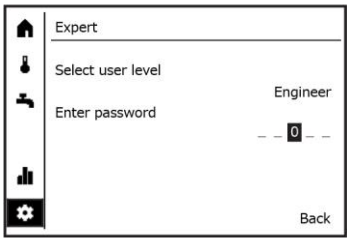
User levels
No symbol: end-user (no password)
1: commissioning (no password)
2: expert (password 00017)
3: OEM level (password 24358)



Enter the settings menu (gear symbol) and select the option Expert.

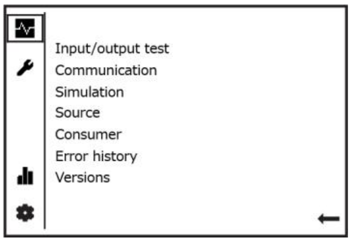


Specify the user level desired.

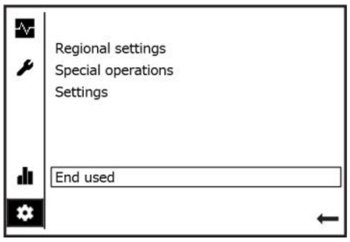


Enter the password, if needed.

The interface will inform about a successful log-on.



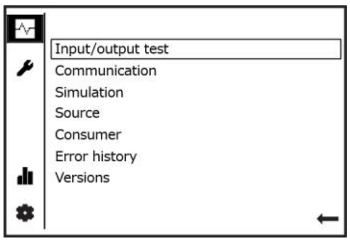
The menus change in accordance with the user level.



Returning to end-user level

10.4.7 Diagnostics menu

To enable access to the diagnostics menu, the user level must be set to “commissioning,” at minimum (chapter 10.4.6). The sub-menus displayed in the menu system depend on the selected user level.

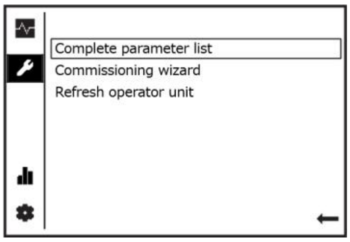


Diagnostics menu

10.4.8 Service menu

To enable access to the diagnostics menu, the user level must be set to “commissioning”, at minimum (chapter 10.4.6). The service menu provides access to the setting list based on line numbers (parameter list). The parameter list allows for a much more in-depth configuration of the automation settings than the basic displays.

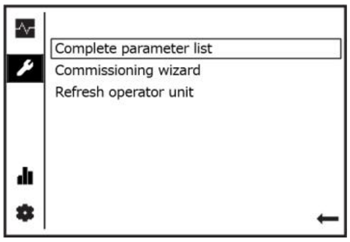
In addition, the commissioning wizard can be launched again, and the interface can be updated via the service menu. The user interface should be updated always after any changes in connections, e.g. after adding heating circuits. The service menu does not display an updating option if there is no need to update the interface.



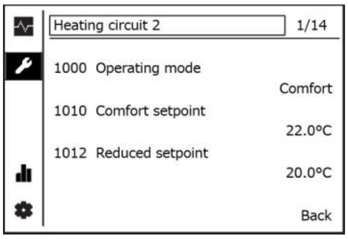
Service menu.

10.4.9 Settings based on line numbers (parameters)

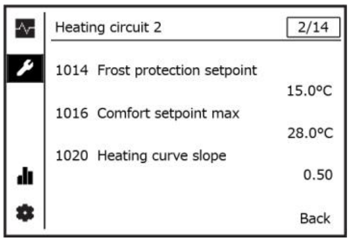
The setting list based on line numbers (parameters) is found in the service menu. To enable access to the diagnostics menu, the user level must be set to “commissioning”, at minimum (chapter 10.4.6). The lines displayed in the parameter list depend on the chosen user level. User interface loads the parameter list a while during first start-up and after changing the user level.



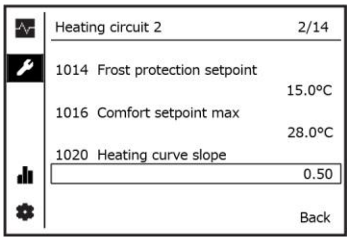
Open the parameter list.



First, select the desired menu in the status bar.



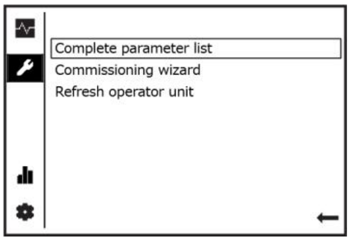
Then select the relevant sub-page in the menu hierarchy.



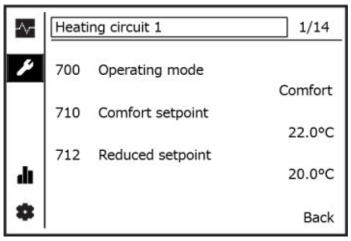
Finally, go to the desired setpoint to change it.

10.4.10 Detail-level settings for the heating circuits

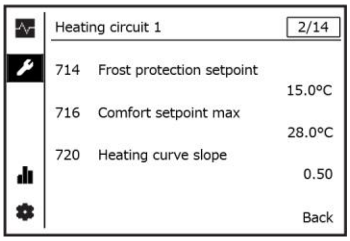
The detail-level settings for the heating circuits are accessed from the parameter list (chapterWarm side 10.4.10). To enable access to the service menu, the user level must be set to “commissioning”, at minimum. The heating circuit settings are presented in the chapter 10.5.



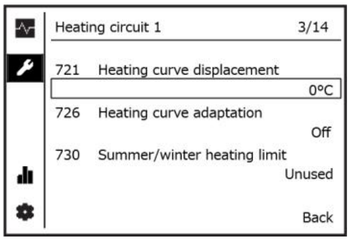
Open the parameter list.



First, select the desired menu in the status bar.



Then select the relevant sub-page in the menu hierarchy.

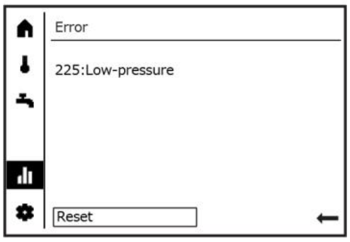


Finally, go to the desired setpoint to change it.

10.4.11 Resetting the heat pump

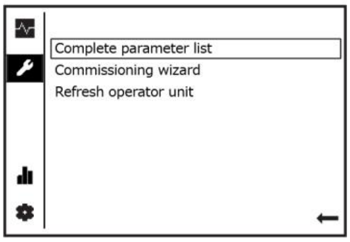
From the settings, the heat pump can be reset from a fault condition. Before the reset, you should investigate the cause(s) of the fault and make the necessary corrections.

10.4.11.1 All interfaces during an active fault

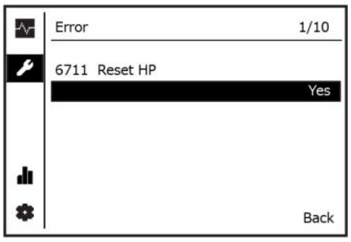


Select Reset in the diagnostics menu, then select Confirm.

10.4.11.2 All interfaces on the parameter list

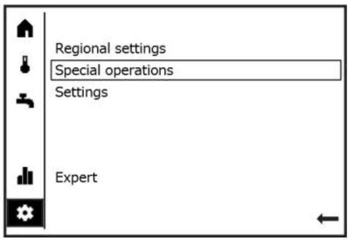


Open the parameter list (chapter 10.4.9).

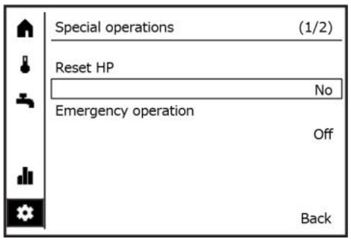


Enter the fault menu and select Reset HP on line 6711. Switch the line value to Yes. Other lines displayed in the menu depend on the user level.

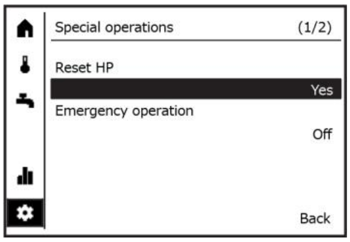
10.4.11.3 User interface in all situations



Select Special operations.



Select “Reset HP.”

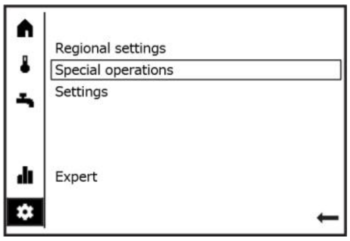


Change the setting to “Yes.”

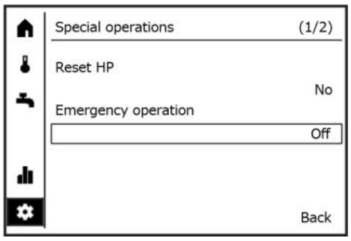
10.4.12 Emergency operation

Emergency operation mode switched on through the automation disables the heat pump's compressor. In emergency operation mode, heating is performed with only the electric immersion heater connected to the heat pump automation. Emergency operation is only available when the heat pump's automation is connected to an electric immersion heater that supports emergency operation. Usually, electric immersion heaters connected to the condenser line are used (chapter 15).

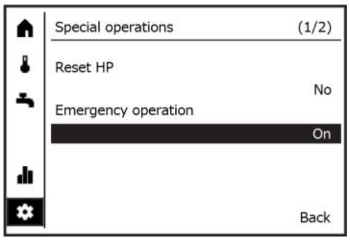
10.4.12.1 User interface, integrated to the heat pump



Select "Special operations."



Select "Emergency operation."



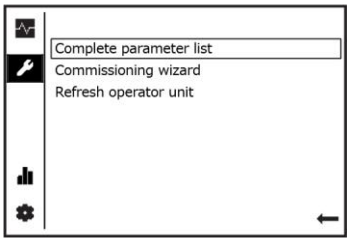
Change the setting to "Yes."

10.4.12.2 All interfaces on the parameter list

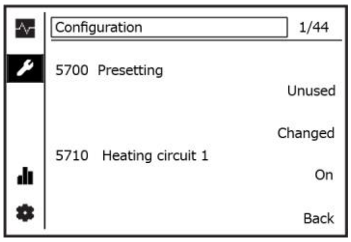
Emergency operation can be switched on from the parameter list (chapter 10.4.9), in the menu Service/special operation on line 7141.

10.4.13 Switching on heating circuit 2

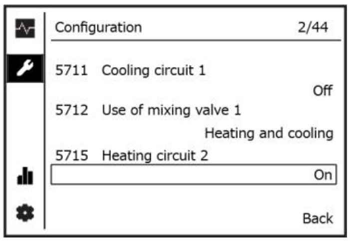
Heating circuit 2 is switched on from the parameter list's (chapter 10.4.9) configuration menu on line 5715.



Open the parameter list.



Select the configuration menu from the status bar.

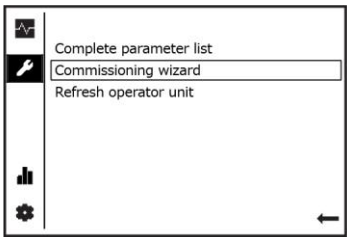


Switch the heating circuit (On) on line 5715.

10.5 Detail-level settings for the commissioning menus

10.5.1 Connecting the user interfaces to the heating circuits

The user interfaces are connected to the heating circuits by using the commissioning wizard. The wizard starts when the user interface is commissioned for the first time. The settings presented here have been configured at the factory in most models. They can be edited later by starting the wizard from the diagnostics menu. To enable access to the diagnostics menu, the user level must be set to “commissioning”, at minimum (chapter 10.4.6). After changing the settings, the user interface must be updated by selecting the function Refresh operator unit in the service menu. This function is displayed only when the user interface needs to be updated.



Select Commissioning wizard in the service menu.

10.5.1.1 Line 40 Intended use of the user interface

Used as (line 40)	Heating circuit connected to the user interface
Operator unit 1 / Room unit 1	Heating circuit 1 (can be additionally connected to heating circuits 2 and 3 on line 42)
Operator unit 2 / Room unit 2	Heating circuit 2
Operator unit 3 / Room unit 3	Heating circuit 3

Line 40 is for selecting the user interface sequence number and the connected heating circuit (zone). The sequence number is the same as the connected heating circuit’s number. The first user interfaces by sequence number (operator unit 1 and room unit 1) are the primary interfaces, which can be used to control heating circuit 1 and all other heating circuits centrally (circuits 2 and 3). Other heating circuits connected to operator unit 1 are selected on line 42.

The correct sequence number for the operator unit is Operator unit 1. For the primary room unit, select Room unit 1. The system may not have two interfaces of the same type sharing the same sequence number. For example, the system may contain an operator unit 1 and a room unit 1, but not two room units with the sequence number 1. You can select the room unit type “user interface” as long as the system does not have another interface with the same number.

If more interfaces are added to the system, their correct sequence number is either 2 or 3. Interface 2 is connected to heating circuit 2 only, and interface 3 is connected to heating circuit 3 only. All interfaces can adjust the settings for all heating circuits via the parameter list, regardless of the connection. However, changes in for example operation mode and room setpoint only affect the heating circuits connected to the user interface. The other operating lines presented below are not available for interfaces 2 and 3, because they can only be connected to the heating circuit indicated by the interface sequence number.

10.5.1.2 Line 42: Connecting the user interface to other heating circuits

This line is for selecting the heating circuits connected to user interface 1, other than heating circuit 1. Here you should select All zones, so user interface 1 can be used to control all heating circuits connected to the system.

Assignment device 1 (line 42)	Heating circuits connected to the user interface
All zones	User interface 1 can control heating circuits 1, 2 and 3.
Zone 1	User interface 1 can control heating circuit 1 only.
Zone 1 and 2	User interface 1 can control heating circuits 1 and 2.
Zone 1 and 3	User interface 1 can control heating circuits 1 and 3.

10.5.2 Lines 44 and 46: Operation of zones 2 and 3 via user interface 1

Lines 44 and 46 are for selecting the connection of operation mode (Automatic, Comfort etc.) of heating circuits 2 and 3, and the room temperature setpoint, to the corresponding settings of heating circuit 1. Here you should select Independently, so heating circuits 2 and 3 can be controlled independently via operator unit 1.

Operation of zones 2 and 3 (lines 44 and 46)	Operation of heating circuits 2 and 3
Independently	Switching the operation mode or room temperature setpoint of heating circuit 1 does not affect the settings of heating circuits 2 and 3. Heating circuits 2 and 3 can be sepa-rately selected to be displayed in the heating circuit menu of user interface 1.
Jointly with zone 1	Changing the operation mode and room temperature setpoint of heating circuit 1 changes the same values for heating circuits 2 and 3. Heating circuits 2 and 3 cannot be separately selected for display in the heating circuit menu of user interface 1.

10.5.3 Line 47 Room temperature’s area of influence from user interface 1

Line 47 selects the area of influence for the room temperature measured by user interface 1 (room unit 1). Here you should select For zone 1 only.

Room temperature’s area of influence from user interface 1 (line 47)	Area of influence
For zone 1 only	The temperature measured by room unit 1 is used for controlling heating circuit 1 only.
For all assigned zones	All heating circuits that are connected to the user interface via line 42 use the room temperature measured by room unit 1 to control the heating.

In order to use the room temperature for controlling the heating circuits, the room unit must be installed in a location that is suitable for measuring temperatures, and the control method based on room temperature must be implemented.

10.5.4 Line 48 Temporary Comfort mode’s area of influence

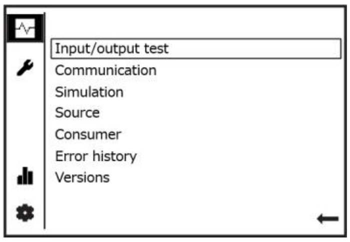
Selects which heating circuits are influenced by the temporary Comfort mode of heating circuit 1 (chapter 10.4.3).

Temporary Comfort mode’s area of influence from user interface 1 (line 48)	Area of influence
For zone 1 only	Temporary Comfort mode selected for heating circuit 1 affects heating circuit 1 only.
For all assigned zones	All heating circuits connected to the user interface via line 42 are switched on to a temporary comfort mode if the function is selected for heating circuit 1.
None	Heating circuit 1 does not support the temporary Comfort mode.

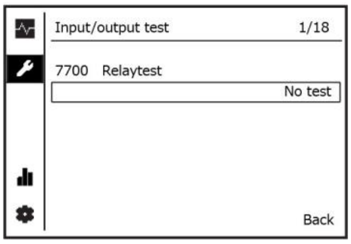
10.6 Relay test

With the relay test, the power can be switched on to the controller´s QX outputs one by one. This way, the functionality and electrical connections of actuators can be ensured before starting the heat pump. The relay test can also be used during maintenance, and troubleshooting. It is found in the diagnostics menu and in the sub-menu of parameter list “Input/output test”. The line number of the relay test is 7700. Note that both the pump´s QX output and the UX signal output have to be switched on in the speed-controlled pumps.

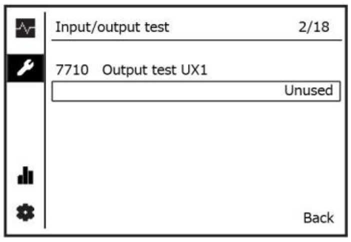
RELAY TEST FROM DIAGNOSTICS MENU



Enter the diagnostics menu (chapter 10.4.7).

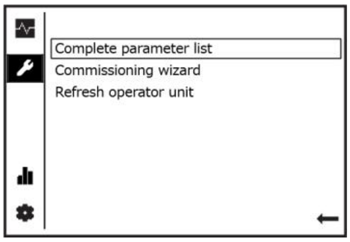


Enter the menu “Input/output test”. Select QX output.

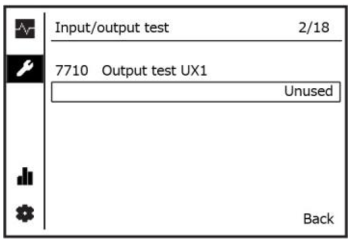


If necessary, also select UX output test (speed controlled pumps and other control signals).

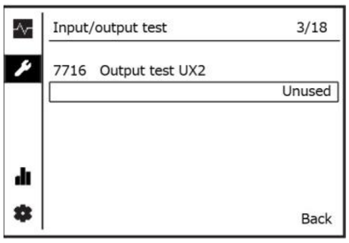
RELAY TEST FROM PARAMETER LIST



Go to the parameter list (chapter 10.4.9)



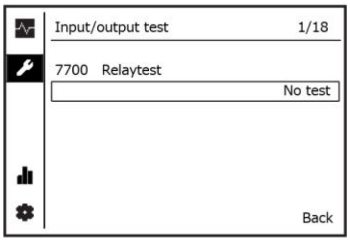
Go to the menu “Input/output test”. Select QX output.

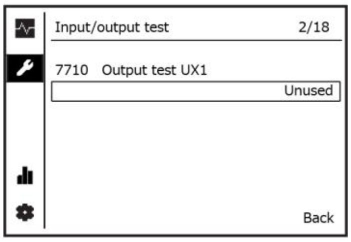


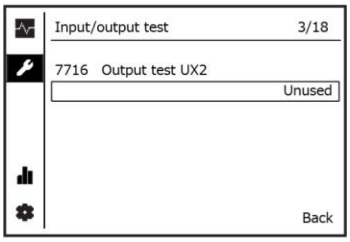
If necessary, also select UX output test (speed controlled pumps and other control signals).

10.6.1.1 Relay test for speed controlled pumps

The test for speed controlled pumps is done by turning on the pump´s QX output and signal output test. The test is finished by selecting the function for relay test (line 7700) ”no test” and putting the test value for UX output ”---”. Relay tests for other control signal-operated devices are accessed similarly.







Select the QX output that is connected to the pump.

Also select the pump’s UX output test. Select the UX output that is connected to the pump (see model-specific factory settings and electrical diagrams). Select a test value, for example 100, 50 and 0 percent.

11 Settings for heating circuits

11.1 Important setpoints and statuses

The following examples use heating circuit 1's line numbers. The corresponding setting lines for other heating circuits operate in the same way. The setpoints for the heating circuits are found in the parameter list of each heating circuit's menu (chapter 10.4.10). If several heating circuits have been connected to the same line or storage tank, the flow temperature request sent to the heat pump with the storage tank temperature is determined in accordance with the highest request.

In the menus, the heating circuits are also referred to as zones. Zone 1 refers to heating circuit 1, zone 2 to heating circuit 2, and zone 3 to heating circuit 3. Connecting the user interface to the heating circuits is presented in chapter 10.4.11.

SEQ Taulukko * ARABIC Table 32. Key setpoints of heating circuit 1

Menu	Line	Setting
Heating circuit 1	700	Operating mode
Heating circuit 1	710	Comfort setpoint max
Heating circuit 1	712	Reduced setpoint
Heating circuit 1	714	Frost protection setpoint
Heating circuit 1	720	Heating curve slope
Heating circuit 1	721	Heating curve displacement (parallel displacement)
Heating circuit 1	730	Summer/winter heating limit
Heating circuit 1	740	Flow temp. setpoint min. (lower limit)
Heating circuit 1	741	Flow temp. setpoint max. (upper limit)
Heating circuit 1	750	Room influence
Heat pump	2855 F	Switch-off temperature in space heating
Heating circuit 1	2839	Setting change time LKV/heating
Status	8000	State heating circuit 1
Diagnostics heat generation	8411	Return temp HP
Diagnostics heat generation	8412	Flow temp HP
Diagnostics consumers	8700	Outside temperature
Diagnostics consumers	8703	Outside temp attenuated
Diagnostics consumers	8704	Outside temp composite
Diagnostics consumers	8743	Flow temp 1
Diagnostics consumers	8744	Flow set value 1 (The setpoint of heating circuit 1's flow (from the heating curve)

11.2 Heat circuit operation and time programs

Three different levels can be saved for the room temperature setpoint. These setpoint values are, from the highest to the lowest, Comfort, Reduced, and Frost Protection. The value can be changed either automatically on the basis of the time program or manually.

Timer programs are enabled only when the heating circuit in automatic-operating mode. A time program toggles the heating circuit's operating mode between Comfort mode and Reduced mode automatically. Comfort mode is used during the period specified in the time program. At other times, Reduced mode is used. Timer programs can be set up for each day of the week separately. Heating circuits should be kept in Automatic mode, because then they can be automatically disabled when the heating period ends (summer/winter heating limit). When using factory settings, the heating circuits have Automatic mode enabled, and the time program keeps Comfort mode on permanently.

Comfort	The setpoint of room temperature is the setpoint of Comfort mode (line 710). The heating circuit time programs are disabled. The Eco functions are not enabled, even if they were switched on.
Reduced	The setpoint of room temperature is the setpoint of Reduced mode (line 712). The heating circuit time programs are disabled. The Eco functions are enabled if they have been switched on.
Protection mode	The setpoint of room temperature is the setpoint of frost protection (line 714). The heating-circuit time programs are disabled. The Eco functions are enabled if they have been switched on.
Automatic	The timed control of the room temperature setpoint is on. The room temperature setpoint is toggled between Comfort mode and Reduced mode in line with the time program. In holiday programs, it is possible to select whether the mode changes from Comfort mode to Reduced mode or Frost Protection mode (line 648) during holidays. Eco functions are enabled.

11.3 Heating curve

The heating system of a building is usually sized according to the calculated heating capacity. The heating capacity of the heating circuits is adjusted by changing their flow temperature. The flow temperature is usually adjusted according to outside temperature, because the need for heating capacity is typically most dependent on the temperature outside. In addition to the outside temperature, the temperature of the heating circuit can be controlled on the basis of room temperature measurements, or on the basis of a combination of the two. In addition to the outside and room temperatures, heating demand is influenced by solar radiation and internal heat sources, such as a sauna, lighting, domestic appliances and people. These heat sources can be taken into account by measuring the room temperature. Different parts of a building may have varying room temperatures and heating demands. Because of this, heating can be divided among several heating circuits, each connected to spaces with similar heating demands. The return temperature from the heating circuits is dependent on the heat emission and discharge of the heating circuits, in addition to the flow temperature.

The heating curve is used to select the heating circuit’s flow temperature in different outside temperatures. The heating curve is set by selecting the room temperature setpoint and also the heating curve slope and parallel displacement. In addition to adjusting the slope and displacement, the heating curve can be equipped with maximum and minimum limits (chapter 11.5.3). The values of the heating curve slope and the parallel displacement are appropriate if the room temperature is appropriate for the heating season regardless of the outside temperature. The heating curve slope and displacement should be changed only slowly (for example, once per 24 hours) and in small increments, because the temperatures of the building structures and indoor air change slowly.

Heating curve slope is set on line 720. If the room temperature is too low in very cold temperatures, a steeper adjustment curve is selected. If the room temperature is too high in very cold temperatures, a more graded adjustment curve is selected. The heating curve displacement is performed on line 721. If the room temperature is consistently too low in both very cold and milder temperatures, the curve is appropriate (line 720 is not changed) but is moved upward by increasing the value on line 721. If the room temperature is consistently too high in both very cold and milder temperatures, the curve is appropriate (line 720 is not changed) but is moved downward by decreasing the value on line 721. In control based on the heating curve, increases and decreases in the room temperature setpoint correspond to the heating curve displacement (line 721) in practice. Thus, the heating curve can also be displaced by changing the room temperature setpoint. For more detailed instructions on setting the heating curve in various situations, see chapter 11.5.

In an appropriately insulated, floor-heated building, a suitable heating curve slope is usually approximately 0.3...0.5. In an older radiator-heated building with poorer insulation the suitable slope is usually approximately 0.5...0.9. The suitable values must be found on a case-by-case basis, since heating systems, buildings, and usage habits vary.

11.3.1 Upper and lower limits of the flow temperature of the heating circuit

The upper and lower limits of the temperature of the space heating circuit flow are set on lines 740 and 741. The heat circuit’s flow setpoint does not breach the limits, even if the heating curve indicates a temperature outside the set limits. The limits are used in control based on both the heating curve and the room temperature. If the connection does not include a heating circuit tank, take the temperature differential on line 5810 and the switching differential on line 2840 into account in the limits (chapter 13).

In addition to the aforementioned limits, you can also set an upper limit to the temperature of the flow water leaving the condenser on line 2855 (F series). If this limit is exceeded, the heat pump shuts down (chapter 24.1). The purpose of this function is to protect the heating circuit from temperatures that are too high. This limit should be set for floor heating if the system is not equipped with a heating circuit’s buffer storage tank and the connected circuit control valve. If the flow water cannot exceed the limit on line 2855 even momentarily, the time set on line 2839 (chapter 11.3.3) should be removed altogether (---).

The upper and lower limits of the temperature depend on the operating mode of the heating circuit and on the floor structure. The appropriate values should always be checked from the instructions provided by the heating-circuit manufacturer and supplier. For example, the flow temperature in floor heating circuits usually should be no higher than approximately 35–45 °C and no lower than approximately 25 °C. The desired heating effect is usually reached with a flow temperature of 30–

35 °C for concrete floors, and 40–45 °C for wooden floors. The suitable values must be found on a case-by-case basis, since heating systems, buildings, and usage habits vary.

If the system is not equipped with a supplementary heat source, such as an electric immersion heater or an electric kettle, the upper limit of the heating circuit's flow water temperature must be set below the factory-set switch-off temperature (line 2844). This prevents the heating curve from requesting water that is hotter than the switch-off temperature. When setting the limit, pay attention to the switching differential, which designates how much above the setpoint the water temperature leaving the heat pump can be. Due to this the upper limit can be within 2...4 °C from the switch-off temperature, at most.

11.3.2 Room temperature setpoint

The temperature of the heating circuit can be controlled on the basis of room temperature measurements. Control based on room temperature requires a sensor measuring room temperature in the heat pump controller. The measurement can be carried out by means of either a wall-mounted user interface (room unit) or a separate sensor measuring the room temperature. There can be several room units and temperature sensors. The impact of the room temperature measurement on the flow temperature of the heating circuit (room influence) is selected on line 750.

If the room influence is switched off (the value on line 750 is "---") or there is no room sensor, the flow temperature in the heating circuit is based only on the heating curve. In that situation, the room temperature setpoint is used to select the lowest flow temperature. For example, if the room temperature setpoint is 22 °C, the lowest flow temperature is 22 °C if a lower limit higher than the room temperature setpoint has not been set separately for the temperature (line 740). In control based on the heating curve, increasing and decreasing the room temperature setpoint corresponds to the heating curve displacement (line 721) in practice. Thus, the heating curve can also be displaced by changing the room temperature setpoint.

If the room temperature sensor is connected to the controller and the room influence value is 1–99%, the flow temperature is based on both the outside temperature (the heating curve) and the room temperature. In that case, the controller changes the flow temperature determined by the curve on the basis of the room temperature. The higher the proportion of room influence is set on line 750, the bigger the change is. If the value set for room influence is 100%, the flow temperature ignores the heating curve. In that case, the flow temperature is based only on the setpoint of room temperature and the change in the measured room temperature.

If the measured room temperature is a good representation of the temperature of the spaces connected to the heating circuit but the flow temperature should take the outside temperature also into consideration, then the level of room influence can typically be set to approximately 60%. If the measured room temperature is not a very good representation of the entire heating circuit's area of influence, then the selected room influence can be approximately 20%.

11.3.3 Operating time after DHW heating

When the domestic water has been heated, the heat pump turns the flow into the heating circuit with the diverting valve and then operates for the switching duration set on line 2839, even if the heating circuit does not request heat at that moment. This lets the automation measure the heating circuit's return temperature (sensor B71), which is used to guide the compressor on and off. If the sensor's reading is below the setpoint and switch-off temperatures (chapter 24.1), the heat pump is kept operational. The purpose of the function is to avoid unnecessary stoppages in heat pump's operation and heating after the DHW has been charged. The switch-off temperature on line 2844 is in effect during the switching time even if the switch-off temperature designed to protect the heating circuit on line 2855 (chapter 24.1.2) is in use. Having a switching time is not usually necessary in systems that are equipped with a heating circuit buffer storage tank (**Error! Reference source not found.**).

11.3.4 Heating curve equation

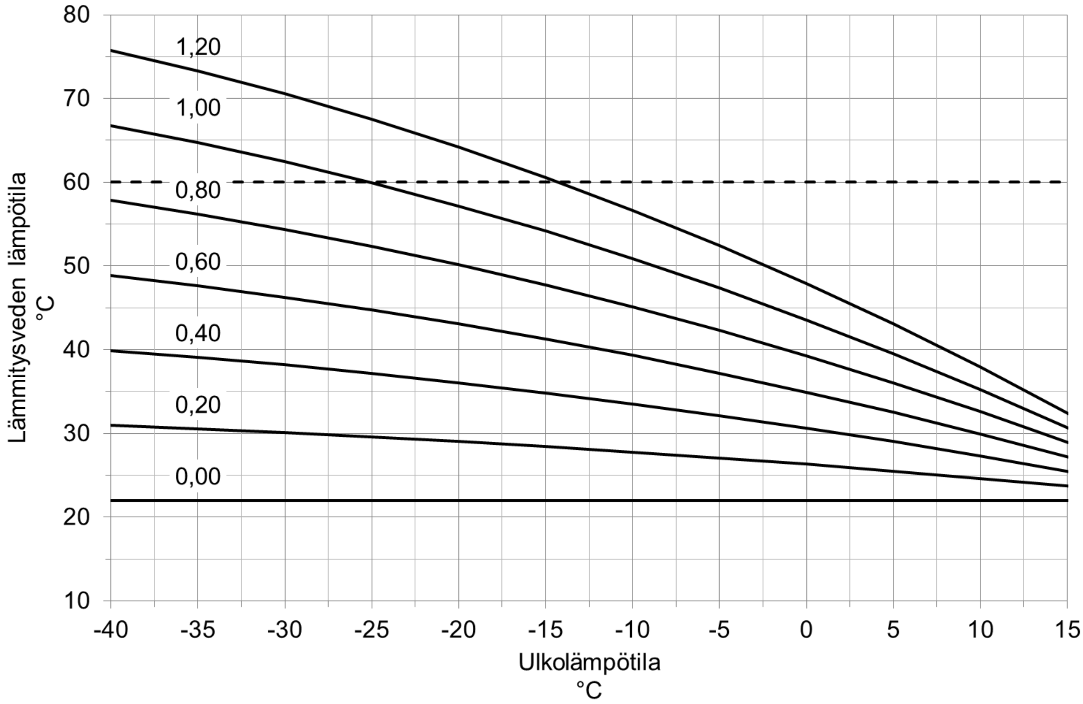
The heating curve equation is

$$\mathrm{T_{meno}} = \mathrm{T_{ha}} + [2 + (\mathrm{T_{ha}} - \mathrm{T_{ulkov}}) - 0.005 \cdot (\mathrm{T_{ha}} - \mathrm{T_{ulkov}})^2] \cdot \mathrm{k} \tag{1}$$

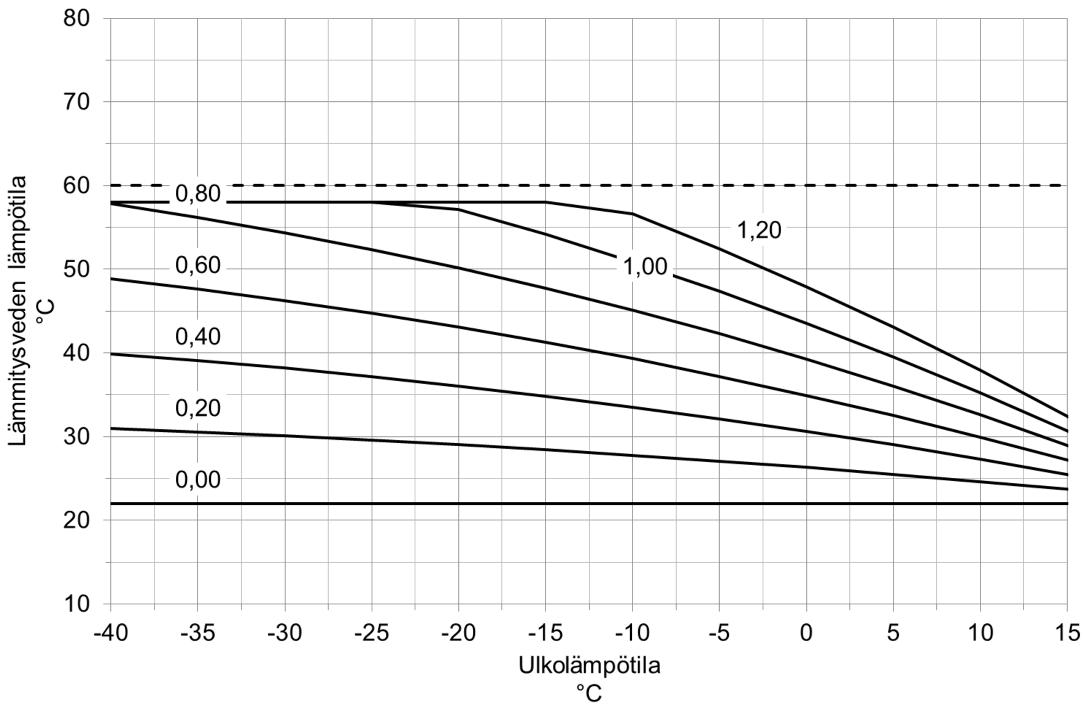
where $\mathrm{T_{meno}}$ is the heating circuit's flow temperature, $\mathrm{T_{ha}}$ is the room temperature setpoint,$\mathrm{T_{ulkov}}$ is the outdoor temperature, observing also the building's heat capacity (composite outside temperature, line 8704) and k is the heating curve slope.

11.3.5 Heating curve diagrams

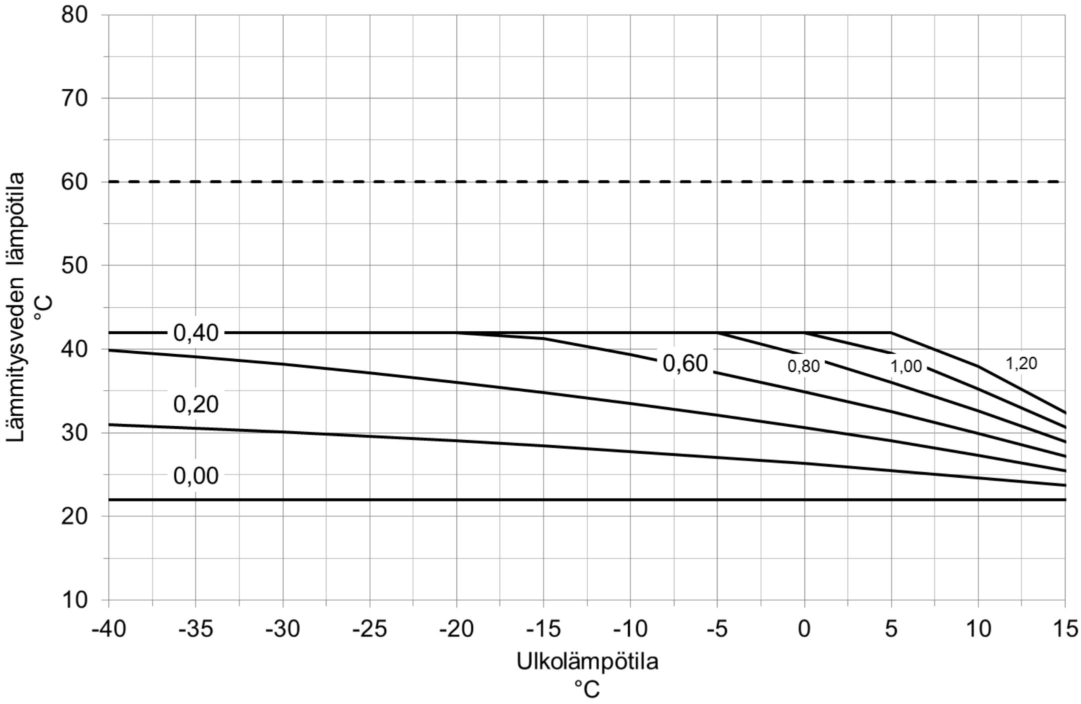
In the diagram x-axis refers to the outdoor temperature (°C) and the y-axis to the heating flow temperature setpoint (°C).



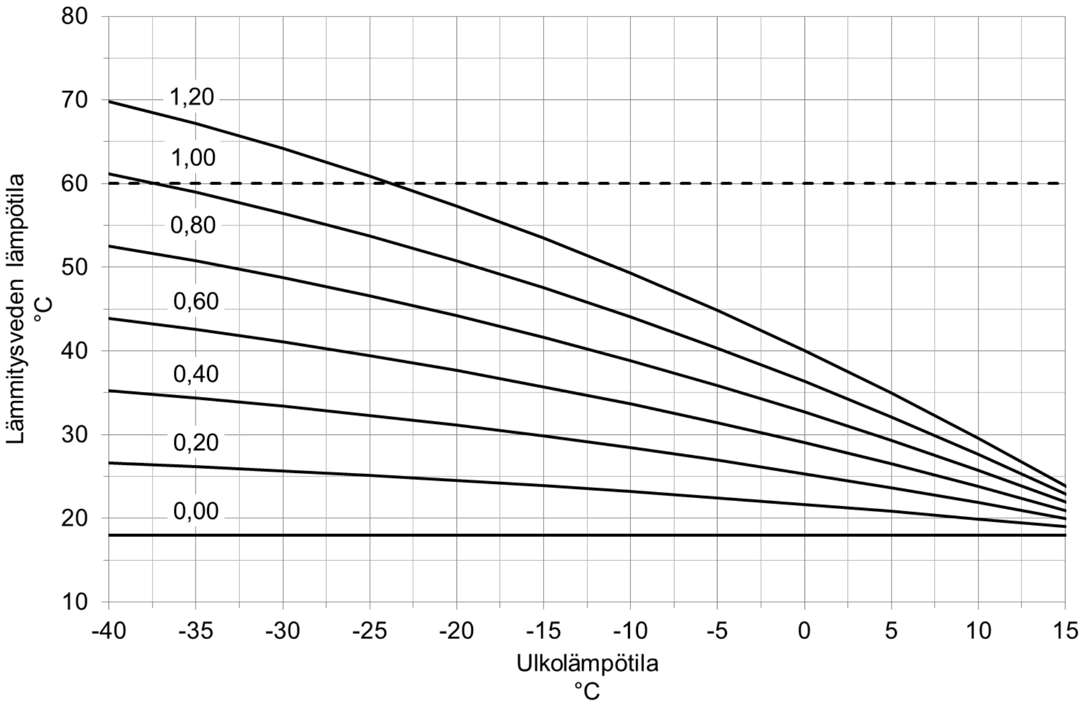
Kuva 28. Heating curves when the room temperature setpoint is 22 °C, the heating curve displacement is 0 °C, and the upper and lower limits do not restrict the heating water temperature.



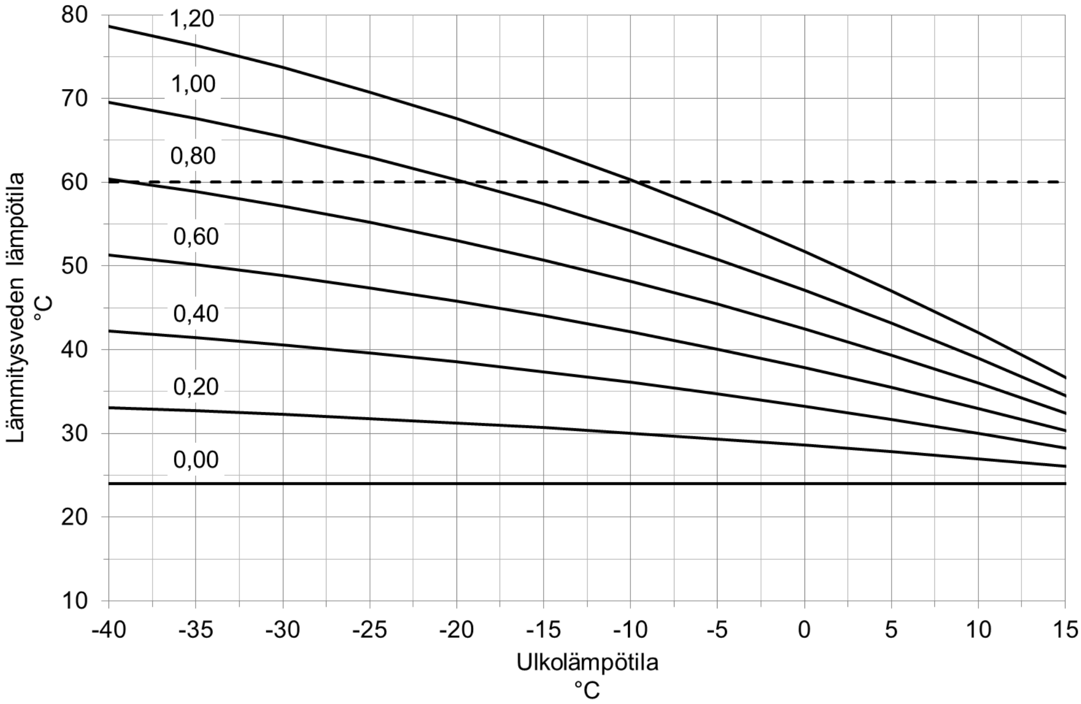
Kuva Heating curves when the room temperature setpoint is 22 °C, the heating curve displacement is 0 °C, and the upper limit of the heating water temperature is 58 °C.



Kuva 29. Heating curves when the room temperature setpoint is 22 °C, the heating curve displacement is 0 °C, and the upper limit of the heating water temperature is 42 °C.



Kuva 30. Heating curves when the room temperature setpoint is 18 °C, the heating curve displacement is 0 °C, and the upper and lower limits do not restrict the heating water temperature.



Kuva 31. Heating curves when the room temperature setpoint is 24 °C, the heating curve displacement is 0 °C, and the upper and lower limits do not restrict the heating water temperature.

11.3.6 Heating curve tables

Heat pumps made for consumer use usually achieve a temperature of approximately 60...68 °C. For higher flow temperatures, a heat pump capable of higher temperatures, or an extra heat source installed in the heating circuit's flow line and capable of higher temperatures, such as an electric heating or oil boiler, is required.

Table 33. Heating curves with room temperature setpoint at 22 °C

Setpoint for room temperature: 22 °C	Heating curve slope and heating circuit's flow temperature (°C)															
Outside temperature (°C)	**0.0**	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**1.0**	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**
−50	22.0	26.8	31.6	36.4	41.2	46.0	50.8	55.7	60.5	65.3	70.1	74.9	79.7	84.5	89.3	94.1
−45	22.0	26.7	31.3	36.0	40.6	45.3	49.9	54.6	59.2	63.9	68.6	73.2	77.9	82.5	87.2	91.8
−40	22.0	26.5	31.0	35.4	39.9	44.4	48.9	53.3	57.8	62.3	66.8	71.3	75.7	80.2	84.7	89.2
−35	22.0	26.3	30.6	34.8	39.1	43.4	47.7	51.9	56.2	60.5	64.8	69.0	73.3	77.6	81.9	86.1
−30	22.0	26.0	30.1	34.1	38.2	42.2	46.3	50.3	54.4	58.4	62.5	66.5	70.6	74.6	78.7	82.7
−25	22.0	25.8	29.6	33.4	37.2	41.0	44.8	48.6	52.4	56.2	60.0	63.8	67.5	71.3	75.1	78.9
−20	22.0	25.5	29.0	32.6	36.1	39.6	43.1	46.6	50.1	53.7	57.2	60.7	64.2	67.7	71.3	74.8
−15	22.0	25.2	28.4	31.6	34.9	38.1	41.3	44.5	47.7	50.9	54.2	57.4	60.6	63.8	67.0	70.2
−10	22.0	24.9	27.8	30.7	33.6	36.4	39.3	42.2	45.1	48.0	50.9	53.8	56.7	59.5	62.4	65.3
−5	22.0	24.5	27.1	29.6	32.1	34.7	37.2	39.7	42.3	44.8	47.4	49.9	52.4	55.0	57.5	60.0
0	22.0	24.2	26.3	28.5	30.6	32.8	34.9	37.1	39.3	41.4	43.6	45.7	47.9	50.1	52.2	54.4
5	22.0	23.8	25.5	27.3	29.0	30.8	32.5	34.3	36.0	37.8	39.6	41.3	43.1	44.8	46.6	48.3
10	22.0	23.3	24.7	26.0	27.3	28.6	30.0	31.3	32.6	34.0	35.3	36.6	37.9	39.3	40.6	41.9
15	22.0	22.9	23.8	24.6	25.5	26.4	27.3	28.1	29.0	29.9	30.8	31.6	32.5	33.4	34.3	35.1
20	22.0	22.4	22.8	23.2	23.6	24.0	24.4	24.8	25.2	25.6	26.0	26.4	26.8	27.2	27.6	28.0
25	22.0	21.9	21.8	21.7	21.6	21.5	21.4	21.3	21.2	21.1	21.0	20.9	20.7	20.6	20.5	20.4
30	22.0	21.4	20.7	20.1	19.5	18.8	18.2	17.6	16.9	16.3	15.7	15.0	14.4	13.8	13.2	12.5

Table 34. Heating curves with room temperature setpoint at 24 °C

Setpoint for room temperature: 24 °C	Heating curve slope ja lämmityspiirin flow temperature (°C)															
Outside temperature (°C)	**0.0**	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**1.0**	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**
−50	24.0	28.9	33.7	38.6	43.4	48.3	53.2	58.0	62.9	67.8	72.6	77.5	82.3	87.2	92.1	96.9
−45	24.0	28.7	33.4	38.2	42.9	47.6	52.3	57.0	61.8	66.5	71.2	75.9	80.6	85.4	90.1	94.8
−40	24.0	28.6	33.1	37.7	42.2	46.8	51.3	55.9	60.4	65.0	69.5	74.1	78.6	83.2	87.7	92.3
−35	24.0	28.4	32.7	37.1	41.4	45.8	50.2	54.5	58.9	63.2	67.6	72.0	76.3	80.7	85.0	89.4
−30	24.0	28.1	32.3	36.4	40.6	44.7	48.9	53.0	57.1	61.3	65.4	69.6	73.7	77.8	82.0	86.1
−25	24.0	27.9	31.8	35.7	39.6	43.5	47.4	51.3	55.2	59.1	63.0	66.9	70.8	74.7	78.6	82.5
−20	24.0	27.6	31.3	34.9	38.5	42.2	45.8	49.4	53.1	56.7	60.3	64.0	67.6	71.2	74.8	78.5
−15	24.0	27.3	30.7	34.0	37.4	40.7	44.0	47.4	50.7	54.1	57.4	60.7	64.1	67.4	70.8	74.1
−10	24.0	27.0	30.0	33.1	36.1	39.1	42.1	45.2	48.2	51.2	54.2	57.2	60.3	63.3	66.3	69.3
−5	24.0	26.7	29.4	32.0	34.7	37.4	40.1	42.8	45.4	48.1	50.8	53.5	56.2	58.8	61.5	64.2
0	24.0	26.3	28.6	30.9	33.2	35.6	37.9	40.2	42.5	44.8	47.1	49.4	51.7	54.1	56.4	58.7
5	24.0	25.9	27.8	29.8	31.7	33.6	35.5	37.4	39.4	41.3	43.2	45.1	47.0	49.0	50.9	52.8
10	24.0	25.5	27.0	28.5	30.0	31.5	33.0	34.5	36.0	37.5	39.0	40.5	42.0	43.5	45.0	46.5
15	24.0	25.1	26.1	27.2	28.2	29.3	30.4	31.4	32.5	33.5	34.6	35.7	36.7	37.8	38.8	39.9
20	24.0	24.6	25.2	25.8	26.4	27.0	27.6	28.1	28.7	29.3	29.9	30.5	31.1	31.7	32.3	32.9
25	24.0	24.1	24.2	24.3	24.4	24.5	24.6	24.7	24.8	24.9	25.0	25.1	25.2	25.3	25.4	25.5
30	24.0	23.6	23.2	22.7	22.3	21.9	21.5	21.1	20.7	20.2	19.8	19.4	19.0	18.6	18.1	17.7

Table 35. Heating curves with room temperature setpoint at 18 °C

Setpoint for room temperature: 18 °C	Heating curve slope ja lämmityspiirin flow temperature (°C)															
Outside temperature (°C)	**0.0**	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**	**1.0**	**1.1**	**1.2**	**1.3**	**1.4**	**1.5**
−50	18.0	22.7	27.4	32.1	36.8	41.4	46.1	50.8	55.5	60.2	64.9	69.6	74.3	78.9	83.6	88.3
−45	18.0	22.5	27.0	31.5	36.1	40.6	45.1	49.6	54.1	58.6	63.2	67.7	72.2	76.7	81.2	85.7
−40	18.0	22.3	26.6	31.0	35.3	39.6	43.9	48.2	52.5	56.9	61.2	65.5	69.8	74.1	78.5	82.8
−35	18.0	22.1	26.2	30.3	34.4	38.5	42.6	46.7	50.8	54.9	59.0	63.1	67.1	71.2	75.3	79.4
−30	18.0	21.8	25.7	29.5	33.4	37.2	41.1	44.9	48.8	52.6	56.5	60.3	64.2	68.0	71.9	75.7
−25	18.0	21.6	25.2	28.7	32.3	35.9	39.5	43.0	46.6	50.2	53.8	57.3	60.9	64.5	68.1	71.6
−20	18.0	21.3	24.6	27.8	31.1	34.4	37.7	40.9	44.2	47.5	50.8	54.1	57.3	60.6	63.9	67.2
−15	18.0	21.0	23.9	26.9	29.8	32.8	35.7	38.7	41.6	44.6	47.6	50.5	53.5	56.4	59.4	62.3
−10	18.0	20.6	23.2	25.8	28.4	31.0	33.6	36.3	38.9	41.5	44.1	46.7	49.3	51.9	54.5	57.1
−5	18.0	20.2	22.5	24.7	26.9	29.2	31.4	33.6	35.9	38.1	40.4	42.6	44.8	47.1	49.3	51.5
0	18.0	19.8	21.7	23.5	25.4	27.2	29.0	30.9	32.7	34.5	36.4	38.2	40.1	41.9	43.7	45.6
5	18.0	19.4	20.8	22.2	23.7	25.1	26.5	27.9	29.3	30.7	32.2	33.6	35.0	36.4	37.8	39.2
10	18.0	19.0	19.9	20.9	21.9	22.8	23.8	24.8	25.7	26.7	27.7	28.6	29.6	30.6	31.6	32.5
15	18.0	18.5	19.0	19.5	20.0	20.5	21.0	21.5	22.0	22.5	23.0	23.5	23.9	24.4	24.9	25.4
20	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
25	18.0	17.5	17.0	16.4	15.9	15.4	14.9	14.3	13.8	13.3	12.8	12.2	11.7	11.2	10.7	10.1
30	18.0	16.9	15.9	14.8	13.7	12.6	11.6	10.5	9.4	8.4	7.3	6.2	5.1	4.1	3.0	1.9

11.4 Standard settings for heating circuits

Comfort temperature	°C	22		Heating circuit 1 line 720	Heating circuit 1 line 741	Heating circuit 1 line 741	On demand
Parallel displacement	°C	0		Heating circuit 2 line 1020	Heating circuit 2 line 1041	Heating circuit 2 line 1041	line 2855
				Heating circuit 3 line 1320	Heating circuit 3 line 1341	Heating circuit 3 line 1341	
Heating system and floor structure	Weather zone	Design outside temperature	Flow temperature in the design outside tem-perature	Heating curve's slope	Flow upper limit	Flow lower limit	Switch-off tempera-ture in space heating (on demand)
		°C	°C		°C	°C	
Floor heating, concrete structure, flagstone	I	−26	30	0.22	32	15–22	37
Floor heating, concrete structure, flagstone	II	−29	30	0.20	32	15–22	37
Floor heating, concrete structure, flagstone	III	−32	30	0.20	32	15–22	37
Floor heating, concrete structure, flagstone	IIII	−38	30	0.18	32	15–22	37
Floor heating, concrete structure, flagstone	I	−26	35	0.34	37	15–22	42
Floor heating, concrete structure, flagstone	II	−29	35	0.34	37	15–22	42
Floor heating, concrete structure, flagstone	III	−32	35	0.32	37	15–22	42
Floor heating, concrete structure, flagstone	IIII	−38	35	0.30	37	15–22	42
Floor heating, wooden structure, parquet, boarded or laminate	I	−26	40	0.48	42	15–22	47
Floor heating, wooden structure, parquet, boarded or laminate	II	−29	40	0.45	42	15–22	47
Floor heating, wooden structure, parquet, boarded or laminate	III	−32	40	0.44	42	15–22	47
Floor heating, wooden structure, parquet, boarded or laminate	IIII	−38	40	0.42	42	15–22	47

Comfort temperature	°C	22		Heating circuit 1 line 720	Heating circuit 1 line 741	Heating circuit 1 line 741	On demand
Parallel displacement	°C	0		Heating circuit 2 line 1020	Heating circuit 2 line 1041	Heating circuit 2 line 1041	line 2855
				Heating circuit 3 line 1320	Heating circuit 3 line 1341	Heating circuit 3 line 1341	
Heating system and floor structure	Weather zone	Design outside temperature	Flow temperature in the design outside tem-perature	Heating curve's slope	Flow upper limit	Flow lower limit	Switch-off tempera-ture in space heating (on demand)
		°C	°C		°C	°C	
Floor heating, wooden structure, parquet, boarded or laminate	I	−26	45	0,60	47	15–22	52
Floor heating, wooden structure, parquet, boarded or laminate	II	−29	45	0.58	47	15–22	52
Floor heating, wooden structure, parquet, boarded or laminate	III	−32	45	0.56	47	15–22	52
Floor heating, wooden structure, parquet, boarded or laminate	IIII	−38	45	0.52	47	15–22	52
Radiator heating, new buildings (2013-), design 45/30 °C	I	−26	45	0,60	47	15–22	-
Radiator heating, new buildings (2013-), design 45/30 °C	II	−29	45	0.58	47	15–22	-
Radiator heating, new buildings (2013-), design 45/30 °C	III	−32	45	0.56	47	15–22	-
Radiator heating, new buildings (2013-), design 45/30 °C	IIII	−38	45	0.52	47	15–22	-
Radiator heating, (1980-), design 70/40 °C	I	−26	70	1.26	72	15–22	-
Radiator heating, (1980-), design 70/40 °C	II	−29	70	1.20	72	15–22	-
Radiator heating, (1980-), dimensioning 70/40 °C	III	−32	70	1.16	72	15–22	-
Radiator heating, (1980-), design 70/40 °C	IIII	−38	70	1.10	72	15–22	-
Radiator heating, older buildings, design 80/60 °C	I	−26	80	1.52	82	15–22	-

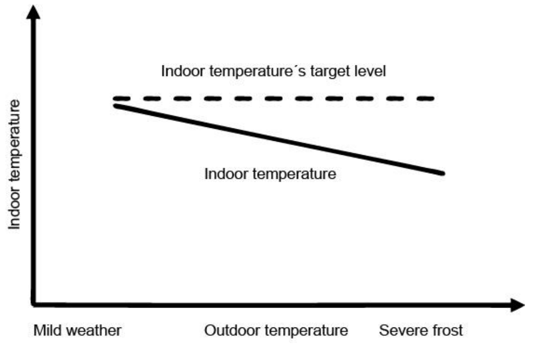
Comfort temperature	°C	22		Heating circuit 1 line 720	Heating circuit 1 line 741	Heating circuit 1 line 741	On demand
Parallel displacement	°C	0		Heating circuit 2 line 1020	Heating circuit 2 line 1041	Heating circuit 2 line 1041	line 2855
				Heating circuit 3 line 1320	Heating circuit 3 line 1341	Heating circuit 3 line 1341	
Heating system and floor structure	Weather zone	Design outside temperature	Flow temperature in the design outside tem- perature	Heating curve's slope	Flow upper limit	Flow lower limit	Switch-off tempera- ture in space heating (on demand)
		°C	°C		°C	°C	
Radiator heating, older buildings, design 80/60 °C	II	−29	80	1.46	82	15–22	-
Radiator heating, older buildings, design 80/60 °C	III	−32	80	1.40	82	15–22	-
Radiator heating, older buildings, design 80/60 °C	IIII	−38	80	1.32	82	15–22	-
Floor heating in damp spaces, new buildings (2013-)	-	-	30	-	30	30	35
Floor heating in damp spaces, new buildings (2013-)	-	-	35	-	35	35	40

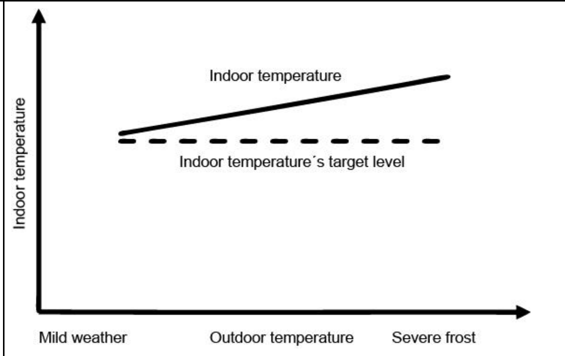
11.5 Adjusting the heating curve in different situations

11.5.1 Indoor temperature too low or high in very cold weather

Problem:	Indoor temperature is too low in very cold weather.	Indoor temperature is too high in very cold weather.
Cause:	Heating curve is too gradual.	Heating curve is too steep.
Action:	Increase the heating curve slope (line 720).	Decrease the heating curve slope (line 720).
Menus:	Chapters 10.4.5 and 10.4.10.	Chapters 10.4.5 and 10.4.10.
Additional information:	Change the curve in small increments until a suitable indoor temperature is reached. Changing the curve affects indoor temperature with a delay of several hours, because the temperature of the building's structures changes slowly.	Change the curve in small increments until a suitable indoor temperature is reached. Changing the curve affects indoor temperature with a delay of several hours, because the temperature of the building's structures changes slowly.

PROBLEM





ADJUST-
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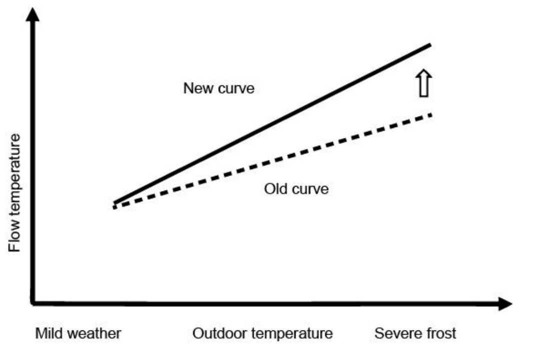
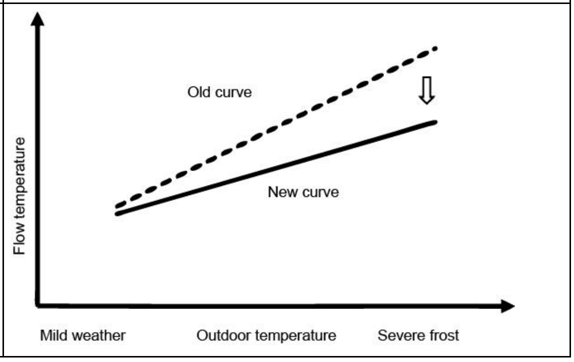
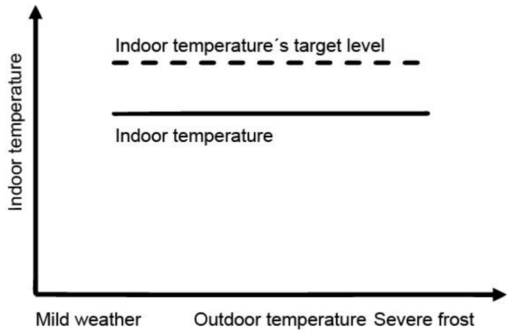
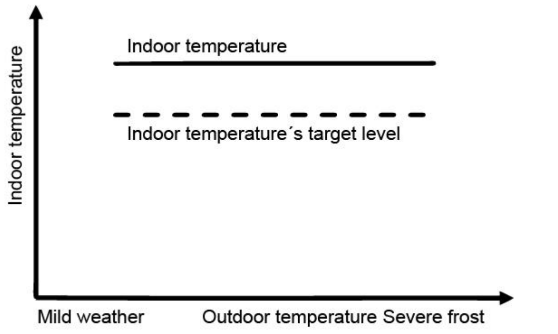




11.5.2 Indoor temperature steadily too high or low

<table>
<tr><td>Problem:</td><td>Indoor temperature remains steady, but is always too low.</td><td>Indoor temperature remains steady, but is always too high.</td></tr>
<tr><td>Cause:</td><td>Heating curve’s slope is suitable, but the curve must be moved upward.</td><td>Heating curve’s slope is suitable, but the curve must be moved downward.</td></tr>
<tr><td>Action:</td><td>Move the heating curve upward by means of either heating curve displacement (line 721) or raising the room temperature set-point (line 710).</td><td>Move the heating curve downward by means of either heating curve displacement (line 721) or lowering the room temperature setpoint (line 710).</td></tr>
<tr><td>Menus:</td><td>Chapter 10.4.10</td><td>Chapter 10.4.10</td></tr>
<tr><td>Additional in-formation:</td><td>Change the curve in small increments until a suitable indoor temperature is reached. Changing the curve affects indoor tempera-ture with a delay of several hours, because the temperature of the building’s structures changes slowly.</td><td>Change the curve in small increments until a suitable indoor temperature is reached. Changing the curve affects indoor temperature with a delay of several hours, because the temperature of the building’s structures changes slowly.</td></tr>
<tr><td>PROBLEM</td><td>
</td><td>
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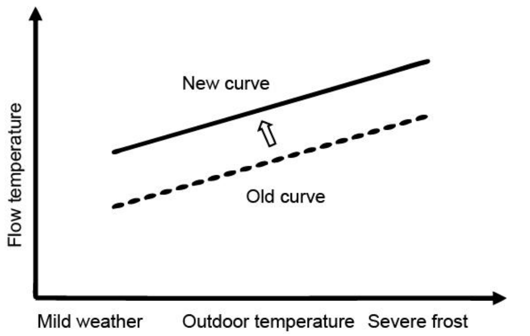
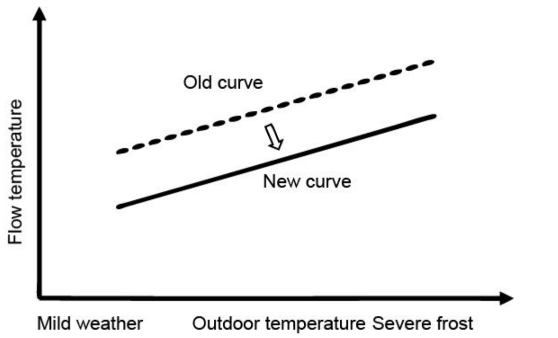
<tr><td>ADJUSTMENT</td><td>
</td><td>
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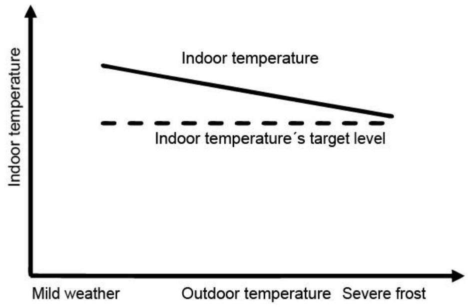
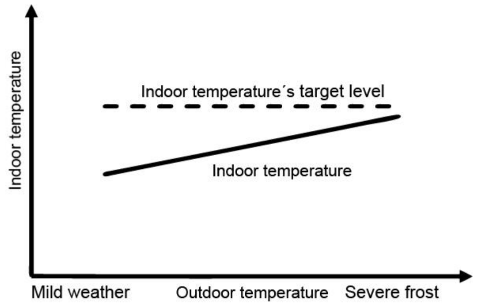
11.5.3 Indoor temperature too high or low in mild weathers

Problem:	Indoor temperature is too high in mild weather.	Indoor temperature is too low in mild weather.
Cause:	Heating curve is too gradual and parallel displacement is too high.	Heating curve is too steep.
Action:	Increase the heating curve's slope (line 720) and then move the heating curve downward by means of either heating curve displacement (line 721) or lower the room temperature setpoint (line 710).	Decrease the heating curve's slope (line 720) and then move the heating curve downward by means of either heating curve displacement (line 721) or raising the room temperature setpoint (line 710).
Menus:	Chapters 10.4.5 and 10.4.10.	Chapters 10.4.5 and 10.4.10.
Additional information:	Change the curve in small increments until a suitable indoor temperature is reached. Changing the curve affects indoor temperature with a delay of several hours, because the temperature of the building's structures changes slowly.	Change the curve in small increments until a suitable indoor temperature is reached. Changing the curve affects indoor temperature with a delay of several hours, because the temperature of the building's structures changes slowly.

PROBLEM





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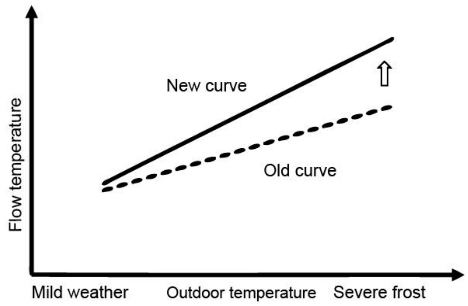
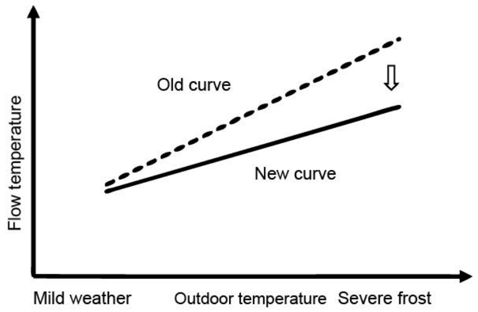
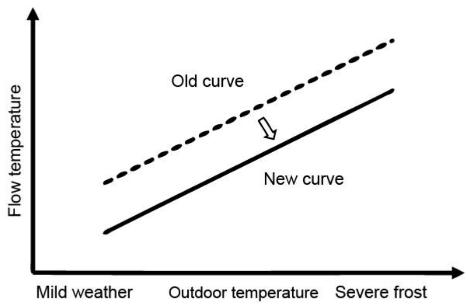
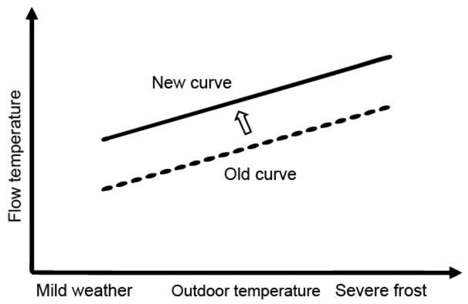




ADJUSTMENT Step 2

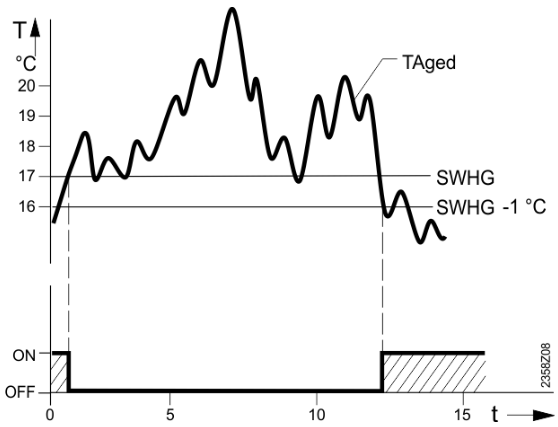




11.6 Outside temperature limits for the heating season and day (ECO functions)

11.6.1.1 Limit temperature for the heating season (summer/winter heating limit)

The summer/winter heating function can be used to switch the heating on and off when the longer time span average of the outside temperature exceeds a predetermined value. This value is set for heating circuit 1 on line 730. If the outside temperature's average exceeds the setpoint, the heating circuit is switched off. The heating circuit is switched back on when the outside temperature is one degree below the setpoint. The function is not available if the heating circuit is set to Comfort mode (without a time program). It uses the delayed outside temperature (line 8703), which takes the building's heat capacity into account (chapter 11.7).



Taged: Outside temperature attenuated (rivi 8703)

SHWG: Switch-off limit

SHGW−1 °C: Switch-on limit

ON: heating on

OFF: heating off

Figure 32. Summer/winter heating limit

11.6.1.2 24-hour temperature limit

Using the 24-hour temperature limit, heating can be switched off when the outside temperature reaches a determined level in relation to the room temperature setpoint (line 710). The temperature differential is set on line 732. It can be set to exceed (+) or go below (-) the room temperature setpoint. If the outside temperature drops 1 °C below the aforementioned level, heating is switched back on.

If the room temperature setpoint on line 710 is for example 22 °C and the temperature differential selected on line 732 is −3 °C, heating is switched on when the outside temperature exceeds 19 °C (22 °C−3 °C). In the example presented above, heating is switched on when the outside temperature drops below 18 °C (19 °C−1 °C).

The function can be set to use the the current measured outside temperature (line 8700) or the composite outside temperature (line 8704), which takes the building's heat capacity into account (chapter 11.7). This is selected on line 733. If the line's value is set to "yes", the function takes the heat capacity into account. Otherwise the current measured outside temperature is used.

11.7 Outside temperature and the building's heat capacity

The heating curve and other functions of the heating circuit use the outside temperature that takes the building's heat capacity into account. Changes in this temperature are slower and more gradual than changes in the temporary outside temperature (line 8700). In this way, the heat accumulation capacity of the building structures and the time delay between changes in the outside temperature and changes in the indoor temperature will be taken into account. Taking the heat capacity into account evens the changes in the flow temperature setpoint of the heating circuit.

Automation uses two different outside temperatures that take heat capacity into account. Heating curve uses the composite outside temperature on line 8704. It follows the changes in outside temperature fairly quickly, but eliminates short-term peaks and lows. The composite outside temperature can also be used with the 24-hour heating limit (chapter 11.6).

The attenuated outside temperature presented on line 8703 is used as the limit temperature for the heating period (chapter 11.6). The attenuated temperature changes more slowly than the composite temperature (line 8704). It rises and falls slowly as the average outside temperature rises, but does not take the temperature variation within the day into account.

The building's heat capacity is taken into account through the building's time constant. The time constant is selected on line 6110. The building's time constant is higher the better insulated the building is and the heavier the building structures are. The changes in the composite and attenuated outside temperature are slower (compared to momentary changes in the outside temperature) the greater the value of parameter 6110 is.

A time constant of 10...20 is suitable for the majority of buildings. If the time constant is higher than 20, the flow temperature changes fairly slowly as the outside temperature changes. Correspondingly, if the time constant is lower than 10, the flow temperature changes fairly quickly as the outside temperature changes. If the time constant is set to 0, the building's heat capacity is not taken into account. Then the composite and attenuated temperatures are always equal to the measured momentary outside temperature.

The tables below present reference values for the time constant. The time constant is calculated by adding the table values together. For example, for a brick-structured building that is insulated from the inside and has triple-glazed windows, the time constant is 8 h (brick) + 0 h (inside) + 6 h (triple-glazed) = 14 h in total.

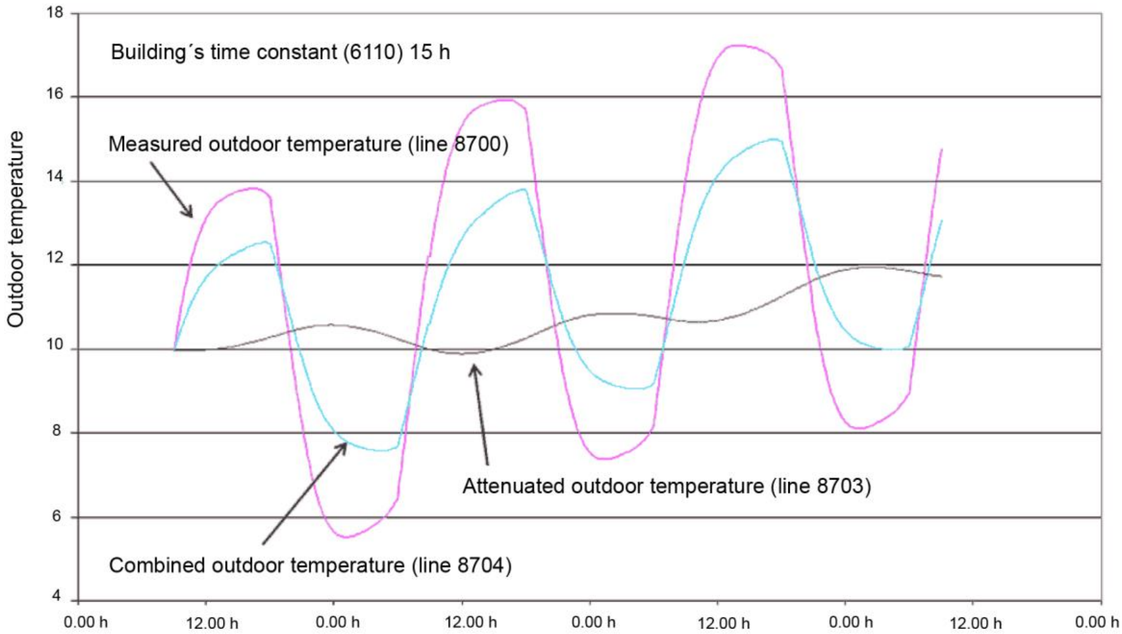


Figure 33. Outside temperature and the building's time constant. Building time constant 15 h.

SEQ Taulukko * ARABIC Table 36. Framework influence on time constant

Framework	**Concrete**	**Lightweight aggregate con-crete**	**Brick**	**Wood**	**Stone**	**Low-energy building**
Time constant (h)	14	10	8	8	18	25

SEQ Taulukko * ARABIC Table 37. Insulation's influence on time constant

Insulation	**Insulation inside framework**	**Insulation outside framework**
Time constant (h)	0	3

SEQ Taulukko * ARABIC Table 38. Window influence on time constant

Insulation and windows	**Double-glazed**	**Triple-glazed**
Time constant (h)	3	6

12 DHW heating

12.1 Important setpoints and statuses

SEQ Taulukko * ARABIC Table 39. Key DHW setpoints

Menu	Line	Setting
Domestic hot water	1600	Operating mode (on / off)
Domestic hot water	1610	Setpoint (normal setpoint)
Domestic hot water	1612	Reduced setpoint
Domestic hot water	1620	Release (time program)
DHW storage tank	5024	Switching differential
DHW storage tank	5030	Charging time limit (E series can also stop charging)
DHW storage tank	5031	Charging pause (F series)
Status	8003	State of the DHW
Diagnostics consumers	8830	Operation temperature 1 (sensor B3)
Diagnostics consumers	8831	DHW setpoint
Diagnostics consumers	8832	Operation temperature 2 (sensor B31)
Service/special operation	7093	Current DHW charging temperature

12.2 DHW temperature setpoint, switching differential and compressor control

Two different setpoints can be selected as setpoints for the DHW. The setpoints are a normal and a reduced setpoint. The setpoint in the DHW menu is the normal setpoint. The normal setpoint can be changed via the DHW menu (chapter 10.4.4) or from the parameter list (chapter 10.4.9) on line 1610. The reduced setpoint can be changed via the parameter list on line 1612. The domestic hot water from the service buffer tank is typically 2...10 °C hotter than the control sensor's reading. The temperature difference is dependent on the sensor's location in the tank and the tank's temperature stratification.

DHW heating is controlled based on the reading given by the DHW sensor (sensor B3, DHW temperature 1). DHW heating stops when the sensor reading reaches the setpoint for the DHW. Heating restarts when the water temperature falls lower than the setpoint by the amount of the switching differential. The differential is the sum of lines 5023 and 5024. The compressor starts when DHW heating begins. The starting temperature for the compressor is

Sensor B3	$$\begin{pmatrix}\text{compressor's}\\\text{starting temperature}\end{pmatrix}=\begin{pmatrix}\text{DHW}\\\text{setpoint}\\\text{line 1610}\end{pmatrix}-\text{line 5024}-\text{line 5023}$$	(2)

The starting temperature for the compressor is

Sensor B3	$$\begin{pmatrix}\text{compressor's}\\\text{stopping temperature is}\end{pmatrix}=\begin{pmatrix}\text{DHW}\\\text{setpoint}\\\text{line 1610}\end{pmatrix}$$	(3)

If the DHW setpoint is high, the compressor may not necessarily reach it. The compressor may switch off before the setpoint is reached either at the highest DHW charging temperature in the compressor selected in the settings (line 5032), the upper limit for the temperature of flow from the condenser (line 2844), the hot-gas temperature (line 2846), or the triggering threshold for the high pressure switch. If any of these limits are reached, recharging the DHW with the compressor is attempted as many times as indicated on line 2893 (including the first charging). Between charging attempts, the compressor is off for the off time that is specified on line 2835 or 2843. The longer off time is used. If the DHW setpoint is not reached after the maximum number of charging attempts permitted, the compressor is disabled temporarily and the DHW is heated to the setpoint by means of electric immersion heaters. The reached DHW temperature is automatically saved on line 7093.

Example

Setting	Line	Value
DHW setpoint	1610, 1612, 8831	55 °C
Switching differential	5024	4 °C
Setpoint reduction B31 (also affects sensor B3's limit)	5023	1 °C
Compressor's starting temperature (DHW sensor B3/B31)		50 °C

12.3 DHW time program

The DHW setpoint can be switched from normal to reduced via a time program, or with an external control message. The normal setpoint is used during the time selected in the time program. At other times, Reduced mode is used. In factory settings, the normal DHW setpoint is always selected. The setpoint can be changed via a time program by selecting the time program 4 for DHW on line 1620. After updating the user interface (chapter 10.4.8), the time program can be customized in the DHW menu of the regular display mode (chapter 10.4.4). When the time program is being used, the normal setpoint (line 1610) is in use when the program is ON, and the reduced setpoint (line 1612) is used when the program is OFF. In other words, the time program does not switch the DHW heating on and off, it only changes its setpoint. DHW heating is started normally after the temperature drops by the switching differential's (5024) amount below the setpoint currently in effect.

12.4 Limiting the DHW charging time

The DHW charging time can be limited on line 5030. The DHW is heated until the DHW setpoint (line 1610) is reached or the time specified on this line has elapsed. The time runs from the moment DHW charging begins. If the time on line 5030 runs out before the temperature setpoint is reached, DHW charging is discontinued. With an E series controller the DHW heating is off for that duration set on line 5030. With an F series controller, heating is off for the duration set on line 5031. During this pause the heat pump is only available for spatial heating, and DHW is not heated. After the space heating portion of the cycle, the DHW is charged again until the setpoint is reached or the time set has elapsed. The charging time limitation is ignored if space heating has been switched off. The time limit can switched off altogether, if the value on line 5030 is set to —. The purpose of the charging limitation is to prevent the building from cooling too much during a long DHW charging period. The charging can be restarted during the pause by choosing Recharging from the DHW menu as a temporary mode, or by switching the DHW charging off and then back on again.

12.5 DHW temperature limit in compressor use

An upper limit can be set for the DHW charging temperature setpoint in compressor use, on line 5032. This value is compared to the reading from the DHW sensor, B3. When the DHW temperature reaches the value set on the aforementioned line, the heat pump compressor is switched off and the DHW is charged to its setpoint with the electric immersion heaters or another additional source of heat. During the approximately one-minute delay to switching off the compressor, the brief temperature increase does not switch the compressor off. The suitability of the value on line 5032 for the system must be determined through experimentation.

The heat pump controller uses primarily electric immersion heater K6 in the DHW storage tank in this operation and switches the diverting valve to the space heating position. In this way, the DHW can be heated while space heating is in operation. If immersion heater K6 has not been installed and configured for use, immersion heater K25/K26 in the flow from the condenser will be used. When these immersion heaters are used, the diverting valve is kept in the DHW position, because the immersion heaters are located before the diverting valve and DHW storage tank in the direction of the flow.

Example

Setting	Line	Value
DHW setpoint	1610, 1612, 8831	55 °C
Switching differential	5024	5 °C
Setpoint reduction B31/B3	5023	0 °C
Aborting charging temperature	5032	52 °C
Compressor start temperature (sensor B3)		50 °C
Compressor stop temperature and immersion heater connection temperature (sensor B3)		52 °C

12.6 Condenser circuit's electric immersion heater control

The setpoint used in counting the degree minutes of the electric immersion heaters can be based on either the DHW setpoint (a fixed value) or the measured temperature of the DHW (changes during heating). This is selected on line 5007 (**Error! Reference source not found.**). The boost to be set on line 5020 is added to this selected temperature value.

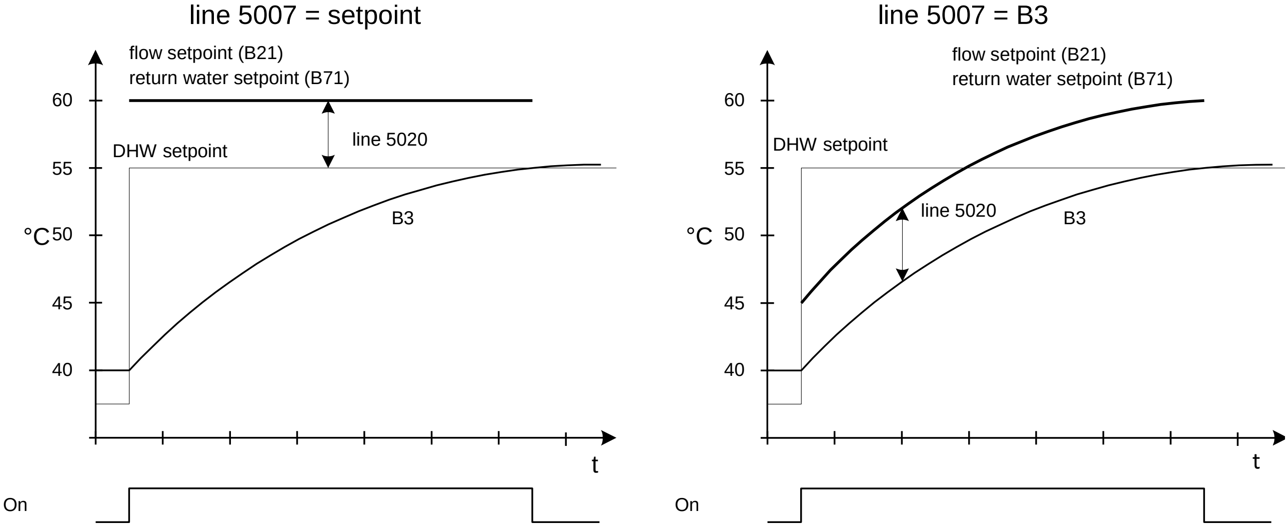


Figure 34. Effect of lines 5007 and 5020

12.6.1 Flow sensor B21 installed

If the value on line 5007 is set to sensor B3, the condenser flow setpoint for electric immersion heaters is

Sensor B21	$\begin{pmatrix}\text{flow}\\\text{setpoint}\\\text{line 8411}\end{pmatrix} = \begin{pmatrix}\text{DHW}\\\text{temperature}\\\text{measured by}\\\text{sensor B3}\\\text{line 8830}\end{pmatrix} + \text{ line 5020}$	(4)

If the value on line 5007 is set to flow setpoint, the condenser flow setpoint for electric immersion heaters is

Sensor B21	$\begin{pmatrix}\text{flow}\\\text{setpoint}\\\text{line 8411}\end{pmatrix} = \begin{pmatrix}\text{DHW}\\\text{setpoint}\\\text{line 1610}\end{pmatrix} + \text{ line 5020}$	(5)

A fixed switching differential of 1 °C is used around the condenser flow setpoint to calculate the upper and lower limit for the immersion heaters' setpoint. The lower limit for the electric immersion heaters' setpoint is

Sensor B21	$\begin{pmatrix}\text{setpoint}\\\text{lower limit}\\\text{for the immersion heater}\end{pmatrix} = \begin{pmatrix}\text{flow}\\\text{setpoint}\\\text{line 8411}\end{pmatrix} - 1$	(6)

Accordingly, the upper limit is

Sensor B21	$\begin{pmatrix} \text{setpoint} \\ \text{upper limit} \\ \text{for the immersion heater} \end{pmatrix} = \begin{pmatrix} \text{flow} \\ \text{setpoint} \\ \text{line 8411} \end{pmatrix} + 1$	(7)

Example: Flow sensor B21 installed

Setting	Line	Value
Charging request	5007	sensor B3
Flow setpoint boost	5020	7 °C
DHW temperature, measured by sensor B3	8830	48 °C
Condenser flow setpoint (heat pump setpoint)	8411	55 °C
Lower limit for immersion heater setpoint (flow, sensor B21)		54 °C
Upper limit for immersion heater setpoint (flow, sensor B21)		56 °C

Example: Flow sensor B21 installed

Setting	Line	Value
Charging request	5007	setpoint
DHW setpoint	1610, 1612, 8831	50 °C
Flow setpoint boost	5020	7 °C
Heat pump setpoint (flow setpoint)	8411	57 °C
Lower limit for electric heater setpoint (flow, sensor B21)		56 °C
Upper limit for electric heater setpoint (flow, sensor B21)		58 °C

12.6.2 Only return sensor B71 installed

If the heat pump is not equipped with return sensor B21, return sensor B71 and the return setpoint are used to control the electric immersion heaters. The temperature difference produced by the heat pump's compressor over the condenser is displayed on line 2805. If the value on line 2805 is set to ---, automation will use the value 8 °C on line 2805 for calculation.

If the value on line 5007 is set to sensor B3, the return setpoint for electric immersion heaters is

Sensor B71	$\begin{pmatrix} \text{return water} \\ \text{setpoint} \\ \text{line 8411} \end{pmatrix} = \begin{pmatrix} \text{DHW} \\ \text{temperature} \\ \text{measured by} \\ \text{sensor B3} \\ \text{line 8830} \end{pmatrix} - \text{line 2805} + \text{line 5020}$	(8)

If the value on line 5007 is set to DHW setpoint, the return setpoint for electric immersion heaters is

Sensor B71	$\begin{pmatrix} \text{return water} \\ \text{setpoint} \\ \text{line 8411} \end{pmatrix} = \begin{pmatrix} \text{DHW} \\ \text{setpoint} \\ \text{line 1610} \end{pmatrix} - \text{line 2805} + \text{line 5020}$	(9)

The switching differential on line 2840 is used around the condenser's return setpoint to calculate the upper and lower limit of the immersion heaters' setpoint. The lower limit of the immersion heater setpoint is

Sensor B71	$\begin{pmatrix}\text{setpoint}\\ \text{lower limit}\\ \text{for the immersion heater}\end{pmatrix} = \begin{pmatrix}\text{return water}\\ \text{setpoint}\\ \text{line 8411}\end{pmatrix} - \frac{\text{line 2840}}{2}$	(10)

Correspondingly, the upper limit of the immersion heater setpoint is

Sensor B71	$\begin{pmatrix}\text{setpoint}\\ \text{lower limit}\\ \text{for the immersion heater}\end{pmatrix} = \begin{pmatrix}\text{return water}\\ \text{setpoint}\\ \text{line 8411}\end{pmatrix} + \frac{\text{line 2840}}{2}$	(11)

Example: Only return sensor B71 installed

Setting	Line	Value
Charging request	5007	sensor B3
Setpoint of condenser’s temperature difference	2805	5 °C
Flow setpoint boost	5020	7 °C
Switching diff. of return temp.	2840	6 °C
DHW temp. measured by sensor B3	8830	48 °C
Return setpoint (heat pump setpoint)	8411	50 °C
Lower limit for immersion heater setpoint (flow, sensor B21)		47 °C
Upper limit for immersion heater setpoint (flow, sensor B21)		53 °C

Example: Only return sensor B71 installed

Setting	Line	Value
Charging request	5007	setpoint
DHW setpoint	1610, 1612, 8831	50 °C
Setpoint of condenser’s temperature difference	2805	5 °C
Flow setpoint boost	5020	7 °C
Switching diff. of return temp.	2840	6 °C
Return setpoint (heat pump setpoint)	8411	52 °C
Lower limit for immersion heater setpoint (flow, sensor B21)		49 °C
Upper limit for immersion heater setpoint (flow, sensor B21)		55 °C

12.7 DHW storage tank heating with heat exchanger

The heat pump's automation supports several different heating connections for DHW. Presented below is DHW heating with a circuit that includes a heat exchanger and a circulation pump.

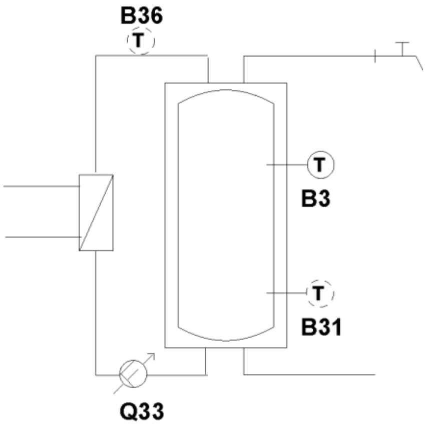


Figure 35. DHW storage tank heating with heat exchanger

The circuit's pump Q33 starts when the DHW heating starts. The operating speed of the pump can be controlled with the temperature sensor 36, which is installed after the exchanger. The setpoint for sensor B36 (line 8837) is

Sensor B36	$\begin{pmatrix}\text{sensor B36}\\ \text{setpoint}\end{pmatrix} = \begin{pmatrix}\text{DHW}\\ \text{setpoint}\\ \text{line 1610}\end{pmatrix} + \text{ line 5140}$	(12)

The boost set on line 5140 is typically around 1…3 °C. If the boost is significant, the return flow temperature from the DHW exchanger to the condenser will reach a high level during the end stage of the charging, because the controller will raise the operating speed of pump Q33 later. This could trigger the switch-off temperature (line 2844).

The starting speed of the pump is set on line 5109. The speed should be set to a reasonably high level so the pump's starting torque is sufficient. Typically 15…40 % is a suitable value. After the starting phase, the controller modulates the pump's speed (line 8826) between the limit values set on lines 5101 and 5102 using a PID mechanism and based on the setpoint of sensor B36. During initial charging, the controller limits the operating speed to a low level, because the reading on sensor B36 is low. The reading increases toward the end of the charging, and the controller gradually increases the operating speed. The pump operates at full speed when sensor B36 reaches its setpoint. The lower limit (line 5101) is set to slightly exceed the lowest possible control message capable of starting the pump (typically 10…15 %). If the lower limit of the operating speed is not sufficient, the pump will not start. The upper limit (line 5102) is usually set to 100 %, enabling the pump to rotate at full speed as the charging is about to end. The pump stops when the overrun set on line 5147 is over after the DHW charging is finished. It is usually a good idea to disable the condenser pump's speed control (chapter 21) during DHW charging, and set the highest permitted speed to full (100 %) on line 2793.

A lower limit can be set for the flow temperature from the condenser to the DHW exchanger as a threshold to keep the pump Q33 from starting. The limit is set via a boost determined on line 5148.

Before the pump is started, the reading on sensor B21 must exceed the DHW setpoint by the amount of the boost on line 5148. In this way, the pump Q33 is not started before the exchanger receives sufficiently warm water. The boost can also be negative, allowing you to set the pump to start before sensor B21's reading exceeds the DHW setpoint. A suitable boost value is usually −5…−15 °C, which lets the pump start early enough, and the condenser circuit's temperature does not close on the switch-off temperature.

The proportional band Xp set on line 5103 should be small enough to allow for a quick enough adjustment in the end stage of the pump's charging. The suitable value is typically approximately 10 °C. For the integral action time (restore time) T set on line 5104, the suitable value is typically approximately 40 s, and for the derivative action time set on line 5105, approximately 1 s.

13 Space heating without a buffer storage tank

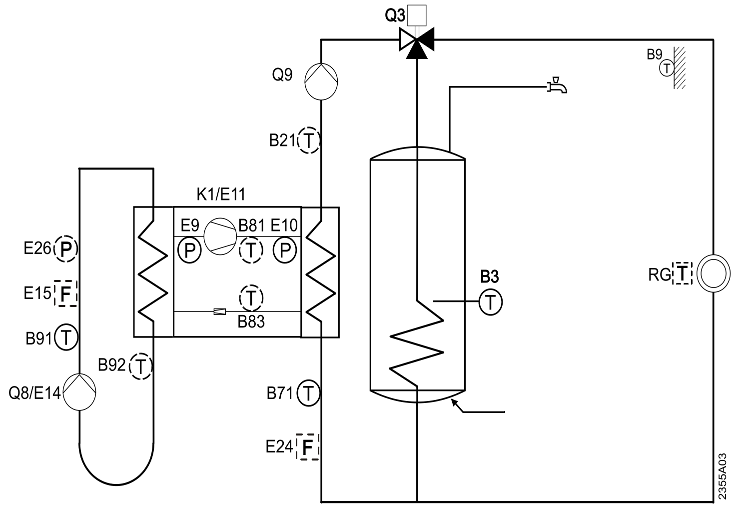


Figure 36. DHW storage tank and space heating without a buffer storage tank (additional storage tank)

13.1 Important setpoints and statuses

SEQ Taulukko * ARABIC Table 40. Key setpoints for space heating without a buffer storage tank

Menu	Line	Setting
Heating circuit 1	710	Comfort mode setpoint, heating circuit 1
Heating circuit 1	720	Heating curve slope, heating circuit 1
Heating circuit 1	721	Heating curve displacement, heating circuit 1
Heating circuit 1	741	Flow max. setpoint, heating circuit 1
Heat pump (Compressor)	2840	Switching diff. return temp.
Configuration (Heat pump)	5810	Heating circuit temp. differential in −10 °C
Status		Function statuses. From line 8000 onward.
Diagnostics heat generation		Statuses of compressors, electric immersion heaters etc. from line 8395 onward
Diagnostics consumers		Statuses of heating circuits
Diagnostics consumers	8744	Flow setpoint from the heating curve with line 741 taken into account, heating circuit 1
Diagnostics heat generation	8411	Heat pump setpoint (return setpoint)

13.2 Compressor control

The heat pump's compressor is controlled based on the condenser's return temperature and return setpoint (heat pump setpoint). Return sensor B71 is used to measure the temperature. The setpoint of the flow to the condenser can be based on a heating curve dependent on the outside temperature, the measured indoor temperature, or a combination thereof. The factory setting is adjustment based on the heating curve. Adjustment based on the indoor temperature requires that the temperature is measured. The measurement can be carried out by means of either wall-mounted user interfaces (room unit) or separate temperature sensors.

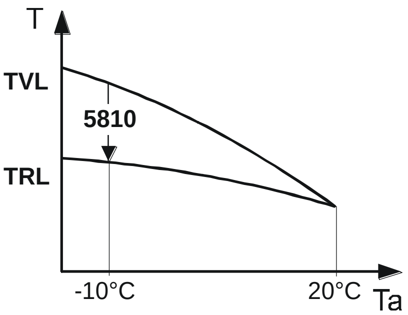
In the adjustment based on the heating curve, the compressor is controlled based on the heating circuit setpoint read from the heating curve, the calculated temperature differential (line 5810) of the condenser and the return switching differential (line 2840). Adjustment based on indoor temperature requires that indoor temperature is measured and the heating curve is not used. In composite adjustment, the controller adjusts the reading received from the curve based on the indoor temperature measurement.

13.2.1 Condenser's calculated temperature difference

The controller calculates the return setpoint (heat pump setpoint) from the heating circuit's flow setpoint (heating curve) based on line 5810. The assumed temperature difference between the condenser flow and return is set on line 5810 for an outside temperature of −10 °C. The controller decreases and increases this value automatically in line with the outside temperature value (Ta) (figure 54). The controller estimates that the temperature difference is smaller in warmer outside temperatures (there is less cooling in the heating circuit) and larger in colder outside temperatures (there is greater cooling in the heating circuit).

Condenser's calculated temperature difference is

	$\begin{pmatrix}\text{temperature difference}\\ \text{calculated}\\ \text{according to}\\ \text{line 5810}\end{pmatrix} = (\text{line 5810}) \cdot \frac{20 - \text{Ta}}{30}$	(13)



TVL: flow water temperature setpoint

TRL: return water temperature setpoint

Ta: outside temperature

Figure 37. Line 5810 operation principle

13.2.2 Condenser return setpoint

The compressor is controlled with the condenser's return setpoint (heat pump setpoint). Condenser's return setpoint is

Sensor B71	$\begin{pmatrix}\text{condenser's}\\ \text{return water}\\ \text{setpoint}\\ \text{line 8411}\end{pmatrix} = \begin{pmatrix}\text{heating circuit's}\\ \text{flow}\\ \text{setpoint}\\ \text{from heating curve}\\ \text{line 8744}\end{pmatrix} - \begin{pmatrix}\text{temperature difference}\\ \text{calculated}\\ \text{according to}\\ \text{line 5810}\end{pmatrix}$	(14)

Basically, the heating curve always displays the heating circuit's flow setpoint. However, the heating curve can be set to use the return setpoint directly if the value on line 5810 is set to 0 °C. In this case, the return setpoint is

Sensor B71 Line 5810=0	$\begin{pmatrix}\text{condenser's}\\ \text{return water}\\ \text{setpoint}\\ \text{line 8411}\end{pmatrix} = \begin{pmatrix}\text{heating circuit's}\\ \text{flow}\\ \text{setpoint}\\ \text{from heating curve}\\ \text{line 8744}\end{pmatrix}$	(15)

An upper and lower limit can be assigned to the heating circuit's flow temperature, read from the heating curve. The lower limit for heating circuit 1 is set on line 740, and the upper limit is set on line 741. The limits are used in control based on both the heating curve and the room temperature. When setting the limits, take the calculated temperature difference on line 5810 and the switching differential on line 2840 into account. If the setpoint read from the heating curve exceeds the upper limit, the upper limit for flow is used as the heating circuit's flow setpoint instead. Thus, the condenser's return setpoint is

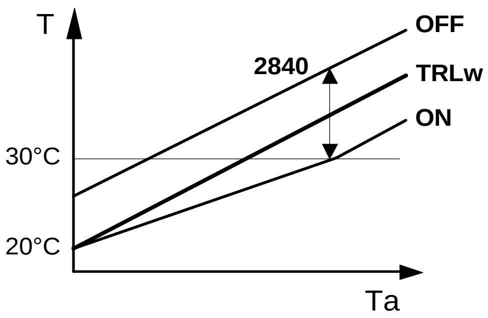
Sensor B71	$\begin{pmatrix}\text{condenser's}\\ \text{return water}\\ \text{setpoint}\\ \text{line 8411}\end{pmatrix} = \begin{pmatrix}\text{heating circuit's}\\ \text{flow}\\ \text{upper limit}\\ \text{line 741}\end{pmatrix} - \begin{pmatrix}\text{temperature difference}\\ \text{calculated}\\ \text{according to}\\ \text{line 5810}\end{pmatrix}$	(16)

If the setpoint goes below the lower limit, the lower limit of flow is used for calculation (line 740 for).

13.2.3 Compressor control

The switching differential set on line 2840 is used around the return setpoint in order to switch the compressor on and off. Increasing the switching differential increases the compressor's operating time, but also increases the temperature variation in the heating circuit. The switching differential also affects the cooling that the switch-off temperature (line 2844) requires (chapter 24.1).

The value on line 2840 is divided equally between the two sides of the setpoint (figure 55). The controller reduces the lower limit of the switching differential automatically (directly proportionally) when the return setpoint is under 30 °C. This starts the compressor earlier when the return temperature drops below the setpoint, and the switching differential is reduced automatically at the same time, as the setpoint is reduced.



OFF: compressor's stopping temperature

TRLw: return temperature's setpoint (heat pump's setpoint, line 8411) based on the heating curve and line 5810

ON: compressor's starting temperature

Ta: outside temperature

Figure 38. Line 2840 switching differential

The upper limit of the switching differential affecting the compressor's stopping temperature stays constant as presented in the image above

Sensor B71	$\begin{pmatrix}\text{switching differential's}\\ \text{upper limit}\\ \text{OFF}\end{pmatrix} = \frac{\text{line 2840}}{2}$	(17)

The lower limit of the switching differential affecting the compressor's starting temperature also stays constant if the return setpoint (line 8411 TRLw) is over 30 °C

Sensor B71	Return setpoint (line 8411) is over 30 °C $\begin{pmatrix}\text{switching differential's}\\ \text{lower limit}\\ \text{ON}\end{pmatrix} = \frac{\text{line 2840}}{2}$	(18)

The upper limit of the switching differential affecting the compressor's starting temperature is reduced in direct proportion when the return setpoint drops below 30 °C

Sensor B71	Return setpoint (line 8411) is under 30 °C $\begin{pmatrix}\text{switching differential's}\\ \text{lower limit}\\ \text{ON}\end{pmatrix} = \frac{\text{line 2840}}{2} \cdot \frac{\text{TRLw} - 30}{10}$	(19)

Therefore the stop temperature for the compressor is

Sensor B71	$\begin{pmatrix}\text{compressor's}\\ \text{stopping temperature is}\\ \text{OFF}\end{pmatrix} = \begin{pmatrix}\text{condenser's}\\ \text{return water}\\ \text{setpoint}\\ \text{line 8411}\end{pmatrix} + \frac{\text{line 2840}}{2}$	(20)

Correspondingly, the starting temperature for the compressor is

Sensor B71	$\begin{pmatrix}\text{compressor's}\\ \text{starting temperature}\\ \text{ON}\end{pmatrix} = \begin{pmatrix}\text{condenser's}\\ \text{return water}\\ \text{setpoint}\\ \text{line 8411}\end{pmatrix} - \begin{pmatrix}\text{switching differential's}\\ \text{lower limit}\\ \text{ON}\end{pmatrix}$	(21)

13.3 Condenser circuit's electric immersion heater control

Condenser circuit's heater is switched on and off based on degree minutes (chapter 15). Degree minutes are calculated using the minimum and maximum limits of the setpoint. Switch-on minutes are calculated below the minimum limit, whereas switch-off minutes are calculated above the meximum limit. Degree minutes are therefore not calculated within the limits.

13.3.1 Flow sensor B21 installed

If flow sensor B21 is installed in the heat pump, the sensor and the condenser's return setpoint are used to calculate the electric immersion heater's degree minutes. Only the return setpoint is used for calculation, even though the flow sensor B21 is the measuring sensor.

If the value on line 5810 is larger than zero, a fixed switching differential of 1 °C is used around the return setpoint to calculate the upper and lower limit for the immersion heater's setpoint. The setpoint's lower limit for an immersion heater is

Sensor B21	$\begin{pmatrix}\text{setpoint}\\ \text{lower limit}\\ \text{for the immersion heater}\end{pmatrix} = \begin{pmatrix}\text{condenser's}\\ \text{return water}\\ \text{setpoint}\\ \text{line 8411}\end{pmatrix} - 1\,°\text{C}$	(22)

Correspondingly, the upper limit is

Sensor B21	$\begin{pmatrix}\text{setpoint}\\ \text{upper limit}\\ \text{for the immersion heater}\end{pmatrix} = \begin{pmatrix}\text{condenser's}\\ \text{return water}\\ \text{setpoint}\\ \text{line 8411}\end{pmatrix} + 1\,°\text{C}$	(23)

If the value on line 5810 is zero, the switching differential on line 2840 is used around the condenser's return setpoint to calculate the upper and lower limit of the immersion heaters' setpoint. The setpoint's lower limit for an immersion heater is

Sensor B21	$$\begin{pmatrix}\text{setpoint}\\ \text{lower limit}\\ \text{for the immersion heater}\end{pmatrix} = \begin{pmatrix}\text{condenser's}\\ \text{return water}\\ \text{setpoint}\\ \text{line 8411}\end{pmatrix} - \frac{\text{line 2840}}{2}\ ^{\circ}\mathrm{C}$$	(24)

Correspondingly, the upper limit is

Sensor B21	$$\begin{pmatrix}\text{setpoint}\\ \text{upper limit}\\ \text{for the immersion heater}\end{pmatrix} = \begin{pmatrix}\text{condenser's}\\ \text{return water}\\ \text{setpoint}\\ \text{line 8411}\end{pmatrix} + \frac{\text{line 2840}}{2}\ ^{\circ}\mathrm{C}$$	(25)

13.3.2 Only return sensor B71 installed

If only return sensor B71 is installed in the heat pump, the sensor and the condenser's return setpoint are used to calculate the electric immersion heater's degree minutes. Like the compressor, the switching differential on line 2840 is used around the setpoint to calculate the upper and lower limit of the immersion heaters' setpoint. The setpoint's lower limit for an immersion heater is

Sensor B71	$$\begin{pmatrix}\text{setpoint}\\ \text{lower limit}\\ \text{for the immersion heater}\end{pmatrix} = \begin{pmatrix}\text{condenser's}\\ \text{return water}\\ \text{setpoint}\\ \text{line 8411}\end{pmatrix} - \frac{\text{line 2840}}{2}\ ^{\circ}\mathrm{C}$$	(26)

Correspondingly, the upper limit is

Sensor B71	$$\begin{pmatrix}\text{setpoint}\\ \text{upper limit}\\ \text{for the immersion heater}\end{pmatrix} = \begin{pmatrix}\text{condenser's}\\ \text{return water}\\ \text{setpoint}\\ \text{line 8411}\end{pmatrix} + \frac{\text{line 2840}}{2}\ ^{\circ}\mathrm{C}$$	(27)

13.4 Summary of the control of the compressor and immersion heaters

SEQ Taulukko * ARABIC Table 41. Summary of the control of the compressor and immersion heaters without a buffer storage tank

B21	B71	B10	5810	Compressor 1 (K1)			Electric immersion heater after the condenser (K25/K26)		
				Sensor	Setp.	Switching differential	Sensor	Setp.	Sw.diff.
-	-	-		Off (Error 138: No control sensor)			Off		
-	-	ok		Off (Error 138: No control sensor)			B10	FLOW	±1 °C
-	ok	-		B71	RETURN	± 2840 / 2 °C	B71	RETURN	± 2840 / 2 °C
-	ok	ok	=0	B71	RETURN	± 2840 / 2 °C	B71	RETURN	± 2840 / 2 °C
			>0				B10	FLOW	±1 °C
ok	-	-		Off (Error 138: No control sensor)			B21	FLOW	±1 °C
ok	-	ok		Off (Error 138: No control sensor)			B21	FLOW	±1 °C
ok	ok	-	=0	B71	RETURN	± 2840 / 2 °C	B71	RETURN	± 2840 / 2 °C

			>0				B21	RETURN	±1 °C
ok	ok	ok	=0	B71	RETURN	± 2840 / 2 °C	B71	RETURN	± 2840 / 2 °C
			>0				B21	FLOW	±1 °C

FLOW: Temperature of the outgoing water from the condenser (flow)

RETURN: Temperature of the incoming water to the condenser (return)

13.5 Examples

Example: Outside temperature −10 °C, heating curve slope 0.50

Setting	Menu	Line	Value
Outside temperature	Diagnostics consumers	8704	−10 °C
Comfort mode setpoint, heating circuit 1	Heating circuit 1	710	22 °C
Heating curve slope, heating circuit 1	Heating circuit 1	720	0.50
Heating curve displacement, heating circuit 1	Heating circuit 1	721	0 °C
Flow max. setpoint, heating circuit 1	Heating circuit 1	741	40 °C
Switching difference of return temperature	Heat pump (Compressor)	2840	6.0 °C
Heating circuit temp. difference at the outside temperature of −10 °C	Configuration (Heat pump)	5810	4.0 °C
Flow setpoint from the heating curve, heating circuit 1			36.4 °C
Flow setpoint from the heating curve with line 741 taken into account, heating circuit 1	Diagnostics consumers	8744	36.4 °C
Heating circuit’s temperature difference based on line 5810 at the outside temperature of −10 °C			4.0 °C
Heat pump setpoint (return setpoint)	Heat generation status information	8411	32.4 °C
Return temperature’s switching difference below the setpoint		2840 / 2	3.0 °C
Return temperature’s switching difference above the setpoint		2840 / 2	3.0 °C
Compressor's start temperature (return, sensor B71)			29.4 °C
Compressor's stopping temperature (return, sensor B71)			35.4 °C
Lower limit for immersion heater setpoint (flow, sensor B21 installed)			31.4 °C
Upper limit for immersion heater setpoint (flow, sensor B21 installed)			33.4 °C
Lower limit for immersion heater setpoint (return, only sensor B71 installed)			29.4 °C
Upper limit for immersion heater setpoint (return, only sensor B71 installed)			35.4 °C

Example: Outside temperature −30 °C, heating curve slope 0.50, flow temperature’s upper limit 42 °C

Setting	Menu	Line	Value
Outside temperature	Diagnostics consumers	8704	−30 °C
Comfort mode setpoint, heating circuit 1	Heating circuit 1	710	22 °C
Heating curve slope, heating circuit 1	Heating circuit 1	720	0.50
Heating curve displacement, heating circuit 1	Heating circuit 1	721	0 °C
Flow max. setpoint, heating circuit 1	Heating circuit 1	741	40.0 °C
Switching difference of return temperature	Heat pump (Compressor)	2840	6.0 °C
Heating circuit temp. difference at the outside temperature of −10 °C	Configuration (Heat pump)	5810	4.0 °C
Flow setpoint from the heating curve, heating circuit 1			42.0 °C
Flow setpoint from the heating curve with line 741 taken into account, heating circuit 1	Diagnostics consumers	8744	40.0 °C
Heating circuit’s temperature difference based on line 5810 at the outside temperature of −30 °C			6.7 °C
Heat pump setpoint (return setpoint)	Heat generation status information	8411	33.3 °C
Return temperature’s switching difference below the setpoint		2840 / 2	3.0 °C
Return temperature’s switching difference above the setpoint		2840 / 2	3.0 °C
Compressor's start temperature (return, sensor B71)			30.3 °C
Compressor's stopping temperature (return, sensor B71)			36.3 °C
Lower limit for immersion heater setpoint (flow, sensor B21 installed)			32.3 °C
Upper limit for immersion heater setpoint (flow, sensor B21 installed)			34.3 °C
Lower limit for immersion heater setpoint (return, only sensor B71 installed)			30.3 °C
Upper limit for immersion heater setpoint (return, only sensor B71 installed)			36.3 °C

Example: Outside temperature −30 °C, heating curve slope 0.80, flow temperature's upper limit 70 °C

Setting	Menu	Line	Value
Outside temperature	Diagnostics consumers	8704	−30 °C
Comfort mode setpoint, heating circuit 1	Heating circuit 1	710	22 °C
Heating curve slope, heating circuit 1	Heating circuit 1	720	0.80
Heating curve displacement, heating circuit 1	Heating circuit 1	721	0 °C
Flow max. setpoint, heating circuit 1	Heating circuit 1	741	70.0 °C
Switching difference of return temperature	Heat pump (Compressor)	2840	6.0 °C
Heating circuit temp. difference at the outside temperature of −10 °C	Configuration (Heat pump)	5810	4.0 °C
Flow setpoint from the heating curve, heating circuit 1			54.4 °C
Flow setpoint from the heating curve with line 741 taken into account, heating circuit 1	Diagnostics consumers	8744	54.4 °C
Heating circuit's temperature difference based on line 5810 at the outside temperature of −30 °C			6.7 °C
Heat pump setpoint (return setpoint)	Heat generation status information	8411	47.7 °C
Return temperature's switching difference below the setpoint		2840 / 2	3.0 °C
Return temperature's switching difference above the setpoint		2840 / 2	3.0 °C
Compressor's start temperature (return, sensor B71)			44.7 °C
Compressor's stopping temperature (return, sensor B71)			50.7 °C
Lower limit for immersion heater setpoint (flow, sensor B21 installed)			46.7 °C
Upper limit for immersion heater setpoint (flow, sensor B21 installed)			48.7 °C
Lower limit for immersion heater setpoint (return, only sensor B71 installed)			44.7 °C
Upper limit for immersion heater setpoint (return, only sensor B71 installed)			50.7 °C

Example: Outside temperature +10 °C

Setting	Menu	Line	Value
Outside temperature	Diagnostics consumers	8704	+10 °C
Comfort mode setpoint, heating circuit 1	Heating circuit 1	710	22 °C
Heating curve slope, heating circuit 1	Heating circuit 1	720	0.50
Heating curve displacement, heating circuit 1	Heating circuit 1	721	0 °C
Flow max. setpoint, heating circuit 1	Heating circuit 1	741	40 °C
Switching difference of return temperature	Heat pump (Compressor)	2840	6.0 °C
Heating circuit temp. difference at the outside temperature of −10 °C	Configuration (Heat pump)	5810	4.0 °C
Flow setpoint from the heating curve, heating circuit 1			28.6 °C
Flow setpoint from the heating curve with the upper limit taken into account, heating circuit 1	Heat consumers status information	8744	28.6 °C
Heating circuit's temperature difference based on line 5810 at the outside temperature of +5 °C			1.3 °C
Heat pump setpoint (return setpoint)	Heat generation status information	8411	27.3 °C
Return temperature's switching difference below the setpoint		2840 / 2	3.0 °C
Return temperature's switching difference above the setpoint (Notice the deduction on line 2840 with a return temperature setpoint below 30 °C)		2840 / 2	2.2 °C
Compressor's start temperature (return, sensor B71)			25.1 °C
Compressor's stopping temperature (return, sensor B71)			30.3 °C
Lower limit for immersion heater setpoint (flow, sensor B21 installed)			26.3 °C
Upper limit for immersion heater setpoint (flow, sensor B21 installed)			28.3 °C
Lower limit for immersion heater setpoint (return, only sensor B71 installed)			25.1 °C
Upper limit for immersion heater setpoint (return, only sensor B71 installed)			30.3 °C

14 Space heating with a regulated storage tank

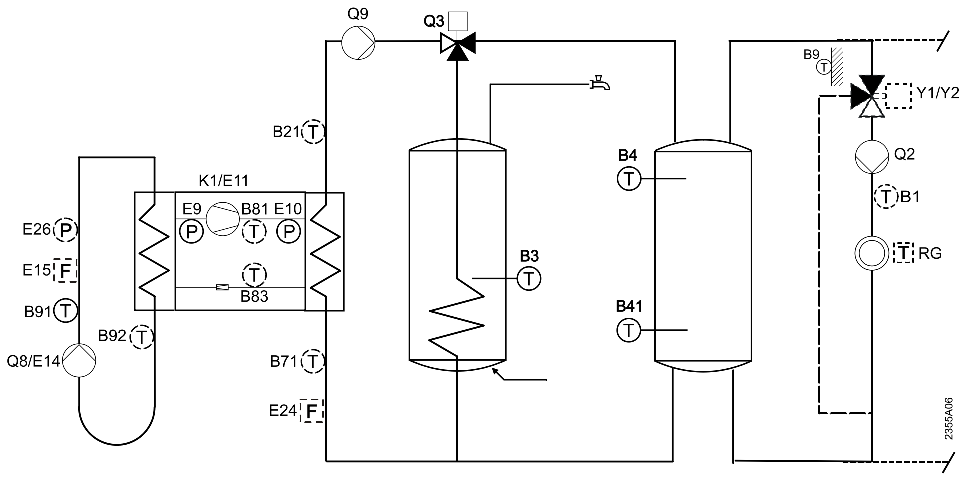


Figure 39. DHW storage tank and space heating with the buffer storage tank (additional storage tank)

In the context of automation, heating circuit's storage tank is called the buffer storage tank. A separate DHW storage tank and a heating circuit buffer storage tank can be replaced by a single storage tank, if needed, in which case the single tank is used as a storage tank for both the heating circuit and the DHW. In this case, sensor B3 is placed at the top of the tank and sensor B4 at the middle of the tank.

14.1 Important setpoints and statuses

SEQ Taulukko * ARABIC Table 42. Key setpoints for space heating with a regulated buffer storage tank

Menu	Line	Setting
Diagnostics consumers	8704	Outside temperature
Heating circuit 1	710	Comfort mode setpoint, heating circuit 1
Heating circuit 1	720	Heating curve slope, heating circuit 1
Heating circuit 1	721	Heating curve displacement, heating circuit 1
Heating circuit 1	741	Flow max. setpoint, heating circuit 1
Heating circuit 1	830	Mixing valve boost, heating circuit 1
Buffer storage tank	4720	Storage tank control sensor
Buffer storage tank	4722	Temperature differential of buffer storage tank and heating circuit
Buffer storage tank	4721	Heat generation switching differential
Buffer storage tank	4735	Setpoint reduction B42/B41
Heat pump (compressor)	2840	Switching diff. return temp.
Heat pump (condenser)	2805	Condenser's temperature differential
Status	8000-	Function statuses. From line 8000 onward.
Diagnostics heat generation	8395-	Statuses of compressors, electric immersion heaters etc. from line 8395 onward
Diagnostics consumers	8740-	Statuses of heating circuits
Diagnostics consumers	8744	Flow setpoint from the heating curve with line 741 taken into account, heating circuit 1
Diagnostics consumers	8981	Buffer tank temperature setpoint

Diagnostics heat generation	8411	Condenser flow setpoint for electric immersion heater (flow sensor B21 installed)
Heat generation status information	8411	Condenser return setpoint for electric immersion heater (only return sensor B71 installed)

14.2 Compressor control

If the heating circuit is connected to the buffer storage tank, the heating circuit setpoint is made the buffer storage tank's setpoint and the buffer storage tank setpoint is used for starting and shutting off the compressor. The heat pump's compressor is switched on and off in accordance with the temperature of the buffer storage tank of the heating circuit. This temperature is measured with sensor B4. The measured temperature is compared to the setpoint of the buffer storage tank temperature.

The storage tank can also be controlled with combinations of sensors B4, B41, B42, and B71. The controlling sensors are selected on line 4720. For example, if sensors B4 and B41 are used (or B71 is used instead of B41), storage tank heating begins if the temperature at both sensors is lower than the compressor's starting temperature and, correspondingly, is stopped only if the reading of both sensors exceeds the shut-off temperature of the compressor. On line 4735, sensor B41 on the bottom of the storage tank can be given a lower setpoint than the top sensor, B4.

On line 4722, the lower limit of the storage tank's temperature is set as a temperature differential to the storage tank's setpoint (line 8981). The row's value can be positive or negative. With a positive value, the storage tank is always above the requested temperature for the heating circuit (storage tank setpoint). With a negative value, the storage tank is allowed to cool to a temperature lower than the requested temperature (storage tank setpoint).

The amount by which the heated storage tank's temperature exceeds the lower limit is selected on line 4721. In other words, line 4721 is for setting the switching differential for the storage tank's temperature, and line 4722 is for setting the level from which the temperature is raised by the amount of the switching differential. The switching differential on line 4721 must be adjusted so that the duration of the heat pump's run time is sufficient. The run time must be at least 5 minutes. The suitable switching differential is dependent on the proportion of the storage tank's volume to the heat pump's capacity. The suitable differential for line 4721 is usually at least 5 °C. If the storage tank is small in proportion to the pump's capacity, the switching differential must be increased to achieve a run time that is sufficiently long.

The starting temperature for the compressor is

Sensor B4	$\begin{pmatrix}\text{compressor's}\\ \text{starting temperature}\end{pmatrix} = \begin{pmatrix}\text{storage tank's}\\ \text{temperature}\\ \text{setpoint}\\ \text{line 8981}\end{pmatrix} + \text{ line 4722}$	(28)

Correspondingly, stopping temperature of compressor is

Sensor B4	$\begin{pmatrix}\text{compressor's}\\ \text{stopping temperature is}\end{pmatrix} = \begin{pmatrix}\text{storage tank's}\\ \text{temperature}\\ \text{setpoint}\\ \text{line 8981}\end{pmatrix} + \text{ line 4722 } + \text{ line 4721}$	(29)

14.3 Buffer storage tank temperature setpoint

The temperature setpoint for the buffer storage tank is equal to the heating circuit's flow setpoint (from the heating curve). If needed, a boost can be added to the flow setpoint in order to take the water cooling in the piping between the storage tank and control valve into account. The boost for heating circuit 1 is set on line 830. If the value on line 830 is set to for example 1 °C, a request is sent to the storage tank for a temperature that is 1 °C higher than the heating circuit's flow setpoint. The boosting mechanism for other heating circuits works in the same way. If several heating circuits are connected to the storage tank, the setpoint is determined on the basis of the highest temperature request.

The temperature setpoint for the upper part of the buffer storage tank is

Sensor B4	$\begin{pmatrix}\text{storage tank's}\\ \text{top section's}\\ \text{temperature}\\ \text{setpoint}\\ \text{line 8981}\end{pmatrix} = \begin{pmatrix}\text{heating circuit's}\\ \text{flow}\\ \text{setpoint}\\ \text{from heating curve}\\ \text{line 8744}\end{pmatrix} + \begin{pmatrix}\text{boost}\\ \text{line 830}\end{pmatrix}$	(30)

The temperature setpoint for the lower part of the buffer storage tank is

Sensor B41	$\begin{pmatrix}\text{storage tank's}\\ \text{bottom section's}\\ \text{temperature}\\ \text{setpoint}\\ \text{line 8982}\end{pmatrix} = \begin{pmatrix}\text{storage tank's}\\ \text{top section's}\\ \text{temperature}\\ \text{setpoint}\\ \text{line 8981}\end{pmatrix} - \begin{pmatrix}\text{reduction}\\ \text{line 4735}\end{pmatrix}$	(31)

14.4 Electric immersion heater control

Condenser circuit's heater is switched on and off based on degree minutes (chapter 15). Degree minutes are calculated using the minimum and maximum limits of the setpoint. Switch-on minutes are calculated below the minimum limit, whereas switch-off minutes are calculated above the meximum limit. Degree minutes are therefore not calculated within the limits.

14.4.1 Flow sensor B21 installed

If flow sensor B21 is installed in the heat pump, the electric immersion heater is switched on and off on the basis of the storage tank's temperature setpoint and the reading of flow sensor B21 from the heat pump's condenser. A switching differential of 1 °C is used around the setpoint to calculate the upper and lower limit for the immersion heater's setpoint. Condenser flow setpoint is

Sensor B21	$$\begin{pmatrix}\text{condenser's}\\\text{flow}\\\text{setpoint}\\\text{line 8411}\end{pmatrix}=\begin{pmatrix}\text{storage tank's}\\\text{temperature}\\\text{setpoint}\\\text{line 8981}\end{pmatrix}$$	(32)

The lower limit of the immersion heater setpoint is

Sensor B21	$$\begin{pmatrix}\text{setpoint}\\\text{lower limit}\\\text{for the immersion heater}\end{pmatrix}=\begin{pmatrix}\text{storage tank's}\\\text{temperature}\\\text{setpoint}\\\text{line 8981}\end{pmatrix}-1\,°\mathrm{C}$$	(33)

Correspondingly, the upper limit of the immersion heater setpoint is

Sensor B21	$$\begin{pmatrix}\text{setpoint}\\\text{upper limit}\\\text{for the immersion heater}\end{pmatrix}=\begin{pmatrix}\text{storage tank's}\\\text{temperature}\\\text{setpoint}\\\text{line 8981}\end{pmatrix}+1\,°\mathrm{C}$$	(34)

14.4.2 Only return sensor B71 installed

If the heat pump is not equipped with flow sensor B21, electric immersion heaters are controlled via return sensor B71. Return sensor B71's setpoint for electric immersion heaters is

Sensor B71	$$\begin{pmatrix}\text{condenser's}\\\text{return water}\\\text{setpoint}\\\text{line 8411}\end{pmatrix}=\begin{pmatrix}\text{storage tank's}\\\text{temperature}\\\text{setpoint}\\\text{line 8981}\end{pmatrix}\text{line 2805}$$	(35)

If the value on line 2805 is set to ---, automation will use the value 8 °C on line 2805 for calculation.

The switching differential for line 2840 is used around the return setpoint to calculate the upper and lower limit of the immersion heaters' setpoint. The lower limit of the immersion heater setpoint is

Sensor B71	$$\begin{pmatrix}\text{setpoint}\\\text{lower limit}\\\text{for the immersion heater}\end{pmatrix}=\begin{pmatrix}\text{condenser's}\\\text{return water}\\\text{setpoint}\\\text{line 8411}\end{pmatrix}-\frac{\text{line 2840}}{2}$$	36

Correspondingly, the upper limit of the immersion heater setpoint is

Sensor B71	$$\begin{pmatrix}\text{setpoint}\\\text{lower limit}\\\text{for the immersion heater}\end{pmatrix}=\begin{pmatrix}\text{condenser's}\\\text{return water}\\\text{setpoint}\\\text{line 8411}\end{pmatrix}+\frac{\text{line 2840}}{2}$$	37

14.5 Keeping the storage tank in standard temperature

The lower limit of the storage tank's temperature setpoint can be kept as standard, regardless of the flow setpoint of the heating circuit. This is done by switching the additional virtual heating circuit on in the automation. The virtual circuit is set with a suitable lower limit for the flow temperature. If one of the non-virtual circuits does not give a higher request, the storage tank's setpoint is always kept on par with the lower limit of the virtual circuit's flow, at a minimum. It is always determined according to the highest requested temperature.

Heating circuit 3 should be used as the virtual heating circuit, so the other two circuits can be used regularly as actual heating circuits. The lower limit of the flow setpoint for circuit 3 is set first (line 1340). This prevents the storage tank's temperature setpoint (line 1341) from ever dropping below the limit. An upper limit should be set (line 1341) to the circuit to avoid the request temperature of the virtual circuit from rising above the set lower limit as the outside temperature drops. The upper limit is set at, for example, one degree above the lower limit. With these settings the storage tank's temperature setpoint varies by under 1 °C and rises above that only if the heating curve from heating circuit 1 or 2 requests a higher setpoint. The compressor stop and start temperatures normally take lines 4721 and 4722 into account.

Menu	Line	Setting	Setpoint
Configuration	5721	Heating circuit 3	On
Heating circuit 3	1470	With buffer (Heating circuit is connected to the storage tank.)	yes
Heating circuit 3	1340	Minimum flow temperature setpoint (This is altered.)	e.g. 45 °C
Heating circuit 3	1341	Maximum flow temperature setpoint (This is set 1 °C above the minimum.)	e.g. 46 °C

14.6 Summary of the control of the compressor and immersion heaters

Table 43. Summary of the control of the compressor and immersion heaters in the buffer storage tank connection

A request from the DHW storage tank[1]	B21	B71	B10	Compressor 1 (K1)			Electric immersion heater after the condenser (K25/K26)		
				Sensor	Setp.	Switching differential	Sensor	Setp.	Sw.diff.
YES	-	-	-				On		
	-	-	ok	Storage tank setpoint (sensor B4)			B10	FLOW	±1 °C
	-	ok	-	Storage tank setpoint (sensor B4)			B71	RETURN	± line 2840 / 2 °C
	-	ok	ok	Storage tank setpoint (sensor B4)			B10	FLOW	±1 °C
	ok	-	-	Storage tank setpoint (sensor B4)			B21	FLOW	±1 °C
	ok	-	ok	Storage tank setpoint (sensor B4)			B21	FLOW	±1 °C
	ok	ok	-	Storage tank setpoint (sensor B4)			B21	STORAGE TANK	±1 °C
	ok	ok	ok	Storage tank setpoint (sensor B4)			B21	FLOW	±1 °C

1) A heating request arriving from the storage tank of the heating circuit.

FLOW: Temperature of the outgoing water from the condenser (flow)

RETURN: Temperature of the incoming water to the condenser (return)

14.7 Examples

Example: Outside temperature −10 °C, compressor's switch-on threshold around the buffer storage tank's setpoint

Setting	Menu	Line	Value
Outside temperature	Diagnostics consumers	8704	−10 °C
Comfort mode setpoint, heating circuit 1	Heating circuit 1	710	22 °C
Heating curve slope, heating circuit 1	Heating circuit 1	720	0.50
Heating curve displacement, heating circuit 1	Heating circuit 1	721	0 °C
Flow max. setpoint, heating circuit 1	Heating circuit 1	741	40 °C
Mixing valve boost, heating circuit 1	Heating circuit 1	830	0 °C
Temperature difference of buffer storage tank and heating circuit	Buffer storage tank	4722	−2 °C
Heat generation switching difference	Buffer storage tank	4721	6 °C
Switching difference of return temperature	Heat pump (compressor)	2840	6.0 °C
Condenser temperature difference	Heat pump (condenser)	2805	3.0 °C
Flow setpoint from the heating curve, heating circuit 1			36.4 °C
Flow setpoint from the heating curve with line 741 taken into account, heating circuit 1	Diagnostics consumers	8744	36.4 °C
Buffer tank temperature setpoint	Diagnostics consumers	8981	36.4 °C
Compressor's starting temperature (storage tank temp., sensor B4)			34.4 °C
Compressor's stopping temperature (storage tank temp., sensor B4)			38.4 °C
Condenser flow setpoint for electric immersion heater (sensor B21 installed)	Heat generation status information	8411	36.4 °C
Lower limit for immersion heater setpoint (flow, sensor B21 installed)			35.4 °C
Upper limit for immersion heater setpoint (flow, sensor B21 installed)			37.4 °C
Condenser return setpoint for electric immersion heater (only return sensor B71 installed)	Heat generation status information	8411	33.4 °C
Lower limit for immersion heater setpoint (return, sensor B71)			30.4 °C
Upper limit for immersion heater setpoint (return, sensor B71)			36.4 °C

Example: Outside temperature −10 °C, buffer storage tank always hotter than heating circuit's request

Setting	Menu	Line	Value
Outside temperature	Diagnostics consumers	8704	−10 °C
Comfort mode setpoint, heating circuit 1	Heating circuit 1	710	22 °C
Heating curve slope, heating circuit 1	Heating circuit 1	720	0.50
Heating curve displacement, heating circuit 1	Heating circuit 1	721	0 °C
Flow max. setpoint, heating circuit 1	Heating circuit 1	741	40 °C
Mixing valve boost, heating circuit 1	Heating circuit 1	830	0 °C
Temperature difference of buffer storage tank and heating circuit	Buffer storage tank	4722	1 °C
Heat generation switching difference	Buffer storage tank	4721	6 °C
Switching difference of return temperature	Heat pump (compressor)	2840	6.0 °C
Condenser temperature difference	Heat pump (condenser)	2805	3.0 °C
Flow setpoint from the heating curve, heating circuit 1			36.4 °C
Flow setpoint from the heating curve with line 741 taken into account, heating circuit 1	Diagnostics consumers	8744	36.4 °C
Buffer tank temperature setpoint	Diagnostics consumers	8981	36.4 °C
Compressor's starting temperature (storage tank temp., sensor B4)			37.4 °C
Compressor's stopping temperature (storage tank temp., sensor B4)			43.4 °C
Condenser flow setpoint for electric immersion heater (sensor B21 installed)	Heat generation status information	8411	36.4 °C
Lower limit for immersion heater setpoint (flow, sensor B21 installed)			35.4 °C
Upper limit for immersion heater setpoint (flow, sensor B21 installed)			37.4 °C
Condenser return setpoint for electric immersion heater (only return sensor B71 installed)	Heat generation status information	8411	33.4 °C
Lower limit for immersion heater setpoint (return, sensor B71)			30.4 °C
Upper limit for immersion heater setpoint (return, sensor B71)			36.4 °C

Example: Outside temperature −10 °C, buffer storage tank temperature always lower than heating circuit's request (mixing valve always open)

Setting	Menu	Line	Value
Outside temperature	Diagnostics consumers	8704	−10 °C
Comfort mode setpoint, heating circuit 1	Heating circuit 1	710	22 °C
Heating curve slope, heating circuit 1	Heating circuit 1	720	0.50
Heating curve displacement, heating circuit 1	Heating circuit 1	721	0 °C
Flow max. setpoint, heating circuit 1	Heating circuit 1	741	40 °C
Mixing valve boost, heating circuit 1	Heating circuit 1	830	0 °C
Temperature difference of buffer storage tank and heating circuit	Buffer storage tank	4722	−7 °C
Heat generation switching difference	Buffer storage tank	4721	6 °C
Switching difference of return temperature	Heat pump (compressor)	2840	6.0 °C
Condenser temperature difference	Heat pump (condenser)	2805	3.0 °C
Flow setpoint from the heating curve, heating circuit 1			36.4 °C
Flow setpoint from the heating curve with line 741 taken into account, heating circuit 1	Diagnostics consumers	8744	36.4 °C
Buffer tank temperature setpoint	Diagnostics consumers	8981	36.4 °C
Compressor's starting temperature (storage tank temp., sensor B4)			29.4 °C
Compressor's stopping temperature (storage tank temp., sensor B4)			35.4 °C
Condenser flow setpoint for electric immersion heater (sensor B21 installed)	Heat generation status information	8411	36.4 °C
Lower limit for immersion heater setpoint (flow, sensor B21 installed)			35.4 °C
Upper limit for immersion heater setpoint (flow, sensor B21 installed)			37.4 °C
Condenser return setpoint for electric immersion heater (only return sensor B71 installed)	Heat generation status information	8411	33.4 °C
Lower limit for immersion heater setpoint (return, sensor B71)			30.4 °C
Upper limit for immersion heater setpoint (return, sensor B71)			36.4 °C

Example: Outside temperature −10 °C, compressor's switch-on threshold around the buffer storage tank's setpoint

Setting	Menu	Line	Value
Outside temperature	Diagnostics consumers	8704	−30 °C
Comfort mode setpoint, heating circuit 1	Heating circuit 1	710	22 °C
Heating curve slope, heating circuit 1	Heating circuit 1	720	0.50
Heating curve displacement, heating circuit 1	Heating circuit 1	721	0 °C
Flow max. setpoint, heating circuit 1	Heating circuit 1	741	40 °C
Mixing valve boost, heating circuit 1	Heating circuit 1	830	0 °C
Temperature difference of buffer storage tank and heating circuit	Buffer storage tank	4722	−2 °C
Heat generation switching difference	Buffer storage tank	4721	6 °C
Switching difference of return temperature	Heat pump (compressor)	2840	6.0 °C
Condenser temperature difference	Heat pump (condenser)	2805	3.0 °C
Flow setpoint from the heating curve, heating circuit 1			42.0 °C
Flow setpoint from the heating curve with line 741 taken into account, heating circuit 1	Diagnostics consumers	8744	40.0 °C
Buffer tank temperature setpoint	Diagnostics consumers	8981	40.0 °C
Compressor's starting temperature (storage tank temp., sensor B4)			38.0 °C
Compressor's stopping temperature (storage tank temp., sensor B4)			44.0 °C
Condenser flow setpoint for electric immersion heater (sensor B21 installed)	Heat generation status information	8411	40.0 °C
Lower limit for immersion heater setpoint (flow, sensor B21 installed)			39.0 °C
Upper limit for immersion heater setpoint (flow, sensor B21 installed)			41.0 °C
Condenser return setpoint for electric immersion heater (only return sensor B71 installed)	Heat generation status information	8411	37.0 °C
Lower limit for immersion heater setpoint (return, sensor B71)			34.0 °C
Upper limit for immersion heater setpoint (return, sensor B71)			40.0 °C

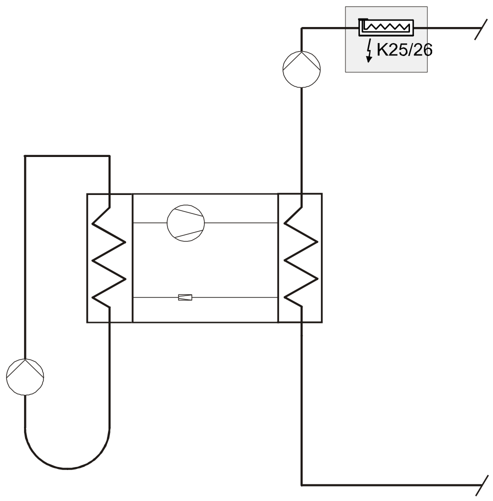
Example: Outside temperature −30 °C, compressor's switch-on threshold around the buffer storage tank's setpoint, heating curve slope 0.80, flow temperature's upper limit 70 °C

Setting	Menu	Line	Value
Outside temperature	Diagnostics consumers	8704	−30 °C
Comfort mode setpoint, heating circuit 1	Heating circuit 1	710	22 °C
Heating curve slope, heating circuit 1	Heating circuit 1	720	0.80
Heating curve displacement, heating circuit 1	Heating circuit 1	721	0 °C
Flow max. setpoint, heating circuit 1	Heating circuit 1	741	70 °C
Mixing valve boost, heating circuit 1	Heating circuit 1	830	0 °C
Temperature difference of buffer storage tank and heating circuit	Buffer storage tank	4722	−2 °C
Heat generation switching difference	Buffer storage tank	4721	6 °C
Switching difference of return temperature	Heat pump (compressor)	2840	6.0 °C
Condenser temperature difference	Heat pump (condenser)	2805	3.0 °C
Flow setpoint from the heating curve, heating circuit 1			54.4 °C
Flow setpoint from the heating curve with line 741 taken into account, heating circuit 1	Diagnostics consumers	8744	54.4 °C
Buffer tank temperature setpoint	Diagnostics consumers	8981	54.4 °C
Compressor's starting temperature (storage tank temp., sensor B4)			52.4 °C
Compressor's stopping temperature (storage tank temp., sensor B4)			58.4 °C
Condenser flow setpoint for electric immersion heater (sensor B21 installed)	Heat generation status information	8411	54.4 °C
Lower limit for immersion heater setpoint (flow, sensor B21 installed)			53.4 °C
Upper limit for immersion heater setpoint (flow, sensor B21 installed)			55.4 °C
Condenser return setpoint for electric immersion heater (only return sensor B71 installed)	Heat generation status information	8411	51.4 °C
Lower limit for immersion heater setpoint (return, sensor B71)			48.4 °C
Upper limit for immersion heater setpoint (return, sensor B71)			54.4 °C

Example: Outside temperature +10 °C, compressor's switch-on threshold around the buffer storage tank's setpoint

Setting	Menu	Line	Value
Outside temperature	Diagnostics consumers	8704	+10 °C
Comfort mode setpoint, heating circuit 1	Heating circuit 1	710	22 °C
Heating curve slope, heating circuit 1	Heating circuit 1	720	0.50
Heating curve displacement, heating circuit 1	Heating circuit 1	721	0 °C
Flow max. setpoint, heating circuit 1	Heating circuit 1	741	40 °C
Mixing valve boost, heating circuit 1	Heating circuit 1	830	0 °C
Temperature difference of buffer storage tank and heating circuit	Buffer storage tank	4722	−2 °C
Heat generation switching difference	Buffer storage tank	4721	6 °C
Switching difference of return temperature	Heat pump (compressor)	2840	6.0 °C
Condenser temperature difference	Heat pump (condenser)	2805	3.0 °C
Flow setpoint from the heating curve, heating circuit 1			28.4 °C
Flow setpoint from the heating curve with line 741 taken into account, heating circuit 1	Diagnostics consumers	8744	28.4 °C
Buffer tank temperature setpoint	Diagnostics consumers	8981	28.4 °C
Compressor's starting temperature (storage tank temp., sensor B4)			26.4 °C
Compressor's stopping temperature (storage tank temp., sensor B4)			32.4 °C
Condenser flow setpoint for electric immersion heater (flow sensor B21 installed)	Heat generation status information	8411	28.4 °C
Lower limit for immersion heater setpoint (flow, sensor B21)			27.4 °C
Upper limit for immersion heater setpoint (flow, sensor B21)			29.4 °C
Condenser return setpoint for electric immersion heater (only return sensor B71 installed)	Heat generation status information	8411	25.4 °C
Lower limit for immersion heater setpoint (return, sensor B71)			22.4 °C
Upper limit for immersion heater setpoint (return, sensor B71)			28.4 °C

15 Electric immersion heater in the condenser line



Functions

QX: electric heater stage 1 K25
QX: electric heater stage 2 K26

Electric heaters must always be equipped with overheat protection and connected behind a fuse and contactor. Automation's QX outputs are for controlling the heater's contactors only. Do not connect the heater to them directly. If the heater has a thermostat in addition to overheat protection, its setpoint must be set high enough so the thermostat does not prevent the heater from operating.

15.1 Important setpoints and statuses

SEQ Taulukko * ARABIC Table 44. Key setpoints for the electric immersion heater in the condenser line

Menu	Line	Setting
Heat pump	2880	Use electric flow (electric immersion heater's operating mode)
Heat pump	2881	Locking time
Heat pump	2882	Release integral, electric immersion heater in flow (switch-on degree minutes)
Heat pump	2883	Reset integral, electric immersion heater in flow (switch-off degree minutes)
Heat pump	2884	Release el. flow below OT (OT limit)
Heat pump	2885	Electric on below flow temp (flow temp. limit)
Diagnostics heat generation	8402	Electric immersion heater stage 1 status
Diagnostics heat generation	8403	Electric immersion heater stage 2 status

15.2 Electric immersion heater settings

15.2.1 Operating mode of electric immersion heater

The operating mode for electric immersion heaters K25/K26 is set on line 2880.

SUBSTITUTE: An electric heater is used only when emergency operation initiated by the automation is on (see lines 7141 and 7142) or when the temperature of the brine from the brine circuit drops below the lower limit defined on line 2816. The electric immersion heater is not on simultaneously with the compressor, and the lines for locking and degree minutes (lines 2881 and 2882) are ignored.

HEATING CIRCUIT ALONGSIDE THE COMPRESSOR: The electric immersion heater is switched on in the space heating mode alongside the compressor when the locking time on line 2881 has elapsed and the number of degree-minutes set on line 2882 has been exceeded. The electric immersion heaters are not in complementary use with the compressor during DHW heating. Electric immersion heaters are used in DHW heating only when the temperature limit on lines 2893 (chapter 24.1) or 5032 (chapter 12.5) is exceeded.

DHW ALONGSIDE THE COMPRESSOR: The electric immersion heater is switched on in the DHW heating mode to complement the compressor when the locking time on line 2881 has elapsed and the number of degree-minutes set on line 2882 has been exceeded. Electric immersion heaters are not available for space heating.

HC+DHW ALONGSIDE THE COMPRESSOR: The electric immersion heater is switched on in the space heating mode and in the DHW heating mode to complement the compressor when the locking time on line 2881 has elapsed and the number of degree-minutes set on line 2882 has been exceeded.

END DHW STORAGE TANK CHARGING: The electric heater is used only if the compressor has been switched off during DHW charging because of the switch-off temperature (line 2844), high pressure switch-off or hot-gas temperature limit (line 2846) and the maximum number of charging attempts (line 2893) has been reached. The electric immersion heater is not on simultaneously with the compressor, and the lines for locking and degree minutes (lines 2881 and 2882) are ignored.

EMERGENCY OPERATION: An electric immersion heater is used only when emergency operation is active (lines 7141 and 7142). The electric immersion heater is not on simultaneously with the compressor, and the lines for delay and degree-minutes (lines 2881 and 2882) are ignored.

LEGIONELLA FUNCTION: This corresponds to the “End DHW charging” mode with the exception that electric immersion heaters are used only when the Legionella function is on.

END DHW STORAGE TANK CHARGING: The electric immersion heater is used only if the compressor has been switched off during DHW charging because of the switch-off temperature (line 2844), high pressure switch-off or hot-gas temperature limit (line 2846) and the maximum number of charging attempts (line 2893) has been reached. The electric immersion heater is not on simultaneously with the compressor, and the lines for locking and degree minutes (lines 2881 and 2882) are ignored.

15.2.2 Switch-on locking time (delay time) and degree minutes

A locking time (delay time) and degree minutes can be set for the switch-on of electic immersion heaters K25/26. The locking time is set on line 2881 and the degree minutes are set on line 2882. Heater stages are switched on when the immersion heaters' delay time has ended and the sum of the degree minutes has elapsed. The calculation of the delay begins when the compressor is switched on. During the delay, the electric immersion heaters are not switched on and degree minutes are not calculated. After the delay, the controller starts calculating the sum of the degree minutes. If flow sensor B21 is installed in the heat pump, the flow temperature is used to calculate the electric immersion heater's degree minutes. Otherwise, return temperature is used (sensor B71).

In switching on the immersion heaters, a degree minute is the remainder of the setpoint's lower limit and the measured temperature, calculated in one minute intervals. When the measured temperature is lower than the setpoint's lower limit, the calculation of degree minutes begins. If the measured temperature exceeds the lower limit, the sum and the degree minutes are reset.

The degree minutes for each minute are summed up as the sum of the degree minutes. When the sum exceeds the degree minutes limit set on line 2882, the first stage of the electric immersion heaters is switched on (K25). After this, the sum of the degree minutes is reset and the calculation starts again. When the sum of the degree minutes again reaches the value on line 2882, the second immersion heater stage is switched on (K26). The same procedure is followed with the third immersion heater stage (K25 + K26). The delay is used only before the calculation of the degree minutes of the first stage. If the degree minute value is set to zero, the heater stages are directly switched on below the setpoint's lower limit.

The time it takes to reach the degree minute sum depends on the difference between the setpoint's lower limit and the measured value. For example, if the degree minute sum is 20 °C min, it corresponds to a temperature difference of 10 °C for two minutes or a temperature difference of 5 °C for four minutes. If, for instance, the lower limit of the heaters' setpoint is 28 °C and the measured temperature is 25 °C, the degree minutes count is incremented by three degree minutes every minute if the measured temperature remains unchanged. Thus, in five minutes, the sum will be 15 degree minutes, and in ten minutes, 30 degree minutes. For example, if the degree-minute sum set on line 2882 is 30 degree minutes, the first immersion heater stage is switched on when 10 minutes have elapsed since the delay time ended. After this, the calculation of the sum for the next immersion heater stage will begin. If the temperature rises during this time above the upper limit for the immersion heaters, the calculation of degree-minutes for that stage is stopped and the sum is reset.

15.2.3 Switch-off degree minutes

Heater stages are switched off when the the sum of the switch-off degree minutes is reached. The degree minutes for switch-off are set on line 2882. The switch-off does not take the locking time into account.

In switching off the immersion heaters, a degree minute is the remainder of the setpoints' upper limit and the measured temperature, calculated in one minute intervals. When the measured temperature exceeds the setpoints' upper limit, the calculation of degree minutes begins. If the measured temperature drops below the upper limit, the sum and the degree minutes are reset. The switch-off degree minutes are usually set to zero so the heater stages are switched off immediately after the measured temperature exceeds the upper limit of the heaters' setpoint.

15.2.4 Temperature limits

An outside temperature limit can be set to the electric immersion heater on line 2884. The heater is not taken into use above this value. This setting also applies to DHW heating. This setting should not be taken into use if DHW needs to be heated also with an electric immersion heater. If the line value is set to for example −15 °C, the electric immersion heater is not available for use until the outside temperature drops below −15 °C.

A flow temperature limit can be set on line 2885, below which the immersion heater is always immediately switched on. If the line value is set to for example 8 °C, the electric immersion heater is always immediately switched on when the flow temperature drops below 8 °C. This function can be used for frost protection, among other things. The flow temperature limit does not prevent the immersion heater from switching on in other normal operating situations. The function only switches the immersion heater on when the flow temperature drops below the set lower limit.

The functions on lines 2884 and 2885 can be enabled simultaneously. If the value on line 2884 is set to for example −2 °C and the value on line 2885 to 8 °C, the electric immersion heater is switched on if the outside temperature is below −2 °C and the flow temperature is below 8 °C.

These temperature limits are not available in Emergency mode. In Emergency mode, the electric immersion heater is switched on regardless of the temperature limits on lines 2884 and 2885.

15.3 Switching off the electric immersion heater

15.3.1 Heater used in emergency operation only

Set the value on line 2880 to Substitute or Emergency operation if you want the heater to be switched off during normal operation. This enables the heater to be switched on during emergency operation only.

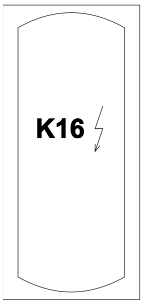
15.3.2 Switching the heater off completely

The electric heater can be entirely decommissioned in the configuration menu by first selecting the option No function for outputs QX1 and QX2 and then switching the heater’s fuse to OFF position. Take into account that after doing this the electric immersion heater is not available for any functions, including emergency operation. Complete decommission is not recommended. Do not switch to heater’s fuse to OFF position before removing the heater from automation use in the manner described above.

16 Electric immersion heater in the storage tank

16.1 Electric immersion heater in heating circuit's storage tank

Automation can control an eletric immersion heater in the heating circuit's storage tank (K16). The heater is switched on if the heat pump is unable to produce heat due to a fault condition, or if the storage tank's frost protection has been switched on. It is controlled with a sensor selected on line 4760. Usually this is sensor B4. The heater is switched on during a heat pump fault condition if the reading on the selected sensor drops 1 °C below the storage tank's setpoint. Correspondingly, the heater is switched off once the reading is 1 °C above the setpoint. The electric immersion heater is switched on during frost protection when the storage's temperature drops below 5 °C and stays switched on until the temperature has risen to 10 °C. In addition to the previously mentioned functions, the heater can also be used for force charging the buffer storage tank (chapter 17).

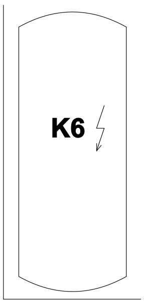


Functions

QX: Buffer tank's electric immersion heater K16

16.2 Electric heater in service buffer tank

The electric immersion heater (K6) located in the service buffer tank can be controlled with the automation. The service buffer tank's electric heater is utilized instead of the condenser circuit heaters K25 and K26. If the connection has a diverting valve, it switches to space heating as the resistor is switched on.



Functions

QX: DHW's electric immersion heater K6

Heater K6 can be used, for example, heating the domestic water to a higher temperature after the compressor has reached the temperature level set on line 5032. To do this, select the option "substitute" on line 5060, "24 h" or "release of domestic hot water" on line 5061, and "DHW sensor" on line 5062. This makes the compressor available for space heating (the diverting valve turns) and heater K6 takes care of the final heating of domestic water once sensor B3 observes a temperature that is above the setpoint on line 5032.

SEQ Taulukko * ARABIC Table 45. Settings of the service buffer tank's electric immersion heater in the DHW menu

Line	Setting	Action
5060	El. imm. heater optg mode	**Substitute:** The electric immersion heater is used only if the heat pump is unable to charge the DHW. Charging can be limited by the compressor temperature limit (line 5032), a time limit (line 5030) or the switch-off temperature (2844), or some type of a fault status (discharge). The temperature, to which the DHW could be heated via the heat pump before the immersion heater switches on, is saved on line 7093. **Summer:** DHW is heated by the immersion heaters in the storage tank if the heating circuits are off due to summer usage (the Eco function). In this case, the compressor is not switched on. **Always:** DHW is always heated only with the immersion heaters in the storage tank. The compressor is not used to charge the DHW. **Emergency operation:** The immersion heaters in the storage tank are used for heating the DHW only when the heat pump is in emergency operation. **LEGIONELLA FUNCTION:** The immersion heaters in the storage tank are used only when the Legionella function is active.
5061	Release of el. immersion heater	**24 h:** Heater K6 is always available for operation, regardless of the operating purpose selected on line 5060. **Release of domestic hot water:** The heater is available for the function selected on line 5060 when DHW heating is on as set on line 1620. **Time program:** Electric immersion heater K6 is available for the function on line 5060 according to time program 4. It is unavailable outside of this time period.
5062	El. immersion heater control	Electric immersion heater K6's control sensor. Here you should select the DHW sensor, putting the heater under sensor B3's control.

17 Forced charging of storage tanks

With forced charging, storage tanks can be heated (charged) based on time or relay contact information. This way the storage tanks can be heated (charged) using a cheaper time-based feed-in tariff, for example.

17.1 Forced charging of heating circuit's storage tank

Heating circuit's storage tank's (additional storage tank, buffer storage tank) forced charging can be started either scheduled or with relay contact information. Forced charging is enabled on line 4705. The time for scheduled forced charging is set on line 4711. Forced charging starts daily at the time set on line 4711. If no time is set, scheduled forced charging is not enabled. The maximum duration is set on line 4712. Relay contact control is enabled selecting low tariff as a vacant EX input's function. The contact can be open (NO) or closed (NC). Function E5 can also be used with smart-grid contact information (chapter 18.2). Forced charging that has been set with relay contact information will stay active as long as the relay contact is active. Relay contact control can run in parallel with scheduled control, or without it.

When forced charging is enabled, automation uses the highest setpoint that occurred in normal mode (chapter 14) as the storage tank's setpoint and reduces it by 10 % daily, if a new, higher setpoint is not presented. When calculating the highest setpoint, automation only takes the setpoints that are within the lower and upper limits on lines 4709 and 4710, respectively, into account (**Error! Reference source not found.**). Give these lines equal values if you want to force charge the storage tank to the same temperature every time. If you want the upper limit to change according to temperature need, instead, but keep the lower limit fixed, then set the desired lower limit on line 4709, and set the upper limit on line 4710 to as hot as the heat pump (or heater) can possibly heat the storage tank.

Forced charging ends when the storage tank's temperature exceeds the storage tank's setpoint in forced charging. Forced charging is also halted if the heat pump is switched off during charging due to a limit or protection function. If the storage tank cools to 5 °C below the setpoint after the forced charging, forced charging starts again if it is still active according to the contact information or schedule. Scheduled forced charging also ends according to the time limit on line 4712 if the storage tank's setpoint has not been reached earlier. DHW is charged normally during forced charging. Forced charging continues after the DHW is charged. IF DHW is also force charged with contact information, DHW is heated first, and heating circuit's storage tank is heated after that.

SEQ Taulukko * ARABIC Table 46. Setpoints for forced buffer charging (buffer tank menu)

Line	Setting	Action
4705	Forced charging	**STOP** Forced charging is not in use. Forced charging is not in use regardless of schedules or contacts. **Demand:** Forced charging is prevented by summer usage (chapter 11.6) **Always:** Forced charging is always on.
4709	Min. forced charging value for heating	The setpoint of forced charging stays within these limits even if the heating circuits' requested temperatures are lower or higher. Set these close to one another if you wish to force charge the storage tank to the same temperature every time. The storage tank is always force charged to the lower limit temperature on line 4709 at the minimum.
4710	Max. forced charging value for heating	
4711	Forced charging time	Forced charging starts on a set schedule at a time selected here. If no time is set, scheduled forced charging is not in use.
4712	Forced charging maximum duration	You can set the duration of scheduled forced charging on this line. Forced charging will be on for the duration set here at the maximum, if the setpoint is not reached earlier.
4761	Forced charging with electric heater	**No:** Electric heater K16 is not used for force charging the storage tank **Yes:** Electric heater K16 is used for force charging the storage tank, if no other heat source (heat pump or supplementary heat source) is not able to start forced charging within one minute of the charging request. **Phase guard, forced shut-down** Electric heater K16 is used for force charging the storage tank if the smart-grid mode is set to forced (draw forced).
4750		If the storage tank's forced charging is started with the smart-grid function "forced" (draw forced), the setpoint on this line is used for the heating circuit's storage tank.
2911	For forced buffer charging	This is used to select whether the compressor is used for forced charging of the heating circuit storage tank.

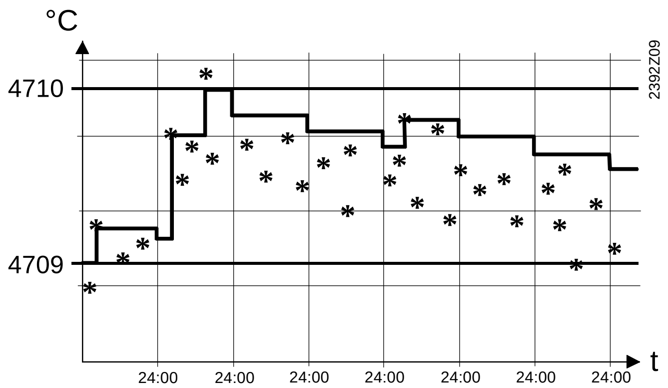


Figure 40. Determining the setpoint for forced charging

Marking	Description
*	Single storage tank temperature setpoint, determined normally according to the requested temperatures of heating circuits as described in chapter 14.
line 4710	Upper limit for acknowledged individual storage tank temperature setpoints.
line 4709	Time limit for acknowledged individual storage tank temperature setpoints.

17.2 Forced service buffer tank charging

Service buffer tank's forced charging is enabled by selecting either “low tariff” or “low tariff” and “time program 4” on line 1620. The low tariff function uses the same E5 contact information as heating circuit storage tank's forced charging. Relay contact control is enabled selecting low tariff as a vacant EX input's function. The contact can be open (NO) or closed (NC). Function E5 can also be used with smart-grid contact information (chapter 18.2).

Forced charging with function E5 starts DHW heating before the switching differential (line 5024) is reached. Forced charging always heats the storage tank to the normal setpoint regardless of the time program's (time program 4) setpoint. Forced charging will heat the storage tank only once if the relay contact information does not change between the charges. Normal switching differential and time program's setpoint are in use after the first forced charging, and remain in use until forced charging is switched on again. If forced charging with function E5 is in use for heating both the service buffer tank and the heating circuit's storage tank, the controller will heat the DHW first, and the heating circuit's tank second.

18 Smart-grid

18.1 Electric utility prevention E6

Heat pump's compressor and electric heaters can be overdriven to OFF state with relay contact information. Relay contact control is enabled by selecting electric utility prevention as a vacant EX input's function. The contact can be open (NO) or closed (NC). Function E6 can also be used with smart-grid contact information (chapter 18.2). Forced OFF state will stay active as long as the relay contact is active.

18.2 Smart-grid relay contact information E61 and E62

Contact information control for smart-grid is enabled by giving vacant EX inputs functions E61 and E62. The contacts can be open (NO) or closed (NC). With these two relay contacts four operating modes in total are possible. These operating modes are presented in the table below.

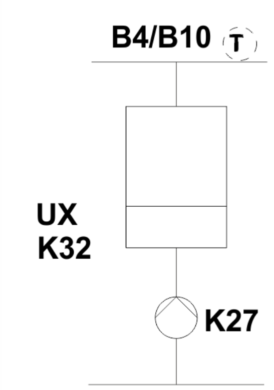
SEQ Taulukko * ARABIC Table 47. Smart-grid relay contact information

E61 status	E62 status	Smart-grid mode (line 8458)	Action
1	0	1 Locked (draw locked)	Corresponds to the electric utility prevention function E6 (chapter 18.1). Compressor and all electric heaters switched off.
0	0	2 Free (draw free)	Normal mode. No limits or forced charging.
0	1	3 Requested setpoint (draw wish)	Corresponds to the low tariff function E5 (forced charging) (chapter 17.1).
1	1	4 Forced (draw forced)	Forced charging on (chapter 16 and chapter 17.1). Corresponds to state 3 (low tariff E5) with the difference that line 4750 is used as the heating circuit storage tank's setpoint, and the electric immersion heater K16 can be selected for parallel use with the compressor on line 4761.

19 Supplementary heat source

19.1 Supplementary heat source functions

The heat pump's automation can be used to give an I/O instruction and a control signal to an external, heating circuit's supplementary heat source. Such source can be, for instance, an electric immersion heater connected to the storage tank, an electric or oil boiler, or another heat pump.



Functions

BX Shared flow sensor B10
QX: Heating request K27 (supplementary heat source's pump)
QX: Supplementary heat source control K32 (on/off control)
UX Output request (output stage control of supplementary heat source 0…10 V)
UX Temperature request (temperature setpoint for supplementary heat source 0…10 V)

The supplementary heat source is commissioned by selecting the temperature sensor B10, saving the sensors from line 6200 and activating at least function K27. Function K27 must be selected for use even if the connection is made to function K32 or UX).

19.1.1 Controlling sensor

The controlling sensor is selected on line 3725. Shared flow sensor B10 or storage tank sensor B4 can be used as the controlling sensor. Usually it is a good idea to use sensor B10. In this way, both sensors have their own distinctive, separate functions. The sensor's installation location in the heating system is selected based on the location of the supplementary heat source. If the supplementary heat source is in the heating circuit's buffer storage tank (electric immersion heater in the storage tank), the sensor is placed in the buffer tank's sensor pocket (usually located in the top half), or in the storage tank's immediate vicinity in the pipeline between the tank and the heating circuit. If an electric or oil boiler is used as a supplementary heat source after the storage tank, the sensor is placed in the pipe between the boiler and the heating circuit, before the circuit's three-way valve.

19.1.2 Heating request K27

A pump of the supplementary heat source can be connected to the function K27. The function can also be used to control the supplementary heat source, if the overrun time (line 3705) is to be noticed in the switch-off after the degree minutes (line 3720) have been completed.

Function K27 is switched on when the temperature measured by the supplementary heat source's control sensor (B10) drops below the supplementary heat source's setpoint (line 8586) for long enough to complete the additional heat source's degree minutes (line 3720). The function is switched off if the temperature measured by the control sensor exceeds the supplementary heat source's setpoint, the degree minutes of the excess (line 3720) are completed, and the temperature remains above the setpoint for the duration of the overrun (line 3705). With the overrun, the additional source's pump can be kept operational for a set time even if a control signal (K32 or UX) shuts down the additional source before it.

19.1.3 Heating request K32 (control)

Control for the supplementary heat source can be connected to function K32. Function K32 is switched on when the temperature measured by the supplementary heat source's control sensor (B10) drops below the supplementary heat source's setpoint (line 8586) for long enough to complete the supplementary heat source's degree minutes (line 3720). The function is switched off if the temperature measured by the control sensor exceeds the supplementary heat source's setpoint, and the degree minutes of the excess (line 3720) are completed. K32 is identical to K27 with the exception that the switch-off does not take the overrun into account after the degree minutes (line 3705).

19.1.4 Output request UX (control with a 0…10 V signal)

By using an output request, the supplementary heat source can be controlled with a 0…10 V signal. The automation increases the control voltage gradually if the reading on the supplementary heat source's control sensor (B10) drops below the setpoint. Correspondingly, the control signal is reduced if the reading exceeds the setpoint. This function should be used for controlling the supplementary heat source via a control signal.

The upper limit of the control signal's voltage can be reduced in the UX output settings. This makes it possible to, for instance, limit the supplementary heat source's output by limiting the control signal. For example, if the supplementary heat source is a 7-stage electric boiler with a 0…10 V signal, one stage equals a 1,4 V increase in the control signal. If the upper limit of the control signal is set to for example 6 V, the signal employs only the first five stages, because switching the sixth stage would a require a control signal that is over 6 V.

19.1.5 Heating request UX (control with a 0…10 V signal)

The supplementary heat source's automation can be given a temperature setpoint by using a heating request. A control signal of 0 V always corresponds to a temperature of 0 °C, and a signal of 10 V corresponds to 100 °C by default. The corresponding temperature of the upper signal limit 10 V can be adjusted in the UX output settings.

19.2 Important setpoints and statuses

Setpoints of a supplementary heat source are found in the menu “supplementary source”. The menu is visible only after the commisioning of supplementary heat source functions (chapter **Error! Reference source not found.**). When a supplementary source is used, the supplementary buffer's switch-on threshold on line 4722 must be at least 0 °C (for example +0…3 °C). This prevents the supplementary storage tank from cooling below the setpoint before the compressor starts.

2. After the start of first compressor the controller waits for delay time on line 3533 and after that starts to count degree-minutes set on line 3530 based on the value of cascade´s supply water sensor B10. Sensor B10 setpoint is the same than the setpoint of heating circuit´s buffer tank

Sensor B10	$\begin{pmatrix}\text{sensor B10 setpoint}\\ \text{line 8139}\end{pmatrix} = \begin{pmatrix}\text{buffer storage tank's setpoint}\\ \text{line 8981}\end{pmatrix}$	(1)

The next compressor in running order starts, when the switch-on degree-minutes run out. If the degree-minutes are set to zero, the next compressor circuit starts immediately, when the value of sensor B10 goes below the lower limit of sensor´s B10 setpoint. In the switch-off the last started compressor circuit is analogously shut down, when the switch-off degree-minutes run out. If the degree-minutes are set to zero, the last started compressor circuit is shut down immediately, when the value of sensor B10 goes below the lower limit of sensor´s B10 setpoint. If the value of sensor B4 exceeds the setpoint of buffer storage tank before the sensor B10, all compressors are shut down along with the first started compressor.

19.3 Cascade´s shared pumps

19.3.1 Shared brine circuit pump

Shared brine circuit pump can be defined for the cascade. The brine circuit´s ordinary pump-output Q8 of one controller, connected to the cascade, is used for connecting the pump. This shared pump starts always in running order, when the first compressor starts, even if it was not the compressor circuit, controlled by the controller in question. Controller, to which the shared pump is connected, is chosen on line 5803. As a default setting on line, there is the device address 1, master controller. By default, the cascade´s shared brine circuit pump is connected to the master controller in accordance with the electrical drawings, and slave-controllers request this output on via the bus. The pump fuse size must be ensured before installing, because the switchboard´s fuse is usually dimensioned for one compressor circuit pump.

Shared brine circuit pump is taken into use on line 5800 by choosing the value external well (externally brine). This value is selected for use with all those controllers that use this shared evaporator circuit pump, with the exception of the controller which the shared pump is connected to. By default, in all slave controllers the value on line 5800 is chosen to be external well, and in the master controller the value on line 5800 is left unchanged. The controllers that use the shared pump may also have the their own brine circuit pump output Q8 configured. This output goes normally on when the compresssor circuit, controlled by the controller, starts, even if the controller requests also shared brine circuit pump to turn on via the bus. Thus, if needed, the shared brine circuit pump can be used as an additional pump alongside the compressor circuit’s own brine circuit pump.

19.3.2 Condenser circuit’s shared pump

Shared condenser-circuit pump can be defined to the cascade. The pump is taken into use by choosing the pump Q25 for the function of master controller QX-output. The output can be selected to free input (connected through a fuse), or it can be changed to replace the Q9-output of condenser pump. When using the condenser pump output, there is a fuse ready for the pump in the electrical center. However, the pump fuse size must be ensured before installing, because the fuse is usually dimensioned for one compressor circuit pump. The pump Q25 starts always, when any compressor circuit starts.

It is usually better to use own condenser circuit pump for each compressor circuit. This way, the flow, heated in turned on compressor circuits, does not go off nor cool off, when going through condensers. Using two pumps also enables that some of the circuits can heat the DHW storage tank while the others heat the heating circuit storage tank at the same time. If the system uses only one pump, the flow through the turned off circuits can be prevented with the engine shutoff valves. Installing own condenser-circuit pump for each compressor circuit is, however, usually simpler solution than the engine shutoff valves.

19.4 Domestic hot water connection

In a cascade the service buffer tank can be heated with all the heat pumps in the system, or just a portion of them. If you want to use all the pumps, the change valve is connected to the master controller and the pumps (condensers) are piped behind this valve. By doing this, the system functions like an ordinary single-pump system.

19.4.1 One pump heating DHW only

The cascade can be piped and programmed so that only one heat pump unit (one condenser) heats the domestic water. This pump's automation directs the flow with a change valve to either DHW heating or the space heating storage tank. The function is enabled by selecting a dedicated circuit for DHW (DHW dedicated) on line 5736 in the desired pump.

The change valve is placed so that it directs the flow to either the service buffer tank or in the shared line that goes to the space heating storage tank. Sensor B10 is placed in the line leading going to the heating circuit's storage tank, i.e. the line where the condensers of both units are connected after change valve Q3.

20 Pump speed control

Speed control options depend on the pump’s model and connection.

SEQ Taulukko * ARABIC Table 51. Pump speed control via heat pump automation

Heat pump	Brine pump	Condenser pump
Junior ECO and GT 4...14	as standard	as standard
Junior ECO and GT 17…21	as standard*	as standard
Cube	with an auxiliary controller, always full speed when standard	as standard
Cube House	as standard	as standard
RE	as standard**	as standard*

*External pump. Adjustment is possible if the pump in the standard delivery is used and the control signal cable is connected. Pumps differing from the standard delivery can also be adjusted if they support PWM or 0...10 V control

** External pump. Depends on the selected pump (chapter 30).

Adjusting the speed affects the temperature difference over the heat exchanger. Decreasing the pump speed (smaller flow) increases the temperature difference, and increasing the speed (larger flow) reduces it. The temperature difference between the flow and return in the condenser circuit is typically approximately 5…12 °C, and in the brine circuit (evaporator circuit) it is ca. 3…4 °C. If the flow is not sufficient (too large a temperature difference) in the evaporator or condenser circuit, the heat pump's performance may be compromised. The temperature difference is not always an accurate indicator of a suitable flow because the flow rate causes changes in the collecting and output capacity. For this reason the brine circuit should be usually kept at full capacity if it is possible and justifiable after the coefficient of performance and electricity consumption are considered.

The lowest permitted speed must be set so that the discharge does not turn out too small and the temperature difference does not grow too large. The suitable minimum speed is usually ca. 15…40 %. The value varies on a case-by-case basis, because it is dependent on the heating system. When setting the lowest permitted speed, the minimum value of the pump’s control signal should be taken into account. For small speed-controlled pumps, it is usually approximately 7...13 %. If the control signal’s level is below the lower limit, the pump usually won’t start.

The control signal’s level can be maxed at full speed (standard signal) or
at its minimum value. This is selected in the settings of the UX control signal output. In the heat production’s status information, “100 %” always indicates full speed, and “0 %” indicates that the pump has stopped. Note that in the input/output test, the UX outputs’ signal level is always displayed at the actual level, so that 100 % corresponds to the full pump speed with a direct signal (standard signal), and with an inverse signal it indicates a stopped pump. Smaller PWM-controlled pumps in condenser and evaporator circuits usually use the inverse control signal. When it is used, the full rotational speed (100 %) corresponds to the smallest value of the signal, and the lowest speed (0%) corresponds to the largest value of the signal. Usually these pumps have an additional protection mechanism for cable break-ups, based on the inverse signal. The mechanism sets the pump on full speed if the control signal is completely cut off. DHW and solar circuit pumps usually

utilize the direct signal, allowing the pump to adjust to minimum speed if the control signal is cut off.

20.1 Important setpoints and statuses

SEQ Taulukko * ARABIC Table 52. Key setpoints in pump speed control

Menu	Line	Setting
Heat pump	2790	Type of condenser circuit pump control (Charging pump modulation)
Heat pump	2792	Condenser circuit pump min. speed (Charging pump min. speed)
Heat pump	2793	Condenser circuit pump max. speed (Pump speed max)
Heat pump	2804	Maximum permitted temperature differential for condenser (DT)
Heat pump	2805	Req temp diff condenser
Heat pump	3009	Type of brine circuit pump control (Modulation source pump)
Heat pump	3010	Brine circuit pump max. speed (Maximum speed of source pump)
Heat pump	3011	Brine circuit pump min. speed (Minimum speed of source pump)
Heat pump	2823	Req temp diff evaporator (Evaporator difference setting)
Diagnostics heat generation	8425	Temperature differential, condenser
Diagnostics heat generation	8426	Temperature differential, evaporator
Heat generation status information	8405	Brine pump speed in rpm (100 % is always the maximum pump speed)
Heat generation status information	8407	Condenser pump's speed (100 % is always the maximum pump speed)
Input/output test	7711	Voltage
Input/output test	7712	PWM signal UX1
Input/output test	7717	Voltage UX2
Input/output test	7719	PWM signal UX2

20.2 Condenser circuit pump speed control

The speed of the condenser circuit's pump can be controlled via automation if the pump is equipped with speed control that is connected to the automation. The pump speed control settings are accessed from the heat pump menu in the parameter list (chapter10.4.9). The speed control method for a condenser pump is selected on line 2790 for space heating, and for DHW charging, the ACS computer program is used.

It is possible to select the minimum (line 2792) and maximum pump speed (line 2793). The maximum pump speed set on line 2793 cannot be lower than the minimum pump speed set on line 2792. The upper limit for the condenser pump's speed (line 2793) is also in effect during DHW charging. Because of this, DHW charging must be taken into account when setting the upper limit. The upper limit should not be set too low. It should be kept at 100 %, so the automation may use the condenser pump's maximum speed during DHW charging if needed. The speed can be adjusted for space heating after this by choosing the appropriate control method on line 2790, which is either temperature difference or the heat pump's setpoint.

20.2.1 Condenser circuit's control methods in space heating

The maximum permissible temperature difference (minimum flow) is set on line 2804. If the differential is exceeded, automation will not reduce the condenser pump's speed. Line 2804 requires a setpoint so that the control methods based on the setpoint and temperature difference can be accessed. A suitable setpoint for line 2804 is 10...15 °C.

No influence: The condenser pump's speed is the maximum speed defined on line 2793. An exception to this is the frost protection mode, in which the pump speed is the minimum speed defined on line 2792. This operation mode is the factory-set default. The factory setting for the maximum speed is full speed, or 100%. Line 2804 does not require a setpoint.

Heat pump setpoint: The temperature of the flow from the condenser is kept at the setpoint (at sensor B21) by adjusting the pump speed. The automation adjusts the pump speed between the maximum and minimum speed (lines 2792 and 2793). The setpoint for sensor B21 is either the flow or return setpoint, depending on the value on line 5810. The maximum temperature difference set on line 2804 is taken into account in controlling.

Condenser's temperature differential: The temperature difference over the condenser is kept at the setpoint (measured with sensors B21 and B71) by adjusting the pump speed. The temperature difference is set on line 2805. The automation adjusts the pump speed between the maximum and minimum speed (lines 2792 and 2793). The maximum temperature difference set on line 2804 is taken into account in controlling.

20.2.1.1 Line 5805's effect on the condenser pump automatic modulation

If the value on line 5805 is upstream/before, automatic modulation is in effect when electric immersion heaters are on. If the value on line 5805 is downstream/after, the condenser pump operates at full speed when electric immersion heaters are on. Line 5805 does not affect the operating speed if the setting on line 2790 is None and the operating speed is set manually on line 2793.

20.2.2 Adjusting the condenser circuit in DHW heating

The control method for DHW heating is set in the ACS program, in the condenser menu, on line "Mod". Cond.pump. DHW. The control method options are similar to space heating (chapter 20.2.1). It is usually recommended to select the condenser's temperature difference option. This is selected in the program, on line "Req. T Cond. DHW". A suitable setpoint is usually 6...8 °C.

If the line value is set to None, the heating control method selected on line 2790 has no effect on the condenser pump's speed during DHW charging. The pump will operate at the maximum permissible speed set on line 2793 (100 %). If the value is set to --- instead, the control method (line 2790) is available during DHW charging. This temperature difference connected to space heating should not generally be used, because DHW charging can be set up with its own temperature difference, as described previously.

The E-series controller uses the same limits for both DHW and space heating (lines 2792 and 2793). In series F controllers, independent upper and lower limits for DHW can be set on lines 2776 and 2777.

20.3 Brine circuit pump speed control

The speed of the brine (evaporator) circuit's pump can be controlled via automation if the pump is equipped with speed control that is connected to the automation. The pump speed control settings are accessed from the heat pump menu in the parameter list (chapter10.4.9). It is possible to select from two distinct control methods (line 3009) for the speed adjustment connected to the automation, along with the minimum (line 3011) and maximum pump speed (line 3010). The higher the percentages set on these lines, the higher the pump speed. The maximum pump speed set on line 3010 cannot be lower than the minimum pump speed set on line 3011.

20.3.1 Methods for controlling the speed of brine circuit's pump

The control method of brine circuit's (evaporator circuit) pump's speed is selected on line 3009.

No influence: The evaporator pump's speed is the maximum permissible speed defined on line 3010. This operation mode is the factory-set default. The factory setting for the maximum speed is full speed, or 100%.

Evaporator's temperature difference: The temperature difference over the evaporator is kept at the setpoint (measured with sensors B91 and B92) by adjusting the pump speed. The temperature difference is set on line 2823 (the line's factory setting is 3 °C). The automation adjusts the pump speed between the maximum and minimum speed (lines 3011 and 3010).

21 Solar collector

Automation supports several different solar collector connections. This manual presents the functions of the two most typical basic connections. All connections are presented in the technical manuals for the automation. All manuals and instructions can be downloaded from Oilon's website.

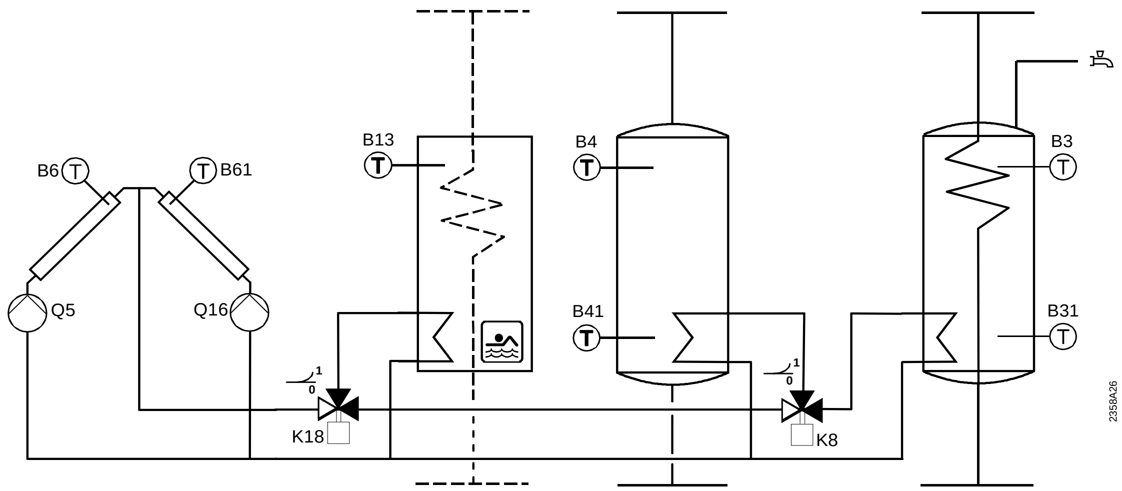
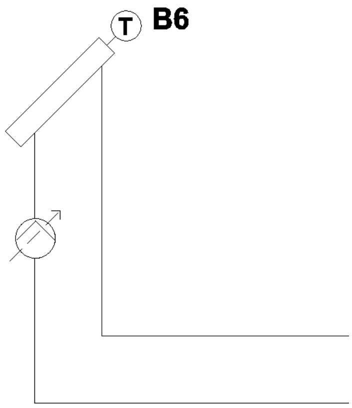


Figure 41. Overview of the solar collector connection options

Solar collector´s functional block is taken into use by configuring at least the collector pump Q5 into use as well as configuring and connecting the collector´s temperature sensor B6. In addition, collector connection has to be selected for use from the menu of DHW storage tank and/or heating circuit buffer tank. Operating speed of pump Q5 can be controlled through UX/ZX-output. In addition, the sensor B63 can be installed to the supply pipe and the sensor B64 to the return pipe to measure supply and return temperatures.

BASIC CONNECTION TO DHW STORAGE TANK

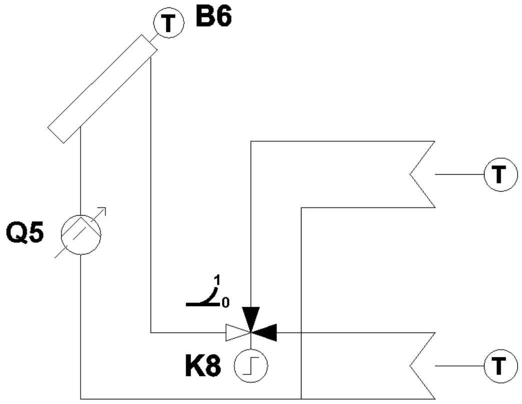


Functions

BX: collector's sensor B6
QX: collector's pump Q5

In addition, the connection to the DHW storage tank is switched on from line 5093.

BASIC CONNECTION TO THE DHW STORAGE TANK AND TO THE HEATING CIRCUIT STORAGE TANK



Functions

BX: collector’s sensor B6
QX: collector´s pump Q5
QX: Buffer tank’s solar actuator K8

In addition, switch-on to the storage tank is selected on lines 4783 and 5093. Change valve K8 must be configured to use even if it is not installed. This connection is used in addition to the two separate storage tanks also in the combined DHW and heating circuit storage tank.

21.1 Important setpoints and statuses

SEQ Taulukko * ARABIC Table 53. Key solar heating setpoints

Menu	Line	Setting	Action
Buffer storage tank	4783	With solar integration	Selected, if the solar collector is connected to the buffer storage tank.
DHW storage tank	5093	With solar integration	Selected, if the solar collector is connected to the DHW storage tank. Additionally, function K8 is enabled for the QX output.
Status	8007	State solar	Status info solar
Solar	3810	Temperature differential on	The collector’s temperature must exceed the DHW storage tank’s temperature by this amount before starting the collector’s pump. The collector temperature must also exceed the value on line 3812.
Solar	3811	Temperature differential off	If the collector’s pump is on and the collector’s temperature exceeds the DHW storage tank’s temperature by this amount only, the collector’s pump is stopped.
Solar	3812	Minimum charging temperature, DHW	Collector's temperature (sensor B6) must be above this to able to heat the DHW.
Solar	3813	Temperature differential on, buffer storage tank	The collector’s temperature must exceed the heating circuit storage tank’s temperature by this amount before starting the collector’s pump. The collector temperature must also exceed the value on line 3815. If ”not in use” is selected, the controller will use the value on line 3810.
Solar	3814	Temperature differential off, buffer storage tank	If the collector’s pump is on and the collector’s temperature exceeds the heating circuit’s buffer storage tank’s temperature by this amount only, the collector’s pump is stopped. If ”not in use” is selected, the controller will use the value on line 3811.
Solar	3815	Minimum charging temperature, DHW	Collector's temperature (sensor B6) must be above this to able to heat the heating circuit’s buffer storage tank.
Solar	3822	Charging priority of storage tank	Primarily heated storage tank After the primarily heated storage tank, the DHW or buffer storage is heated. Lastly, the swimming pool will be heated. If “None” is selected, the controller will heat the DHW or buffer storage tank in increments of 5 °C until the setpoint is reached. After this, the swimming pool will be heated.
Solar	3830	Collector start function	The collector’s pump will be rotated for a time specified on line 3831 with intervals defined here, even if charging

			is not in progress. In this way, the collector's temperature will be measured more reliably (depending on the sensor's position).
Solar	3831	Minimum running time of collector pump	The running time of the collector, affected by the interval function on line 3830.
Solar	3832	Collector start function on	Start time of the interval function on line 3830.
Solar	3833	Collector start function off	End time of the interval function on line 3830.
Solar	3834	Collector start function gradient	If the ascending speed of the collector's temperature exceeds this value (minutes per degree), the collector pump is started.
Solar	3835	Min collector temp start fct	The collector pump is started only if the collector' temperature exceeds this level.
Solar	3840	Collector frost protection	Frost prevention of the collector. If the collector's temperature drops below this level, the collector pump is started, and heat is transferred from the storage tank to the collector. The pump is shut down when the collector's temperature exceeds its setpoint by 1 °C.
Solar	3850	Condenser overtemp protection	If the collector's temperature exceeds this level, the collector pump is kept on (storage tank charging will continue) until the storage tank's temperature reaches the safety limit.
DHW storage tank	5050	Charging temp. max.	If the temperature on line 3850 is exceeded, the DHW storage tank is heated using the collector (the collector's pump is kept on) until the desired temperature is reached.
DHW storage tank	5051	Storage tank temp. max.	If the DHW temperature exceeds this level, the collector's pump is stopped, overriding the function on line 3850. The pump is restarted when the storage tank's temperature drops 1 °C below the maximum temperature.
Buffer storage tank	4750	Charging temp. max. in solar heating	For the heating circuit's buffer storage tank. Equivalent to the DHW buffer storage tank's function on line 5050.
Buffer storage tank	4751	Storage tank temperature max.	For the heating circuit's buffer storage tank. Equivalent to the DHW buffer storage tank's function on line 5051.
Diagnostics heat generation (solar)	8499	Collector pump 1	Status info for solar collector pump Q5 (on/off)
Diagnostics heat generation (solar)	8510	Collector temperature 1	Solar collector sensor B6 temperature

21.2 Solar heating control

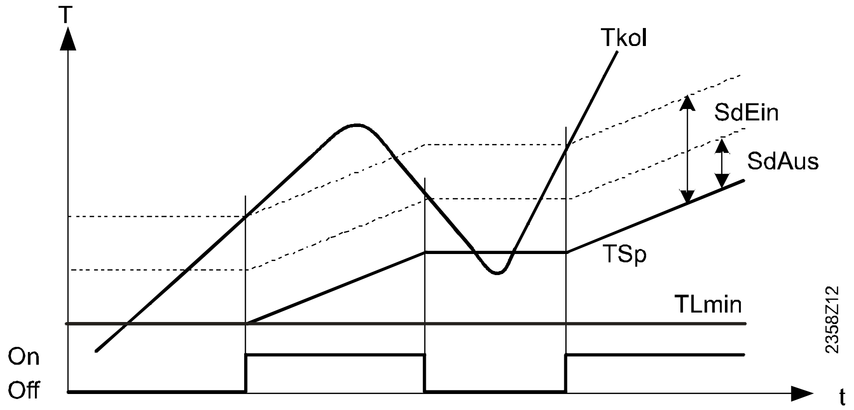


Figure 42. Functions of solar collector control

Legend	Description	Menu	Line
Tkol	Collector's temperature (sensor B6)	Heat generation status information	8510
SdEin	Temperature difference On	Solar	3810
SdAus	Temperature difference Off	Solar	3811
TSp	Storage tank´s or swimming pool´s temperature	Heat consumers status information	DHW storage tank: 8830 Buffer storage tank: 8980 Swimming pool:
TLmin	The lower limit of collector’s temperature (sensor Q6) before starting the collector’s pump (pump Q6)	Solar	DHW storage tank: 3812 Buffer storage tank: 3815 Swimming pool: 3818

22 Cooling

Line	Setting	Action
730	Summer/winter heating limit	Heating is switched off in this temperature (to summer usage).
901	Operating mode	Cooling is switched on in the Automatic mode if the room temperature setpoint on line 902 is exceeded and the time program on line 907 allows it.
902	Comfort setpoint max	Cooling is switched on when the room temperature exceeds this value. Lines 918-920 also affect the connection temperature. This requires that room temperature measuring and room influence are commissioned (line 928).
907	Release	Time program for cooling.
908	Supply water sp/OT 25 °C	Supply water temperature 25/35 degrees is entered on lines 908 and 909. The supply water temperature is determined by a line that runs via these points and the outside temperature.
909	Supply water sp/OT 35 °C	see 908
912	Cooling limit in OT:	Cooling is in use only if the outside temperature exceeds this value.
913	Locking time after heating	Cooling can be switched off after this time has elapsed since heating use.
918	Summer comp. start OT	The setpoint for room temperature in cooling use can be raised for hot outside temperatures by accessing lines 918, 919 and 920. The largest value for the increase is entered on line 920. This value is in use when the outside temperature exceeds the value on line 919. The setpoint increase is enabled when the outside temperature exceeds the value on line 918. The increase between the outside temperatures determined on lines 918 and 919 goes from zero to the value determined on line 920 in direct proportion. The purpose of the increase can be comfort-related, saving energy or avoiding condensation.
919	Summer comp. end OT	see 918
920	Summer comp sp increase	see 918
923	Supply w. min. sp/OT 25 °C	This line is used to determine the minimum value for the supply water setpoint on line 908.
924	Supply w. min. sp/OT 35 °C	This line is used to determine the minimum value for the supply water setpoint on line 909.
928	Room influence	When "---" is selected, supply water's temperature depends on the selected cooling curve and outside temperature. If the value is set to 100 %, the temperature is based on the difference between the room sensor and room temperature's setpoint. With values 1-99 composite outside temperature control (graph) and room sensor control is used; the room sensor corrects the temperature given by the graph up or downward.
932	Room temperature limitation	Cooling circuit's pump is stopped, if the room temperature drops below the setpoint for room temperature in cooling use (line 902, taking lines 918-920 into account) by this amount. The pump starts once the room temperature is above the setpoint. This setting is only used when the room sensor and room influence (line 928) are used.

937	Plant fr.pr., CC pump	If “yes” is selected, the cooling circuit pump is switched on when the plant's frost protection (line 6120) is active.
938	Mixing valve subcooling	This temperature difference is reduced from the temperature that cooling requests from the control valve’s heat pump or storage tank. This can be used, for example, to take the heating of cooling water prior to the control valve into account.
939	Actuator type	Cooling control valve type.
940	Switching differential two-position	If the control valve for cooling is a two-way valve, this is used to set the valve’s switching differential. If the flow temperature exceeds the setpoint by the temperature differential entered here, the valve opens. Conversely, the valve is closed if the temperature is below the setpoint by the amount entered as the differential.
941	Actuator running time	The running time of the three-way valve motor between the extreme positions.
942	Mixing valve P-zone Xp	The proportional band of the PI controller controlling the three-way valve. The proportional band indicates how much the quantity to be adjusted must change for the actuator to move from one extreme position to the other. Thus, the proportional band is the change in flow temperature (in degrees Celsius) in the heating circuit that causes the regulator to move from one extreme position of the valve motor to the other. Increasing the value usually results in steadier adjustment, slower adjustment, and greater deviation from the setpoint after the adjustment. Decreasing the value usually results in less steady adjustment, faster adjustment, and a smaller deviation from the setpoint after the adjustment. The deviation after the adjustment is corrected with the I-action of the PID controller.
943	Mixing valve res.time Tn	The integral action time (restore time) of the PI controller in the three-way valve. The integral action time refers to the time over which the actuator moves the distance determined by the proportional band. The integral action time is the time in which the I-action achieves the same change in the control quantity as the P-action (in a gradual change in the quantity of difference). The greater the integral action time, the smaller the effect of the I-action. An integral action time that is too short may result in unstable control.
945	Mixing valve heat. on	Selects the mixing valve’s position in heating use. This setting is only used when the heating and cooling circulation both run through the same pipes. If “open” is selected, the mixing valve is always fully open in heatiing use, and only regulates during cooling use. If “regulation” is selected, the valve regulates the flow temperature in heating and cooling use.
946	Dew point sensor stop time	A dew point sensor can be connected to the controller’s Hx input. The sensor’s contact can either opening or closing. The sensor is switched on and the direction of the contact is selected in the Hx input lines of the configuration menu. Cooling stops when the sensor gives a stop signal. It is started again when the time determined here has elapsed since the end of the stop signal.
947	Flow sp. cor. hygros	A humidity controller (hygrostat) can be connected to the controller’s Hx input. It is selected for use in the configuration menu’s Hx input lines. When the hygrostat gives a signal, the flow setpoint is increased by the amount determined here. This setpoint is also

		used when relative humidity measurement is enabled (see line 948).
948	Flow sp. boost start r.h.	Relative humidity measurement can be connected to the controller's Hx inputs (DC 0...10 V) The measurement settings are selected in the Hx input lines of the configuration menu. When the relative humidity exceeds the value defined here, the controller will start to increase the flow setpoint. The larger the relative humidity, the larger the setpoint will be. The largest value for the increase is entered on line 947.
950	Flow temp. diff. dew point	The controller can calculate the dew point based on the relative humidity measurement (0...10 V) and room temperature measurement. This line determines how many degrees above the dew point the flow water temperature is kept. Relative humidity measurement is connected to an Hx input. The room temperature can be measured with a room unit inside the room (for example, temperature measurement in a remote control) or with a 0...10 V temperature measurement connected to an Hx input.
953	Relative room humidity	This line is for selecting the relative humidity measurement input that the dew point supervision uses.
954	Room temperature measuring	This line is for selecting the temperature measurement input that controls the cooling. If no input is selected, temperature is measured with the room unit (remote control for example) connected to the heating/cooling circuit in question. Thus, in cooling use, the room unit's temperature will control both the room temperature and dew point supervision. If an input is selected here, and a room unit measuring the temperature is being used simultaneously, dew point supervision is done with a temperature sensor connected to an Hx input and room temperature is regulated with the room unit's temperature sensor. If only a temperature sensor in an Hx input is used, that sensor is used for both supervising the dew point and controlling the room temperature.
962	With buffer	The line is used to select whether a cooling circuit is connected to a buffer storage tank. The tank must be the same one that is used for heating. If "yes" is selected, the cooling circuit must be connected to draw the water from the buffer storage tank.
963	Primary controller/syst. pump	The line used to select whether a cooling circuit is connected to a main line controlled by the primary controller or, instead, whether there is an additional pump in the cooling circuit (Q14). Instructions on using this function are also provided on line 872 and in the primary controller's settings, starting on line 2110.
969	Optg mode changeover	Selects which operating mode cooling switches to after the Hx input receives a signal.
3000	Cool. max. s.o. temp.	If the return sensor (B71) observes a temperature that exceeds this value, the compressor is shut down.
3002	Cooling min. source temp.	If the ground circuit's return sensor (B92) observes a temperature that is below this value, cooling is switched off.
3004	Pass/act cool switch c. diff.	If the ground circuit's return sensor's (B92) temperature is this much colder than the cooling circuit flow (storage connection) or return (direct connection) water, passive cooling is switched on.

3007	Pass. cool. during operation	Whether the condenser pump is on during passive cooling.
3008	Cond. pump cool. temp. difference	Temperature difference between flow and return in active cooling. If this is set to zero, the flow setpoint (graph) and compressor control are based on the return temperature. If a value that is larger than zero is entered, the cooling water setpoint (graph) is based on the flow temperature, and compressor control is based on the return temperature. The return setpoint controlling the compressor is equal to flow temperature + this value.
4723	Switching differential	Buffer storage tank's temperature (B4) may rise (+) or fall (-) by this amount compared the cooling circuit setpoint (cooling graph) before the storage tank's cooling starts.
4721	Running temperature	The storage tank is cooled by this amount from the temperature level determined on line 4723.
5807	Cooling	Off, passive, active, or passive and active
5808	Cooling system	Cooling distribution pipework to the cooling circuits. In a two-pipe connection cooling and heating water share the same piping to the circuits. In a four-pipe connection they have independent pipes.

23 Heat pump’s protection functions

23.1 Switch-off temperature

Set the upper limit of the heating circuit’s flow (chapter 11.3.1) slightly below the switch-off temperature. This prevents the heating curve from requesting water that is hotter than the switch-off temperature.

23.1.1 Series E controller

The upper temperature limit for the flow leaving the heat pump’s condenser is set on line 2844. This limit is called the switch-off temperature. Its purpose is to protect the heat pump from temperatures that are too high. If the flow temperature (sensor B21) exceeds the setpoint on line 2844, the compressor is switched off. It is kept switched off until the temperature in the condenser’s flow and return sensors (B71 and B21) has fallen below the switch-off temperature by the amount of the switching differential, and the compressor’s off time has elapsed (line 2842). The value on line 2840 is used as the switching differential. The minimum value for the differential is 7 °C. If the value on line 2840 is less than that, the minimum value is used. The switch-off temperature must be set slightly lower than the temperature that triggers the heat pump's high pressure switch.

If DHW heating with the compressor stops at the switch-off temperature, charging is attempted again with the compressor after the off time selected on line 2835 or 2843 is completed, and until the number of charging attempts indicated on line 2893 is reached. The longer off time of these two is used. After this, the DHW is charged to its setpoint with the electric immersion heaters (K25/K26 or K6). The delay time or degree-minutes is not taken into account in connection of the immersion heaters.

23.1.2 Series F controller

The flow from the heat pump’s condenser can have two upper limits. They are set on lines 2844 and 2855. The switch-off temperature on line 2844 that was presented above is for protecting the heat pump from temperatures that are too high (chapter 24.1.1). It is in effect during DHW heating and for the duration of the switching time set on line 2839 (chapter 11.3.3) after DHW has been heated. The purpose of the switch-off temperature on line 2855 is to protect the heating circuit from temperatures that are too high. It is in effect only during space heating, otherwise 2844 is used. If line 2855 is not enabled, line 2844 is in use also during space heating.

When the system switches from DHW heating to space heating (the change valve turns from the DHW position to the space heating position), the switch-off temperature on line 2855 is enabled only after the switching time on line 2839. The higher switch-off temperature on line 2844 is in effect during the switching time. The switching time on line 2839 must be disabled if the heating circuit has to be protected from excessive temperature right after the DHW has been charged.

23.1.3 Observing the switch-off temperature with the electric immersion heater on

If the electric immersion heater is chosen to locate after the sensor B21 (after/downstream) on line 5805, the automation switches the compressor off at the switch-off temperature (measured by sensor B21) also then, when the immersion heater is in use. If the electric immersion heater is chosen to locate before the sensor B21 (before/upstream) on line 5805, the automation does not switch the compressor off at the switch-off temperature (measured by sensor B21), if the immersion heater is on. With the latter setting the heat pump can produce water that is hotter than the compressor’s output temperature, when both the compressor and immersion heater are in use. This setting line is not in use, if the supply water sensor B21 is not installed to the heat pump.

23.2 Temperature limits of brine circuit

23.2.1 Lower temperature limit of brine circuit

The minimum permissible temperature of brine circuit is set on line 2816. If the brine circuit's temperature drops below this temperature (the sensor is selected on line 5804), circuit’s pump and compressor are switched off for the time set on line 2822. This way, the brine circuit is allowed to recover and to warm up. Brine circuit’s pump and compressor are restarted after this. If the brine circuit’s temperature is still below the permissible minimum limit, the heat pump enters a fault state (chapter 28).

The min. permissible temperature of brine circuit must be set slightly higher than the temperature, that triggers the heat pump's low pressure switch. Also the freezing temperature of the brine is to be noticed in the temperature limit. Typically, the temperature limit is ca. −5 °C.

In starting phase, the brine circuit's temperature must rise to the increase, set on line 2817 and higher than the lower limit, set on line 2816 within the waiting time, set on line 2821. Time is calculated from the fluid pump start. If this condition is not actualized, the heat pump is switched off and the fault must be reset manually. At the same time, emergency-operation mode is automatically activated if the value selected on line 7142 is automatic. If, e.g., the value on line 2816 is −6 °C, and the value on line 2817 is 3 ° C, and the value on line 2821 is ten minutes, the brine circuit temperature (sensor selected on line 5804) must even momentarily increase above the temperature of -4 ° C within ten minutes from the startup of the brine circuit's pump.

23.2.2 Upper temperature limit of brine circuit

If the brine inlet temperature (sensor B91) exceeds the value on line 2814, the compressor is not switched on but the fluid pump runs for the time set on line 2821 (from fluid pump startup). If the brine temperature during this time drops to one degree below this limit, the compressor is started. If the brine temperature does not fall below this limit (by at least one degree lower) during the time set on line 2821, the controller waits for a new starting attempt for the duration of the compressor's off time (line 2843). If the brine inlet temperature is not in use, the brine outlet temperature is used here (sensor B92). This function can be switched off altogether, if the value on line 2814 is set to —.

23.3 Running and off times

23.3.1 Compressor's shortest runtime

The compressor's minimum running time is set on line 2842. The compressor will be on for the duration of this time even if the temperature setpoint was reached. This ensures among other things the circulation of the compressor's lubricating oil in the system. Do not shorten the running time's factory setting.

23.3.2 Compressor's minimum off time

The compressor's minimum off time is set on lines 2843 and 2835. Off time is enabled when the compressor stops to the setpoint or due to some protective function.

The off time on line 2843 is in use when the heat pump's setpoint is reached, but the pump's state does not change from space heating to DHW heating, or vice versa. This may occur for example when the heating circuit's setpoint is reached and the compressor is stopped. In this type of situation the compressor will be off for the time set on line 2843, even if the heating circuit has gone below its setpoint during the off time. Do not shorten the off time's factory setting.

The off time on line 2835 is in effect when the heat pump's state changes from space heating to DHW heating, or vice versa. This may occur when the DHW setpoint has been reached but space heating does not yet request heat (i.e. the heating circuit's temperature is in its setpoint). In this type of situation the compressor will be off for the time set on line 2835, even if the heating circuit has gone below its setpoint during the off time. Do not shorten the off time's factory setting.

Off times are disabled when the heat pump goes directly from space heating to DHW heating (or vice versa) without shutting the compressor down. This occurs when the heating circuit's setpoint has not been reached (the compressor has not been shut down) before the DHW's heating request, or when the DHW setpoint is reached as the heating circuit requests heat. In both cases the compressor stays on without off time after the change valve has turned.

23.3.3 Compressor's minimum off time

The minimum off time for pumps is set on line 6123. Off time's purpose is to prevent the pump's regulating electronics from breaking due to too frequent starts. A suitable off time for pumps is typically approximately 120 seconds. The compressor and electric immersion heater will not start before the pumps' off time has concluded. If the off times on lines 2843 and 2835 are in use, the pump off time is not entirely necessary, because these two other off times prevent the pumps from starting too frequently.

23.4 The upper temperature limit for the hot gas

The upper temperature limit for the hot gas is set on line 2846. The compressor is switched off if this hot gas temperature is exceeded (sensor B81). The hot gas temperature must fall at least this far below the limit set on line 2846 before the compressor is permitted to run. Temperature factory setting is typically ca. 120 °C. The temperature limit can not be raised.

23.5 High and low pressure switches

High and low pressure switches are installed to the heat pump refrigerant circuit. Cut-off pressures for switches are shown in the equipment technical data. The switch-off temperature of heat pump´s condenser circuit (line 2844) and the lower limit of brine circuit temperature (line 2816) are set so, that the switches do not trigger under ordinary operating circumstances. However, the rapid rise or fall in temperature may trigger the pressure switch. The pressure switch automatically returns to normal mode, when the pressure reaches the switch-back pressure.

24 Valve-controlled heating circuit selection

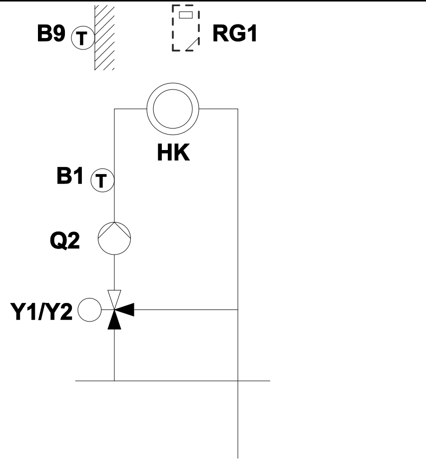
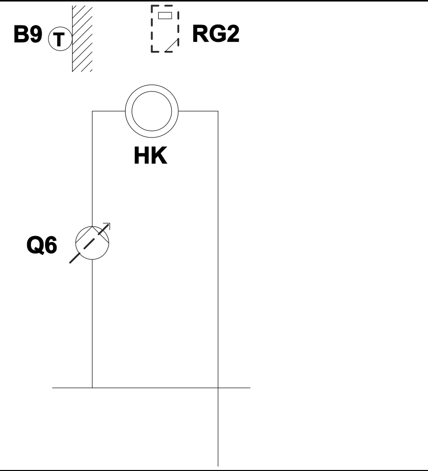
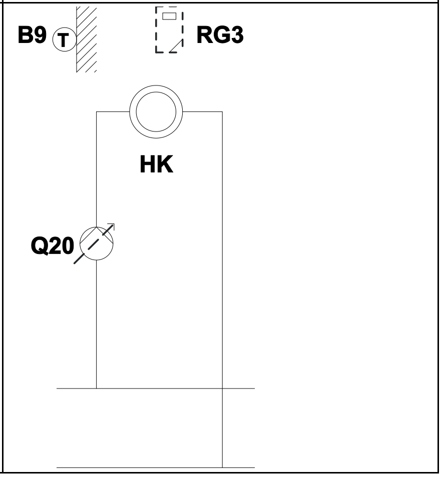
Only change these settings if the heating circuits' connections differ from the device's factory settings. Factory settings are presented in the electrical diagrams of each model and their respective installation chapters. Outputs, marked blank, have no function. A function to those can be freely chosen. The function can be changed, if needed.

The heat pump automation comprises a user interface, master controller and parallel auxiliary controllers. The automation can be used to control one service buffer tank, one heating circuit storage tank and three heating circuits. The automation controller can be used to control one heating circuit regulated by a control valve (mixing valve) and two additional circuits, without a control valve. Two other valve-regulated heating circuits can be enabled by connecting two or more auxiliary controllers in parallel with the master controller. The heating-circuit control valve can be a two- or three-way valve. The connections described in this section of the manual use a three-way valve.

Heating circuit's storage tank can be either controlled or uncontrolled. An uncontrolled tank does not have a temperature measurement function connected to the automation, and the automation does not regulate the tank's temperature. The only function of such a storage tank is to provide the system more volumetric capacity. In the connected heating circuits the condenser pump pumps the heating water directly to the circuits, which are not equipped with a control valve. The connection principle and control methods are presented in chapter 13. A controlled storage tank is equipped with a temperature sensor that is connected to the automation, and the automation regulates the tank's temperature. In this connection the condenser pump circulates the water between the storage tank and the condenser, and the heating circuits' pumps circulate the water between the storage tank and the heating circuits. Heating circuits are almost always equipped with control valves. Connection principle and control are presented in chapter 14.

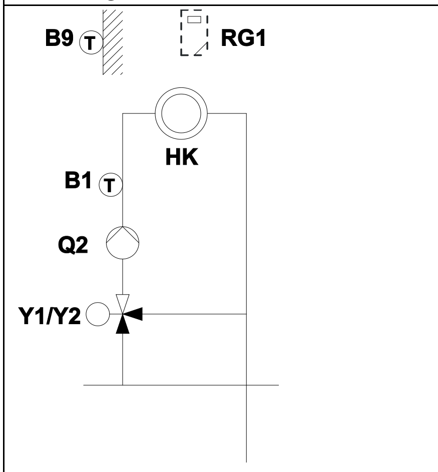
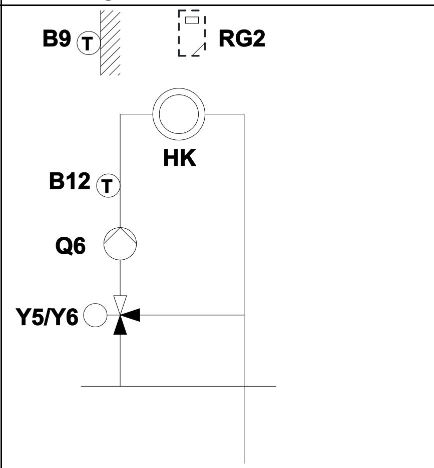
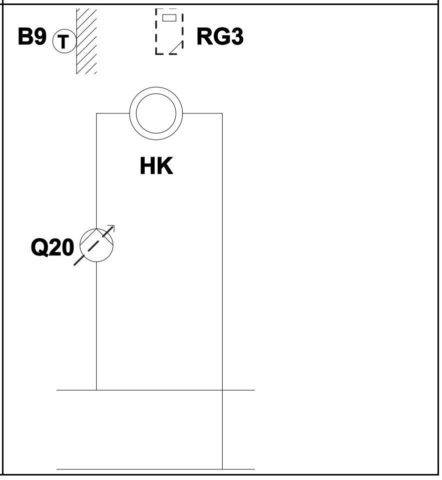
Connecting the circuits to the storage tank is selected in the heating circuit settings. The connection for heating circuit 1 is selected on line 870, for heating circuit 2 on line 1170, and for heating circuit 3 on line 1470. An automation block diagram matching the buffer storage tank connection is enabled when the selected line value is “Yes” and sensor B4 is connected and configured for use.

SEQ Taulukko * ARABIC Table 54. Connection options with a master controller (no auxiliary controllers)

Heating circuit 1	Heating circuit 2	Heating circuit 3
		

A circuit regulated with a three-way valve can also act as heating circuit 2, which leaves circuits 1 and 3 without a control valve. All three can also be uncontrolled. Pumps can be left unconnected in uncontrolled circuits if the circuit has its own pump, or if the circuit uses the condenser circuit’s pump.

SEQ Taulukko * ARABIC Table 55. Connection options with a master controller and one auxiliary controller

Heating circuit 1	Heating circuit 2	Heating circuit 3
		

A circuit regulated with a three-way valve can also act as heating circuit 3, which leaves circuit 1 or 2 uncontrolled and without a control valve. All three can also be uncontrolled. Pumps can be left unconnected in uncontrolled circuits if the circuit has its own pump, or if the circuit uses the condenser circuit’s pump.

24.1 Selecting a regulated heating circuit connected to the controller

The heat pump's controller can be used to control any of the three heating circuits controlled by a control valve. The circuit with a mixing valve is selected on line 6014. The inputs and outputs of the heating circuit selected on that line are automatically enabled; they do not need to be configured separately. The inputs and outputs are shown in the table below.

SEQ Taulukko * ARABIC Table 56. The controller inputs and outputs selected on line 6014

Line 6014: Function mixing group 1	BX11	QX10	QX11	QX9
None	None	None	None	None
Heating circuit 1	B1	Y1	Y2	Q2
Heating circuit 2	B12	Y5	Y6	Q6
Heating circuit 3	B14	Y11	Y12	Q20

If there is no temperature sensor on the controller-temperature input line (BX11), the controller automatically assumes that the circuit does not have a temperature sensor and control valve. Accordingly, the heating circuit selected on line 6014 may only contain a heating-circuit pump without a control valve and temperature sensor. The uncontrolled circuit’s pump can be left unconnected to the heat pump’s automation if the circuit has its own pump or it uses the condenser circuit’s pump (Q9). However, in these two cases the master controller’s valve control stays reserved for the heating circuit selected on line 6014, even if valve control is disabled. If the circuit does not have a mixing valve, it is a good idea to enable the heating circuit on lines 5710, 5715 and 5721, and then configure the circuit pump to a vacant QX output, if necessary. In this way, line 6014’s valve control can be used by some other heating circuit, or for some other control function.

In the factory settings of Junior ECO and Junior GT units, the control circuit function selected for the controller on line 6014 is heating circuit 1 and heating circuits are selected for a storage tank connection (lines 870, 1170 and 1470). The heating circuit function selected for the main controller in the Cube and Cube House factory settings is heating circuit 2, because in these models heating circuit 1 is by default connected to the building's heating network without a storage tank and a control valve, and condenser circuit’s pump Q9 operates directly as the circulation pump. In these models, heating circuit 2 connected to the controller can be equipped with a control valve, because the control block of the regulated heating circuit has not been reserved for heating circuit 1 on line 6014.

24.2 Selecting the regulated heating circuit connected to an extension module

The extension modules of the heat pump can be used to control any of the three heating circuits regulated by a mixing valve. The heating circuit for extension module 1 is selected on line 7300. The inputs and outputs of the heating circuit selected on this line are automatically enabled in the extension module; they do not need to be configured separately. The inputs and outputs are shown in the table below.

SEQ Taulukko * ARABIC Table 57. The extension module inputs and outputs selected on line 7300

Line 7300: Function extension module 1	BX21	QX21	QX22	QX23
None	None	None	None	None
Heating circuit 1	B1	Y1	Y2	Q2
Heating circuit 2	B12	Y5	Y6	Q6
Heating circuit 3	B14	Y11	Y12	Q20

If a temperature sensor is not connected to the extension module's temperature input (BX21), the module automatically assumes that the circuit does not have a temperature sensor and control valve. Therefore, the heating circuit selected on line 7300 may only contain a heating-circuit pump without a control valve and temperature sensor. The uncontrolled circuit’s pump can be left unconnected to the heat pump’s automation if the circuit has its own pump or it uses the condenser circuit’s pump (Q9). However, in these two cases the auxiliary controller’s valve control (line 7300 for aux. controller 1) stays reserved for that heating circuit, even if valve control is disabled. If the circuit does not have a mixing valve, it is a good idea to enable the heating circuit on lines 5710, 5715 and 5721, and then configure the circuit pump to a vacant QX output, if necessary. In this way, the auxiliary controller’s valve control can be used by some other heating circuit, or for some other control function.

25 Other setpoints

25.1 Heating circuit 1

716	Comfort setpoint max.	The maximum setpoint for the Comfort temperature.
726	Heating curve adaption	An automatic selection of the heating curve. There must be a temperature sensor in the heated space, and the room influence (line 799) value must be 1–99%.
742	Flow temp setpoint room stat	The line that sets the fixed flow temperature if the thermostat is requesting heating. Using this setting requires a room thermostat.
744	Swi-on ratio room stat	Change of the fixed flow temperature in line with the room thermostat, set on line 742, on the basis of the room temperature and earlier heat need. The available range is 1–99%. If you select "---" here, the fixed value is not changed.
760	Room temperature limitation	If the temperature measured by the room sensor exceeds the room temperature setpoint (line 710) by this much, the heating-circuit pump is switched off and the heating request is not sent. When the room temperature falls below the room temperature setpoint (line 710), heating is switched on.
770	Boost heating	Temporary raising of the Comfort temperature in moving from a reduced room temperature to the Comfort temperature. Thereby, the room warms up more quickly from the reduced temperature to the Comfort temperature.
780	Quick setback	Shutting of the heating-circuit pump and control valve for a while in moving from the Comfort mode temperature to the reduced temperature or frost protection temperature.
790	Optimum start control max.	A setting designed for reaching the Comfort temperature more or less at the time specified by the time program instead of just changing the setpoint from the Reduced mode temperature to the Comfort temperature at the time specified by the time program. The regulator switches on the heating no earlier than the number of hours specified here before the setpoint would switch from the reduced temperature to the Comfort temperature in line with the time program.
791	Optimum stop control max	A setting designed for reaching the reduced temperature more or less at the time specified by the time program instead of just changing the setpoint from the Comfort temperature to the reduced temperature at the time specified by the time program. The regulator switches off the heating no earlier than the number of hours specified here before the setpoint would switch from the Comfort temperature to the reduced temperature in line with the time program.
794	Heat-up gradient	Specification for lines 790 and 791 of how long (in minutes) it takes the heating system to raise the room temperature by one degree.
800	Reduced setp increase start	The reduced setpoint of the room temperature is increased from this temperature in colder temperatures (directly proportionally between lines 800 and 801).
801	Reduced setp increase end	The temperature at which the reduced setpoint of the room temperature has been increased so much that it is equal to the Comfort setpoint of the room temperature. This setting can be used, for example, when the time program is used for moving (e.g., at nighttime) from the room temperature Comfort mode to the reduced mode but in cold temperatures, heating the space from Reduced mode back to Comfort mode would take too long.
810	Frost prot. plant HC pump	A setting that, when on, causes the heating circuits' pumps to switch on when the plant's frost protection in accordance with line 6120 is switched on.
813	Frost protection, room model	If there is no room sensor in use, the automation will calculate an estimate of the room temperature. If the calculated temperature is below the frost protection temperature for flow (line 714), heating switches on until the calculated temperature exceeds the protection temperature by one degree.
820	Overtemp prot pump circuit	Switching off the heating-circuit pump if the flow temperature exceeds the temperature according to the curve.
832	Actuator type	Mixing valve type (three-way or two-way valve).
833	Switching differential two-position	The temperature difference between the two-way valve's on and off modes.
834	Actuator running time	The running time of the three-way valve motor between the extreme positions.

835	Mixing valve Xp	The proportional band of the PI controller controlling the three-way valve. The proportional band indicates how much the quantity to be adjusted must change for the actuator to move from one extreme position to the other. Thus, the proportional band is the change in flow temperature (in degrees Celsius) in the heating circuit that causes the regulator to move from one extreme position of the valve motor to the other. Increasing the value usually results in steadier adjustment, slower adjustment, and greater deviation from the setpoint after the adjustment. Decreasing the value usually results in less steady adjustment, faster adjustment, and a smaller deviation from the setpoint after the adjustment. The deviation after the adjustment is corrected with the I-action of the PID controller.
836	Mixing valve Tn	The integral action time (restore time) of the PI controller in the three-way valve. The integral action time refers to the time over which the actuator moves the distance determined by the proportional band. The integral action time is the time in which the I-action achieves the same change in the control quantity as the P-action (in a gradual change in the quantity of difference). The greater the integral action time, the smaller the effect of the I-action. An integral action time that is too short may result in unstable control.
861	Excess heat draw	If this is on, the heating circuit may request heat through the bus from another controller (from another heat source or storage tank).
870	With buffer	The line used to select whether a heating circuit is connected to a buffer storage tank. If this heating circuit is connected to the storage tank (either directly or through a main line with a primary controller), select Yes. This function requires the use of buffer sensor B4.
872	With prim. contr. / system pump	The line used to select whether a heating circuit is connected to a main line controlled by the primary controller or instead there is an additional pump in the heating circuit (Q14). The primary controller controls the three-way valve of the heat distribution line connected to the buffer storage tank (a main line with a primary controller). If the heating circuit is connected to the heat distribution line with a primary controller and controlled by the heat pump automation (the main line), the setpoint selected here is “Yes.” The precontroller is a kind of heat source for the heating circuits installed behind it. The heating circuits (or the mixing valves of the heating circuit) installed behind the primary controller indicate to the primary controller the desired water temperature. This is the setpoint that the primary controller attempts to achieve with sensor B15. The precontroller adds the mixing valve boost (line 2130) to this setpoint when the precontroller conveys the heat need information to its heat source. If more than one heating circuit is connected behind the primary controller (e.g., heating circuits 1 and 2), the heating circuit's highest temperature request determines the primary controller setpoint. For example, with the primary controller, three heating circuits can be installed in the buffer storage tank. In one of them, the temperature level is considerably higher than in the other two. A circuit with a higher temperature level can be connected to the storage tank directly, and the other two circuits can be connected to the main line with a primary controller. The precontroller then adjusts the temperature of the flow from the storage tank to a lower level for the two lower-temperature circuits. These two lower-temperature circuits may still have separate three-way valves, which are used to adjust the temperature precisely for each circuit. The precontroller's own heat source is usually the buffer storage tank connected to the heat pump. This is the case if the value selected on line 2150 is “After buffer.” The precontroller adjusts the temperature of the main line from the buffer storage tank. Alternatively, the precontroller's heat source can be another external storage tank. In that case, the value selected on line 2150 is “Before buffer.” In this case, the precontroller adjusts the temperature of the buffer storage tank's return. The heat distribution circuit may have a system pump (Q14) as an additional pump. The pump may be in the aforementioned precontrolled circuit (in the main line downstream from the three-way valve) or separate, without a three-way valve, if no precontroller action is needed. The system pump can be used either as a circulating pump for the precontrolled main line (the main line circulating pump) or for additional pump in heat distribution lines with a large pressure loss. Instructions on using this function are also provided in the precontroller settings, starting at line 2110.
882	Pump speed min.	A speed-controlled heating-circuit pump can be connected to inputs Zx and Ux. The minimum speed that the controller can generate for the pump can be set here. For example, if the control message is 0–10 V and the setting here is 40%, the minimum control message is 4 V.
883	Pump speed max	A setting that can be used if a speed-controlled heating-circuit pump is connected to inputs Zx and Ux. The maximum speed that the controller can generate for the pump can be set here.

		For example, if the control message is 0–10 V and the setting here is 100%, the maximum control message is 10 V.
900	Optg mode changeover	The heating-circuit mode is changed in accordance with this line if this function is selected for the Hx input (H1 or H3) and the input receives a control message.

25.2 Buffer storage tank (heating circuit buffer storage tank)

4708	Forced charging setp. cooling	In the use of cooling, the forced charging of the buffer (buffer storage tank) is stopped when the tank temperature reaches the value defined here.
4723	Temp. difference of buffer tank´s cooling circuit	Compressor start temperature in cooling = storage tank temperature setpoint + line 4723 + 1 °C. Compressor shut-off temperature in cooling = storage tank temperature setpoint – line 4723.
4724	Buffer tank´s min. temp. in heating	If the storage tank temperature falls below this limit in heating, the heating circuits are switched off (the mixing valve is closed and the circulating pump is switched off).
4726	Buffer tank´s max. temp. in cooling	If the storage tank temperature rises above this limit in cooling, the heating circuits are switched off (the mixing valve is closed and the circulating pump is switched off). When the storage tank temperature falls to 1 °C below this limit, the cooling circuits are switched on again.
4728	Rel. temp. difference in storage tank heating	Reading, calculated with this function, is added to the value on line 4722. If the value on this line is 0%, the function of this line is off and nothing is added to line 4722. The higher the risk setpoint and the higher the reading set on this line, the higher the increase. Increase = (storage tank's temperature setpoint – 20 °C) * line 4728 / 100.
4749	Min. charging setpoint, solar	The buffer tank is always heated by means of solar heating to at least this temperature, depending on the storage tank's heating need.
4755	Recooling temperature	If the storage tank is heated above the setpoint on line 4750 to the temperature on line 4751 with a solar collector, the storage tank is cooled as soon as possible to the points specified on lines 4756 and 4757, until the storage tank's temperature has reached the temperature specified on this line. The storage tank can be cooled by means of the DHW storage tank and heating circuits (line 4756) or via the solar heat collectors (line 4757) on cold nights, for example.
4756	Recooling of DHW storage tank/heating circuit	See line 4755.
4757	Recooling of collector	See line 4755.
4760	Charg. sensor el. imm. heater	The electric immersion heater (K16) in buffer tank can be switched on (if it is controlled by heat pump automation) when the buffer tank undergoes forced charging (see line 4705), the heat pump is not on (e.g., in lockout mode), or frost protection for the buffer tank is on. This line is used to select which temperature sensor is used to control the electric immersion heater. This setting has no effect if immersion heater K16 has not been enabled.
4761	Forced charging electric	This line is used for selecting whether the electric immersion heater in the buffer tank is used for heating the storage tank, if no other heat source (heat pump, solar collector, etc.) has been able to start within one minute from the start of forced charging.

25.3 Domestic hot water

1601	Optg mode selection Eco	If this mode is on, the DHW is charged only if the DHW temperature decreases below the reduced setpoint or if the Legionella function is on.
1614	Nominal setpoint max	Maximum DHW charging temperature.
1620	DHW heating release	The method used for changing of the DHW temperature setpoint between normal and reduced mode temperature. If the selected method is 24 h, the normal DHW temperature is used throughout the day. If the selected control method is “Time program 4/DHW,” the DHW setpoint can be controlled independently by means of time program 4. If time programs for HCs is selected as the control method, the DHW setpoint adheres to the heating-circuit time program such that the start temperature for the heating-circuit time pro-

		gram is moved one hour earlier (if the value selected on line 5010 is “Several times/day"). Therefore, if the time program for heating circuit 1, for example, switches from Reduced temperature to the normal temperature at 6am, the DHW setpoint changes from the reduced temperature to the normal temperature at 5am (the end time of the time program will not change). The DHW setpoint switches from reduced to normal when the setpoint of heating circuit 1 switches from reduced to comfort during the current 24 hr period and from the corresponding normal setpoint to reduced, once all heating circuits have switched from the comfort mode to the reduced setpoint. If any heating circuit remains in the comfort mode throughout the 24 hr period, the DHW setpoint is not decreased from normal to the reduced setpoint. If “Low-tariff” is selected as the control method, DHW charging starts when the low tariff input (ES) is active.
1630	Charging priority	A setting determining the controller action applied to heating circuits if the DHW and the heating circuits request heat simultaneously. This parameter affects only heating-circuit pumps and control valves, not the functioning of the heat pump's condenser pump. If you select “None,” it is possible to simultaneously perform DHW charging and building space heating, if this is possible in the pipe connection. Domestic hot water and spaces can be heated simultaneously when the DHW and the heating circuit are connected to the same storage tank. In a connection of this type, the heating circuit is connected directly to the storage tank and the DHW circulates in the storage tank through a closed spiral. With “None" selected as the setpoint, the pump of the storage tank's connected heating circuit (e.g., Q2) is kept on and the control valve is kept open during DHW charging. The DHW can be heated simultaneously with the spaces also when the system is equipped with a separate DHW storage tank and the heating circuit is connected directly to the change valve of the heat pump condenser (this switches the flow either to the heating circuit or to the DHW storage tank) and through a buffer storage tank where the heat pump automation does not control the temperature. In this case, the heating-circuit pump (e.g., Q2) is kept on while the DHW storage tank is being heated. If the selection here is “Absolute,” the building space is not heated during DHW charging, even if it was otherwise possible in the pipe connection (the heating-circuit pumps are switched off and the three-way valve is closed). Usually, the value “None" should be selected here.
1640	Legionella prevention function	A setting that switches the Legionella function on and off. This function can be set to start either periodically at the interval defined on line 1641 and at the time set on line 1644, or at a set time (line 1644) on a certain day of the week (line 1642). When the function is switched on at the aforementioned time, the DHW setpoint is increased to the value given on line 1645 and that value is maintained for the amount of time set on line 1646.
1641	Legionella funct periodically	The interval (in days) for starting of the Legionella function when the value on line 1640 is “Periodically.”
1642	Legionella funct weekday	The day of the week for starting of the Legionella function when the value on line 1640 is “Fixed weekday.”
1644	Legionella function time	The start time of the Legionella function. The time when the DHW setpoint is increased to the value on line 1645. After this, the DHW temperature is kept at said setpoint for the amount of time set on line 1646. If a time has not been set (the value is “---”), the function is started when DHW charging is launched at the normal setpoint for the first time on the day when the Legionella function is scheduled to start; if the DHW temperature setpoint is in Reduced mode for the entire day, the function is started when the day changes (at midnight).
1645	Legionella function setpoint	The DHW temperature setpoint when the Legionella function is on. This DHW temperature, measured with sensor B3 or sensors B3 and B31, must be reached. The sensor is selected on line 5022.
1646	Legionella function duration	The duration of maintaining the DHW storage tank temperature at the temperature set on line 1645. The clock starts when the DHW temperature exceeds the value on line 1645. If the temperature falls below this setpoint, the clock stops and restarts when the temperature again exceeds this setpoint.
1647	Legionella funct circ pump	If yes is selected here, the DHW circulating pump connected to the controller is kept on when the Legionella function is on.
1648	Temperature difference of circulating water circuit during legionella function	If a temperature sensor (sensor B4) is connected to the DHW circulation, the DHW temperature (measured with sensor B39) must reach the value set on line 1645 (for the time set on line 1646) less the value of this line. If this setting is not used (as value ---), no requirements are set for the temperature of the circulation water.

1660	Release of circulation pump	The schedule followed by the DHW circulation pump.
1661	Circulation pump cycle	If this function is on, the DHW circulation pump is periodically first on for 10 minutes and then off for 20 minutes when it is being used in accordance with the time program (line 1660).
1663	Circulation setpoint	If the temperature sensor (B39) for DHW circulation is in use and the circulation water temperature (measured by sensor B39) falls below this value, the circulation pump (Q4) is started. The circulation pump is on for at least 10 minutes or until this setpoint is reached. If this value is less than 8 °C lower than the DHW setpoint, the controller uses the DHW setpoint minus 8 °C here.
1680	Optg mode changeover	The state that the DHW enters if the changeover function has been enabled in the Hx input (H1 or H3) and a control message is received in the input.

25.4 DHW storage tank

5010	Charging	The DHW charging time. This setting is used only when DHW charging is controlled with the same time program as the heating circuit (line 1620).
5022	Type of charging	If only sensor B3 (the top-section sensor) is being used, the Recharging function is always enabled. The DHW is charged until sensor B3 reaches the DHW setpoint. With the option "Full charging," both sensor B3 (top sensor) and sensor B31 (bottom sensor) must reach the DHW setpoint. With the option "Full charg 1st time day," the option "Full charging" is used in the first DHW charging of the day and the option "Recharging" is used thereafter. With the Legionella function option, the aforementioned charging options are also applied when the Legionella function is in use.
5040	Discharging protection	If this setting is always on and pump Q3 is used for DHW charging, pump Q3 is started only when the heat pump supply water (sensor B21 or B71) is at least 0.5 times hotter than the DHW temperature measured (with sensor B3 or B31) by the value on line 5020. If the flow temperature falls below the DHW setpoint less 1/8 of the value on line 5040 during charging, the charging pump (Q3) is switched off again. If the option "Automatic" is selected here, this setting is applied only when the heat pump is in lockout mode.
5041	Discharging prot. sensor	This setting is used to select whether the discharging protection on line 5040 uses sensor B3 or B31.
5057	Recooling of collector	This function can be used to recool the DHW storage tank to the solar collectors (in cloudy weather).
5070	Automatic push	If the selected option is "Off," forced charging of the DHW can be started only manually. A manual start can be performed from the DHW menu or through the LPB bus. An older version of the user interface can be used for manual start by keeping the user interface DHW button depressed for 3 seconds. If the selected option is "On," forced charging of the DHW is started if the DHW temperature falls below the DHW setpoint by twice the value on line 5024.
5071	DHW charging prior. time limit	If forced charging of the DHW has been initiated, the DHW is charged for the time period defined here. It overrides the space heating need (this corresponds to the absolute priority on line 1630).
5090	With buffer	If the DHW storage tank is connected to the heating-circuit storage tank, the value "Yes" can be selected here, in which case it is possible to transfer heat from the heating-circuit storage tank to the DHW storage tank, if needed (lines 5021 and 5130).
5093	Solar integration	If a solar collector is connected to the DHW storage tank, select "Yes" here.

25.5 Heat pump

2886	Compensation heat deficit	If this is on, the heating water temperature (measured with sensor B21 or B71) is compared to the heating water setpoint (the heating curve value) over a longer time span. If the measured value exceeds the setpoint over a longer time span, the compressor off time is extended, and the measured value is lower than the setpoint, the compressor off time is reduced. This function is not in use during DHW charging or if there is a storage tank in any heating circuit.
2889	Duration error repetition	If the number of error situations (e.g., trips of the high pressure switch) during this time is

		higher than permitted for the error situation in question (the number defined in the ACS program), the heat pump initiates a lockout and must be reset manually.
2893	Number DHW charg attempts	The number of attempts to charge the DHW with the compressor after the first charging attempt (n + 1) if the DHW setpoint is not reached until another limit, such as the switch-off temperature (line 2844), is reached. A new charging attempt is initiated when the time defined on line 2843 has elapsed from the previous charging attempt. After the number of charging attempts set here, DHW charging is completed with electric immersion heaters. On line 7093, the controller saves the temperature to which the DHW was charged with the compressor. If this saved temperature is lower than the value defined on line 7092, a notification is shown on the screen.
2894	Delay 3-ph current error	If electrical interference (undervoltage or phase sequence) is of shorter duration than the time defined here, it is not noted as an error.
2895	Delay flow switch	If the flow switch signal is of shorter duration than the time defined here, it is not noted as an error.
2896	Brine circuit flow guard active	This line specifies taking into consideration the flow switch connected to an Ex input.
2908	OT limit with DHW charging	This is used to select whether lines 2809 and 2910 are taken into consideration during DHW charging.
2909	Release below outside temp	If the outside temperature is lower than this, the heat pump is used for heating (prior to this, another source of heat can be used).
2910	Release above outside temp.	If the outside temperature is lower than this, the heat pump is used for cooling (prior to this, another source of cooling can be used).
2911	For forced buffer charging	This is used to select whether the heat pump is used for forced charging of the heating-circuit storage tank. Forced charging can be switched on via line 4705.
2912	Full charging buffer	If the value selected here is "Off," the compressor is stopped when the storage tank temperature reaches its setpoint. If the value selected here is "On," the compressor stays on for the duration of the running time set on line 2842, even if the storage tank temperature has reached its setpoint. The setpoint of the storage tank temperature is determined on the basis of the setpoints of the heating circuits (or the precontrolled heat distribution circuit) connected to the tank, to which a mixing valve boost is added. The sensors used for measuring the setpoint are specified on line 4720.
2922	Condenser overtemp protection	This function can be used to cool the condenser by starting the condenser pump when the switch-off temperature set on line 2844 is reached. The condenser pump is started if the storage tank requests heat and its temperature (measured by sensor B4) is lower than the flow temperature (measured by sensors B21 and B71) at which the compressor is allowed to restart (see parameter 2844).
2923	Condens prot buffer sensor	This line is used to select the storage tank sensor to be used by parameter 2922.

25.5.1 Condenser

2789	Condenser pump with DHW	This is used to indicate whether the condenser pump (Q9) is on during DHW charging.
2800	Frost prot. plant cond. pump	The condenser pump is on/off when the plant's frost protection (line 6120) is on.
2801	Control cond. pump	This is used to select when the condenser pump is to be on. If the value selected here is "Parallel compr. operation," the pump is on whenever the compressor is on or when the electric immersion heaters installed in the condenser line are on. If the value selected here is "Temp. request," the pump is on whenever a heating circuit or the DHW requests heat. With this setting, the pump is on even when the compressor is off but there is heat in the buffer storage tank installed in the condenser line. In the automatic mode, the controller decides independently when the condenser pump is to be on.
2802	Prerun time cond. pump	The condenser pump starts this much earlier than the compressor.
2803	Overrun time cond pump	The condenser pump runs this much longer after the compressor is stopped.
2806	Max dev temp diff cond	This is used to define by how much the temperature differential across the condenser may deviate from the setpoint on line 2805 before a message on the deviation is shown on the

		screen.
2809	Temp frost alarm	If sensor B21's reading drops below this value, the heat pump is stopped. It can only be started by resetting the automation.
2810	Condenser frost protection	If the reading from both sensor B21 and sensor B71 drops below this limit in heating, the condenser pump is started. If the temperature does not reach this limit + 1 °C within the time set with parameter 2811 (or within two minutes if line 2811's value is less than two minutes), the electric immersion heaters are switched on. After this, the controller waits again for the time set on line 2811 (or at least two minutes) and then switches the compressor on if the temperature still does not exceed the value of this line + 1 °C. If the temperature in either of the aforementioned stages exceeds the value of this line + 1 °C, the immersion heaters (or immersion heaters and the compressor) are kept on for the duration of the overrun time defined on line 2811.
2811	Overrun cond frost protect	See line 2810.

25.5.2 Evaporator

2814	Source temp max	If the brine inlet temperature (sensor B91) exceeds this value, the compressor is not switched on but the fluid pump runs for the time set on line 2821 (from fluid pump start). If the brine temperature during this time drops to one degree below this limit, the compressor is started. If the brine temperature does not fall below this limit (by at least one degree) during the time set on line 2821, the controller waits for a new starting attempt for the duration of the compressor's off time (line 2843). If the brine inlet temperature is not in use, the brine outlet temperature is used here.
2819	Prerun time source	The evaporator pump starts this much earlier than the compressor.
2820	Overrun time source	The evaporator pump runs for this period of time after the compressor is switched off.
2823	Req temp diff evaporator	This value is the targeted temperature difference across the condenser (measured by sensors B91 and B92).
2824	Max. dev. temp. diff. evap.	If the temperature difference across the condenser deviates from the parameter 2823 setpoint by more than this, a notification is shown onscreen (if the compressor has been on for a minimum of three minutes). If this line is disabled (value "---"), line 2823 too is not enabled.

25.5.3 Compressor

2835	Compressor lockout	If the compressor has been switched off, the compressor is not switched back on again until the time set on this line has elapsed.
2836	Start swi-off temp red	This can be used to reduce the switch-off temperature (line 2844) in inverse proportion to the evaporation temperature (brine temperature). The colder the brine, the lower the switch-off temperature. Reducing the switch-off temperature begins when the evaporation temperature drops below the value set here. The switch-off temperature is not reduced further when it has been reduced to the level set on line 2837. The function is switched off by disabling line 2837 (set the value to ---).
2837	Swi-off temp max reduced	See parameter 2836.
2839	'Set' time ch'over DHW/HC	The compressor runs for this time period after DHW charging is switched to space heating, even if there was no need for heat at the time of making the switch.
2841	Keep compr run time min	This is used to select whether the time periods on lines 2841 and 2842 are in use.
2842	Compressor run time min.	Every time the compressor is started, it is kept running at least for this amount of time (starting from compressor start), even if there is no longer a heating request. This parameter is in use if the value selected on line 2841 is "Yes."
2843	Compressor off time min	Every time the compressor is switched off, it is kept off at least for this amount of time, even if a new heating request has been made in the meantime.
2845	Red switch-off temp max	This is the amount by which the line-2844 switch-off temperature is reduced during DHW charging and storage tank forced charging and also when two compressors are on at the same time. If this limit is reached, DHW charging is completed with immersion heaters (if the value

		on line 2880 is not “Substitute”). After this, the compressor remains on for the time set on line 2839 even if there is no need for heat in the heating circuits.
2846	Hot-gas temp max	The compressor is switched off if this hot-gas temperature is exceeded (it is measured by sensor B81 or B82).
2847	Swi diff hot-gas temp max	The hot-gas temperature (as measured by sensor B81 or B82) must fall at least this far below the limit set on line 2846 before the compressor is permitted to run.
2848	Reduction hot-gas temp max	DHW charging and storage tank forced charging are suspended if the hot-gas temperature (measured by sensor B81 or B82) is only this much lower than the upper limit defined on line 2846. Charging is restarted when the hot-gas temperature has fallen below the upper limit defined on line 2846 by the sum of this line and line 2847.
2849	Setpoint hot-gas temp	If the hot-gas temperature (measured by sensor B81) rises above this level, output K31 is switched on (if output K31 has been activated in the configuration).
2850	SD setp hot-gas temp	If the hot-gas temperature (measured by sensor B81) becomes this much lower than the level set on line 2849, output K31 is switched off.
2851	Cont'type setp. hot-gas temp.	If the value selected here is “NO,” output K31 is open (the loop is open) when the upper limit set on line 2851 has not been exceeded. When this is selected, output K31 is closed (the loop is closed) if the value on line 2851 is exceeded. With the selection “NC,” the direction of operation is reversed.
2852	LP delay on startup	If the low pressure switch is triggered for a period shorter than this when the compressor starts, the triggering is ignored.
2853	LP delay during operation	If the low pressure switch is triggered for a period shorter than this when the compressor is in continuous use, the triggering is ignored.

25.5.4 Compressor 2

2860	Lock stage 2 with DHW	If the selected value is “On,” the second compressor is kept switched off for the duration of DHW charging.
2861	Release stage 2 below OT	If the selected value is “On,” the second compressor is enabled only when the outside temperature is lower than the value set here. The outside temperature used is the attenuated outside temperature given on line 8703.
2862	Locking time stage 2/mod	The second compressor is kept switched off for this period, even if the need for heat entails it being started after starting of the first compressor. The calculation of line 2863’s degree-minutes starts only when the time set here has elapsed from the start of the first compressor.
2863	Release integral stage 2/mod	The second compressor is enabled when the sum of the degree-minutes for the flow temperature has reached this value. The calculation of degree-minutes begins when the time set on line 2862 has elapsed. A degree-minute in this case is the difference between the flow setpoint of the heating circuit and the measured value. These differences are summed up at one-minute intervals. When the sum calculated (in other words, total degree-minutes) exceeds the value set here, the second compressor is started. For example, a setpoint of 100 means a 10-degree temperature difference for 10 minutes or a 5-degree temperature difference for 20 minutes. If, after the first minute, for example, the flow setpoint is 45 degrees and the measured value is 25 degrees, the number of degree-minutes is 20 (= 45–25). If after the next minute, the setpoint is still 45 degrees and the measured flow temperature is 30 degrees, the number of degree-minutes is 15 (=45–30). After two minutes, the sum of the degree-minutes is thus 35 °C-min (20 + 15).
2864	Reset integral stage 2/mod	When both compressors are on, the second compressor is switched off when the degree-minute sum exceeds this value. In this context, a degree-minute is the difference between the measured value for the heating-circuit flow and the heating-circuit flow setpoint. The degree-minute calculation method is shown on line 2863.
2865	Compr sequence changeover	The compressors' switch-on sequence is reversed when the compressor that starts first has been on for the time set here. This setting is used to ensure that the two compressors run for approximately the same time in the long term.

25.6 Configuration

5700	Presetting	The preset plant diagram in accordance with the Siemens manual. Each option changes approximately twenty lines. The same outcome is achieved by changing these lines manually one by one.
6014	Function of mixing group 1	A parameter, used to select for what the three-way mixing valve, controlled by the heat pump main controller, is used. This option also locks certain BX, QX, and EX inputs and outputs even if they would otherwise be freely selectable. For more precise information see the automation manual.
6120	The plant's frost protection.	The plant's frost protection. This setting can be used to switch on the selected pumps separately (e.g., the condenser pump Q9 or the heating circuit pumps Q2, Q6, and Q20), in accordance with the outside temperature, even if they otherwise would not be switched on (e.g., because of a heating request). Each pump has its own link to this parameter. The pumps attached to this parameter are used in the following manner: If the outside temperature is below –4 °C, the selected pumps are always on. If the outside temperature is between –3 and 4 °C, the pumps are on for a period of 10 minutes every 6 hours, and if the temperature is above 1.5 °C, the pumps are always off unless they e.g. are on because of the need for heat. This setting has no effect on how the pumps are started in response to heating requests, for example.
6123	Blocking a pump restart	The time for which the circulating pumps are off before they are restarted after stopping. At the same time, the compressor and the electric immersion heaters are off. This setting is used to allow the NTC immersion heater of low-energy pumps to cool down before restart.
5710	Heating circuit 1	Switching of heating circuit 1 on/off.
5715	Heating circuit 2	Switching of heating circuit 2 on/off.
5721	Heating circuit 3	Switching of heating circuit 3 on/off.
5712	Operation mode of mixing valve 1	This setting is active only if it is used solely in cooling connections.
5734	Basic position for DHW diff. control valve (Q3)	This line is used to select to which position the change valve (space heating or DHW heating), connected to output Q3, stays, if there is no need for DHW or space heating. Usually, heating circuit should be selected.
5803	LPB address of the controller supervising the shared brine pump	If several heat pumps in the cascade are using the same brine circuit pump, this setting can be used to select to which device, connected to the LPB, the shared pump is connected.
5806	Type el imm heater flow	A setting in line with the connection sequence of the electric immersion heater stages, which is as follows:

	3-stage		2-stage, excluding		2-stage, complementary		1-stage	
Contactor	**K25**	**K26**	**K25**	**K26**	**K25**	**K26**	**K25**	**K26**
0	0	0	0	0	0	0	0	0
1	1	0	1	0	1	0	1	0
2	0	1	0	1	1	1	---	---
3	1	1	---	---	---	---	---	---

25.7 Solar collector

3816	Swimming pool temperature difference On	The collector's temperature must exceed the swimming pool's temperature by this amount before starting the collector's pump. The collector temperature must also exceed the value on line 3812. If "not in use" is selected, the controller will use the value on line 3810.
3817	Swimming pool temperature difference Off	If the collector's pump is on and the collector's temperature exceeds the swimming pool's temperature by this amount only, the collector's pump is stopped. If "not in use" is selected, the controller will use the value on line 3811.
3818	Minimum charging temperature for swimming pool	The collector's temperature must exceed this before the collector's pump is started during swimming pool heating.

25.8 Other settings

7092	DHW min. charging temperature with a compressor	If the temperature on line 7093 is below the value on this line, the user interface will display a service notification (a wrench symbol). If this temperature can be exceeded at the next DHW charging, the service notification disappears. This monitoring can be switched off.
7093	Current DHW temperature with a compressor	The DHW storage tank temperature (B3/B31) to which the DHW can be heated with the heat pump before the high pressure switch-off or switch-off temperature (line 2844), or the upper limit of hot gas temperature (line 2846).
7119	Economy function on/off	This can be used to disable the option of using line 7120.
7141	Emergency operation	This line is used to switch on emergency operation. In this case, only the electric immersion heaters controlled by the heat pump are used for heating.
7142	Automatic emergency operation mode in fault condition	This line is used to select whether emergency operation is switched on only manually via line 7141 or if emergency operation switches on automatically in the case of a fault, if needed.
7150	Simulation outside temp.	This line can be used to set the outside temperature manually. The setting is valid for 5 hours, after which it is disabled automatically. This setting line can be used, for example, during commissioning in the summer.

26 Heat pump status messages

Menu	Line	Setting	
Fault	6800	History 1	Last fault time
Fault	6801	Error code 1	Last fault message
Service/special operation	7093	Current DHW charging tempera-ture	DHW temperature last reached with a compressor.
Service/special operation	7120	Eco use	Eco use on/off. In eco mode the heat pump heats DHW only.
Service/special operation	7141	Emergency operation	Emergency operation (electric heater heating) on/off
Service/special operation	7150	Simulation outside temp.	Bypassing the outside temperature sensor and setting the temperature manually. In effect for five hours, after which the sensor is commissioned.
Input/output test	7705...		Input and output status messages.
Status	8000	State heating circuit 1	Chapter 26.2
Status	8001	The state of heating circuit 2.	Chapter 26.2
Status	8002	The state of heating circuit 3.	Chapter 26.2
Status	8003	State of the DHW	Chapter 26.4
Status	8006	State heat pump	Chapter 26.1
Status	8010	Additional storage tank (buffer storage tank) state	Chapter 26.3
Status	8050	History 1	Last anomalous state time
Status	8051	State code 1	Last anomalous state message time
Heat generation status infor-mation	8400	Compressor 1	Compressor on/off
Heat generation status infor-mation	8402	Electrical heater for flow 1	Electric immersion heater stage 1 (K25) on.
Heat generation status infor-mation	8403	Electrical heater for flow 2	Electric immersion heater stage 2 (K26) on.
Heat generation status infor-mation	8403	Source pump	Brine circuit pump on/off.
Heat generation status infor-mation	8405	Brine pump speed in rpm	Brine circuit pump’s speed (for speed-controlled pumps), 100 % always corresponds to full pump speed.
Heat generation status infor-mation	8406	Condenser pump	Condenser circuit pump on/off.
Heat generation status infor-mation	8407	Condenser pump’s speed	Condenser circuit pump’s speed (for speed-controlled pumps), 100 % always corresponds to full pump speed.
Heat generation status infor-mation	8410	Return temperature for heat pump	Condenser circuit sensor B71’s temperature.
Heat generation status infor-mation	8411	Heat pump’s flow temperature	Condenser circuit sensor B21’s temperature.
Heat generation status infor-mation	8425	Condenser temperature difference	
Heat generation status infor-mation	8426	Temperature differential, evapora-tor	
Heat generation status infor-mation	8427	Brine return temperature	Brine temperature from the brine circuit (sensor B91).
Heat generation status infor-mation	8428	Brine min. return temperature	Lowest brine temperature from the brine circuit (sen-sor B91).
Heat generation status infor-mation	8429	Brine flow temperature	Brine temperature when entering the brine circuit (sensor B92).
Heat generation status infor-mation	8440	Minimum remaining off time 1	Compressor’s remaining off time before it can start again.
Diagnostics consumers	8700	Outside temperature	Measured outside temperature (sensor B9)
Diagnostics consumers	8703	Outside temp attenuated	chapter 11.7
Diagnostics consumers	8704	Outside temp composite	chapter 11.7
Diagnostics consumers	8730	Heating circuit pump 1	Heating circuit 1 pump on/off
Diagnostics consumers	8735	LP1 pump speed in rpm	Heating circuit pump speed (for speed-controlled

			pumps)
Diagnostics consumers	8743	Flow temperature 1	Heating circuit 1 flow temperature (sensor B1)
Diagnostics consumers	8744	Flow setpoint 1	The setpoint of heating circuit 1's flow (sensor B1)
Diagnostics consumers	8830	DHW temperature 1	DHW charging sensor's temperature (sensor B3)
Diagnostics consumers			
Diagnostics consumers	8980	Buffer tank temperature 1	Supplementary buffer sensor B4's temperature
Diagnostics consumers	8981	Buffer setpoint	Buffer tank temperature setpoint
Diagnostics consumers	9031...	Relay output QX	QX relay outputs' state

26.1 State of the heat pump

Heat pump's state information (line 8006) indicates the state of the pump's compressor and electric heater.

Status	
No request	Heat pump's compressor and electric immersion heater are off, because the setpoints for space and DHW heating have been reached. The heat pump starts when one of the two heating modes requests more heat.
Compressor's off time in effect	A start request has been sent to the compressor, but its off time has not yet elapsed. The compressor starts after the off time if heat requesting (additional storage tank or DHW) is still on.
Flow active	Condenser circuit's pump is on (prerun), but the compressor has not yet started.
Compressor 1 on	Heat pump compressor is on.
Switch-off temp. max. (Locked, flow temperature max.)	Heat pump's flow water (sensor B21) temperature exceeds the switch-off temperature (chapter 23.1). The heat pump will restart when the compressor's off time has elapsed and flow temperature has cooled sufficiently.
Compressor ready for operation	Compressor is ready to operate, for example after stopping due to switch-off temperature.
Overrun time active	Compressor has been switched off, but the overrun time for the brine or condenser circuit's pump is still on.
Source temperature lower limit, brine	Brine circuit's temperature drops below the safety limit (chapter 23.2).
Compressor and electric immersion heater on simultaneously	Chapter 15.
Emergency operation	Heat pump's compressor is not operating due to a fault state (chapter 27)
Electric immersion heater on	Heat pump's electric heater is on, but the compressor is off. • Electric heater's locking time and degree minutes are at zero and the compressor has not yet started due to condenser circuit pump's prerun time. • The highest DHW charging temperature with a compressor (chapter 12.5) is enabled and DHW's temperature (sensor B3) has exceeded the highest charging temperature, but DHW setpoint (line 1610) has not yet been exceeded. • DHW charging temperature with a compressor has stopped to the switch-off temperature and heating continues with an electric heater until the setpoint is reached. The number of charging attempts is set on line 2893.

26.2 State of the heating circuit

The heating circuit settings are presented in the chapter 10.5. Heating circuit 1's state is reported on line 8000. Heating circuit 2's state is reported on line 8001.

Status	
Comfort mode	Heating circuit uses a Comfort mode setpoint.
Reduced heating	Heating circuit uses a reduced setpoint.
Protection mode	Heating circuit uses a Protection mode setpoint.
Overrun time active	Heating circuit is about to switch off.
Summer usage	Summer/winter heating limit is on (chapter 11.6)
STOP	Heating in the heating circuit is off.

26.3 Additional storage tank (buffer storage tank) state

Settings for the buffer tank are presented in chapter 14. In the context of automation, heating circuit's storage tank is called the buffer storage tank. The line number for the tank's status is 8010.

Status	
Charged, target temperature	Buffer storage tank has been heated to the temperature setpoint.
Producer released / Source released	Buffer storage tank's temperature is below the setpoint and the compressor or other heat source has been given a running request.

26.4 State of the DHW

Settings for domestic water are presented in chapter 12. The line number for the DHW state is 8003.

Status	
Charged, rated temperature	DHW has been heated to the normal setpoint set on line 1610: sensor B3 observes a higher temperature than the setpoint.
Charging, rated temperature	The heat pump heats the domestic water to the normal setpoint on line 1610.
Overrun time active	DHW temperature exceeds the setpoint (sensor B3), but the compressor has not yet shut down.
STOP	DHW heating is off or has stopped to a switch-off temperature and the compressor's off time has not yet ended.

27 Fault situations

27.1 Anomalous status information or fault condition

Heat pump's automation saves abnormal situations as statuses. The latest anomalous status is saved in the status menu on lines 8050 and 8051 (history 1 and state code 1), and the second to last on lines 8052 and 8053 (history 2 and state code 2).

If the status is repeated enough times within a set time frame (line 2889), the heat pump enters a fault state. The latest fault status is found in the fault menu on lines 6800 and 6801 (history 1 and error code 1). The amount of permitted fault statuses before entering the fault state is presented in the table below for the most common faults (can be modified with the ACS program).

The heat pump's compressor is not available for use under a fault condition. A fault state requires that the heat pump's automation is reset before its compressor can be restarted. Reset the automation in the fault menu on line 6711 (chapter 10.4.11). The reason for the fault must be investigated before resetting.

SEQ Taulukko * ARABIC Table 58. Number of permitted fault statuses before entering fault state

Status	Permitted amount
107: Hot gas temperature	2
222: Higher pressure	3
225: Lower pressure	2
226: Compressor's overload	2
355: Phase order	2
385: Undervoltage	2

27.2 Emergency operation

During a fault state the heat pump enters the the emergency operation mode automatically, if the automatic emergency operation function is enabled on line 7142. When emergency operation is active, the automation uses the connected electric heaters or some other heat source, like an electric boiler. Typically electric heaters K25 and K26 connected to the automation are used. Heating will continue in emergency operation mode only if an electric heater or some other heat source has been connected to the automation. The emergency operation mode can be switched off on line 7141. Emergency operation switches off automatically after the automation has been reset. Reset the automation in the fault menu on line 6711 (chapter 10.4.11).

27.2.1 Cube House

The device has two different emergency operation modes: automation-controlled and automation-bypassing modes. When the automation-controlled mode (chapters 10.4.12 and 27.2) is used, the compressor is switched off and the heat pump's internal electric heater is used for heating according to the automation's normal temperature levels.

When this mode is enabled, the operating switch is kept in position 1. Emergency operation mode that bypasses the automation is enabled by moving the switch to position 2. In the automation-bypassing mode, the compressor and automation are switched off and only the electric heater (6 kW) controlled by the thermostat on the side of the switchboard is used. In this mode the heat pump's change valve will always direct the flow to space heating (valve position B).

The temperature of the water entering the heating circuit is set by means of the emergency operation thermostat, found at the side of the switchboard. The emergency operation mode bypasses the automation. The factory setting is 35 °C. Use the emergency-operation thermostat to select a safe temperature that is suitable for the building's heating system.

27.3 State/error codes and troubleshooting

Faultless operation of the heat pump requires an adequate flow (adequately small temperature difference) and a suitable temperature level in the brine and condenser circuits. The temperature sensors and actuators must be properly installed for the automation to work properly. If these basic requirements are met, the heat pump's adjustment and troubleshooting can be done by changing the setpoint values. See the technical data for the temperatures differences corresponding to the flows and the maximum output temperature.

27.3.1 Brine circuit temperature and underpressure

Underpressure and the lower limit temperature in the brine circuit are caused by an inadequate flow or entry temperature in the circuit. If the automation reports that there is underpressure, check the brine circuit's

- valves
- filters
- pump's operation (rotation, rotational speed)
- liquid flow when the device operates from a temperature difference (line 8426)
- lowest temperature level of the liquid when the device is running (line 8428)
- frost resistance and adequacy of liquid
- dimensioning.

Use a flow meter to measure the brine circuit's flow if required: The temperature difference does not always indicate the brine circuit's flow properly, because the flow impacts the output and thus, the temperature difference. The temperature sensor reading may also be incorrect due to the sensor, its location or isolation, or some other factor.

27.3.2 Switch-off temperature and overpressure

The switch-off temperature and overpressure are caused by an inadequate flow in the condenser circuit, excessive return temperature from the circuit to the condenser, or by an overly high request temperature in the heating circuit.

If the automation gives an indication of a switch-off temperature or overpressure, check the heating circuit and DHW settings first. Pay special attention to the heating curve's temperature request, and the DHW setpoint, neither of which may not be too high. Also take the upper and lower limits of the heating curve's setpoint into account. If required, reduce the heating curve's slope (line 720) or its upper limit (line 741) and the domestic hot water setpoint (line 1610).

The excessive return temperature can be caused by an inadequate heat release to heating or by a needlessly large flow in the condenser circuit. The temperature difference between the supply and return temperatures can be increased by reducing the flow. A suitable difference is usually approximately 5…7 °C.

If the switch-off temperature or overpressure keep on occurring despite the setpoints, check the condenser circuit's

- valves
- filters
- pump's operation (rotation, rotational speed)
- water flow when the device operates from a temperature difference (line 8425)
- highest return and supply water temperature (lines 8410 and 8411)
- flow routes and heat release.

27.3.3 State codes and error codes

QTY: Number of permitted state messages before they become error messages.
STATE: State message, until the permitted state message quantity is reached and they become error messages. If the table reads ---, the state message becomes an error message directly.
HP: Heat pump is operational if the error or state message is active.

ERROR MESSAGE	SENSOR /CONNECTOR	QTY	STATE	HP	
10: Outside sensor	B9	0	---	Yes	Sensor is missing or faulty. Check the sensor’s connection and cap. Change the sensor if necessary.
26: Shared flow sensor 1	B10	0	---	Yes	
27: Shared flow sensor 2	B11	0	---	Yes	
30: Flow sensor 1	B1	0	---	Yes	
31: Cooling flow sensor 1	B16	0	---	Yes	
32: Flow sensor 2	B12	0	---	Yes	
33: Heat pump flow sensor	B21	0	---	Yes	
35: Source inlet sensor	B91	0	---	No	
36: Hot gas sensor 1	B81	0	---	Yes	
37: Hot gas sensor 2	B82	0	---	Yes	
38: Precontroller flow sensor	B15	0	---	Yes	
39: Evaporator sensor	B84	0	---	No	
44: Heat pump return sensor	B71	0	---	Yes	
45: Source outlet sensor	B92	0	---	No	
46: Cascade return sensor	B70	0	---	Yes	
47: Shared return sensor	B73	0	---	Yes	
48: Refrigerant sensor, liquid	B83	0	---	Yes	
50: DHW sensor 1	B3	0	---	Yes	

ERROR MESSAGE	SENSOR /CONNECTOR	QTY	STATE	HP	
52: DHW sensor 2	B31	0	---	Yes	
54: DHW flow sensor	B35	0	---	Yes	
57: DHW circulation sensor	B39	0	---	Yes	
60: Room sensor 1		0	---	Yes	
65: Room sensor 2		0	---	Yes	
68: Room sensor 3		0	---	Yes	
70: Buffer tank sensor 1	B4	0	---	Yes	
71: Buffer tank sensor 2	B41	0	---	Yes	
72: Buffer tank sensor 3	B42	0	---	Yes	
73: Collector sensor 1	B6	0	---	Yes	
74: Collector sensor 2	B61	0	---	Yes	
76: Special temperature sensor 1	BX	0	---	Yes	
81: LBP short circuit/communication		0	---	Yes	LBP bus has short-circuited. Check the cable and connections.
81 (remote connection device): No bus input					The connection between the remote connection device and heat pump's controller has been cut off. This may be caused by a power cut-off from the heat pump or by a faulty cable.
82: LBP address collision		0	---	Yes	Two controllers in a cascade have the same LBP address. Check the addresses from the LBP menu.
83: BSB short circuit		0	---	Yes	BSB bus has short-circuited. Check the cable and connections.
84: BSB address collision		0	---	Yes	Two user interfaces are used for the same purpose. Set separate purposes on line 40.
85: BSB wireless data transfer		0	---	Yes	Remote controller's range does not reach the antenna connected to the controller.
98: Additional module 1		0	---	Yes	Connection to auxiliary module has been cut off. Check the module's flat cable and change it if necessary. If there is no
99: Additional module 2		0	---	Yes	

ERROR MESSAGE	SENSOR /CONNECTOR	QTY	STATE	HP	
					auxiliary module, select “yes” on lines 6200 (save sensors) and 6201 (remove sensors).
100: Two time hosts		0	---	Yes	Multiple controller’s or remote connection devices in cascade have been selected as the masters for time. Choose one controller as the time master from the LBP menu and set the others as slaves remotely.
106: Source temperature too low		0	---	No	See chapters 23.2 and 27.3.1.
107: Hot gas, compressor 1		2	Hot gas, compressor 1	No	Hot gas temperature is too high. This may be caused by expansion valve’s desuperheating. If the error message keeps occurring, reach out to a refrigeration specialist to check the desuperheating.
108: Hot gas, compressor 2		2	Hot gas, compressor 2	No	
117: Water pressure too high	Hx	0	---	Yes	Hx input is selected for pressure supervision and the pressure in the supervised circuit is too high. Check the circuit’s pressure and reduce it if required. Deselect the supervision if required.
118: Water pressure too low	Hx	0	---	No	Hx input is selected for pressure supervision and the pressure in the supervised circuit is too low. Check the circuit’s pressure and increase it if required. Deselect the supervision if required.
121: Flow temperature LP1		0	---	Yes	There is an error in the reading of heating circuit 1’s supply water sensor B1. Check the sensor and its connection. Change the sensor if necessary.
122: Flow temperature LP2		0	---	Yes	There is an error in the reading of heating circuit 1’s supply water sensor B12. Check the sensor and its connection. Change the sensor if necessary.
134: Joint error, heat pump	E20	2	Fault	No	EX input has been configured with an error message that is active.
138: No heat pump control sensor		0	---	No	Sensor B71 or B4 missing. Sensor B71 is used for controlling the

ERROR MESSAGE	SENSOR /CONNECTOR	QTY	STATE	HP	
					heat pump when the space heating circuit is not equipped with a buffer storage tank (additional storage tank). The buffer storage tank is controlled with sensor B4. Check the operation and connection of sensor B71/B4. Change the sensor if necessary.
146: Sensor/actuator configuration		0	---	Yes	The connection requires a sensor or actuator that has not been configured for use. Configure the inputs and outputs of the required sensors and actuators for operation.
171: Alarm contactor 1 active	H1/H31	0	---	Yes	Hx input has been configured with an alert message that is active.
172: Alarm contactor 2 aktiivinen	H2/H21/H22/H32	0	---	Yes	
173: Alarm contactor 3 active	EX	0	---	Yes	
174: Alarm contactor 4 active	H3/H33	0	---	Yes	
176: Water pressure 2 too high	Hx	0	---	Yes	Hx input is selected for pressure supervision and the pressure in the supervised circuit is too high. Check the circuit's pressure and reduce it if required. Deselect the supervision if required.
177: Water pressure 2 too high	Hx	0	---	No	Hx input is selected for pressure supervision and the pressure in the supervised circuit is too low. Check the circuit's pressure and increase it if required. Deselect the supervision if required.
201: Frost protection alert	B21	0	---	No	Temperature measured by sensor B21 is below the frost protection limit.
222: Overpressure of heat pump operation	E10	2	Overpressure of heat pump operation	No	Chapter 27.3.2
223: Overpressure in heat pump start	E10	0	---	No	Chapter 27.3.2

ERROR MESSAGE	SENSOR /CONNECTOR	QTY	STATE	HP	
224: Overpressure in DHW start	E10	0	---	No	Chapter 27.3.1
225: Underpressure	E9	2	Underpressure	No	Chapter 27.3.1
226: Compressor 1 overload	E11	2	Overload, compressor 1	No	Compressor’s motor protection (fuse) is in OFF position. If the fuse was triggered during operation, contact the maintenance personnel.
227: Compressor 2 overload	E12	2	Overload, compressor 1	No	Compressor’s motor protection (fuse) is in OFF position. If the fuse was triggered during operation, contact the maintenance personnel.
228: Heat source’s flow guard	E15	2	Heat source’s flow guard	No	A flow guard that is unable to recognize the flow has been selected for input Hx. Check the flow and the guard. Decommission the flow guard if required.
229: Heat source’s pressure guard	E15	2	Heat source’s pressure guard	No	Hx input is selected for pressure supervision and the pressure in the supervised circuit is not within the permitted limits. Check the circuit’s pressure. Decommission the pressure guard if required.
230: Source pump’s overload	E14	2	Source pump’s overload	No	Brine circuit’s motor protection (fuse) is in OFF position. If the fuse was triggered during operation, contact the maintenance personnel.
243: Swimming pool sensor	B13	0	---	Yes	
260: Flow sensor 3	B14	0	---	Yes	
320: DHW charging sensor	B36	0	---	Yes	Sensor B36 (Cube) has an erroneous reading. Check the sensor and its connection. Change the sensor if necessary.

ERROR MESSAGE	SENSOR /CONNECTOR	QTY	STATE	HP	
321: DHW consumption sensor	B38	0	---	Yes	Sensor B38 has an erroneous reading. Check the sensor and its connection. Change the sensor if necessary.
324: BX, same sensors		0	---	Yes	Two BX inputs have been configured for the same sensor or actuator. Check the configuration and the automatic configuration of inputs on lines 6014, 7300 and 7375.
325: BX/additional module, same sensors		0	---	Yes	
326: BX/mixing group, same sensors		0	---	Yes	
327: Additional module, same function		0	---	Yes	
328: Mixing group, same function		0	---	Yes	
329: Additional module mixing group, same function		0	---	Yes	
330: BX1 no function		0	---	Yes	A sensor has been connected to the terminal but no function has been selected. Select a function for the sensor or remove it from the terminal.
331: BX2 no function		0	---	Yes	
332: BX3 no function		0	---	Yes	
333: BX4 no function		0	---	Yes	
334: BX5 no function		0	---	Yes	
335: BX21 no function		0	---	Yes	
336: BX22 no function		0	---	Yes	
337: B1 no function		0	---	Yes	
338: B12 no function		0	---	Yes	
339: Collector pump Q5 missing		0	---	Yes	The solar collector has been commissioned from the service buffer tank's or an additional storage tank's settings, but the sensor or actuator has not been configured. Configure the required actuators for operation.
340: Collector pump Q16 missing		0	---	Yes	
341: Collector sensor B6 missing		0	---	Yes	
342: Sensor B31 missing (collector)		0	---	Yes	
343: Solar connection missing		0	---	Yes	The solar collector's actuators have been configured for use, but

ERROR MESSAGE	SENSOR /CONNECTOR	QTY	STATE	HP	
					the connection to the service buffer tank or an additional storage tank is missing (lines 5093 and 4783).
344: Solar collector function K8 missing		0	---	Yes	The solar collector's change valve has been selected for use on line 5840, but it is not set for use with any QX output. Having the valve is not mandatory for the piping if a combined DHW and heating circuit storage tank is in use. Otherwise the change valve must be used. Select function K8 for a vacant QX output or change the setting on line 5840.
353: Cascade sens. B10 missing		0	---	Yes	Sensor B10 missing. Configure the sensor for use, connect it to the automation and install it in the piping.
355: 3-phase current asym.	E21/E22/E23	2	3-phase asymmetry	No	Automation's phase guard reports that there are faults. If the report concerns a device that is being installed and the compressor rotates in the wrong direction, switch the order of two phases with one another in the heat pump's current supply. Then try restarting the device. If the report is about a previously installed pump, check whether the phase order of the building's current supply has changed. If the fault cannot be located, contact maintenance.
358: Soft starter	E25	2	---	No	Soft starter's error message is confgured to an EX input and the message is active. Fault in the soft starter. Check the connections and the soft starter's operation.
361:Source sens B91 miss		0	---	Yes	
362: Source sens. B92 missing		0	---	Yes	Sensor B92 is configured for use, but it has not been installed or it is malfunctioning. Check the sensor and connections. Change the sensor if necessary.

ERROR MESSAGE	SENSOR /CONNECTOR	QTY	STATE	HP	
441:BX31 no function		0	---	Yes	A sensor has been connected to the terminal but no function has been selected. Select a function for the connection or remove it from the terminal.
442:BX32 no function		0	---	Yes	
443:BX33 no function		0	---	Yes	
444:BX34 no function		0	---	Yes	
445:BX35 no function		0	---	Yes	
446:BX36 no function		0	---	Yes	
447:BX6 no function		0	---	Yes	
452:HX1 no function		0	---	Yes	
453:HX3 no function		0	---	Yes	
454:HX31 no function		0	---	Yes	
455:HX32 no function		0	---	Yes	
456:HX33 no function		0	---	Yes	
457:BX7 no function		0	---	Yes	
462:BX8 no function		0	---	Yes	
463:BX9 no function		0	---	Yes	
464:BX10 no function		0	---	Yes	
465:BX11 no function		0	---	Yes	
466:BX12 no function		0	---	Yes	
467:BX13 no function		0	---	Yes	
468:BX14 no function		0	---	Yes	
469:HX21 no function		0	---	Yes	
470:HX22 no function		0	---	Yes	
493: Outdoor temperature sensor	B9	0	---	Yes	Outside temperature sensor has not been installed or it is malfunctioning. Check the sensor and connections. Change the

ERROR MESSAGE	SENSOR /CONNECTOR	QTY	STATE	HP	
					sensor if necessary

TECHNICAL DATA

The individual performance of the devices may vary. These differences are due to the properties of the liquids in the circuits, heat transferring surfaces getting dirty, flow rates, individual differences in compressors (standard EN 12900), and the filling and adjustment done to the refrigerant circuit during installation, among other things.

28 ON/OFF MODELS

28.1 Junior ECO

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Dimensions and weight								
Width	mm	525	525	525	525	525	525	525
Depth	mm	562	562	562	562	562	562	562
Height	mm	655	655	655	655	655	655	655
Weight when empty	kg	124	126	128	129	140	145	150
Electric immersion heater								
Electric immersion heater as standard		no	no	no	no	no	no	no
Readiness for an electric immersion heater (6 kW)		yes	yes	yes	yes	yes	yes	yes
Heater steps	pcs	3	3	3	3	3	3	3
Soft starter								
Soft starter as standard		yes	yes	yes	yes	yes	yes	yes
Pipe connections								
Condenser and brine circuits' connection (ISO 228 thread)		G 1	G 1	G 1	G 1	G 1	G 1	G 1
Maximum permissible operating pressure:	bar	6	6	6	6	6	6	6
Noise level								
A-weighted sound pressure level At 1 m distance	dB (A)	less than 40	less than 40	less than 40	less than 40	less than 40	less than 40	less than 40
Fuse								
Without joint use of compressor and electric immersion heater	3 x	10 A	10 A	10 A	10 A	16 A	16 A	20 A
With joint use of compressor and electric immersion heater	3 x	16 A	16 A	16 A	20 A	25 A	25 A	32 A

28.1.1 Dimensions

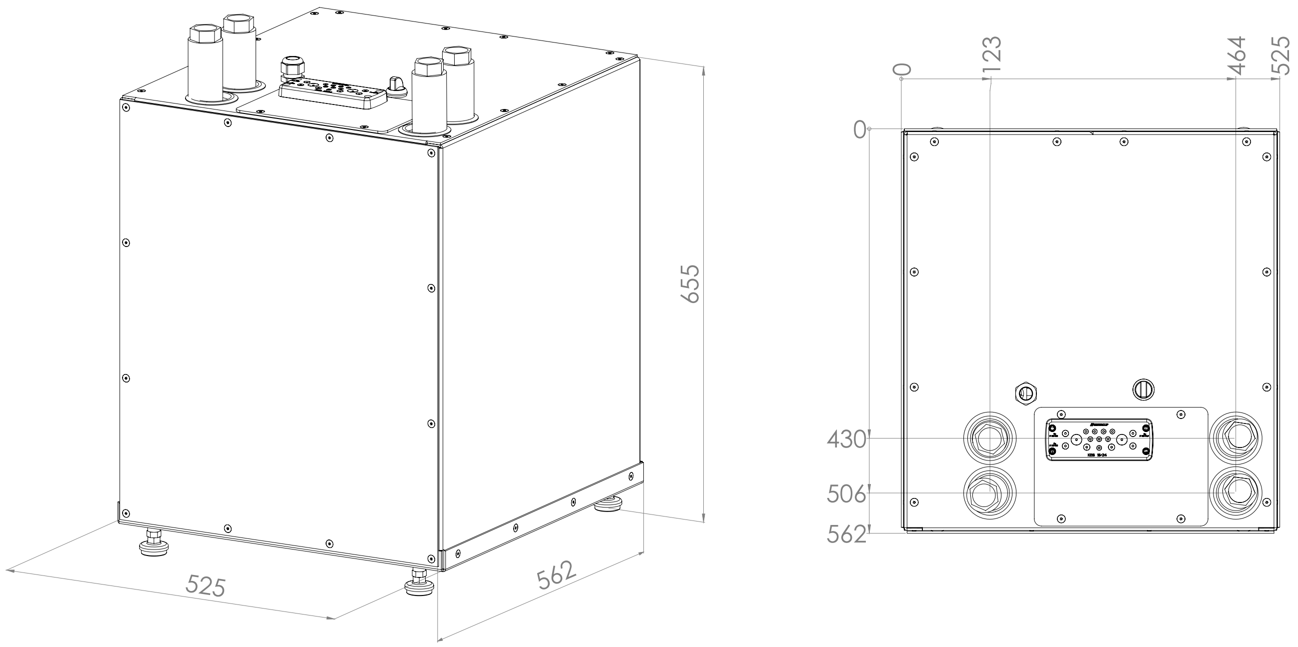


Figure 43. Junior ECO dimensions

28.2 Cube House

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE		**4**	**6**	**8**	**10**	**13**
Dimensions and weight						
Width	mm	599	599	599	599	599
Depth	mm	626	626	626	626	626
Height (frame)	mm	1910	1910	1910	1910	1910
Weight when empty	kg	241	242	244	245	256
Electric immersion heater						
Internal electric immersion heater as standard		yes	yes	yes	yes	yes
Heater capacity	kW	6	6	6	6	6
Heater steps	pcs	3	3	3	3	3
Heater step output	kW	2	2	2	2	2
Soft starter						
Soft starter		yes	yes	yes	yes	yes
Pipe connections						
Condenser circuit connection (copper pipe)	mm	28	28	28	28	28
Brine circuit connection (copper pipe)	mm	28	28	28	28	28
Maximum permissible operating pressure:	bar	3	3	3	3	3
Noise level						
A-weighted sound pressure level At 1 m distance	dB (A)	less than 40	less than 40	less than 40	less than 40	less than 40
Fuse						
Without joint use of compressor and electric immersion heater	3 x	10 A	10 A	10 A	10 A	16 A
With joint use of compressor and electric immersion heater	3 x	16 A	16 A	16 A	20 A	25 A

DHW storage tank		
Type		Coil storage tank
Volume	L	185
DHW plate heat exchanger		no
DHW coil		yes
Mixing valve as standard		no
Mixing valve as optional equipment		yes
Mixing valve directly connectable to storage tank couplings		yes
Pipe connection (stainless steel)	mm	22
Maximum permissible operating pressure:	bar	10
Storage tank's material (stainless/acid-proof steel)		LDX 2101 (EN 1.4162)
Coil material		AISI 316L (EN 1.4404)

28.2.1 Dimensions

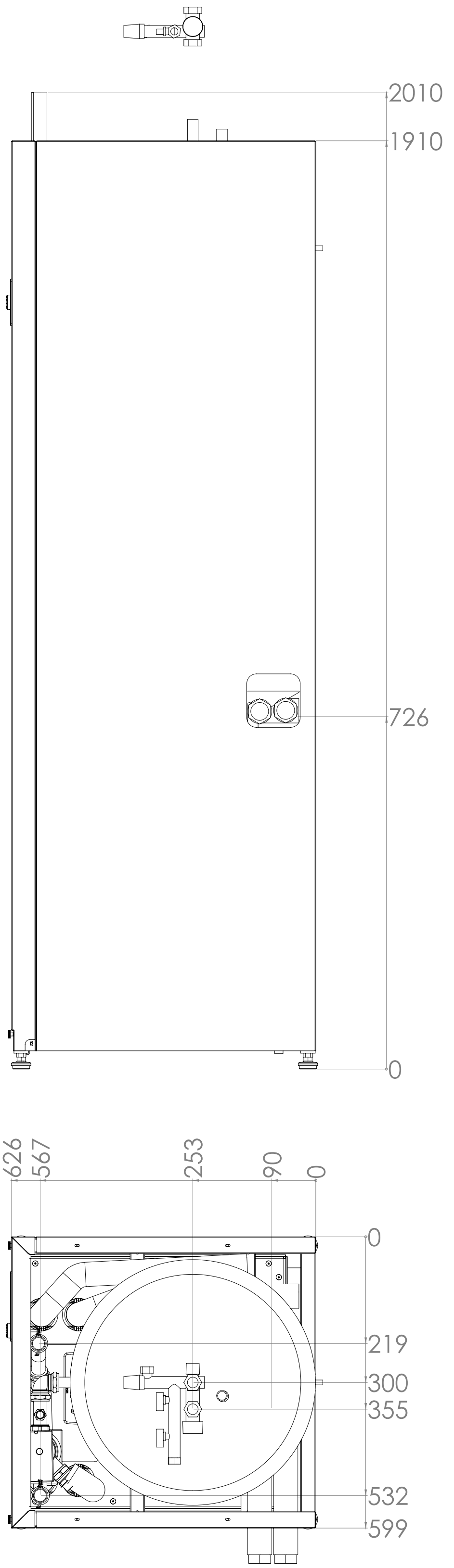


Figure 44. Cube House dimensions

28.3 Heat pump units

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Heat pump version		03	03	03	03	03	03	03
Refrigerant circuit (EU517/2014)								
Contains fluoridized greenhouse gases		yes	yes	yes	yes	yes	yes	yes
Hermetically sealed device		yes	yes	yes	yes	yes	yes	yes
To be checked periodically for leaks (threshold 10 CO_2-eq t)		no	no	no	no	no	no	no
Refrigerant		R-410A	R-410A	R-410A	R-410A	R-410A	R-410A	R-410A
Refrigerant’s PED group (EN 378:2016)		2	2	2	2	2	2	2
Refrigerant’s safety classification (EN 378:2016)		A1	A1	A1	A1	A1	A1	A1
Refrigerant’s GWP value (global warming potential)		2088	2088	2088	2088	2088	2088	2088
Refrigerant quantity*	g	750	750	900	1100	1250	2000	2100
Refrigerant quantity*	kg	0.75	0.75	0.90	1.10	1.25	2.00	2.10
Refrigerant quantity*	CO_2-eq kg	1566	1566	1879	2297	2610	4176	4385
Refrigerant quantity*	CO2eq t	1.566	1.566	1.879	2.297	2.610	4.176	4.385
Maximum permissible operating pressure PS	bar g	45	45	45	45	45	45	45
The maximum permissible temperature:	°C	140	140	140	140	140	140	140
Minimum permitted temperature	°C	−15	−15	−15	−15	−15	−15	−15
Low pressure switch								
Low pressure switch-off	bar g	3.4 ± 0.5	3.4 ± 0.5	3.4 ± 0.5	3.4 ± 0.5	3.4 ± 0.5	3.4 ± 0.5	3.4 ± 0.5
Recovery pressure	bar g	5.9 ± 0.5	5.9 ± 0.5	5.9 ± 0.5	5.9 ± 0.5	5.9 ± 0.5	5.9 ± 0.5	5.9 ± 0.5
High pressure switch								
High pressure switch-off	bar g	43 ± 1.7	43 ± 1.7	43 ± 1.7	43 ± 1.7	43 ± 1.7	45 ± 1.7	45 ± 1.7
Recovery pressure	bar g	34 ± 1.7	34 ± 1.7	34 ± 1.7	34 ± 1.7	34 ± 1.7	35 ± 1.7	35 ± 1.7
Compressor								
Compressor type		scroll	scroll	scroll	scroll	scroll	scroll	scroll
Compressor model		ZH04K1P	ZH05K1P	ZH06K1P	ZH09K1P	ZH12K1P	ZH15K1P	ZH19K1P
Motor code		TFM	TFM	TFM	TFM	TFM	TFM	TFM

* Always consult the device’s name plate or maintenance report first for the refrigerant quantity.

28.4 Performance data

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Design conditions of condenser and brine circuits Brine 0 °C / –3 °C and water 30 °C / 35 °C (B0/W35)		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Heating power	kW	4.7	5.6	7.4	10.0	12.7	17.0	21.1
Cooling power	kW	3.6	4.4	5.8	8.0	10.2	13.5	16.9
Coefficient of performance (COP)	-	4.3	4.4	4.6	4.8	4.8	4.7	4.8
Compressor electric power (actual output)	kW	1.1	1.3	1.6	2.1	2.7	3.6	4.4
Electric current taken by the compressor	A	2.4	2.6	3.2	4.0	5.4	6.9	8.1
Brine 0 °C / –3 °C and water 40 °C / 45 °C (B0/W45)		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Heating power	kW	4.5	5.4	7.1	9.6	12.2	16.2	20.1
Cooling power	kW	3.2	3.9	5.2	7.1	9.1	12.0	15.0
Coefficient of performance (COP)	-	3.4	3.4	3.5	3.7	3.7	3.7	3.8
Compressor electric power (actual output)	kW	1.3	1.6	2.0	2.6	3.3	4.4	5.3
Electric current taken by the compressor	A	2.7	3.0	3.7	4.6	6.1	7.8	9.2
Brine 0 °C / –3 °C and water 50 °C / 55 °C (B0/W55)		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Heating power	kW	4.3	5.1	6.8	9.1	11.7	15.4	19.1
Cooling power	kW	2.7	3.3	4.4	6.1	7.8	10.4	13.0
Coefficient of performance (COP)	-	2.6	2.7	2.8	2.9	2.9	2.9	3.0
Compressor electric power (actual output)	kW	1.7	1.9	2.5	3.2	4.1	5.4	6.4
Electric current taken by the compressor	A	3.0	3.4	4.3	5.4	6.9	9.1	10.6
Brine 0 °C / –3 °C and water 55 °C / 60 °C (B0/W60)		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Heating power	kW	4.3	5.0	6.7	8.9	11.4	15.1	18.6
Cooling power	kW	2.5	3.0	4.1	5.6	7.1	9.5	11.9
Coefficient of performance (COP)	-	2.3	2.4	2.4	2.5	2.5	2.6	2.7
Compressor electric power (actual output)	kW	1.8	2.1	2.7	3.5	4.6	5.9	7.0
Electric current taken by the compressor	A	3.2	3.6	4.6	5.7	7.5	9.9	11.5
Brine 0 °C / –3 °C and water 60 °C / 65 °C (B0/W65)		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Heating power	kW	4.2	4.9	6.5	8.7	11.2	14.8	18.1
Cooling power	kW	2.3	2.7	3.6	5.0	6.3	8.6	10.8
Coefficient of performance (COP)	-	2.0	2.1	2.2	2.3	2.2	2.3	2.4
Compressor electric power (actual output)	kW	2.1	2.3	3.0	3.9	5.1	6.5	7.7
Electric current taken by the compressor	A	3.5	3.9	5.0	6.1	8.1	10.7	12.4

Performance data for other conditions found at www.oilon.com

28.4.1 Output temperature with a heat pump

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Brine out of the evaporator −1 °C								
Max. output temperature	°C	67	67	67	67	67	67	67
Max. return temperature (ΔT 5 °C)	°C	62	62	62	62	62	62	62
Brine out of the evaporator −3 °C								
Max. output temperature	°C	65	65	65	65	65	65	65
Max. return temperature (ΔT 5 °C)	°C	60	60	60	60	60	60	60
Brine out of the evaporator −6 °C								
Max. output temperature	°C	62	62	62	62	62	62	62
Max. return temperature (ΔT 5 °C)	°C	57	57	57	57	57	57	57

The table presents the highest compressor-produced temperature of the condenser circuit's flow water. The temperature level produced by the compressor can be further elevated with an immersion heater placed in the condenser or heating circuit's flow line.

28.4.2 SCOP and SPF value

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE	**4**	**6**	**8**	**10**	**13**	**17**	**21**
Low temperature application, cold climate, brine 0 °C, flow water upper limit 35 °C							
SCOP (EN 14825) SPF value (Finnish building code collection)	5.0	5.1	5.6	5.6	5.6	5.5	5.6
High temperature application, cold climate, brine 0 °C, flow water upper limit 55 °C							
SCOP (EN 14825) SPF value (Finnish building code collection)	3.8	3.9	4.0	4.2	4.2	4.1	4.2

28.5 Condenser circuit flow

Pump models are presented in chapter 31. Standard pump is internal.

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE CLEAN WATER		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Standard pump		A	A	A	A	A	B	B
Design conditions of condenser and brine circuits (B0/W35) Condenser circuit ΔT 5 °C: design flow rate		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Water temperature difference	°C	5	5	5	5	5	5	5
Water flow rate	kg/s	0.22	0.27	0.35	0.48	0.61	0.81	1.01
Water flow rate	L/s	0.23	0.27	0.35	0.48	0.61	0.82	1.01
Water flow rate	m3/h	0.81	0.97	1.27	1.73	2.20	2.93	3.65
Standard pump lifting height	m	7.5	7.5	7.5	6.5	6.0	5.8	4.5
Internal pressure loss		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Junior ECO	kPa	6	9	10	11	13	11	14
Cube House	kPa	7	10	12	14	17	-	-
Internal pressure loss in lifting height		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Junior ECO	m	0.7	0.9	1.0	1.1	1.3	1.2	1.4
Cube House	m	0.7	1.0	1.2	1.4	1.8	-	-
Standard pump lifting height for external pressure loss		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Junior ECO	m	6.8	6.6	6.5	5.4	4.7	4.6	3.1
Cube House	m	6.8	6.5	6.3	5.1	4.2	-	-
Design conditions of condenser and brine circuits (B0/W35) Condenser circuit ΔT 6 °C		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Water temperature difference	°C	6	6	6	6	6	6	6
Water flow rate	kg/s	0.19	0.22	0.29	0.40	0.51	0.68	0.84
Water flow rate	L/s	0.19	0.22	0.29	0.40	0.51	0.68	0.85
Water flow rate	m3/h	0.68	0.81	1.06	1.44	1.83	2.45	3.04
Design conditions of condenser and brine circuits (B0/W35) Condenser circuit's ΔT 12 °C		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Water temperature difference	°C	12	12	12	12	12	12	12
Water flow rate	kg/s	0.09	0.11	0.15	0.20	0.25	0.34	0.42
Water flow rate	L/s	0.09	0.11	0.15	0.20	0.25	0.34	0.42
Water flow rate	m3/h	0.34	0.40	0.53	0.72	0.92	1.22	1.52

Maximum permissible temperature difference is 15 °C.

28.6 Brine circuit flow

Check the brine circuit's dimensioning before ordering and installing a heat pump. If necessary, install an additional brine circuit pump (second standard pump placed outside the device) or order the heat pump with an optional brine circuit pump. Pump models are presented in chapter 31.

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE WATER AND ETHANOL SOLUTION, 30 m-% OF ETHANOL		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Pumps								
Standard pump		A	A	A	B	B	C	C
Standard pump location		internal	internal	internal	internal	inner	external	external
Special order pump for circuits with large pressure loss		B	B	B	C	C	dimensioned	dimensioned
Special order pump location		internal	internal	inner	external	external	external	external
Design conditions of condenser and brine circuits (B0/W35) Brine circuit ΔT 3 °C: design discharge of brine circuit		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Brine temperature difference	°C	3	3	3	3	3	3	3
Brine flow rate	kg/s	0.29	0.35	0.47	0.64	0.81	1.08	1.35
Brine flow rate	L/s	0.30	0.36	0.48	0.66	0.84	1.12	1.40
Brine flow rate	m3/h	1.09	1.31	1.74	2.39	3.03	4.03	5.05
Standard pump lifting height	m	7.5	7.6	6.8	7.5	5.7	11.9	11.1
Special order pump lifting height	m	9.2	9.3	8.7	11.7	11.8	-	-
Internal pressure loss		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Junior ECO	kPa	10	14	16	18	21	19	29
Cube House	kPa	11	16	19	23	28	-	-
Internal pressure loss in lifting height		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Junior ECO	m	1.1	1.5	1.7	1.9	2.2	2.1	3.1
Cube House	m	1.2	1.7	2.0	2.5	3.0	-	-
Standard pump lifting height for external pressure loss		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Junior ECO	m	6.4	6.1	5.1	5.6	3.5	9.8	8.0
Cube House	m	6.3	5.9	4.8	5.0	2.7	-	-

Special order pump lifting height for external pressure loss		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Junior ECO	m	8.1	7.8	7.0	9.8	9.6	-	-
Cube House	m	8.0	7.6	6.7	9.2	8.8	-	-
Design conditions of condenser and brine circuits (B0/W35) Brine circuit ΔT 4 °C:		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Brine temperature difference	°C	4	4	4	4	4	4	4
Brine flow rate	kg/s	0.22	0.26	0.35	0.48	0.61	0.81	1.02
Brine flow rate	L/s	0.23	0.27	0.36	0.50	0.63	0.84	1.05
Brine flow rate	m3/h	0.81	0.98	1.31	1.79	2.27	3.02	3.78
Standard pump lifting height	m	7.5	7.6	7.6	8.2	7.4	11.8	11.9
Special order pump lifting height	m	9.1	9.2	9.3	11.4	11.7		
Internal pressure loss		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Junior ECO	kPa	7	9	10	11	20	12	17
Cube House	kPa	7	10	12	15	17		
Internal pressure loss in lifting height		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Junior ECO	m	0.7	1.0	1.1	1.2	2.2	1.3	1.8
Cube House	m	0.8	1.1	1.2	1.5	1.8	-	-
Standard pump lifting height for external pressure loss		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Junior ECO	m	6.8	6.6	6.5	7.0	5.2	10.5	10.1
Cube House	m	6.7	6.5	6.4	6.7	5.6	-	-
Special order pump lifting height for external pressure loss		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Junior ECO	m	8.5	8,3	7.6	10.5	9.6	-	-
Cube House	m	8.4	8.2	7.5	10.2	10.0	-	-
Design conditions of condenser and brine circuits (B0/W35) Brine circuit ΔT 5 °C: min. allowed discharge		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Brine temperature difference	°C	5	5	5	5	5	5	5
Brine flow rate	kg/s	0.18	0.21	0.28	0.38	0.49	0.65	0.81
Brine flow rate	L/s	0.18	0.22	0.29	0.40	0.50	0.67	0.84
Brine flow rate	m3/h	0.65	0.79	1.04	1.43	1.82	2.42	3.03

28.7 Electrical currents

28.7.1 Starting currents

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE		**4**	**6**	**8**	**10**	**13**	**17**	**21**
Compressor in direct start-up								
Starting current, depending on circumstances	A	29...38	29...38	37…50	44…59	58…78	78...104	92...122
Typical duration of starting current period	ms	below 50	below 50	below 50	below 50	below 50	below 50	below 50
Compressor with soft starter								
Min. permitted starting voltage for soft starter	V	200	200	200	200	200	200	200
Soft starter ramp-up time	s	below 1	below 1	below 1	below 1	below 1	below 1	below 1
Soft starter ramp-down time	s	below 1	below 1	below 1	below 1	below 1	below 1	below 1
Highest starting current, depending on circumstances	A	10...14	10...14	12…19	15…22	19…29	26...39	31...46

28.7.2 Currents of the components

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE		**4**	**6**	**8**	**10**	**13**	**17**	**21**
compressor, nominal value	A	4.8	4.8	6.2	7.4	9.7	13.0	15.3
compressor, maximum typical operating current, 90 % of nominal value	A	4.3	4.3	5.6	6.7	8.7	11.7	13.8
compressor, maximum value within technical data's conditions	A	3.5	3.9	5.0	6.1	8.1	10.7	12.4
condenser circuit's standard pump ~1	A	0.7	0.7	0.7	0.7	0.7	0.7	0.7
brine circuit's standard pump ~1	A	0.7	0.7	0.7	0.7	0.7	1.4	1.4
automation	A	0.4	0.4	0.4	0.4	0.4	0.4	0.4
internal electric immersion heater 6 kW	A	8.7	8.7	8.7	8.7	8.7	8.7	8.7
heating circuit pumps 1~ (default)	A	0.7	0.7	0.7	0.7	0.7	0.7	0.7

29 INVERTER MODELS

29.1 ECO Inverter+

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE		**2–9**	**3–12**	**7–25**
Dimensions and weight				
Width	mm	525	525	525
Depth	mm	562	562	562
Height	mm	655	655	655
Weight when empty	kg	148	148	160
Electric immersion heater				
Electric immersion heater as standard		no	no	no
Readiness for an electric immersion heater (6 kW)		yes	yes	yes
Heater steps	pcs	3	3	3
Pipe connections				
Condenser and brine circuits’ connection (ISO 228 thread)		G 1	G 1	G 1 1/4
Maximum permissible operating pressure:	bar	6	6	6
Noise level				
A-weighted sound pressure level At 1 m distance	dB (A)	less than 40	less than 40	less than 40
Fuse				
Without joint use of compressor and electric immersion heater		3 x 16 A	3 x 16 A	3 x 32 A

29.1.1 Dimensions

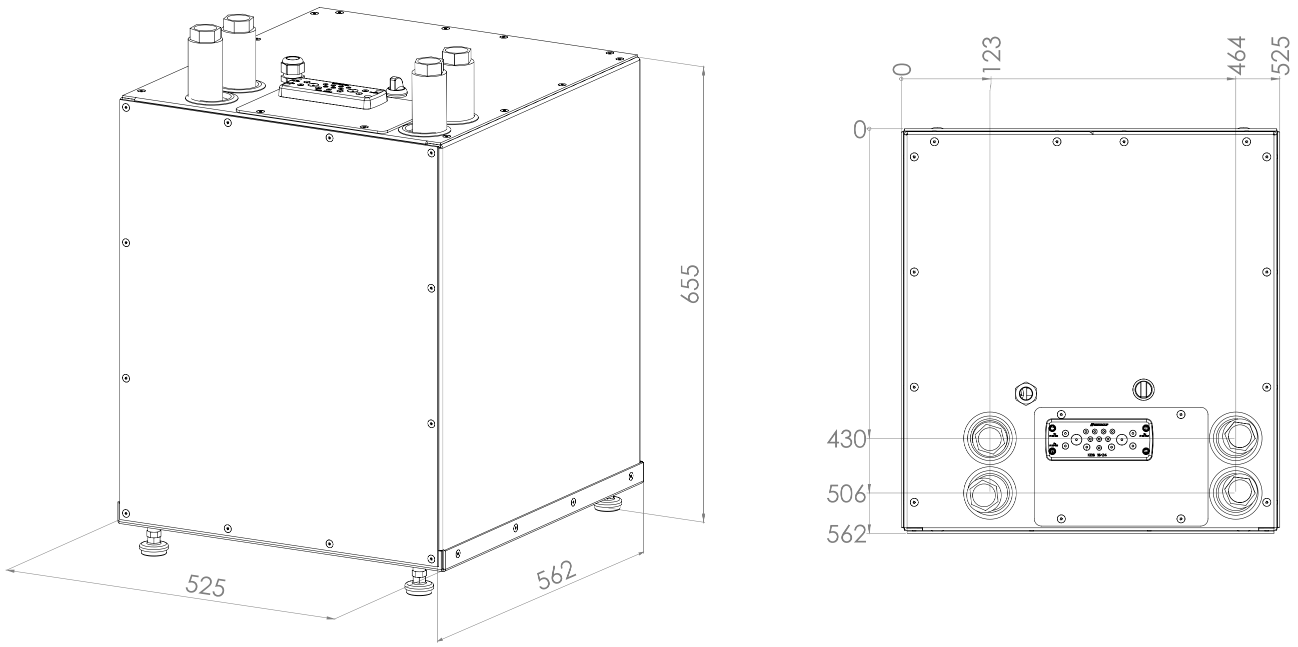


Figure 45. ECO Inverter+ dimensions

29.2 Cube Inverter+

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE		**2–9**	**3–12**
Dimensions and weight			
Width	mm	599	599
Depth	mm	626	626
Height (frame)	mm	1910	1910
Weight when empty	kg	256	256
Electric immersion heater			
Internal electric immersion heater as standard		yes	yes
Heater capacity	kW	6	6
Heater steps	pcs	3	3
Heater step output	kW	2	2
Pipe connections			
Condenser circuit connection (copper pipe)	mm	28	28
Brine circuit connection (copper pipe)	mm	28	28
Maximum permissible operating pressure:	bar	3	3
Noise level			
A-weighted sound pressure level At 1 m distance	dB (A)	less than 40	less than 40
Fuse			
Without joint use of compressor and electric immersion heater		3 x 16 A	3 x 16 A

DHW storage tank		
Type		Coil storage tank
Volume	L	185
DHW plate heat exchanger		no
DHW coil		yes
Mixing valve as standard		no
Mixing valve as optional equipment		yes
Mixing valve directly connectable to storage tank couplings		yes
Pipe connection (stainless steel)	mm	22
Maximum permissible operating pressure:	bar	10
Storage tank's material (stainless/acid-proof steel)		LDX 2101 (EN 1.4162)
Coil material		AISI 316L (EN 1.4404)

29.2.1 Dimensions

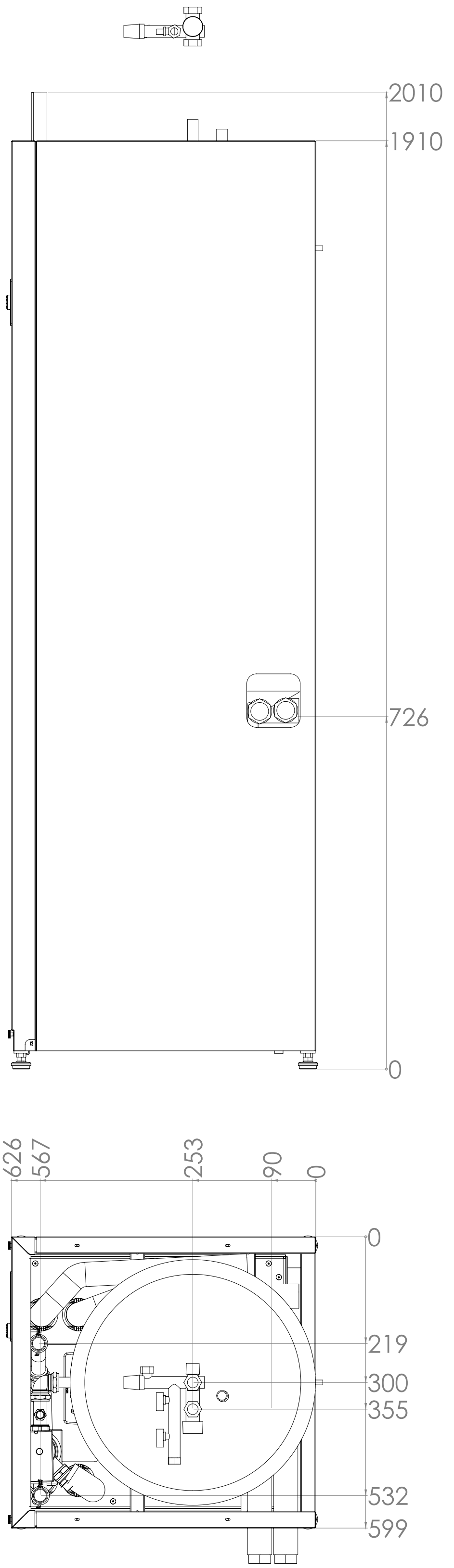


Figure 46. Cube Inverter+ dimensions

29.3 Heat pump units

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE		**2–9**	**3–12**	**7–25**
Heat pump version		03	03	03
Refrigerant circuit (EU517/2014)				
Contains fluoridized greenhouse gases		yes	yes	yes
Hermetically sealed device		yes	yes	yes
To be checked periodically for leaks (threshold 10 CO_2-eq t)		no	no	no
Refrigerant		R-410A	R-410A	R-410A
Refrigerant’s PED group (EN 378:2016)		2	2	2
Refrigerant’s safety classification (EN 378:2016)		A1	A1	A1
Circuit’s PED category (2014/68/EU)		1	1	1
Refrigerant’s GWP value (global warming potential)		2088	2088	2088
Refrigerant quantity*	g	1200	1200	1500
Refrigerant quantity*	kg	1.20	1.20	1.50
Refrigerant quantity*	CO_2-eq kg	2506	2506	3132
Refrigerant quantity*	CO2eq t	2.506	2.506	3.13
Maximum permissible operating pressure PS	bar g	45	45	45
The maximum permissible temperature:	°C	135	135	135
Minimum permitted temperature	°C	−15	−15	−15
Low pressure switch				
Low pressure switch-off	bar g	3.4 ± 0.5	3.4 ± 0.5	3.4 ± 0.5
Recovery pressure	bar g	5.9 ± 0.5	5.9 ± 0.5	5.9 ± 0.5
High pressure switch				
High pressure switch-off	bar g	43 ± 1.7	43 ± 1.7	45 ± 1.7
Recovery pressure	bar g	34 ± 1.7	34 ± 1.7	34 ± 1.7
Compressor				
Compressor type		scroll	scroll	scroll

29.4 Performance data

29.4.1 Inverter+ 2–9

Heating, kW	Brine in, °C	Brine out, °C	Water in, °C	Water out, °C	Minimum output	Maximum output
B0/W25	0	−3	20	25	3.5	9.3
B0/W35	0	−3	30	35	3.4	9.0
B0/W45	0	−3	40	45	3.3	8.6
B0/W55	0	−3	47	55	3.2	8.2

Coefficient of performance, -	Brine in, °C	Brine out, °C	Water in, °C	Water out, °C	Minimum output	Maximum output
B0/W25	0	−3	20	25	6.1	5.6
B0/W35	0	−3	30	35	4.6	4.4
B0/W45	0	−3	40	45	3.5	3.5
B0/W55	0	−3	47	55	2.8	2.8

Cooling capacity, kW	Brine in, °C	Brine out, °C	Water in, °C	Water out, °C	Minimum output	Maximum output
B0/W25	0	−3	20	25	2.9	7.7
B0/W35	0	−3	30	35	2.7	6.9
B0/W45	0	−3	40	45	2.4	6.2
B0/W55	0	−3	47	55	2.1	5.3

Electrical power, kW	Brine in, °C	Brine out, °C	Water in, °C	Water out, °C	Minimum output	Maximum output
B0/W25	0	−3	20	25	0.6	1.7
B0/W35	0	−3	30	35	0.7	2.0
B0/W45	0	−3	40	45	0.9	2.4
B0/W55	0	−3	47	55	1.2	2.9

Electrical current, A	Brine in, °C	Brine out, °C	Water in, °C	Water out, °C	Minimum output	Maximum output
B0/W25	0	−3	20	25	1.2	2.6
B0/W35	0	−3	30	35	1.4	3.1
B0/W45	0	−3	40	45	1.7	3.6
B0/W55	0	−3	47	55	2.0	4.3

Standard	Climate	City	Brine in, °C	Brine out, °C	Max. flow temperature, °C	SCOP
EN 14825:2016	Average (A)	Strasbourg	0	−3	55	4.0
EN 14825:2016	Warm (W)	Athens	0	−3	55	4.0
EN 14825:2016	Cold (C)	Helsinki	0	−3	55	4.1
EN 14825:2016	Average (A)	Strasbourg	0	−3	35	5.3
EN 14825:2016	Warm (W)	Athens	0	−3	35	5.4
EN 14825:2016	Cold (C)	Helsinki	0	−3	35	5.5

Condenser circuit liquid: water
Evaporator circuit liquid: mix of water and ethanol, 30 mass-% ethanol (25 volume-%)

Technical data sheet	**EN 14825:2016**				
Model (indoor + outdoor)	ECO Inverter+ 2-9 03 / Cube Inverter+ 2-9 03				
Air-to-water heat pump	N				
Water-to-water heat pump	N				
Brine-to-water heat pump	Y				
Low-temperature heat pump	N				
Equipped with supplementary heater	N/ Y				
Heat pump combination heater	N / Y				
Parameters shall be declared for medium-temperature application, except for low-temperature heat pumps. For low temperature heat pumps, parameters shall be declared for low-temperature heat pumps					
Parameters shall be declared for average climate conditions and for warmer and/or colder climate conditions, where applicable					
Rated heat output*	Prated			8,3	kW
Seasonal space heating energy efficiency	η_s			151	%
Declared capacity for heating at indoor conditions 20°C and outdoor temperature Tj	climate (average, warmer or colder)	Tj = −7°C		7,6	kW
		Tj = 2°C		5,8	kW
		Tj = 7°C		4,6	kW
		Tj = 12°C		3,4	kW
		Tj = bivalent temperature		8,2	kW
		Tj = operation limit	Pdh	-	kW
		Tj = −15°C (if TOL < −20°C) (for air to water heat pumps)	Pdh	-	kW
Bivalent temperature		T_{biv}		-10	°C
Degradation coefficient**		Cdh		0,996	-
Declared coefficient of performance for heating at indoor conditions 20°C and outdoor temperature Tj	Tj = −7°C	COPd		3,05	-
	Tj = 2°C	COPd		3,91	-
	Tj = 7°C	COPd		4,57	-
	Tj = 12°C	COPd		5,24	-
	Tj = bivalent temperature	COPd		2,85	-
	Tj = operation limit	COPd		-	-
	Tj = −15°C (if TOL < −20°C) (for Air to water heat pumps)	COPd		-	-
Operation limit temperature	TOL			-	°C
Heating water operation limit temperature	WTOL			65	°C
Power consumption in modes other than active mode	Off mode	P_{OFF}		2	W
	Thermostat-off mode	P_{TO}		20	W
	Standby mode	P_{SB}		2	W
	Crankcase heater mode	P_{CK}		0	W
Supplementary heater	Rated heat output*	P_{sup}		6,0	kW
	Type of energy input			Electricity	
Other items	Capacity control			Fixed	
	Annual energy consumption	Q_{HE}		4313	kWh
For water/brine-to-water heat pumps	Rated brine or water flow rate, outdoor heat exchanger			2,0	m^3/h
For air-to-water heat pumps	Rated air flow rate, outdoors			-	m^3/h
Contact details	**Oilon Oy, Metsä-Pietilänkatu 1, 15800 Lahti, Finland**				

*** For heat pumps space heaters and heat pump combination heaters, the rated heat output Prated is equal to the design load for heating Pdesignh, and the rated heat output of a supplementary heater Psup is equal to the supplementary capacity for heating sup(Tj)**

**** If Cdh is not determined by measurement then the default degradation coefficient is Cdh = 0,9**

29.4.2 Inverter+ 3–12

Heating, kW	Brine in, °C	Brine out, °C	Water in, °C	Water out, °C	Minimum output	Maximum output
B0/W25	0	−3	20	25	3.4	11.5
B0/W35	0	−3	30	35	3.3	11.0
B0/W45	0	−3	40	45	3.3	10.5
B0/W55	0	−3	47	55	3.2	10.0

Coefficient of performance, -	Brine in, °C	Brine out, °C	Water in, °C	Water out, °C	Minimum output	Maximum output
B0/W25	0	−3	20	25	5.9	5.2
B0/W35	0	−3	30	35	4.5	4.2
B0/W45	0	−3	40	45	3.5	3.4
B0/W55	0	−3	47	55	2.7	2.7

Cooling capacity, kW	Brine in, °C	Brine out, °C	Water in, °C	Water out, °C	Minimum output	Maximum output
B0/W25	0	−3	20	25	2.8	9.3
B0/W35	0	−3	30	35	2.6	8.4
B0/W45	0	−3	40	45	2.3	7.4
B0/W55	0	−3	47	55	2.0	6.3

Electrical power, kW	Brine in, °C	Brine out, °C	Water in, °C	Water out, °C	Minimum output	Maximum output
B0/W25	0	−3	20	25	0.6	2.2
B0/W35	0	−3	30	35	0.7	2.6
B0/W45	0	−3	40	45	0.9	3.1
B0/W55	0	−3	47	55	1.2	3.7

Electrical current, A	Brine in, °C	Brine out, °C	Water in, °C	Water out, °C	Minimum output	Maximum output
B0/W25	0	−3	20	25	1.2	3.3
B0/W35	0	−3	30	35	1.4	3.9
B0/W45	0	−3	40	45	1.7	4.6
B0/W55	0	−3	47	55	2.0	5.4

Standard	Climate	City	Brine in, °C	Brine out, °C	Max. flow temperature, °C	SCOP
EN 14825:2016	Average (A)	Strasbourg	0	−3	55	4.0
EN 14825:2016	Warm (W)	Athens	0	−3	55	4.0
EN 14825:2016	Cold (C)	Helsinki	0	−3	55	4.1
EN 14825:2016	Average (A)	Strasbourg	0	−3	35	5.3
EN 14825:2016	Warm (W)	Athens	0	−3	35	5.3
EN 14825:2016	Cold (C)	Helsinki	0	−3	35	5.5

Condenser circuit liquid: water
Evaporator circuit liquid: mix of water and ethanol, 30 mass-% ethanol (25 volume-%)

Technical data sheet — EN 14825:2016

Model (indoor + outdoor)	ECO Inverter+ 3-12 03 / Cube Inverter+ 3-12 03				
Air-to-water heat pump	N				
Water-to-water heat pump	N				
Brine-to-water heat pump	Y				
Low-temperature heat pump	N				
Equipped with supplementary heater	N/ Y				
Heat pump combination heater	N/ Y				

Parameters shall be declared for medium-temperature application, except for low-temperature heat pumps. For low temperature heat pumps, parameters shall be declared for low-temperature heat pumps

Parameters shall be declared for average climate conditions and for warmer and/or colder climate conditions, where applicable

Rated heat output*	Prated			10,2	kW
Seasonal space heating energy efficiency	η_s			150	%
Declared capacity for heating at indoor conditions 20°C and outdoor temperature Tj	climate (average, warmer or colder)	Tj = −7°C		9,4	kW
		Tj = 2°C		6,7	kW
		Tj = 7°C		5,1	kW
		Tj = 12°C		3,4	kW
		Tj = bivalent temperature		10,1	kW
		Tj = operation limit	Pdh	-	kW
		Tj = −15°C (if TOL < −20°C) (for air to water heat pumps)	Pdh	-	kW
Bivalent temperature		T_{biv}		-10	°C
Degradation coefficient**		Cdh		0,997	-
Declared coefficient of performance for heating at indoor conditions 20°C and outdoor temperature Tj	Tj = −7°C	COPd		3,02	-
	Tj = 2°C	COPd		3,88	-
	Tj = 7°C	COPd		4,57	-
	Tj = 12°C	COPd		5,24	-
	Tj = bivalent temperature	COPd		2,82	-
	Tj = operation limit	COPd		-	-
	Tj = −15°C (if TOL < −20°C) (for Air to water heat pumps)	COPd		-	-
Operation limit temperature	TOL			-	°C
Heating water operation limit temperature	WTOL			65	°C
Power consumption in modes other than active mode	Off mode	P_{OFF}		2	W
	Thermostat-off mode	P_{TO}		20	W
	Standby mode	P_{SB}		2	W
	Crankcase heater mode	P_{CK}		0	W
Supplementary heater	Rated heat output*	P_{sup}		6,0	kW
	Type of energy input			Electricity	
Other items	Capacity control			Fixed	
	Annual energy consumption	Q_{HE}		5334	kWh
For water/brine-to-water heat pumps	Rated brine or water flow rate, outdoor heat exchanger			2,5	m^3/h
For air-to-water heat pumps	Rated air flow rate, outdoors			-	m^3/h
Contact details	**Oilon Oy, Metsä-Pietilänkatu 1, 15800 Lahti, Finland**				

*** For heat pumps space heaters and heat pump combination heaters, the rated heat output Prated is equal to the design load for heating Pdesignh, and the rated heat output of a supplementary heater Psup is equal to the supplementary capacity for heating sup(Tj)**

**** If Cdh is not determined by measurement then the default degradation coefficient is Cdh = 0,9**

29.4.3 ECO Inverter+ 7–25 (65 °C output temperature)

Maximum output temperature is selected at the factory. Oilon's maintenance personnel may changer the settings on-site.

Heating, kW	Brine in, °C	Brine out, °C	Water in, °C	Water out, °C	Minimum output	Maximum output
B0/W25	0	−3	20	25	7.4	20.9
B0/W35	0	−3	30	35	7.1	20.1
B0/W45	0	−3	40	45	6.9	19.6
B0/W55	0	−3	47	55	6.8	19.0
B0/W65	0	−3	55	65	6.7	18.3

Coefficient of performance, -	Brine in, °C	Brine out, °C	Water in, °C	Water out, °C	Minimum output	Maximum output
B0/W25	0	−3	20	25	6.2	5.4
B0/W35	0	−3	30	35	4.8	4.3
B0/W45	0	−3	40	45	3.7	3.5
B0/W55	0	−3	47	55	2.9	3.0
B0/W65	0	−3	55	65	2.4	2.5

Cooling capacity, kW	Brine in, °C	Brine out, °C	Water in, °C	Water out, °C	Minimum output	Maximum output
B0/W25	0	−3	20	25	6.2	17.0
B0/W35	0	−3	30	35	5.6	15.5
B0/W45	0	−3	40	45	5.1	14.0
B0/W55	0	−3	47	55	4.4	12.7
B0/W65	0	−3	55	65	4.0	11.1

Electrical power, kW	Brine in, °C	Brine out, °C	Water in, °C	Water out, °C	Minimum output	Maximum output
B0/W25	0	−3	20	25	1.2	3.9
B0/W35	0	−3	30	35	1.5	4.7
B0/W45	0	−3	40	45	1.9	5.6
B0/W55	0	−3	47	55	2.3	6.3
B0/W65	0	−3	55	65	2.8	7.2

Electrical current, A	Brine in, °C	Brine out, °C	Water in, °C	Water out, °C	Minimum output	Maximum output
B0/W25	0	−3	20	25	2.3	6.3
B0/W35	0	−3	30	35	2.8	7.2
B0/W45	0	−3	40	45	3.4	8.2
B0/W55	0	−3	47	55	4.1	9.2
B0/W65	0	−3	55	65	4.6	10.5

Standard	Climate	City	Brine in, °C	Brine out, °C	Max. flow temperature, °C	SCOP
EN 14825:2016	Average (A)	Strasbourg	0	−3	55	4.1
EN 14825:2016	Warm (W)	Athens	0	−3	55	4.2
EN 14825:2016	Cold (C)	Helsinki	0	−3	55	4.2
EN 14825:2016	Average (A)	Strasbourg	0	−3	35	5.4
EN 14825:2016	Warm (W)	Athens	0	−3	35	5.5
EN 14825:2016	Cold (C)	Helsinki	0	−3	35	5.3

Condenser circuit liquid: water

Evaporator circuit liquid: mix of water and ethanol, 30 mass-% ethanol (25 volume-%)

Technical data sheet	**EN 14825:2016**				
Model (indoor + outdoor)	ECO Inverter+ 7-25 03				
Air-to-water heat pump	N				
Water-to-water heat pump	N				
Brine-to-water heat pump	Y				
Low-temperature heat pump	N				
Equipped with supplementary heater	N				
Heat pump combination heater	N				
Parameters shall be declared for medium-temperature application, except for low-temperature heat pumps. For low temperature heat pumps, parameters shall be declared for low-temperature heat pumps					
Parameters shall be declared for average climate conditions and for warmer and/or colder climate conditions, where applicable					
Rated heat output*	Prated			18,8	kW
Seasonal space heating energy efficiency	η_s			156	%
Declared capacity for heating at indoor conditions 20°C and outdoor temperature Tj	climate (average, warmer or colder)	Tj = −7°C		17,1	kW
		Tj = 2°C		12,5	kW
		Tj = 7°C		10,0	kW
		Tj = 12°C		7,2	kW
		Tj = bivalent temperature		18,7	kW
		Tj = operation limit	Pdh	-	kW
		Tj = −15°C (if TOL < −20°C) (for air to water heat pumps)	Pdh	-	kW
Bivalent temperature		T_{biv}		-10	°C
Degradation coefficient**		Cdh		0,997	-
Declared coefficient of performance for heating at indoor conditions 20°C and outdoor temperature Tj	Tj = −7°C	COPd		3,19	-
	Tj = 2°C	COPd		4,04	-
	Tj = 7°C	COPd		4,65	-
	Tj = 12°C	COPd		5,45	-
	Tj = bivalent temperature	COPd		2,96	-
	Tj = operation limit	COPd		-	-
	Tj = −15°C (if TOL < −20°C) (for Air to water heat pumps)	COPd		-	-
Operation limit temperature	TOL			-	°C
Heating water operation limit temperature	WTOL			65	°C
Power consumption in modes other than active mode	Off mode	P_{OFF}		0	W
	Thermostat-off mode	P_{TO}		20	W
	Standby mode	P_{SB}		2	W
	Crankcase heater mode	P_{CK}		0	W
Supplementary heater	Rated heat output*	P_{sup}		6,0	kW
	Type of energy input			Electricity	
Other items	Capacity control			Fixed	
	Annual energy consumption	Q_{HE}		9461	kWh
For water/brine-to-water heat pumps	Rated brine or water flow rate, outdoor heat exchanger			4,5	m^3/h
For air-to-water heat pumps	Rated air flow rate, outdoors			-	m^3/h
Contact details	**Oilon Oy, Metsä-Pietilänkatu 1, 15800 Lahti, Finland**				

*** For heat pumps space heaters and heat pump combination heaters, the rated heat output Prated is equal to the design load for heating Pdesignh, and the rated heat output of a supplementary heater Psup is equal to the supplementary capacity for heating sup(Tj)**

**** If Cdh is not determined by measurement then the default degradation coefficient is Cdh = 0,9**

29.4.4 ECO Inverter+ 7–25 (60 °C output temperature)

Maximum output temperature is selected at the factory. Oilon's maintenance personnel may changer the settings on-site.

Heating, kW	Brine in, °C	Brine out, °C	Water in, °C	Water out, °C	Minimum output	Maximum output
B0/W25	0	−3	20	25	7.4	25.6
B0/W35	0	−3	30	35	7.1	24.7
B0/W45	0	−3	40	45	6.9	24.1
B0/W55	0	−3	47	55	6.8	23.5
B0/W65	0	−3	55	65	6.7	22,6

Coefficient of performance, -	Brine in, °C	Brine out, °C	Water in, °C	Water out, °C	Minimum output	Maximum output
B0/W25	0	−3	20	25	6.2	5.1
B0/W35	0	−3	30	35	4.8	4.1
B0/W45	0	−3	40	45	3.7	3.4
B0/W55	0	−3	47	55	2.9	2.9
B0/W65	0	−3	55	65	2.4	2.5

Cooling capacity, kW	Brine in, °C	Brine out, °C	Water in, °C	Water out, °C	Minimum output	Maximum output
B0/W25	0	−3	20	25	6.2	20.6
B0/W35	0	−3	30	35	5.7	18.7
B0/W45	0	−3	40	45	5.1	17.1
B0/W55	0	−3	47	55	4.5	15.5
B0/W65	0	−3	55	65	4.0	13.6

Electrical power, kW	Brine in, °C	Brine out, °C	Water in, °C	Water out, °C	Minimum output	Maximum output
B0/W25	0	−3	20	25	1.2	5.0
B0/W35	0	−3	30	35	1.5	6.0
B0/W45	0	−3	40	45	1.9	7.1
B0/W55	0	−3	47	55	2.3	8.0
B0/W65	0	−3	55	65	2.8	9.0

Electrical current, A	Brine in, °C	Brine out, °C	Water in, °C	Water out, °C	Minimum output	Maximum output
B0/W25	0	−3	20	25	2.3	8.1
B0/W35	0	−3	30	35	2.8	8.9
B0/W45	0	−3	40	45	3.4	10.0
B0/W55	0	−3	47	55	4.1	11.1
B0/W65	0	−3	55	65	4.6	12.4

Standard	Climate	City	Brine in, °C	Brine out, °C	Max. flow temperature, °C	SCOP
EN 14825:2016	Average (A)	Strasbourg	0	−3	55	4.1
EN 14825:2016	Warm (W)	Athens	0	−3	55	4.2
EN 14825:2016	Cold (C)	Helsinki	0	−3	55	4.2
EN 14825:2016	Average (A)	Strasbourg	0	−3	35	5.4
EN 14825:2016	Warm (W)	Athens	0	−3	35	5.5
EN 14825:2016	Cold (C)	Helsinki	0	−3	35	5.3

Condenser circuit liquid: water
Evaporator circuit liquid: mix of water and ethanol, 30 mass-% ethanol (25 volume-%)

29.5 Operating conditions

29.5.1 Inverter+ 2–9

Brine temperature may exceed the maximum values momentarily during the start-up phase.

		Minimum value	Maximum value	Design value
Evaporator circuit’s flow	kg/s	0.23	-	0,55
Temperature differential of the evaporator circuit	°C	1	4	3
Brine into the evaporator	°C	−5	9	0
Brine out of the evaporator	°C	−8	5	−3
Condenser circuit’s flow rate:	kg/s	0.08	-	0.43
Condenser circuit’s temperature difference	°C	3	15	5
Water into the condenser	°C	15	60	30
Water from condenser	°C	20	67	35

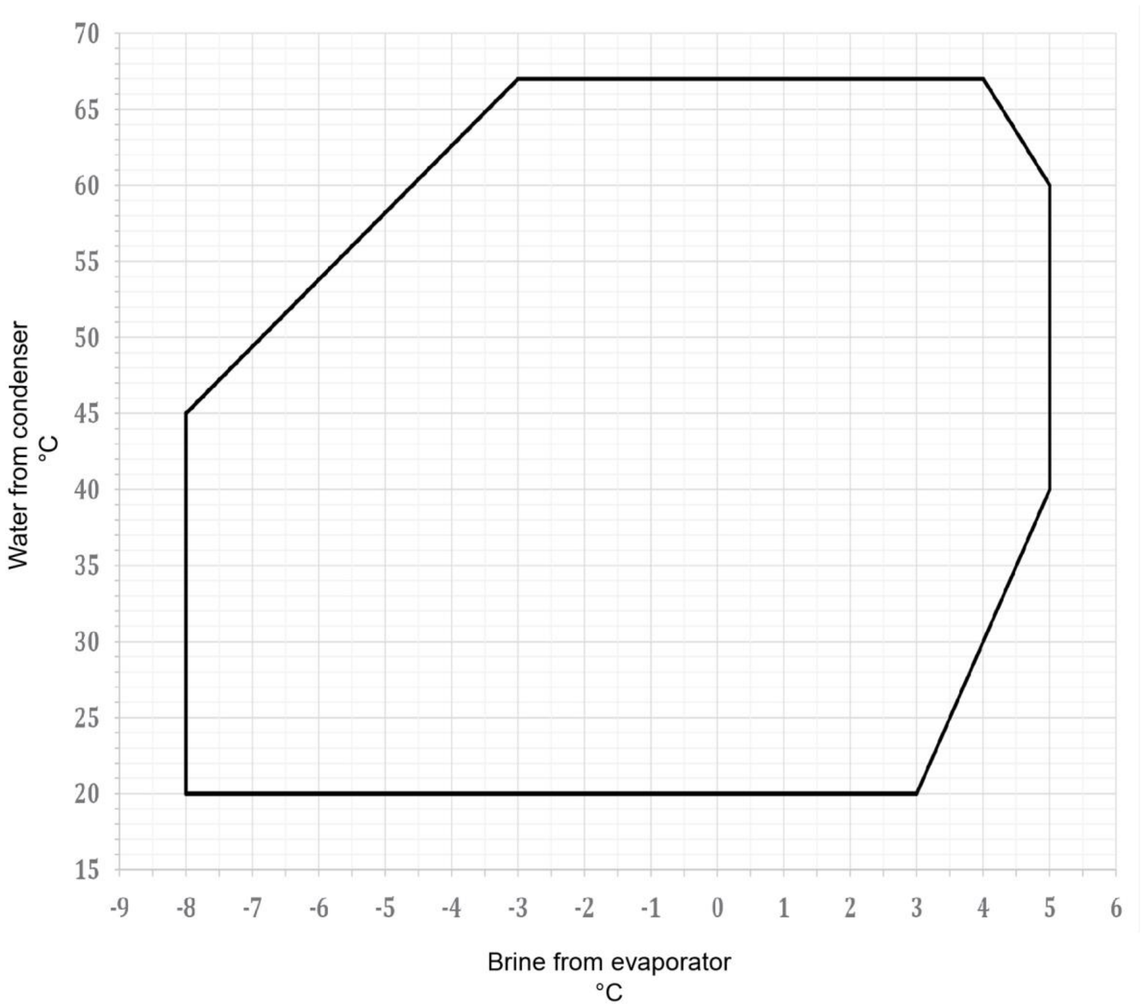


Figure 47. Inverter+ 2–9 operating range

Condenser circuit liquid: water
Evaporator circuit liquid: mix of water and ethanol, 30 mass-% ethanol (25 volume-%)

29.5.2 Inverter+ 3–12

Brine temperature may exceed the maximum values momentarily during the start-up phase.

		Minimum value	Maximum value	Design value
Evaporator circuit’s flow	kg/s	0.23	-	0.66
Temperature differential of the evaporator circuit	°C	1	4	3
Brine into the evaporator	°C	−5	9	0
Brine out of the evaporator	°C	−8	5	−3
Condenser circuit’s flow rate:	kg/s	0.08	-	0.53
Condenser circuit’s temperature difference	°C	3	15	5
Water into the condenser	°C	15	60	30
Water from condenser	°C	20	65	35

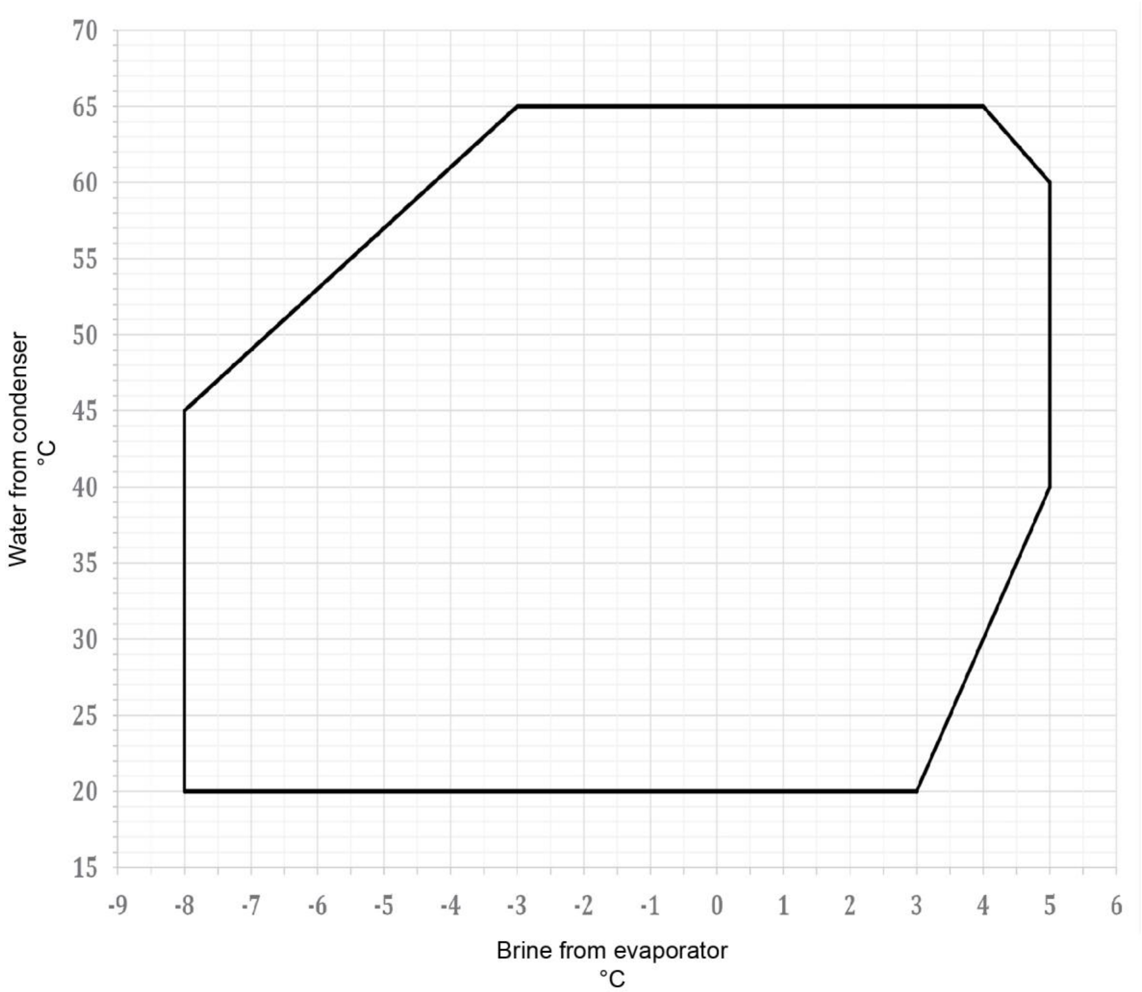


Figure 48. Inverter+ 3–12 operating range

Condenser circuit liquid: water
Evaporator circuit liquid: mix of water and ethanol, 30 mass-% ethanol (25 volume-%)

29.5.3 ECO Inverter 7–25 (65 °C output temperature)

Brine temperature may exceed the maximum values momentarily during the start-up phase.

		Minimum value	Maximum value	Design value
Evaporator circuit’s flow	kg/s	0.47	-	1.22
Temperature differential of the evaporator circuit	°C	1	4	3
Brine into the evaporator	°C	−5	12	0
Brine out of the evaporator	°C	−8	9	−3
Condenser circuit’s flow rate:	kg/s	0.16	-	0.96
Condenser circuit’s temperature difference	°C	3	25	5
Water into the condenser	°C	15	60	30
Water from condenser	°C	20	65	35

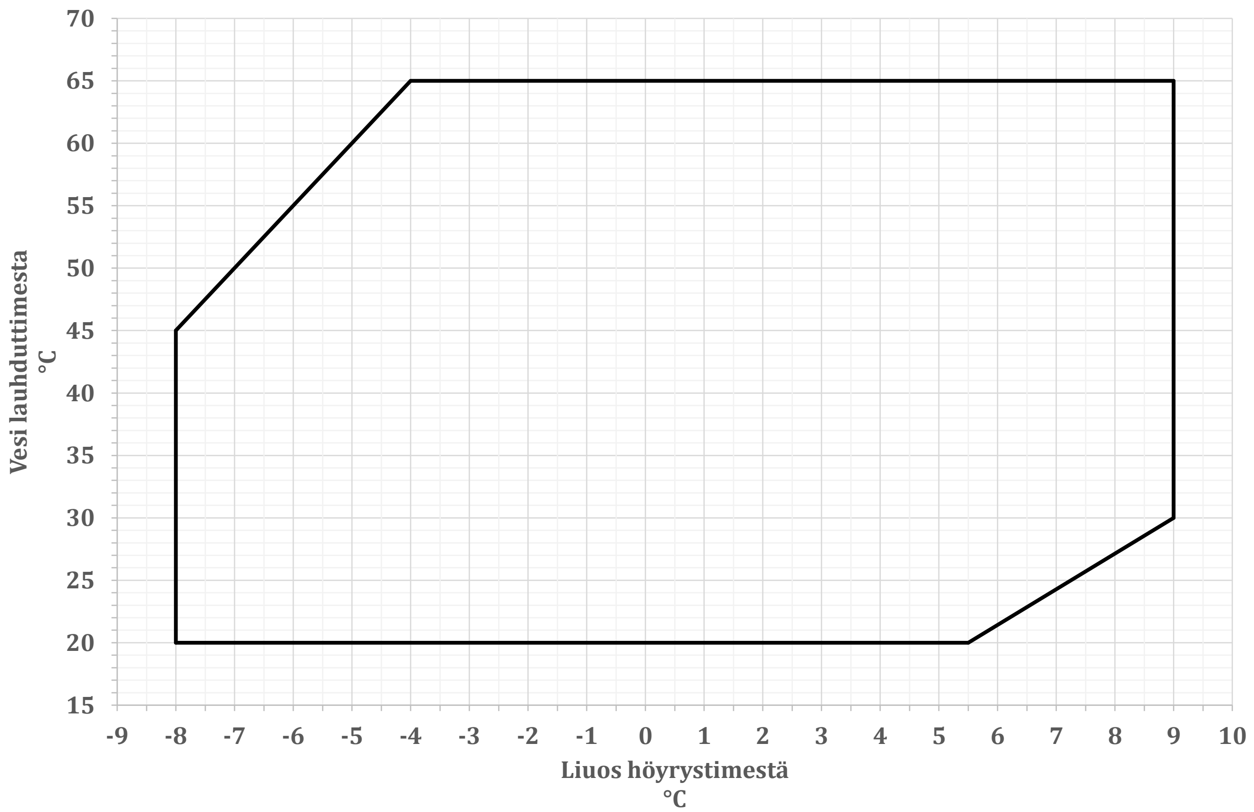


Figure 49. Inverter+ 7–25 operating range, 65 °C output temperature

Condenser circuit liquid: water
Evaporator circuit liquid: mix of water and ethanol, 30 mass-% ethanol (25 volume-%)

29.5.4 ECO Inverter 7–25 (60 °C output temperature)

Brine temperature may exceed the maximum values momentarily during the start-up phase.

		Minimum value	Maximum value	Design value
Evaporator circuit's flow	kg/s	0.47	-	1.48
Temperature differential of the evaporator circuit	°C	1	4	3
Brine into the evaporator	°C	−5	12	0
Brine out of the evaporator	°C	−8	9	−3
Condenser circuit's flow rate:	kg/s	0.16	-	1.18
Condenser circuit's temperature difference	°C	3	25	5
Water into the condenser	°C	15	55	30
Water from condenser	°C	20	60	35

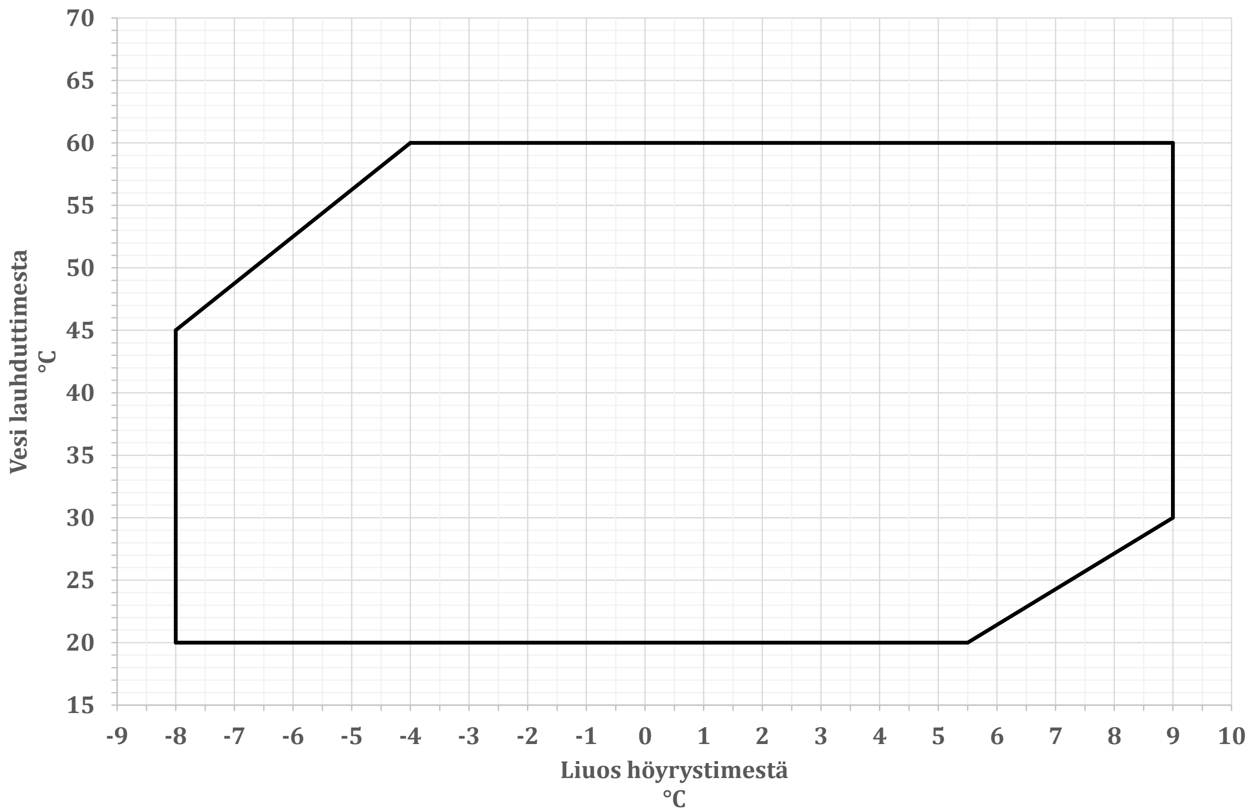


Figure 50. Inverter+ 7–25 operating range, 60 °C output temperature

Condenser circuit liquid: water
Evaporator circuit liquid: mix of water and ethanol, 30 mass-% ethanol (25 volume-%)

29.6 Internal pressure loss in brine circuit

29.6.1 ECO Inverter+ 2–9 and 3–12

The thick ascending graph in the image indicates the device's pressure loss as a function of the flow rate. The remaining portion of the pump's lifting height can be used for the brine circuit. A suitable design value for the internal pressure loss is 20 kPa.

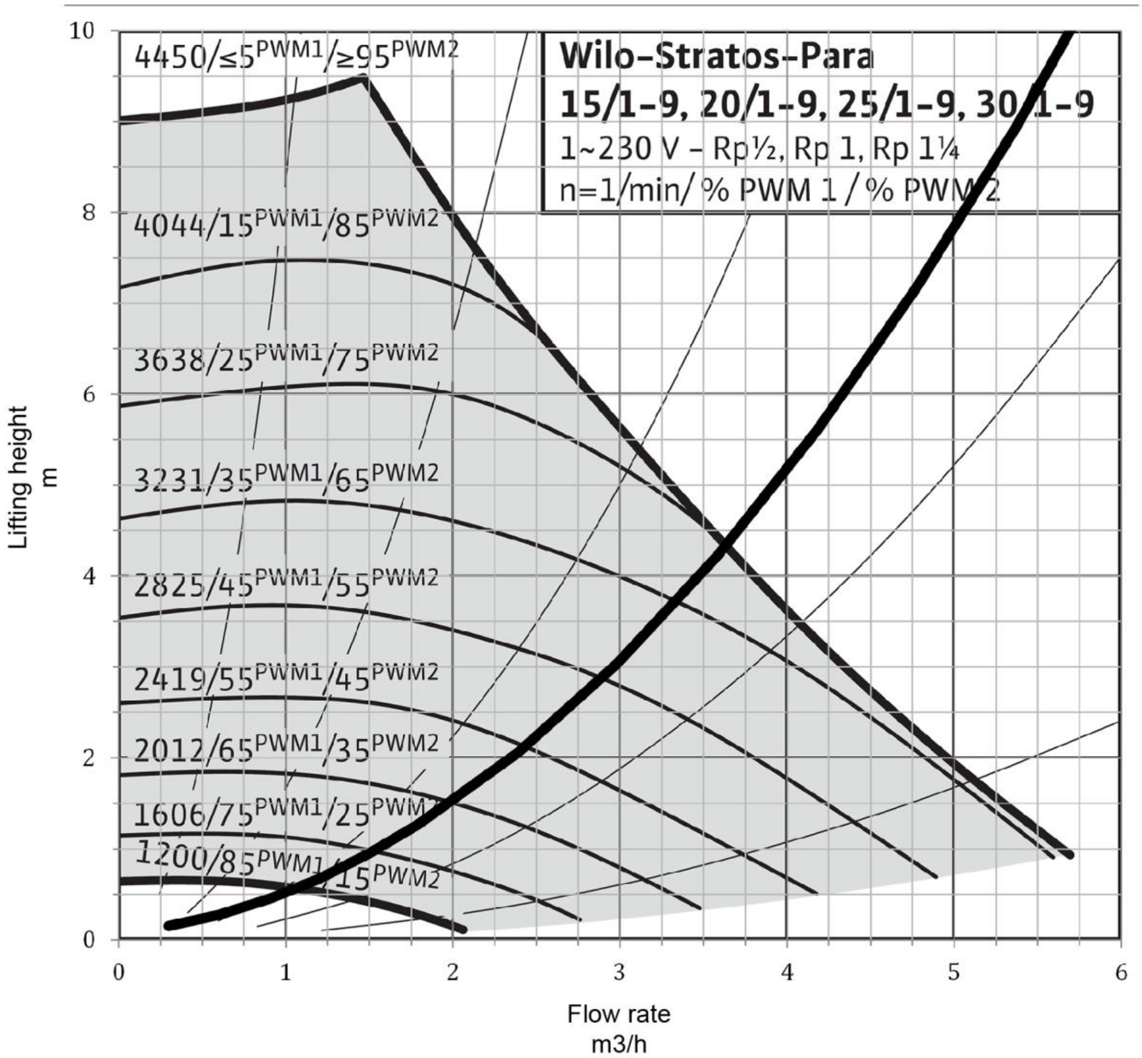


Figure 51. Internal pressure loss as a function of the flow rate, ECO Inverter+

Evaporator circuit liquid: mix of water and ethanol, 30 mass-% ethanol (25 volume-%), average temperature −1.5 °C

29.6.2 Cube Inverter+ 2–9 and 3–12

The thick ascending graph in the image indicates the device's pressure loss as a function of the flow rate. The remaining portion of the pump's lifting height can be used for the brine circuit. A suitable design value for the internal pressure loss in the brine circuit is 25 kPa.

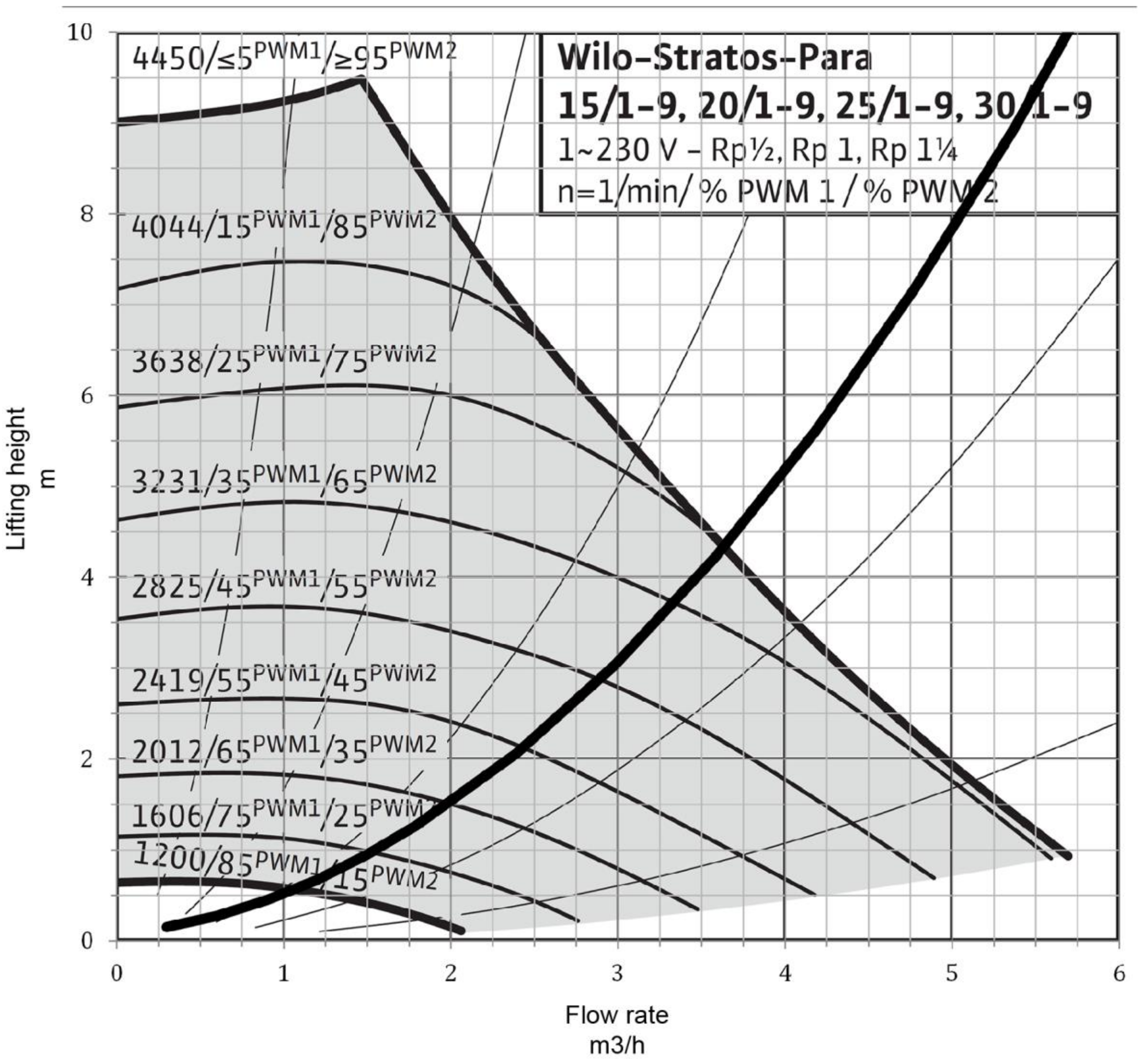


Figure 52. Internal pressure loss as a function of the flow rate, Cube Inverter+

Evaporator circuit liquid: mix of water and ethanol, 30 mass-% ethanol (25 volume-%), average temperature −1.5 °C

29.6.3 ECO Inverter 7–25

A suitable design value for the internal pressure loss in the brine circuit is 40 kPa.

Evaporator circuit liquid: mix of water and ethanol, 30 mass-% ethanol (25 volume-%), average temperature −1.5 °C

30 RE MODELS

30.1 Technical data

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Version		04	04	04	04	04	04	04	04	04	04	04	04
Refrigerant		R-134a	R-410A	R-410A	R-410A	R-410A	R-410A	R-134a	R-410A	R-410A	R-410A	R-410A	R-410A
Heat pump units													
Number of units		1	1	1	1	1	1	2	2	2	2	2	2
Unit type		28 HT	28	33	38	42	48	28 HT + 28 HT	28 + 28	33 + 33	38 + 38	42 + 42	48 + 48
Compressor no.		1	1	1	1	1	1	2	2	2	2	2	2
Number of evaporators		1	1	1	1	1	1	2	2	2	2	2	2
Number of condensers		1	1	1	1	1	1	2	2	2	2	2	2
Dimensions and weight													
Total width	mm	970	970	970	970	970	970	970	970	970	970	970	970
Width without switchboard	mm	750	750	750	750	750	750	750	750	750	750	750	750
Depth (incl. changer connections)	mm	750	750	750	750	750	750	750	750	750	750	750	750
Height	mm	930	930	930	930	930	930	1830	1830	1830	1830	1830	1830
Mass	kg	*	*	*	270	273	*	598	*	517	*	*	543
Soft starter													
Compressor’s soft starter as standard		yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Pipe connections													
Condenser connections, ISO 228 outer thread		G 1 1/4	G 1 1/4	G 1 1/4	G 1 1/4	G 1 1/4	G 1 1/4	G 1 1/4	G 1 1/4	G 1 1/4	G 1 1/4	G 1 1/4	G 1 1/4
Evaporator connections, ISO 228 outer thread		G 1 1/4	G 1 1/4	G 1 1/4	G 2	G 2	G 2	G 1 1/4	G 1 1/4	G 1 1/4	G 2	G 2	G 2
Maximum permissible operating pressure:	bar	10	10	10	10	10	10	10	10	10	10	10	10
Maximum permissible operating pressure with connection hoses	bar	3	3	3	3	3	3	3	3	3	3	3	3
Noise level													
A-weighted sound pressure level At 1 m distance	dB (A)	*	*	*	*	*	*	*	*	*	*	*	*

* To be published later

30.2 Single-unit model dimensions

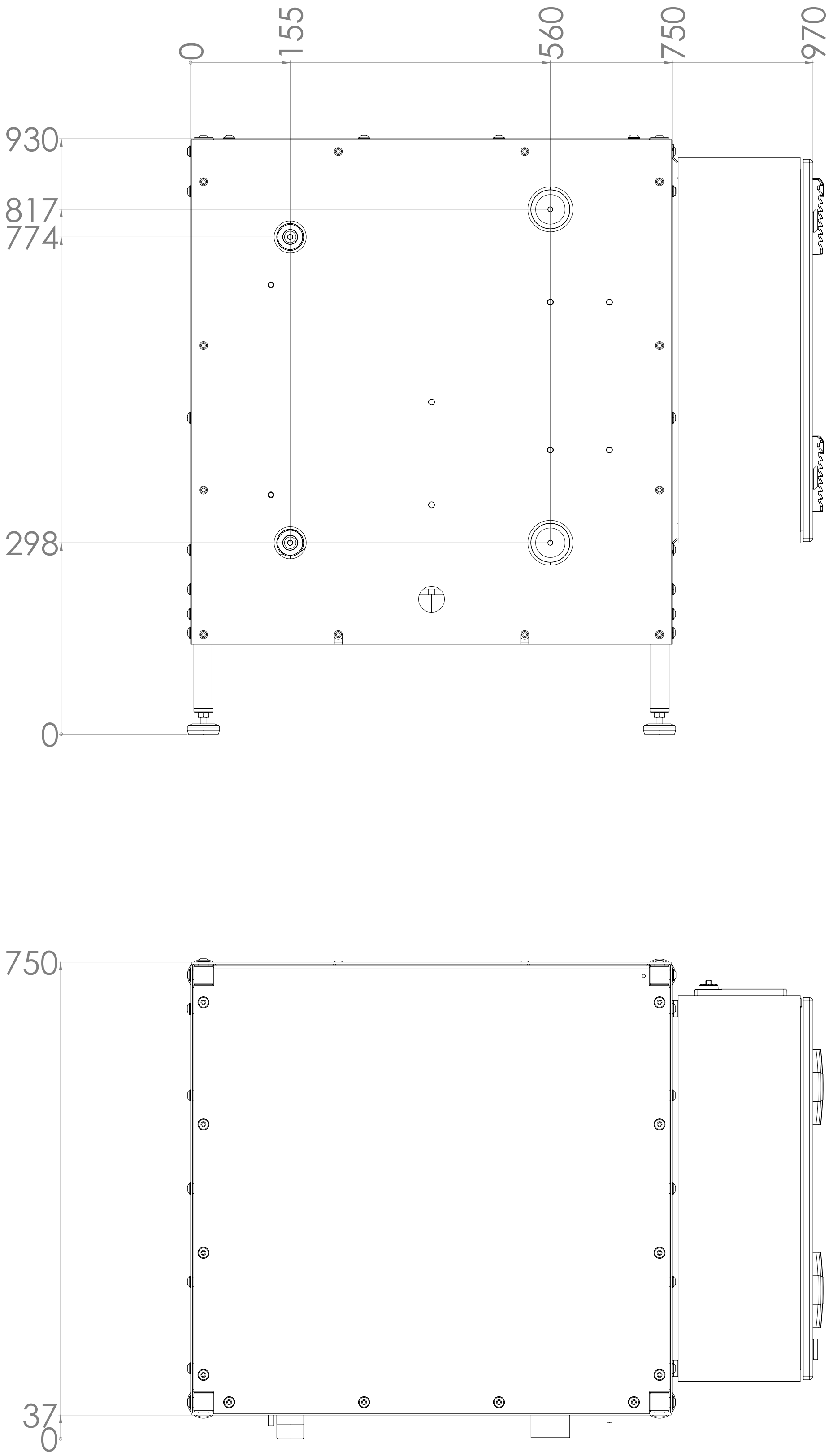
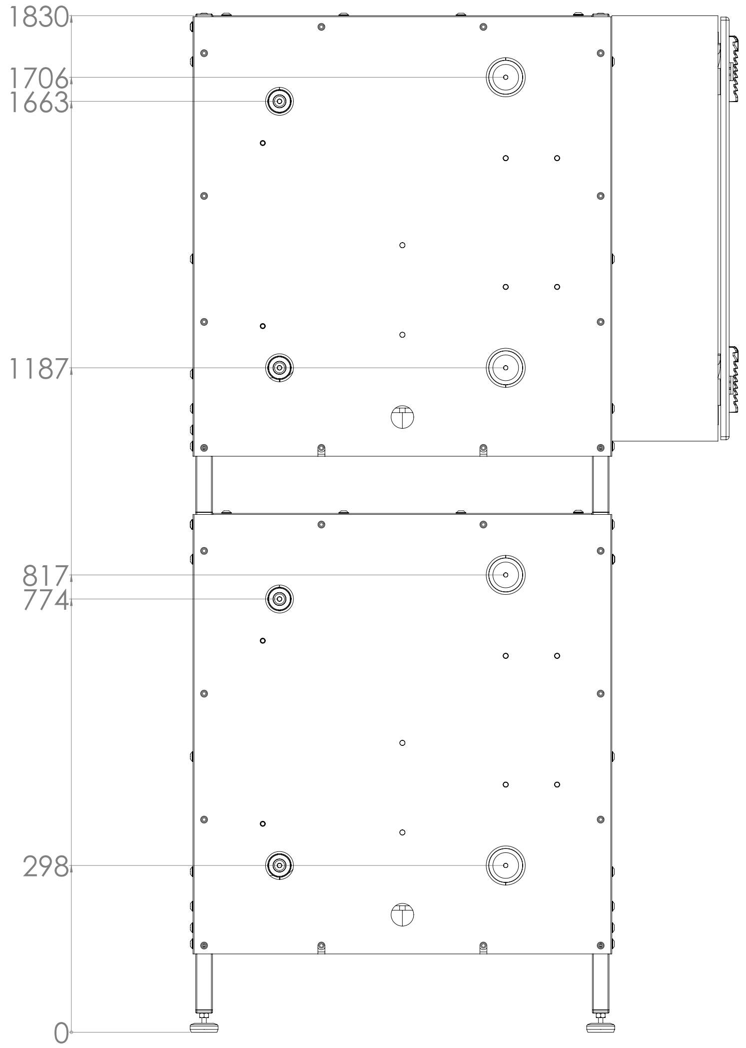


Figure 53. RE 04 dimensions, single unit

30.3 Two-unit model dimensions



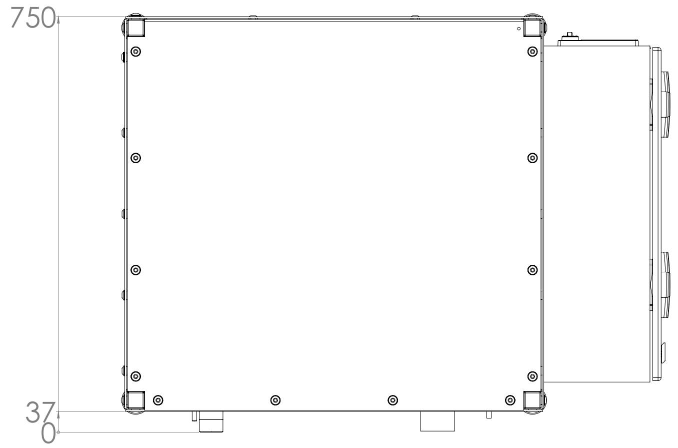


Figure 54. RE 04 dimensions, two units

30.4 Heat pump units

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE		**28 HT**	**28**	**33**	**38**	**42**	**48**
Heat pump version		04	04	04	04	04	04
Refrigerant		R-134a	R-410A	R-410A	R-410A	R-410A	R-410A
Number of refrigerant circuits		1	1	1	1	1	1
Compressor no.		1	1	1	1	1	1
Number of evaporators		1	1	1	1	1	1
Number of condensers		1	1	1	1	1	1
Refrigerant circuit (EU517/2014)							
Contains fluoridized greenhouse gases		yes	yes	yes	yes	yes	yes
Hermetically sealed device		yes	yes	yes	yes	yes	yes
To be checked periodically for leaks (threshold 10 CO2-eq t)		no	no	no	no	no	yes
Refrigerant		R-134a	R-410A	R-410A	R-410A	R-410A	R-410A
Refrigerant's GWP value (global warming potential)		1430	2088	2088	2088	2088	2088
Refrigerant quantity*	g	3200	3750	4500	4600	4788	5100
Refrigerant quantity*	kg	3.20	3.75	4.5	4.6	4,788	5,100
Refrigerant quantity*	CO_2-eq kg	4576	7830	9396	9605	9997	10649
Refrigerant quantity*	CO2eq t	4,576	7,830	9,396	9,605	9,997	10,649
Low pressure switch							
Low pressure switch-off	bar g	0.5 ± 0.5	3.4 ± 0.5	3.4 ± 0.5	3.4 ± 0.5	3.4 ± 0.5	3.4 ± 0.5
Recovery pressure	bar g	1.5 ± 0.5	5.9 ± 0.5	5.9 ± 0.5	5.9 ± 0.5	5.9 ± 0.5	5.9 ± 0.5
High pressure switch							
High pressure switch-off	bar g	23 ± 1.0	45 ± 2.0	45 ± 2.0	45 ± 2.0	45 ± 2.0	45 ± 2.0
Recovery pressure	bar g	19 ± 1.0	34 ± 1.7	34 ± 1.7	34 ± 1.7	34 ± 1.7	34 ± 1.7
Compressor							
Compressor type		scroll	scroll	scroll	scroll	scroll	scroll
Compressor model		ZH11M4E	ZHI27K1P	ZHI32K1P	ZHI35K1P	ZHI40K1P	ZHI46K1P
Motor code		TWD	TFD	TFD	TFD	TFD	TWD

*Always check the refrigerant and filling from the name plate primarily. Pay attention to any filling changes made after installation.
** To be published later.

30.5 Performance data

MODEL / RATED OUTPUT (kW) **3~ 400 V, 50 Hz, PE**		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Refrigerant		R-134a	R-410A	R-410A	R-410A	R-410A	R-410A	R-134a	R-410A	R-410A	R-410A	R-410A	R-410A
Design conditions of condenser and brine circuits Brine 0 °C / –3 °C and water 30 °C / 35 °C (B0/W35)		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Heating power	kW	27.7	27.6	32.3	36.5	41.5	47.7	55.4	55.2	64.6	73.0	83.0	95.4
Cooling power	kW	21.7	22.3	26.0	29.1	33.3	38.2	43.4	44.6	52.0	58.2	66.6	76.4
Coefficient of performance (COP)	-	4.4	4.9	4.8	4.7	4.8	4.8	4.4 and 4.4	4.9 and 4.9	4.8 and 4.8	4.7 and 4.7	4.8 and 4.8	4.8 and 4.8
Compressor electric power (actual output)	kW	6.4	5.6	6.7	7.8	8.7	10.1	12.7	11.2	13.4	15.6	17.4	20.1
Electric current taken by the compressor	A	15.2	12.1	14.8	21.0	21.5	23.1	30.5	24.1	29.6	42.0	43.0	46.2
Brine 0 °C / –3 °C and water 40 °C / 45 °C (B0/W45)		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Heating power	kW	26.3	27.7	33.0	37.1	41.7	48.3	52.6	55.4	66.0	74.2	83.4	96.6
Cooling power	kW	19.4	21.0	24.9	27.9	31.5	36.5	38.8	42.0	49.8	55.8	63.0	73.0
Coefficient of performance (COP)	-	3.6	3.9	3.9	3.8	3.9	3.9	3.6 and 3.6	3.9 and 3.9	3.9 and 3.9	3.8 and 3.8	3.9 and 3.9	3.9 and 3.9
Compressor electric power (actual output)	kW	7.3	7.1	8.5	9.7	10.7	12.5	14.5	14.1	17.0	19.4	21.3	24.9
Electric current taken by the compressor	A	16.1	13.7	16.9	22.5	23.3	25.9	32.2	27.5	33.8	45.0	46.7	51.8
Brine 0 °C / –3 °C and water 50 °C / 55 °C (B0/W55)		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Heating power	kW	25.0	27.9	33.6	37.7	42.1	48.8	50.0	55.8	67.2	75.4	84.2	97.6
Cooling power	kW	17.2	19.4	23.3	26.2	29.4	34.1	34.3	38.7	46.6	52.4	58.8	68.2
Coefficient of performance (COP)	-	3.0	3.1	3.1	3.1	3.2	3.2	3.0 and 3.0	3.1 and 3.1	3.1 and 3.1	3.1 and 3.1	3.2 and 3.2	3.2 and 3.2
Compressor electric power (actual output)	kW	8.2	9.0	10.9	12.2	13.4	15.5	16.5	18.0	21.7	24.4	26.7	30.9
Electric current taken by the compressor	A	17.1	16.1	19.8	24.6	25.9	29.5	34.2	32.3	39.5	49.3	51.8	58.9
Brine 0 °C / –3 °C and water 55 °C / 60 °C (B0/W60)		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Heating power	kW	24.4	28.1	33.9	38.1	42.5	49.1	48.8	56.2	67.8	76.2	85.0	98.2
Cooling power	kW	16.1	18.4	22.3	25.1	28.2	32.7	32.2	36.8	44.6	50.2	56.4	65.4
Coefficient of performance (COP)	-	2.8	2.8	2.8	2.8	2.8	2.8	2.8 and 2.8	2.8 and 2.8	2.8 and 2.8	2.8 and 2.8	2.8 and 2.8	2.8 and 2.8
Compressor electric power (actual output)	kW	8.8	10.2	12.3	13.8	15.1	17.3	17.6	20.4	24.5	27.5	30.1	34.6
Electric current taken by the compressor	A	17.7	17.7	21.5	26.4	27.8	31.7	35.4	35.4	43.0	52.7	55.6	63.4

Brine 0 °C / –3 °C and water 60 °C / 65 °C (B0/W65)		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Heating power	kW	23.9	28.4	34.3	38.6	43.0	49.4	47.8	56.8	68.6	77.2	86.0	98.8
Cooling power	kW	15.0	17.4	21.1	23.8	26.9	31.0	30.0	34.8	42.2	47.6	53.8	62.0
Coefficient of performance (COP)	-	2.6	2.5	2.5	2.5	2.5	2.6	2.6 and 2.6	2.5 and 2.5	2.5 and 2.5	2.5 and 2.5	2.5 and 2.5	2.6 and 2.6
Compressor electric power (actual output)	kW	9.3	11.6	13.9	15.6	17.0	19.4	18.7	23.1	27.7	31.2	34.0	38.8
Electric current taken by the compressor	A	18.4	19.5	23.6	28.7	30.4	34.4	36.7	39.0	47.1	57.4	60.8	68.7
Brine 0 °C / –3 °C and water 65 °C / 70 °C (B0/W70)		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Heating power	kW	23.3						46.6					
Cooling power	kW	13.9						27.7					
Coefficient of performance (COP)	-	2.3						2.3 and 2.3					
Compressor electric power (actual output)	kW	10.0						19.9					
Electric current taken by the compressor	A	19.1						38.2					
Brine 0 °C / –3 °C and water 70 °C / 75 °C (B0/W75)		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Heating power	kW	22.9						45.8					
Cooling power	kW	12.8						25.5					
Coefficient of performance (COP)	-	2.2						2.2 and 2.2					
Compressor electric power (actual output)	kW	10.7						21.3					
Electric current taken by the compressor	A	19.9						39.7					

30.5.1 Output temperature with a heat pump

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE		**28 HT and 56 HT**	**28–96**
Refrigerant		R-134a	R-410A
Brine out of the evaporator −1 °C			
Max. output temperature	°C	75	68
Max. return temperature (ΔT 5 °C)	°C	70	62
Brine out of the evaporator −3 °C			
Max. output temperature	°C	75	68
Max. return temperature (ΔT 5 °C)	°C	70	62
Brine out of the evaporator −6 °C			
Max. output temperature	°C	75	65
Max. return temperature (ΔT 5 °C)	°C	70	60

The table presents the highest compressor-produced temperature of the condenser circuit's flow water. The temperature level produced by the compressor can be further elevated with an immersion heater placed in the condenser or heating circuit's flow line.

Performance data for other conditions found at www.oilon.com

30.5.2 SCOP and SPF value

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE	**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Refrigerant	R-134a	R-410A	R-410A	R-410A	R-410A	R-410A	R-134a	R-410A	R-410A	R-410A	R-410A	R-410A
Low temperature application, cold climate, brine 0 °C, flow water upper limit 35 °C												
SCOP (EN 14825) SPF value (Finnish building code collection)	4.9	5.6	5.5	5.3	5.4	5.4	4.9	5.6	5.5	5.3	5.4	5.4
High temperature application, cold climate, brine 0 °C, flow water upper limit 55 °C												
SCOP (EN 14825) SPF value (Finnish building code collection)	4.0	4.4	4.3	4.2	4.3	4.3	4.0	4.4	4.3	4.2	4.3	4.3

30.6 Condenser circuit flow

The condenser circuit's pump is external. Select the pump b ased on the pressure loss calculation. Pump models are presented in chapter 31. In two-unit devices both condenser circuits have their own pumps. The total flow rate is distributed into the individual circuits according to the corresponding individual units. The total flow rate in the condenser circuit of the RE 56 model is, for example, 9.56 m^3/h, and both individual units have a flow rate of 4.78 m^3/h in their circuits, which makes the internal pressure loss for a single circuit 16 kPa.

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE CLEAN WATER		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Standard pump		C	C	C	C	C	C	C and C	C and C	C and C	C and C	C and C	C and C
Design conditions of condenser and brine circuits (B0/W35) Condenser circuit ΔT 5 °C: design flow rate		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Water temperature difference	°C	5	5	5	5	5	5	5	5	5	5	5	5
Water flow rate	kg/s	1.33	1.32	1.55	1.75	1.99	2.28	2.65	2.64	3.09	3.49	3.97	4.56
Water flow rate	L/s	1.33	1.33	1.55	1.76	2.00	2.29	2.66	2.65	3.11	3.51	3.99	4.59
Water flow rate	m3/h	4.80	4.78	5.59	6.32	7.18	8.26	9.59	9.56	11.18	12.64	14.37	16.52
Standard pump lifting height	m	11.9	11.2	10.5	9.7	8.8	7.5	-	-	-	-	-	-
Internal pressure loss	kPa	15	16	15	19	25	27	15 and 15	16 and 16	15 and 15	19 and 19	25 and 25	27 and 27
Internal pressure loss in lifting height	m	1.5	1.7	1.6	2.0	2.5	2.7	1.5 and 1.5	1.7 and 1.7	1.6 and 1.6	2.0 and 2.0	2.5 and 2.5	2.7 and 2.7
Standard pump lifting height for external pressure loss	m	10.4	9.5	8.9	7.7	6.3	4.8	-	-	-	-	-	-
Design conditions of condenser and brine circuits (B0/W35) Condenser circuit ΔT 6 °C		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Water temperature difference	°C	6	6	6	6	6	6	6	6	6	6	6	6
Water flow rate	kg/s	1.10	1.10	1.29	1.46	1.65	1.90	2.21	2.20	2.58	2.91	3.31	3.80
Water flow rate	L/s	1.11	1.11	1.29	1.46	1.66	1.91	2.22	2.21	2.59	2.93	3.33	3.82
Water flow rate	m3/h	4.00	3.98	4.66	5.27	5.99	6.88	7.99	7.96	9.32	10.53	11.97	13.76
Design conditions of condenser and brine circuits (B0/W35) Condenser circuit's ΔT 12 °C		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Water temperature difference	°C	12	12	12	12	12	12	12	12	12	12	12	12
Water flow rate	kg/s	0,55	0,55	0.64	0.73	0.83	0.95	1.10	1.10	1.29	1.46	1.65	1.90

Water flow rate	L/s	0.56	0,55	0.65	0.73	0.83	0.96	1.11	1.11	1.29	1.46	1.66	1.91
Water flow rate	m3/h	2.00	1.99	2.33	2.63	2.99	3.44	4.00	3.98	4.66	5.27	5.99	6.88

Maximum permissible temperature difference is 16 °C.

30.7 Brine circuit flow

The brine circuit pump is external. Select the pump b ased on the pressure loss calculation. Pump models are presented in chapter 31. Two-unit devices usually share the same brine circuit pump. The total flow rate is distributed into both units according to the corresponding individual units. The total flow rate in the brine circuit of the RE 84 model is, for example, 19.88 m^3/h, and both individual units have a flow rate of 9.94 m^3/h in their condenser circuits, which makes the internal pressure loss for a single circuit 18 kPa.

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE WATER AND ETHANOL SOLUTION, 30 m-% OF ETHANOL		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Design conditions of condenser and brine circuits (B0/W35) Brine circuit ΔT 3 °C: design discharge of brine circuit		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Brine temperature difference	°C	3	3	3	3	3	3	3	3	3	3	3	3
Brine flow rate	kg/s	1.74	1.79	2.08	2.33	2.67	3.06	3.48	3.57	4.17	4.66	5.34	6.12
Brine flow rate	L/s	1.80	1.85	2.16	2.41	2.76	3.17	3.60	3.70	4.31	4.83	5.52	6.34
Brine flow rate	m3/h	6.48	6.66	7.76	8.69	9.94	11.40	12.96	13.31	15.52	17.37	19.88	22.81
Internal pressure loss		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Internal pressure loss	kPa	21	21	15	15	18	17	21	21	15	15	18	17
Internal pressure loss in lifting height	m	2.2	2.2	1.6	1.6	1.9	1.8	2.2	2.2	1.6	1.6	1.9	1.8
Lifting height of pumps		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Pump C (1-phase)	m	10.0	9.5	8,3	7.3	-	-	-	-	-	-	-	-
Pump E (1-phase)	m	12.0	11.9	11.3	11.0	10.4	9.7	9.2	8.7	7.5	-	-	-
Pump F (1-phase)	m	15.6	15.3	14.6	14.1	13.4	12.5	11.9	11.5	10.5	9.7	8.7	7.2
Pump G (1-phase)	m	16.5	16.5	16.5	16.4	16.4	15.9	15.4	15.1	14.3	13.5	12.8	11.7
Pump H (3-phase)	m	12.0	12.0	11.7	11.5	11.1	10.5	10.0	9.6	8.2	-	-	-
Pump I (3-phase)	m	11.9	11.9	11.8	11.6	11.5	11.3	11.0	10.9	10.4	9.8	9.0	7.8
Pump J (3-phase)	m	14.3	14.3	14.3	14.3	14.2	14.2	14.2	14.2	14.1	14.0	13.8	13.4
Pump K (3-phase)	m	18.0	18.0	18.0	17.9	17.9	17.9	17.8	17.8	17.7	17.7	17.5	17.2
Pump lifting height for external pressure loss		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Pump C (1-phase)	m	7.8	7.3	6.7	5.7	-	-	-	-	-	-	-	-
Pump E (1-phase)	m	9.8	9.7	9.7	9.4	8.5	7.9	7.0	6.5	5.9	-	-	-
Pump F (1-phase)	m	13.4	13.1	13.0	12.5	11.5	10.7	9.7	9.3	8.9	8.1	6.8	5.4
Pump G (1-phase)	m	14.3	14.3	14.9	14.8	14.5	14.1	13.2	12.9	12.7	11.9	10.9	9.9
Pump H (3-phase)	m	9.8	9.8	10.1	9.9	9.2	8.7	7.8	7.4	6.6	-	-	-
Pump I (3-phase)	m	9.7	9.7	10.2	10.0	9.6	9.5	8.8	8.7	8.8	8.2	7.1	6.0

Pump J (3-phase)	m	12.1	12.1	12.7	12.7	12.3	12.4	12.0	12.0	12.5	12.4	11.9	11.6
Pump K (3-phase)	m	15.8	15.8	16.4	16.3	16.0	16.1	15.6	15.6	16.1	16.1	15.6	15.4
Design conditions of condenser and brine circuits (B0/W35) Brine circuit ΔT 4 °C:		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Brine temperature difference	°C	4	4	4	4	4	4	4	4	4	4	4	4
Brine flow rate	kg/s	1.30	1.34	1.56	1.75	2.00	2.30	2.61	2.68	3.13	3.50	4.00	4.59
Brine flow rate	L/s	1.35	1.39	1.62	1.81	2.07	2.38	2.70	2.77	3.23	3.62	4.14	4.75
Brine flow rate	m3/h	4.86	4.99	5.82	6.52	7.46	8.55	9.72	9.99	11.64	13.03	14.91	17.11
Design conditions of condenser and brine circuits (B0/W35) Brine circuit ΔT 5 °C: min. allowed discharge		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
Brine temperature difference	°C	5	5	5	5	5	5	5	5	5	5	5	5
Brine flow rate	kg/s	1.04	1.07	1.25	1.40	1.60	1.84	2.09	2.14	2.50	2.80	3.20	3.67
Brine flow rate	L/s	1.08	1.11	1.29	1.45	1.66	1.90	2.16	2.22	2.59	2.90	3.31	3.80
Brine flow rate	m3/h	3.89	3.99	4.66	5.21	5.96	6.84	7.77	7.99	9.31	10.42	11.93	13.68

30.8 Electrical currents

30.8.1 Starting currents

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE		28 HT	28	33	38	42	48
Compressor with soft starter							
Min. permitted starting voltage for soft starter	V	240	240	240	240	240	240
Soft starter ramp-up time	s	below 1	below 1	below 1	below 1	below 1	below 1
Soft starter ramp-down time	s	below 1	below 1	below 1	below 1	below 1	below 1
Highest starting current, depending on circumstances	A	64...96	42…63	52…78	65…98	66…99	75…112

30.8.2 Currents of the components

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE		28 HT	28	33	38	42	48	56 HT	56	66	76	84	96
compressor, nominal value	A	32.0	21.0	26.0	32.5	33.0	37.4	64.0	42.0	52.0	65.0	66.0	74.8
compressor, maximum typical operating current, 90 % of nominal value	A	27.2	17.9	22.1	27.6	28.1	31.8	54.4	35.7	44.2	55.3	56.1	63.6
compressor, maximum value within technical data's conditions	A	19.9	19.5	23.6	28.7	30.4	34.4	39.7	39.0	47.1	57.4	60.8	68.7
condenser circuit pumps 1~, standard 1 unit: 2nd phase, 2 units: 2nd and 3rd phase	A	1.4	1.4	1.4	1.4	1.4	1.4	2.8	2.8	2.8	2.8	2.8	2.8
brine circuit pump 1~ (default) 1 unit: 1st phase, 2 units: 1st phase	A	3.5	3.5	3.5	3.5	3.5	3.5	5.5	5.5	5.5	5.5	5.5	5.5
brine circuit pump 3~, default	A	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2
automation	A	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
heating circuit 1 pump 1~, default 1 unit: 3rd phase, 2 units: 1st phase	A	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4

30.8.3 Currents for different combinations

MODEL / RATED OUTPUT (kW) 3~ 400 V, 50 Hz, PE		**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
compressor's nominal value + condenser circuit pumps 1~ (standard) + brine circuit pump 1~ (default)	A	35.9	24.9	29.9	36.4	36.9	41.3	69.9	47.9	57.9	70.9	71.9	80.7
compressor, maximum typical operating current, 90 % of nominal value + condenser circuit pumps 1~ (standard) + brine circuit pump 1~ (default)	A	31.1	21.8	26.0	31.5	32.0	35.7	60.3	41.6	50.1	61.2	62.0	69.5
compressor, maximum value within technical data's conditions + condenser circuit pumps 1~ (standard) + brine circuit pump 1~ (default)	A	23.8	23.4	27.5	32.6	34.3	38.3	45.6	44.9	53.0	63.3	66.7	74.6
compressor's nominal value + condenser circuit pumps 1~ (standard) + brine circuit pump 1~ (default) + heating circuit 1 pump 1~ (default)	A	35.9	24.9	29.9	36.4	36.9	41.3	72.3	50.3	60.3	73.3	74.3	83.1
compressor, maximum typical operating current, 90 % of nominal value + condenser circuit pumps 1~ (standard) + brine circuit pump 1~ (default) + heating circuit 1 pump 1~ (default)	A	31.1	21.8	26.0	31.5	32.0	35.7	62.7	44.0	52.5	63.6	64.4	71.9
compressor, maximum value within technical data's conditions + condenser circuit pumps 1~ (standard) + brine circuit pump 1~ (default) + heating circuit 1 pump 1~ (default)	A	23.8	23.4	27.5	32.6	34.3	38.3	48.0	47.3	55.4	65.7	69.1	77.0
compressor's nominal value + condenser circuit pumps 1~ (standard) + brine circuit pump 3~ (default)	A	36.6	25.6	30.6	37.1	37.6	42.0	70.0	48.0	58.0	71.0	72.0	80.8
compressor, maximum typical operating current, 90 % of nominal value + condenser circuit pumps 1~ (standard) + brine circuit pump 3~ (default)	A	31.8	22.5	26.7	32.2	32.7	36.4	60.4	41.7	50.2	61.3	62.1	69.6

compressor, maximum value within technical data’s conditions + condenser circuit pumps 1~ (standard) + brine circuit pump 3~ (default)	A	24.5	24.1	28.2	33.3	35.0	39.0	45.7	45.0	53.1	63.4	66.8	74.7
compressor’s nominal value + condenser circuit pumps 1~ (standard) + brine circuit pump 3~ (default) + heating circuit 1 pump 1~ (default)	A	37.6	26.6	31.6	38.1	38.6	43.0	70.0	48.0	58.0	71.0	72.0	80.8
compressor, maximum typical operating current, 90 % of nominal value + condenser circuit pumps 1~ (standard) + brine circuit pump 3~ (default) + heating circuit 1 pump 1~ (default)	A	32.8	23.5	27.7	33.2	33.7	37.4	60.4	41.7	50.2	61.3	62.1	69.6
compressor, maximum value within technical data’s conditions + condenser circuit pumps 1~ (standard) + brine circuit pump 3~ (default) + heating circuit 1 pump 1~ (default)	A	25.5	25.1	29.2	34.3	36.0	40.0	45.7	45.0	53.1	63.4	66.8	74.7

30.9 Main fuses

Designing and selecting the main fuse is always the responsibility of the designated electrical designer and installer. Pay attention to possible additional pumps and devices connected to the system.

MODEL / RATED OUTPUT (kW) **3~ 400 V, 50 Hz, PE**	**28 HT**	**28**	**33**	**38**	**42**	**48**	**56 HT**	**56**	**66**	**76**	**84**	**96**
compressor's nominal value + condenser circuit pumps 1~ (standard) + brine circuit pump 1~ (default)	3 x 40 A	3 x 25 A	3 x 32 A	3 x 40 A	3 x 40 A	3 x 50 A	3 x 80 A	3 x 50 A	3 x 63 A	3 x 80 A	3 x 80 A	3 x 100 A
compressor, maximum typical operating current, 90 % of nominal value + condenser circuit pumps 1~ (standard) + brine circuit pump 1~ (default)	3 x 32 A	3 x 25 A	3 x 32 A	3 x 32 A	3 x 32 A	3 x 40 A	3 x 63 A	3 x 50 A	3 x 63 A	3 x 63 A	3 x 63 A	3 x 80 A
compressor, maximum value within technical data's conditions + condenser circuit pumps 1~ (standard) + brine circuit pump 1~ (default)	3 x 25 A	3 x 25 A	3 x 32 A	3 x 40 A	3 x 40 A	3 x 40 A	3 x 50 A	3 x 50 A	3 x 63 A	3 x 80 A	3 x 80 A	3 x 80 A
compressor's nominal value + condenser circuit pumps 1~ (standard) + brine circuit pump 1~ (default) + heating circuit 1 pump 1~ (default)	3 x 40 A	3 x 25 A	3 x 32 A	3 x 40 A	3 x 40 A	3 x 50 A	3 x 80 A	3 x 63 A	3 x 63 A	3 x 80 A	3 x 80 A	3 x 100 A
compressor, maximum typical operating current, 90 % of nominal value + condenser circuit pumps 1~ (standard) + brine circuit pump 1~ (default) + heating circuit 1 pump 1~ (default)	3 x 32 A	3 x 25 A	3 x 32 A	3 x 32 A	3 x 32 A	3 x 40 A	3 x 63 A	3 x 50 A	3 x 63 A	3 x 80 A	3 x 80 A	3 x 80 A
compressor, maximum value within technical data's conditions + condenser circuit pumps 1~ (standard) + brine circuit pump 1~ (default) + heating circuit 1 pump 1~ (default)	3 x 25 A	3 x 25 A	3 x 32 A	3 x 40 A	3 x 40 A	3 x 40 A	3 x 50 A	3 x 50 A	3 x 63 A	3 x 80 A	3 x 80 A	3 x 80 A
compressor's nominal value + condenser circuit pumps 1~ (standard) + brine circuit pump 3~ (default)	3 x 40 A	3 x 32 A	3 x 32 A	3 x 40 A	3 x 40 A	3 x 50 A	3 x 80 A	3 x 50 A	3 x 63 A	3 x 80 A	3 x 80 A	3 x 100 A

compressor, maximum typical operating current, 90 % of nominal value + condenser circuit pumps 1~ (standard) + brine circuit pump 3~ (default)	3 x 32 A	3 x 25 A	3 x 32 A	3 x 40 A	3 x 40 A	3 x 40 A	3 x 63 A	3 x 50 A	3 x 63 A	3 x 63 A	3 x 63 A	3 x 80 A
compressor, maximum value within technical data's conditions + condenser circuit pumps 1~ (standard) + brine circuit pump 3~ (default)	3 x 25 A	3 x 25 A	3 x 32 A	3 x 40 A	3 x 40 A	3 x 40 A	3 x 50 A	3 x 50 A	3 x 63 A	3 x 80 A	3 x 80 A	3 x 80 A
compressor's nominal value + condenser circuit pumps 1~ (standard) + brine circuit pump 3~ (default) + heating circuit 1 pump 1~ (default)	3 x 40 A	3 x 32 A	3 x 32 A	3 x 40 A	3 x 40 A	3 x 50 A	3 x 80 A	3 x 50 A	3 x 63 A	3 x 80 A	3 x 80 A	3 x 100 A
compressor, maximum typical operating current, 90 % of nominal value + condenser circuit pumps 1~ (standard) + brine circuit pump 3~ (default) + heating circuit 1 pump 1~ (default)	3 x 40 A	3 x 25 A	3 x 32 A	3 x 40 A	3 x 40 A	3 x 40 A	3 x 63 A	3 x 50 A	3 x 63 A	3 x 63 A	3 x 63 A	3 x 80 A
compressor, maximum value within technical data's conditions + condenser circuit pumps 1~ (standard) + brine circuit pump 3~ (default) + heating circuit 1 pump 1~ (default)	3 x 32 A	3 x 25 A	3 x 32 A	3 x 40 A	3 x 40 A	3 x 40 A	3 x 50 A	3 x 50 A	3 x 63 A	3 x 80 A	3 x 80 A	3 x 80 A

31 Temperature sensors

Sensor	Sensor type	β value	Tolerance:
Outside temperature B9	NTC 1 kOhm	3464 K (25 °C / 50 °C)	+/- 100 K
Other sensors (B3, B4, B21, B71, B91, B92 etc.)	NTC 10 kOhm	3978 K (25 °C / 85 °C)	B85: +/- 10 K Other sensors: +/- 100 K

A Pt1000 sensor can also be used with the solar collector. The collector's sensor type is selected on line 6097.

32 Pumps

32.1 Pump options

SEQ Taulukko * ARABIC Table 59. Pump options

	Oilon label:	Pump	Information	
A	34023071	Wilo-Yonos PARA GT 15/7.5 PWM1 130 mm 6h	1–phase, wet-motor, G 1 outer thread, installation dimension 130 mm, inverse PWM, 4-75 W (0.04–0.66 A)	graph information
B	34023073	Wilo-Stratos PARA 15/1-9 T10 130 mm 6h	1–phase, wet-motor, G 1 outer thread, installation dimension 130 mm, inverse PWM, 3.5-90 W (0.05–0.70 A)	graph information
C	34023075	Wilo-Stratos PARA 25/1-12 T16 180 mm 6h	1–phase, wet-motor, G 1 1/2 outer thread, installation dimension 180 mm, manual control and 0...10 V, 16–310 W (0.16 …1.37 A), motor protection 1.6-2.5	graph information
D	34023081	Wilo-Yonos PARA HF 40/0.5-12 (Wilo-Yonos MAXO 40/0.5-12)	1-phase, wet-motor, DN 40 flange, distance between flanges 250 mm, manual control, 15–550 W (0.17–2.4 A), motor protection 1.6-2.5	graph
E	34023070	Wilo-Stratos 40/1-12	1-phase, wet-motor, DN 40 flange, distance between flanges 250 mm, manual control, with accessory card* 0…10 V and bus control etc., 25–550 W (0.20–2.40 A), motor protection 1.6-2.5	graph
F	34023082	Wilo-Yonos MAXO 40/0.5-16	1-phase, wet-motor, DN 40 flange, distance between flanges 250 mm, manual control, 30–800 W (0.27–3.5 A), motor protection 2.5-4	graph
G	34023083	Wilo-Yonos MAXO 50/0.5-16	1-phase, wet-motor, DN 50 flange, distance between flanges 340 mm, manual control, 40–1250 W (0.3–5.5 A), motor protection 4-6.3	graph
H	34023066	Wilo-Veroline-IPL 40/115-0.55/2	3-phase, dry-motor, DN 40 flange, distance between flanges 250 mm, 1-speed, 1.34 A, motor protection 1.6-2.5	graph
I	34023067	Wilo-Veroline-IPL 50/105-0.75/2	3-phase, dry-motor, DN 50 flange, distance between flanges 280 mm, 1-speed, 1.7 A, motor protection 1.6-2.5	graph
J	34023068	Wilo-Veroline-IPL 50/120-1.5/2	3-phase, dry-motor, DN 50 flange, distance between flanges 340 mm, 1-speed, 3.2 A, motor protection 2.5-4	graph
K	34023063	Wilo-VeroLine-IPL 50/130-2.2/2	3-phase, dry-motor, DN 50 flange, distance between flanges 340 mm, 1-speed, 4.5 A, motor protection 4-6.3	graph
KV1	34023076	Wilo-Yonos PARA Z 25/7.0 PWM2 180 mm 6h	1-phase, bronze housing (DHW pump), wet-motor, G 1 1/2 outer thread, setting dimension 180 mm, PWM, 3–45 W (0.03–0.44 A)	graph

* For example, an accessory card with status information and 0…10 V control (Wilo product number 2030495)

Pump selection criteria (+ indicates a redeem-	Price	Noise	Electrical	Energy efficiency	Adjustability

ing feature)			current		
1~ small wet-motor pump	+	+	+	+	+
1~ large wet-motor pump	−	+	−	+	+
3~ dry-motor pump	+	−	+	+/−	−

32.2 Technical data

32.2.1 Wilo-Yonos PARA GT 15/7.5 PWM1 130 mm

Wilo-Yonos PARA GT 15/7.5 PWM1 130 mm		
Motor and control type		EC motor, AC drive, wet motor
Pipe connection		ISO 228 G 1 (1" outer thread)
length (fitting dimension)	mm	130
weight	kg	2.5
Electrical connection		1~ 230 V, 50 Hz, N, PE
maximum allowable fluctuation margin for operating voltage		+10/−15%
motor protection		internal, but has a fuse in the switchboard depending on the model
electrical current	A	0.04–0.66
pump power consumption (P1)	W	4–75
Energy Efficiency Index (EEI)		≤21
maximum allowable static pressure	bar	6
allowable flow temperature range	°C	−10…95
minimum allowable inlet pressure at a flow temperature of 50 °C	kPa	5
minimum inlet pressure at a flow temperature of 95 °C	kPa	45
control message		PWM (the inverse speed in relation to the control signal level)
control message matching the maximum pump speed		PWM 0% (full speed as the control signal is cut)
control message matching the minimum pump speed		PWM 100%
speed when the control signal is cut off		full speed

32.2.2 Wilo-Stratos PARA 15/1-9 T10 130 mm

Wilo-Stratos PARA 15/1-9 T10 130 mm 6h		
Motor and control type		EC motor, AC drive, wet motor
Pipe connection		ISO 228 G 1 (1" outer thread)
length (fitting dimension)	mm	130
weight	kg	1.8
Electrical connection		1~ 230 V, 50 Hz, N, PE
maximum allowable fluctuation margin for operating voltage		+10/−15%
motor protection		internal, but has a fuse in the switchboard depending on the model
electrical current	A	0.05–0.70
pump power consumption (P1)	W	3.5–90
Energy Efficiency Index (EEI)		≤ 23
maximum allowable static pressure	bar	10
allowable flow temperature range	°C	−10…95
minimum allowable inlet pressure at a flow temperature of 50 °C	kPa	5
minimum inlet pressure at a flow temperature of 95 °C	kPa	45
control message		PWM (the inverse speed in relation to the control signal level)
control message matching the maximum pump speed		PWM 0% (full speed as the control signal is cut)
control message matching the minimum pump speed		PWM 100%
speed when the control signal is cut off		full speed

32.2.3 Wilo-Stratos PARA 25/1-12 T16 180 mm

Wilo-Stratos PARA 25/1-12 T16 180 mm		
Motor and control type		EC motor, AC drive, wet motor
Pipe connection		ISO 228 G 1 ½ (1 ½" outer thread)
length (fitting dimension)	mm	180
weight	kg	6.2
Electrical connection		1~ 230 V, 50 Hz, N, PE
maximum allowable fluctuation margin for operating voltage		+10/−15%
motor protection		internal + a fuse in the switchboard
electrical current	A	0.16–1.37
pump power consumption (P1)	W	16–310
Energy Efficiency Index (EEI)		≤ 23
maximum allowable static pressure	bar	10
allowable flow temperature range	°C	−10…95
minimum allowable inlet pressure at a flow temperature of 50 °C	kPa	30
minimum inlet pressure at a flow temperature of 95 °C	kPa	100
control message		0...10 V or manual control
control message matching the maximum pump speed		10 V
a control message matching the minimum pump speed		3 V and 0 V
control signal corresponding to the pump's OFF state		0.5…2 V
speed when the control signal is cut off		minimum rotational speed (with a 0 V control signal or without a control signal minimum speed is used)

32.2.4 Technical data for other pumps

Technical data for other pumps can be found on Wilo's website (link).

32.3 Pump graphs

The manufacturer has drafted pump graphs for pure water. The water temperature in the graphs is approximately 20 °C, making the water density approximately 1000 kg/m3 and viscosity approximately 1,0 mPa·s (1.0 cP). The pressure difference presented the graphs is only applicable to pure water in these circumstances. The lifting height (H) is valid for other circumstances and liquids as well, regardless of the liquid density, as long as its viscosity does not deviate greatly from water's viscosity in the circumstances laid out previously. Pump graphs are usually valid as they are for a typical mixture of 30-m % ethanol and water, because the solution's viscosity is sufficiently close to water's viscosity. Depending on the solution and operating conditions, the graphs can be adjusted according to for example ISO/TR 17766:2005, but this is not usually necessary. The adjusted lifting height for a typical 30-m % ethanol and water solution is approximately 95...98 % of the lifting height used for pure water. The lifting height is presented on the left side of the graphs. The unit is meter (m). The pressure difference is converted into lifting height with the following formula

$$\mathrm{H} = \frac{\Delta \mathrm{p}}{\rho \mathrm{g}}$$

H Is the lifting height (m), $\Delta\mathrm{p}$ the pressure difference (Pa), ρ the density of pumped liquid (kg/m^3) and g the acceleration of Earth's gravitational pull (m/s^2). The value used for acceleration is 9.81 m/s^2. The pressure difference in the formula comes from the pressure loss calculation. The calculation can be presented directly as lifting height, so it can be used directly when reading pump graphs. For water, 1 m in lifting height is approximately 10 kPa (10 m is approx. 100 kPa = 1 bar). This is also roughly valid for water and ethanol solutions.

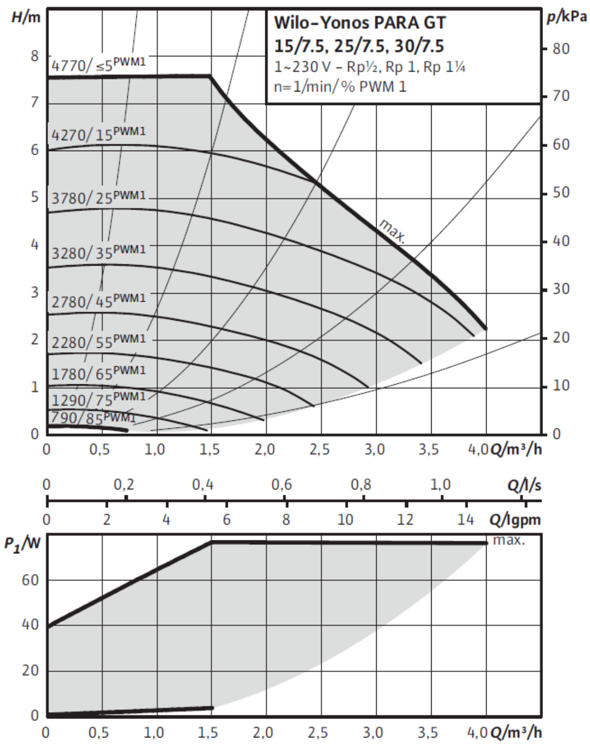
Markings I, II and III in the graphs indicate the default rotational speed's setpoint, the 0-10 V control voltage, and the level of the PWM pulse signal. Δp-c indicates a control type that keeps the pressure difference in the pump at a nearly standard level, and Δp-v indicates a control type based on a fluctuating pressure difference. The pump manufacturer recommends the latter type for single-unit systems. For detail-level explanations on the control types, see the pump manufacturer's instructions and guides. In graphs denoting capacity, P1 is the electrical power supplied to the pump's motor, and P2 is the motor's shaft output. The electrical is calculated from the shaft output using the coefficient of performance.

Outline for checking the pump's flow technical suitability:

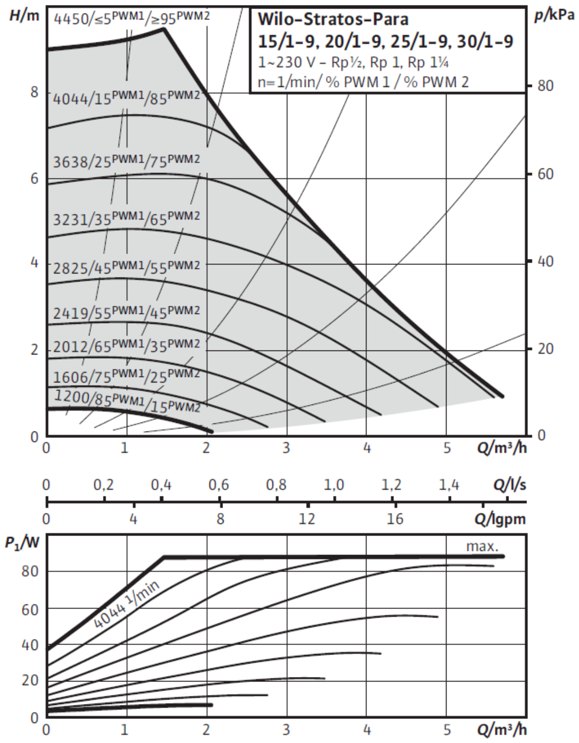
- Determine the brine circuit's pressure loss in terms of pressure difference $\Delta\mathrm{p}$ (kpa) or lifting height $\Delta\mathrm{p}$ (m) using a certain design flow rate. Ethanol solution's viscosity differs from pure water. Be sure to take this into account in the calculation.
- Add the heat pump's internal loss to the brine circuit's pressure loss. The internal pressure loss is presented in the heat pump's technical data as pressure loss (kPa). Convert the pressure difference into lifting height if the brine circuit's pressure loss is already presented as lifting height.
- Convert the total pressure loss $\Delta\mathrm{p}$ (kPa) calculated previously into lifting height H (m), if the pressure loss is not already presented in lifting height. Also convert the flow rate's unit into m^3/h or L/s. These units are found in the pump graphs.

- Check the flow rate Q (m^3/h) corresponding to the pressure loss calculation from the horizontal axis, and the lifting height H (m) corresponding to the total pressure loss from the vertical axis. Make sure that this design point is withn the pump's operating range. If not, change the pump or the design.
- For reduced electricity consumption, also check the consumption in the design point. If the consumption is high, change the pump or the design.
- Note that even a carefully drafted pressure loss calculation can have a margin of error as high as +/− 20 %, and that the pressure loss usually grows as the system ages.

32.3.1 Wilo-Yonos PARA GT 7.5 PWM1

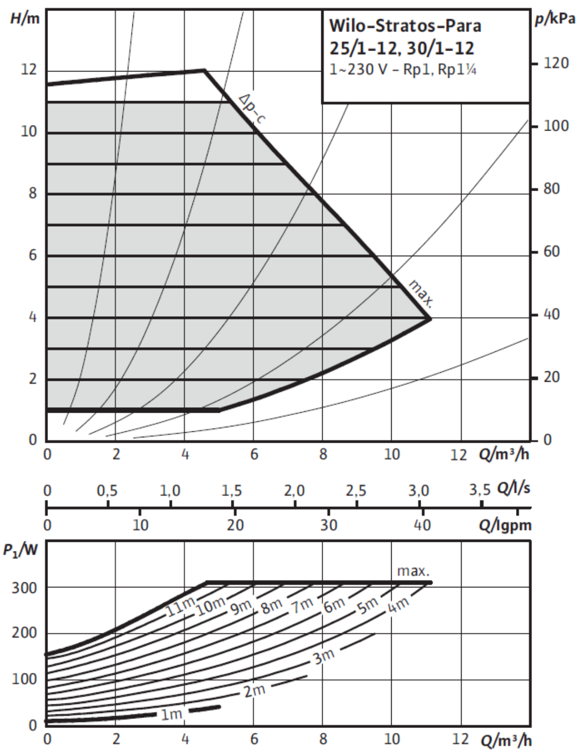


32.3.2 Wilo-Stratos PARA 1-9 T10

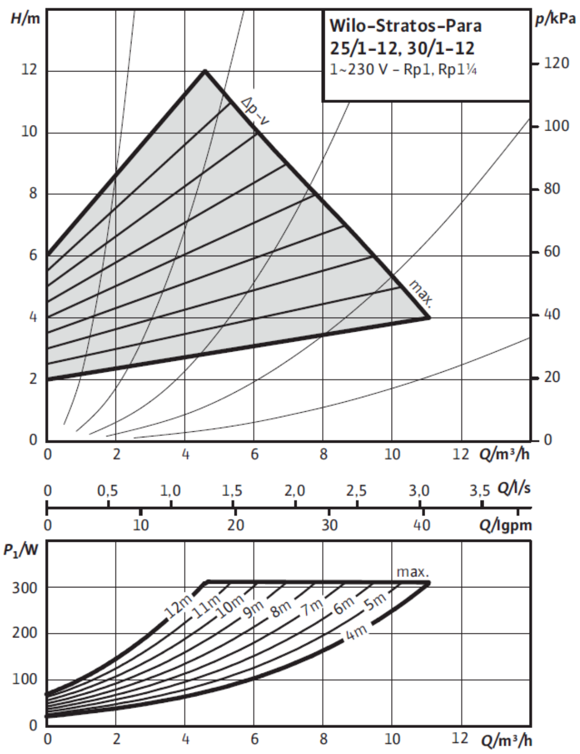


32.3.3 Wilo-Stratos PARA 1-12 T16

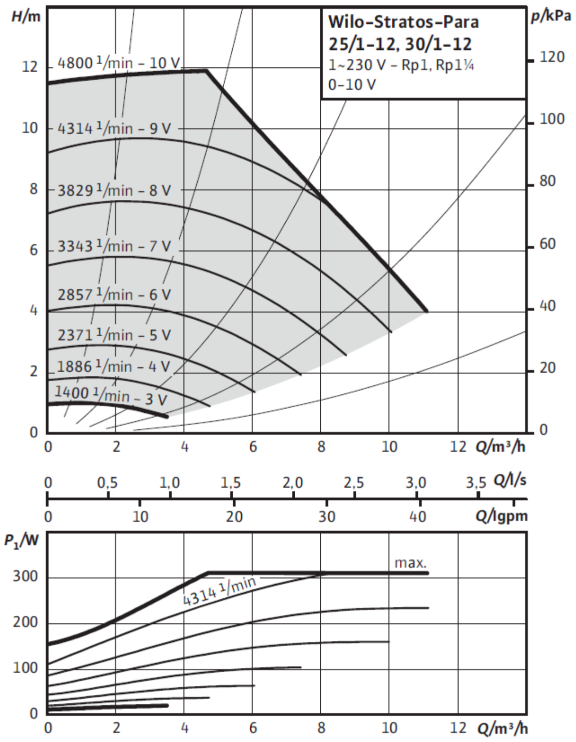
Δp-c (constant)



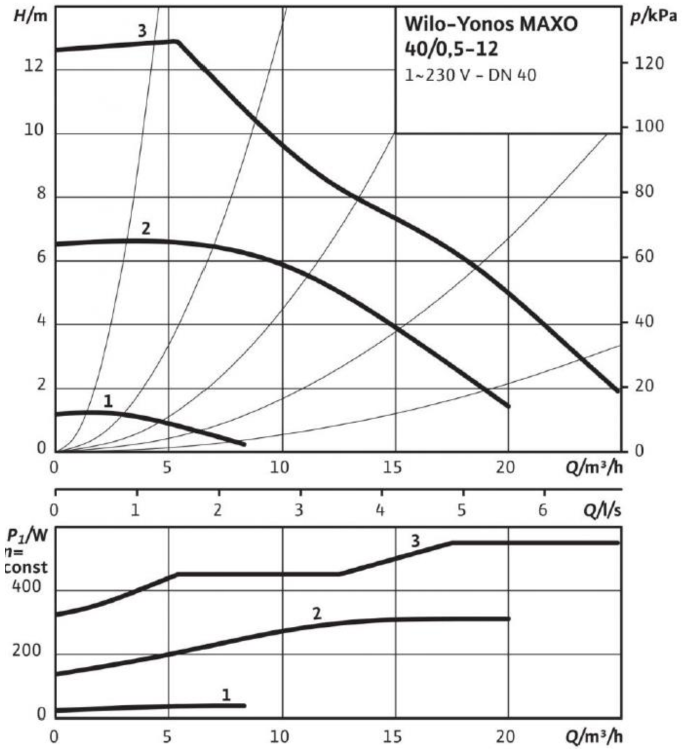
Δp-v (variable)

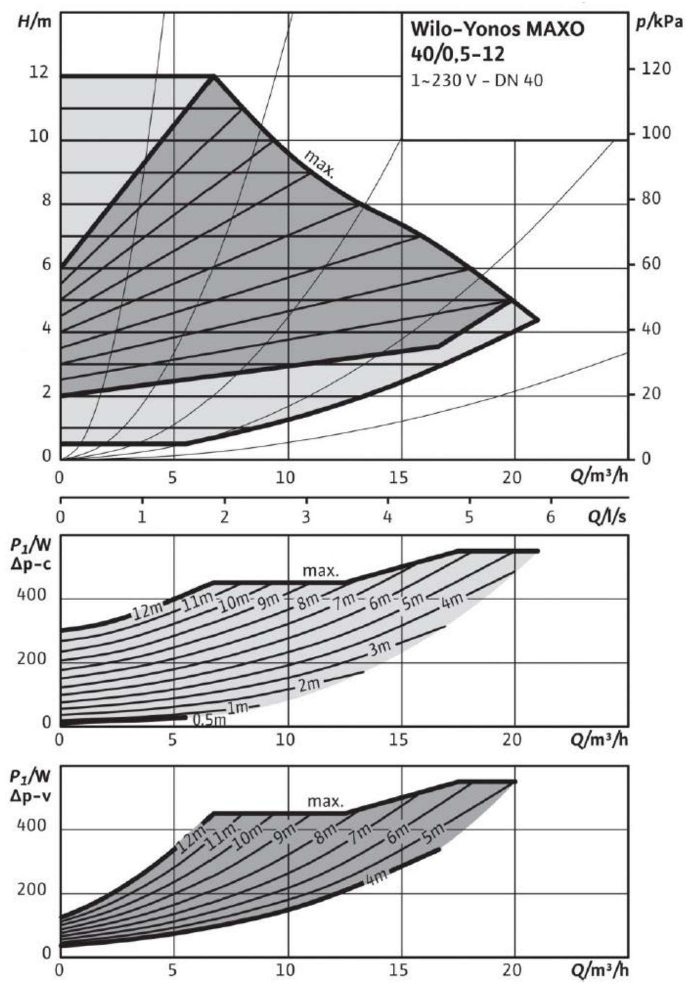


External control mode via Analog-In 0–10 V

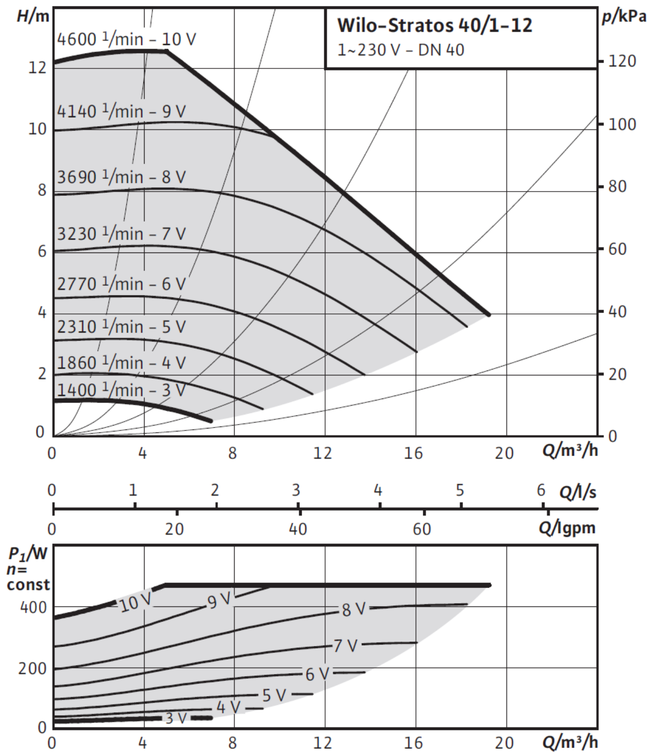


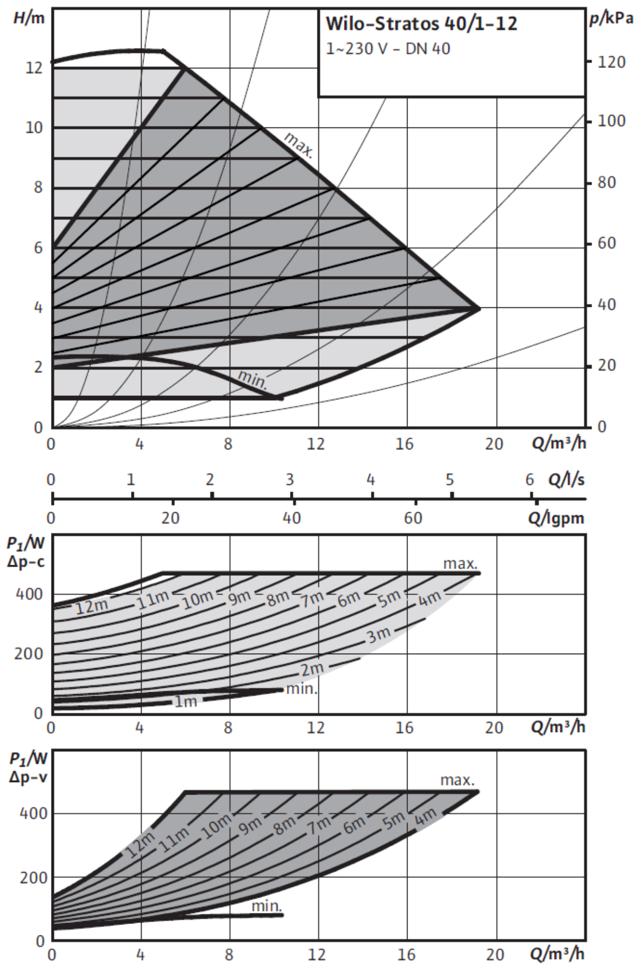
32.3.4 Wilo-Yonos MAXO 40/0.5-12



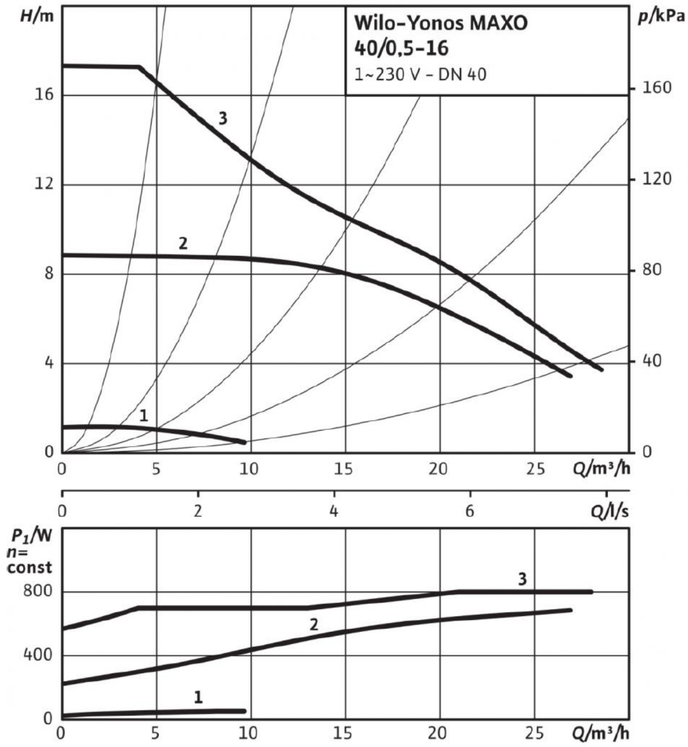


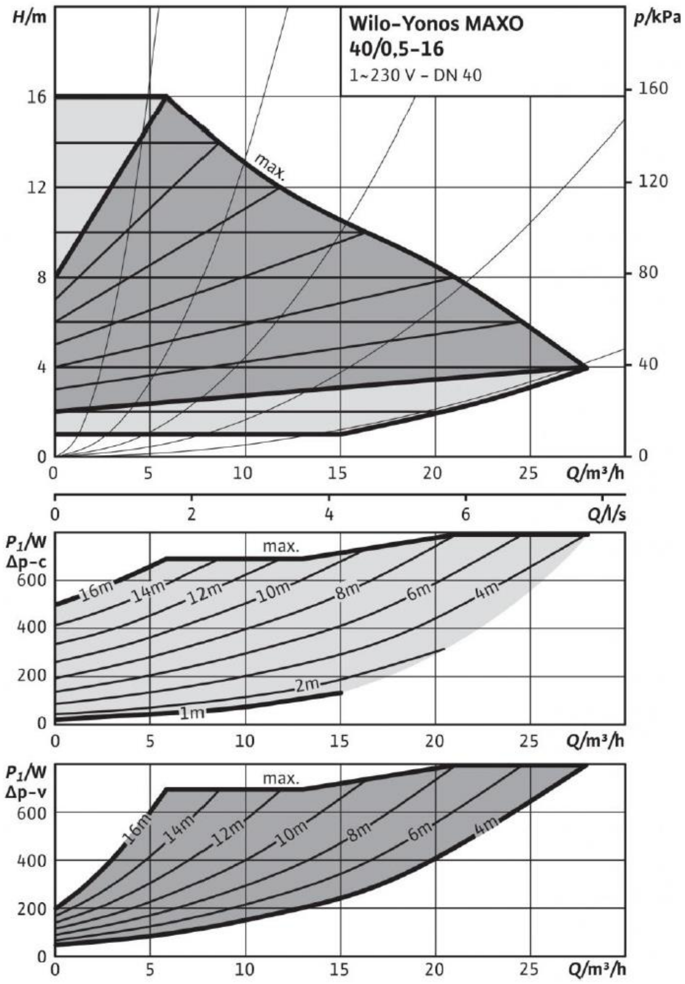
32.3.5 Wilo-Stratos 40/1-12



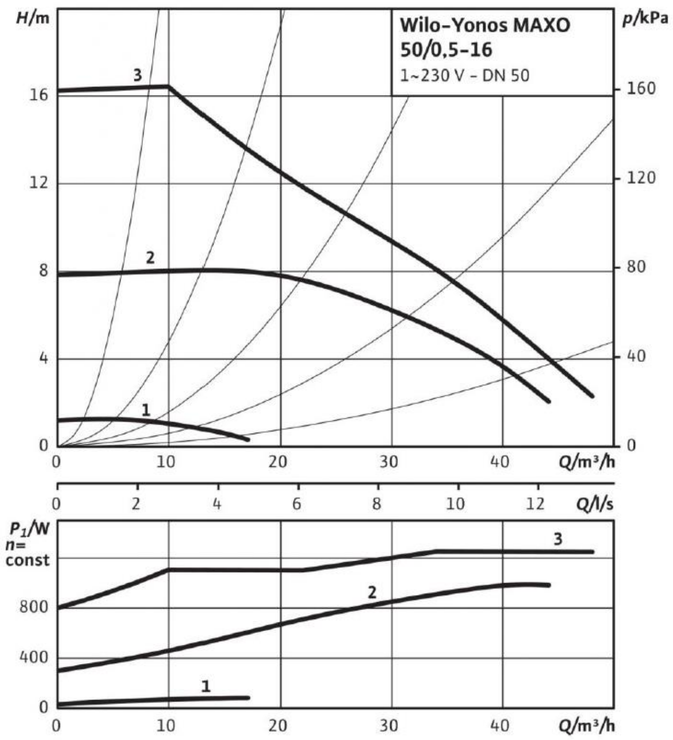


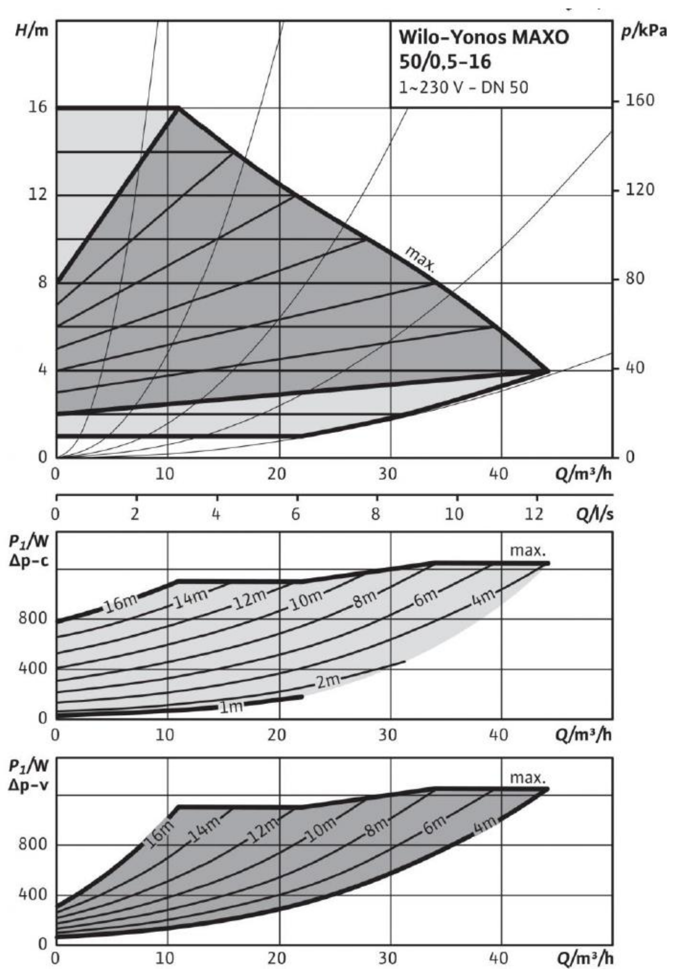
32.3.6 Wilo-Yonos MAXO 40/0.5-16



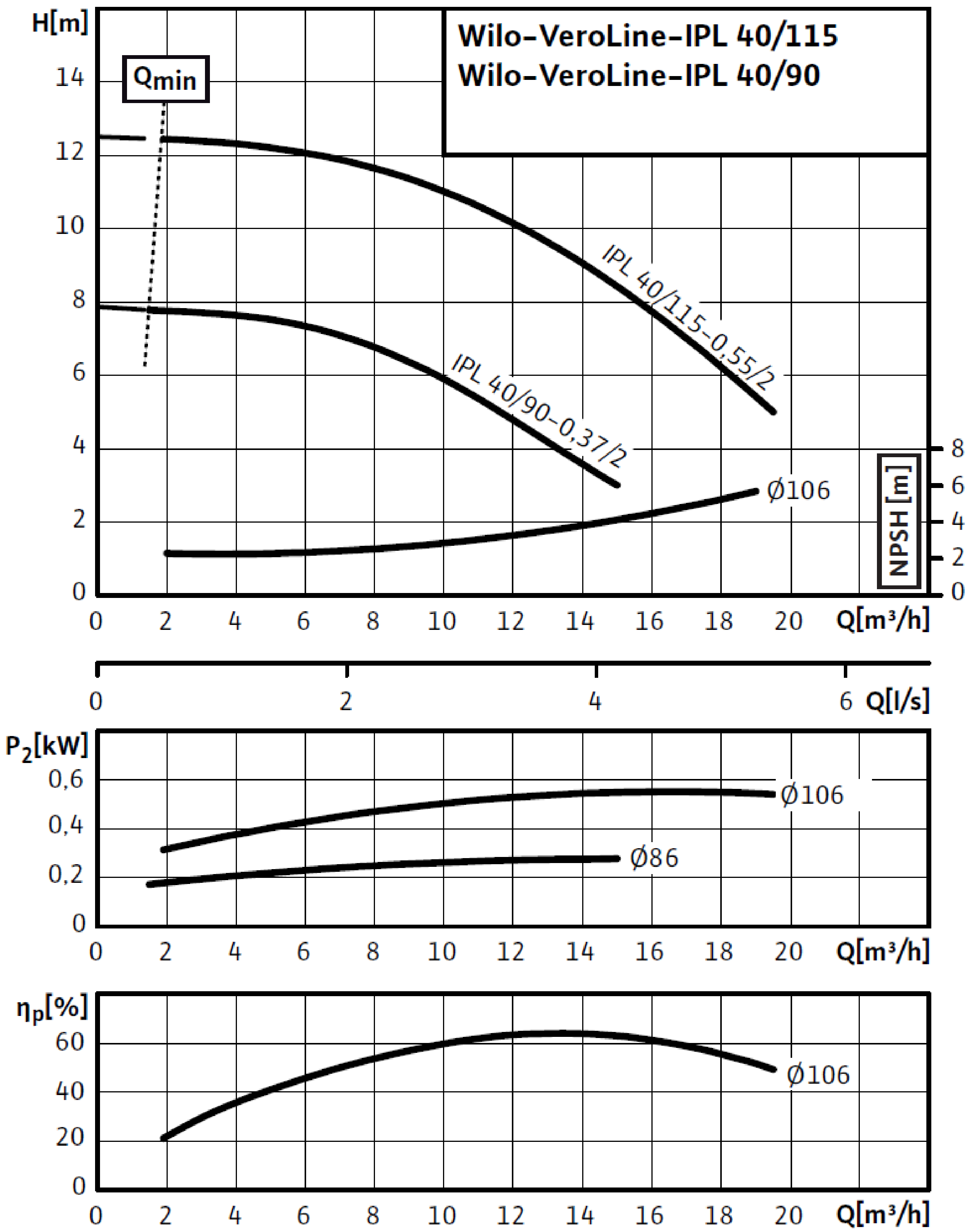


32.3.7 Wilo-Yonos MAXO 50/0.5-16

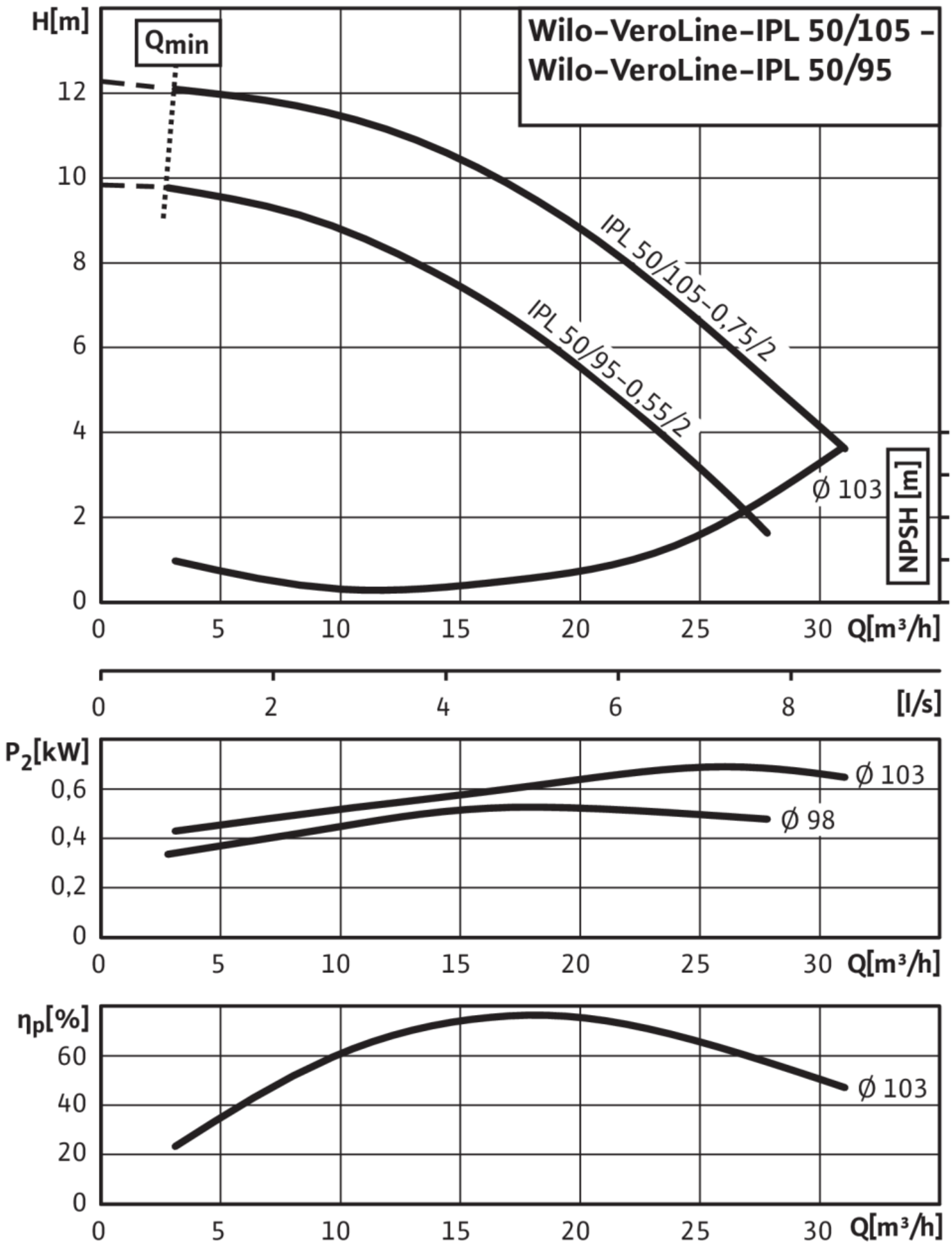




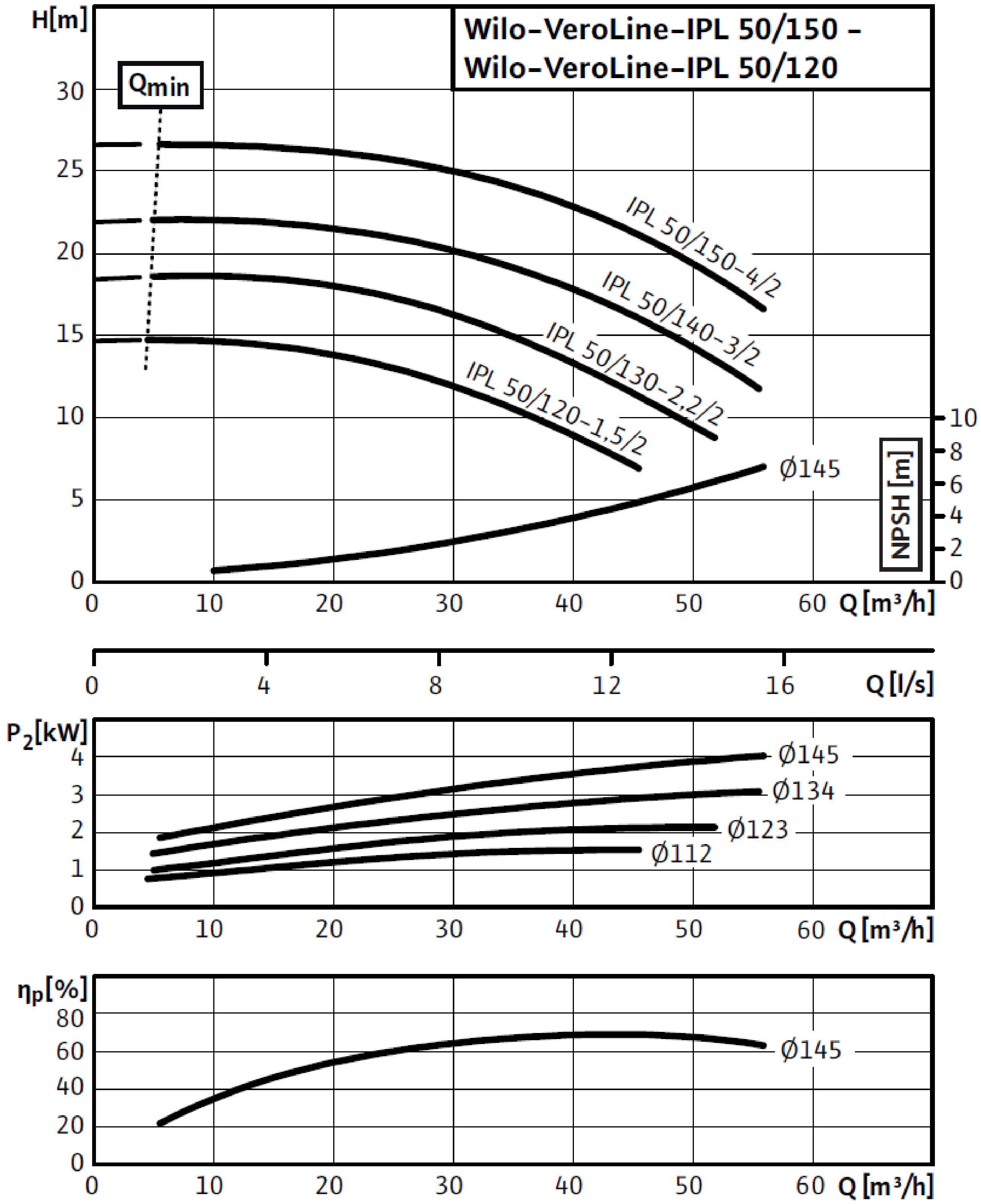
32.3.8 Wilo-Veroline-IPL 40/115-0.55/2



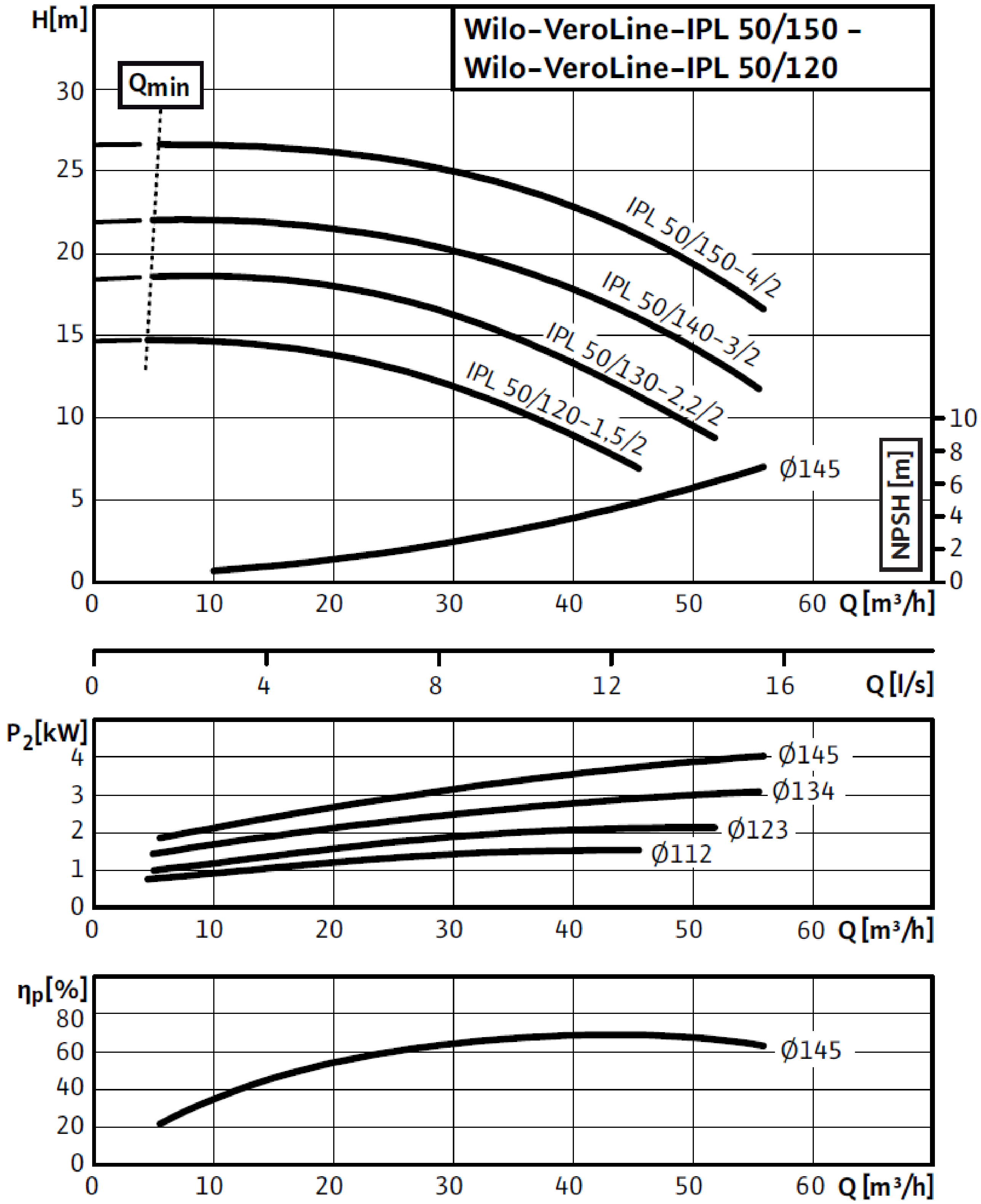
32.3.9 Wilo-Veroline-IPL 50/105-0.75/2



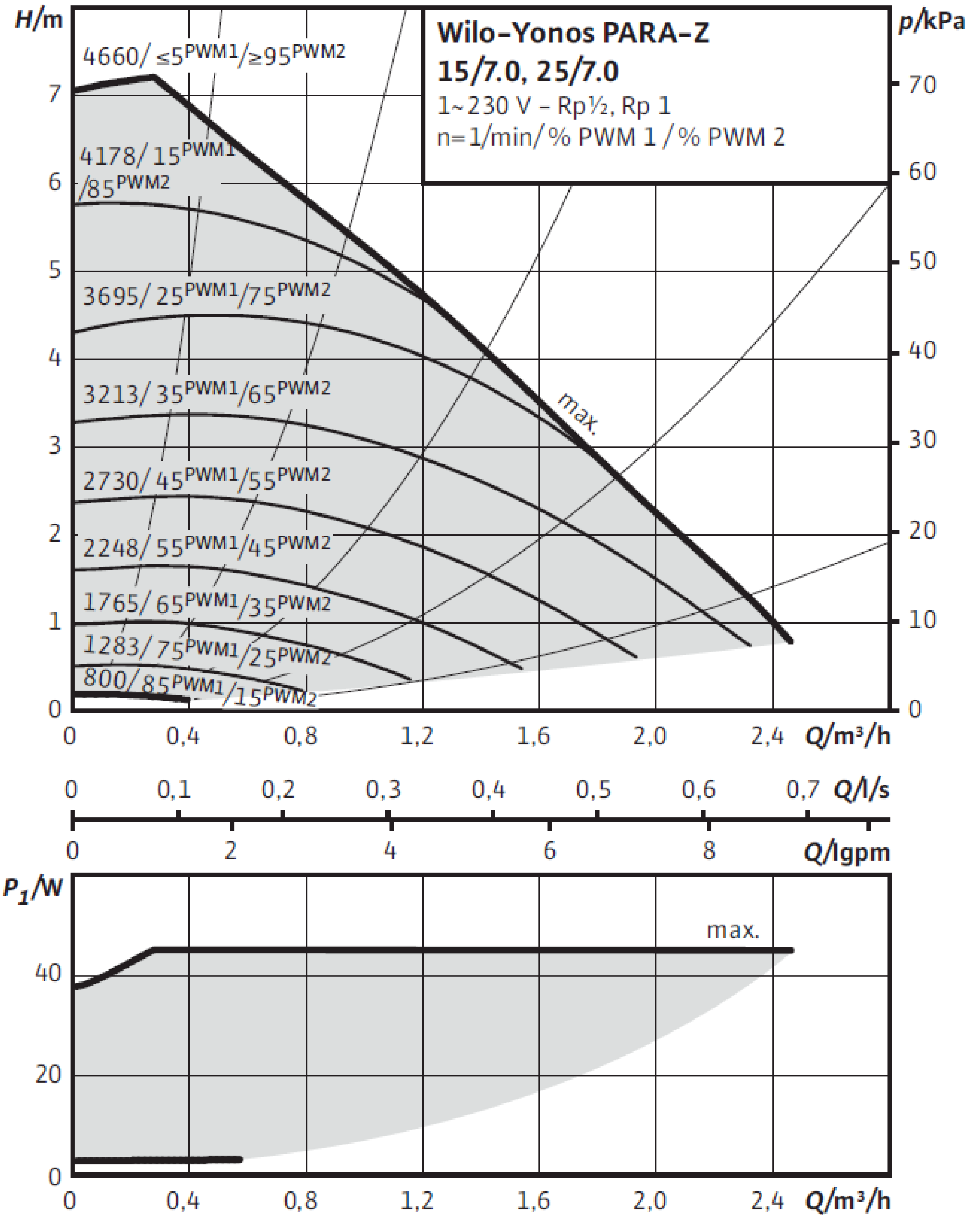
32.3.10 Wilo-Veroline-IPL 50/120-1.5/2



32.3.11 Wilo-VeroLine-IPL 50/130-2.2/2



32.3.12 Wilo-Yonos PARA Z 25/7.0 PWM2



33 Material properties

33.1 Water

	ρ	cp	μ	k
Temperature °C	kg/m^3	kJ/(kg·K)	mPa·s	W/(m·K)
5.0	1000,0	4.20	1.52	0.571
10.0	999.8	4.19	1.31	0.580
15.0	999.2	4.19	1.14	0.589
20.0	998.3	4.18	1.00	0.599
25.0	997.1	4.18	0.89	0.607
30.0	995.7	4.18	0.80	0.616
32.5 (30 °C / 35 °C dimensioning)	994.9	4.18	0.76	0.620
35.0	994.1	4.18	0.72	0.623
40.0	992.3	4.18	0.65	0.631
45.0	990,3	4.18	0.60	0.637
50.0	988.1	4.18	0,55	0.644
55.0	985.7	4.18	0.50	0.649
65.0	980.6	4.19	0.43	0.659
70.0	977.8	4.19	0.40	0.663
75.0	974.9	4.19	0.38	0.667

ρ: density
c_p: specific heat capacity at constant pressure
μ: viscosity, mPa·s = cP = centipoise
k: thermal conductivity

Water: NIST Standard Reference Database 23, Version 9.0
Water and ethanol solution: Properties of Secondary Working Fluids for Indirect Systems, editor Melinder Åke, International Institute of Refrigeration, 2010

33.2 Water and ethanol solution

WATER AND ETHANOL SOLUTION, 28 m-% OF ETHANOL

Water and ethanol solution, 28 m-% ethanol	ρ	cp	μ	k
Temperature °C	kg/m^3	kJ/(kg·K)	mPa·s	W/(m·K)
−15.0	973.1	4.17	16.84	0.397
−10,0	971.4	4.19	11.90	0.400
−9.0	971.1	4.19	11.14	0.401
−8.0	970.7	4.19	10.45	0.402
−7.0	970.3	4.19	9.80	0.402
−6,0	969.9	4.20	9.21	0.403
−5,0	969.5	4.20	8.67	0.404
−4.0	969.1	4.20	8.16	0.404
−3.0	968.7	4.21	7.70	0.405
−2.0	968.3	4.21	7.26	0.406
−1,5	968.1	4.21	7.06	0.406
−1,0	967.9	4.21	6.86	0.407
0.0	967.5	4.21	6.49	0.407
1.0	967.0	4.22	6.15	0.408
2.0	966.6	4.22	5.83	0.409
3.0	966.1	4.22	5.53	0.409
4.0	965.6	4.22	5.25	0.410
5.0	965.2	4.22	4.99	0.411
6.0	964.7	4.23	4.75	0.411
7.0	964.2	4.23	4.52	0.412
8.0	963.7	4.23	4.31	0.413
9.0	963.2	4.23	4.11	0.414
10.0	962.7	4.23	3.93	0.414
15.0	960.1	4,24	3.15	0.418

The freezing point for brine is -18 °C for the source used. Altia Naturet's technical data has the value -17 °C.

ρ: density
c_p: specific heat capacity at constant pressure
μ: viscosity, mPa·s = cP = centipoise
k: thermal conductivity

Water and ethanol solution: Properties of Secondary Working Fluids for Indirect Systems, editor Melinder Åke, International Institute of Refrigeration, 2010

EUPRODUCT FICHE

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	COMMISSION DELEGATED REGULATION (EU) No 811/2013 ANNEX IV	COMMISSION DELEGATED REGULATION (EU) No 811/2013 ANNEX IV									
	PRODUCT FICHE, SPACE HEATERS	PRODUCT FICHE, SPACE HEATERS									
a	supplier's name or trademark	supplier's name or trademark			Oilon	Oilon	Oilon	Oilon	Oilon	Oilon	Oilon
b	supplier's model identifier	supplier's model identifier			Junior ECO 4 03 Junior GT 4 03 Cube 4 03 Cube House 4 03	Junior ECO 6 03 Junior GT 6 03 Cube 6 03 Cube House 6 03	Junior ECO 8 03 Junior GT 8 03 Cube 8 03 Cube House 8 03	Junior ECO 10 03 Junior GT 10 03 Cube 10 03 Cube House 10 03	Junior ECO 13 03 Junior GT 13 03 Cube 13 03	Junior ECO 17 03 Junior GT 17 03	Junior ECO 21 03 Junior GT 21 03
	STANDARD RATING CONDITIONS (BRINE 0/−3 °C, WATER 47/55 °C), AVERAGE CLIMATE CONDITIONS	RATED CONDITIONS (BRINE 0/−3 °C, WATER 47/55 °C), AVERAGE CLIMATE CONDITIONS									
c	seasonal space heating energy efficiency class (starting from 26/9/2016), water 47/55 °C	energy efficiency class in building space heating (starting 26.9.2016), water 47/55 °C			A++	A++	A++	A++	A++	A++	A++
c	seasonal space heating energy efficiency class (starting from 26/9/2019*), water 47/55 °C	energy efficiency class in building space heating (starting 26.9.2019*), water 47/55 °C			A++	A++	A++	A+++	A+++	A+++	A+++
d	total rated heat output of heat pump and supplementary heater	combined rated heat output of the heat pump and electric immersion heater	P_{rated} + P_{sup}	kW	4 + 6	5 + 6	7 + 6	9 + 6	12 + 6	15 + 6	19 + 6
e	seasonal space heating energy efficiency	seasonal space heating energy efficiency	η_s	%	141	145	150	157	157	156	159
f	annual electricity consumption to space heating	space heating energy consumption per year	Q_{HE}	kWh	2438	2821	3629	4689	5969	7940	9631
g	sound power level	sound power level	L_{WA}	dB(A)	Junior ECO 40 Junior GT 40 Cube 40 Cube House 40	Junior ECO 40 Junior GT 40 Cube 40 Cube House 40	Junior ECO 44 Junior GT 44 Cube 44 Cube House 44	Junior ECO 45 Junior GT 45 Cube 45 Cube House 45	Junior ECO 47 Junior GT 47 Cube 47 Cube House 47	Junior ECO 48 Junior GT 48	Junior ECO 46 Junior GT 46
h	specific precautions that shall be taken when the space heater is assembled, installed or maintained	specific precautions that shall be taken when the space heater is assembled, installed or maintained			1)	1)	1)	1)	1)	1)	1)
	STANDARD RATING CONDITIONS (BRINE 0/−3 °C, WATER 47/55 °C), COLDER AND WARMER CLIMATE CONDITIONS	RATED CONDITIONS (BRINE 0/−3 °C, WATER 47/55 °C), COLDER AND WARMER CLIMATE CONDITIONS									
j	total rated heat output of heat pump and supplementary heater under colder climate conditions	combined rated heat output of the heat pump and electric immersion heater in colder climate conditions	P_{rated} + P_{sup}	kW	4 + 6	5 + 6	7 + 6	9 + 6	12 + 6	15 + 6	19 + 6
j	total rated heat output of heat pump and supplementary heater under warmer climate conditions	combined rated heat output of the heat pump and electric immersion heater in warmer climate conditions	P_{rated} + P_{sup}	kW	4 + 6	5 + 6	7 + 6	9 + 6	12 + 6	15 + 6	19 + 6
k	seasonal space heating energy efficiency under colder climate conditions	seasonal space heating energy efficiency in colder climate conditions	η_s	%	146	150	156	162	162	161	164
k	seasonal space heating energy efficiency under warmer climate conditions	seasonal space heating energy efficiency in warmer climate conditions	η_s	%	143	146	152	158	159	158	161
l	annual electricity consumption to space heating under colder climate conditions	space heating energy consumption per year in colder climate conditions	Q_{HE}	kWh	2817	3259	4181	5413	6892	9177	11146
l	annual electricity consumption to space heating under warmer climate conditions	space heating energy consumption per year in warmer climate conditions	Q_{HE}	kWh	1563	1808	2317	2997	3818	5075	6157

	COMMISSION DELEGATED REGULATION (EU) No 811/2013, ANNEX IV	COMMISSION DELEGATED REGULATION (EU) No 811/2013 ANNEX IV							
	PRODUCT FICHE, COMBINATION HEATERS	**PRODUCT FICHE, COMBINATION HEATERS**							
a	supplier’s name or trademark	supplier's name or trademark			Oilon	Oilon	Oilon	Oilon	Oilon
b	supplier’s model identifier	supplier's model identifier			Cube 4 03 Cube House 4 03	Cube 6 03 Cube House 6 03	Cube 8 03 Cube House 8 03	Cube 10 03 Cube House 10 03	Cube 13 03 Cube House 13 03
	STANDARD RATING CONDITIONS (BRINE 0/−3 °C, WATER 47/55 °C), AVERAGE CLIMATE CONDITIONS	RATED CONDITIONS (BRINE 0/−3 °C, WATER 47/55 °C), AVERAGE CLIMATE CONDITIONS							
c	space heating application: medium temperature	space heating application			B 0 °C / W 55 °C	B 0 °C / W 55 °C	B 0 °C / W 55 °C	B 0 °C / W 55 °C	B 0 °C / W 55 °C
c	water heating load profile	water heating load profile			L	L	L	L	L
d	seasonal space heating energy efficiency class (starting from 26/9/2016), water 47/55 °C	energy efficiency class in building space heating (starting 26.9.2016), water 47/55 °C			A++	A++	A++	A++	A++
d	seasonal space heating energy efficiency class (starting from 26/9/2019*), water 47/55 °C	energy efficiency class in building space heating (starting 26.9.2019*), water 47/55 °C			A++	A++	A++	A+++	A+++
d	water heating energy efficiency class (starting from 26.9.2016)	energy efficiency class in DHW heating (starting September 26, 2019)			A	A	A	A	A
d	water heating energy efficiency class (starting from 26.9.2019*)	energy efficiency class in DHW heating (starting September 26, 2019*)			A	A	A	A	A
e	total rated heat output of heat pump and supplementary heater	combined rated heat output of the heat pump and electric immersion heater	$P_{rated} + P_{sup}$	kW	4 + 6	5 + 6	7 + 6	9 + 6	12 + 6
f	space heating annual electricity consumption	space heating energy consumption per year	Q_{HE}	kWh	2438	2821	3629	4689	5969
f	water heating annual electricity consumption	electricity consumption in DHW heating per year	*AEC*	kWh	1607	1571	1526	1462	1472
g	seasonal space heating energy efficiency	seasonal space heating energy efficiency	η_s	%	141	145	150	157	157
g	water heating energy efficiency	energy efficiency of DHW heating	η_{wh}	%	104	107	110	115	114
h	sound power level	sound power level	L_{WA}	dB(A)	40	40	44	45	47
i	heater is able to work only during off-peak hours	the combination heater can be timed to operate outside consumption peak periods			✓	✓	✓	✓	✓
j	specific precautions that shall be taken when the space heater is assembled, installed or maintained	specific precautions that shall be taken when the space heater is assem-bled, installed or maintained			1)	1)	1)	1)	1)
	STANDARD RATING CONDITIONS (BRINE 0/−3 °C, WATER 47/55 °C), COLDER AND WARMER CLIMATE CONDITIONS	RATED CONDITIONS (BRINE 0/−3 °C, WATER 47/55 °C), COLDER AND WARMER CLIMATE CONDITIONS							
k	total rated heat output of heat pump and supplementary heater under colder climate conditions	combined rated heat output of the heat pump and electric immersion heater in colder climate conditions	$P_{rated} + P_{sup}$	kW	4 + 6	5 + 6	7 + 6	9 + 6	12 + 6
k	total rated heat output of heat pump and supplementary heater under warmer climate conditions	combined rated heat output of the heat pump and electric immersion heater in warmer climate conditions	$P_{rated} + P_{sup}$	kW	4 + 6	5 + 6	7 + 6	9 + 6	12 + 6
l	annual electricity consumption to space heating under colder climate conditions	space heating energy consumption per year in colder climate conditions	Q_{HE}	kWh	2817	3259	4181	5413	6892
l	annual electricity consumption to space heating under warmer climate conditions	space heating energy consumption per year in warmer climate conditions	Q_{HE}	kWh	1563	1808	2317	2997	3818
l	annual electricity consumption to water heating under colder climate conditions	electricity consumption in DHW heating per year in colder climate conditions	*AEC*	kWh	1607	1571	1526	1462	1472
l	annual electricity consumption to water heating under warmer climate conditions	electricity consumption in DHW heating per year in warmer climate conditions	*AEC*	kWh	1607	1571	1526	1462	1472
m	seasonal space heating energy efficiency under colder climate conditions	seasonal space heating energy efficiency in colder climate conditions	η_s	%	146	150	156	162	162
m	seasonal space heating energy efficiency under warmer climate conditions	seasonal space heating energy efficiency in warmer climate conditions	η_s	%	143	146	152	158	159
m	water heating energy efficiency under colder climate conditions	DHW heating energy efficiency in colder climate conditions	η_{wh}	%	104	107	110	115	114
m	water heating energy efficiency under warmer climate conditions	DHW heating energy efficiency in warmer climate conditions	η_{wh}	%	104	107	110	115	114

COMMISSION REGULATION (EU) No 813/2013 ANNEX II TABLE 2	**COMMISSION REGULATION COMMISSION REGULATION (EU) No 813/2013 ANNEX II TABLE 2**									
Information requirements for heat pump space heaters and heat pump combination heaters	**Information requirements for heat pump space heaters and heat pump combination heaters**									
supplier's name or trademark	supplier's name or trademark			Oilon	Oilon	Oilon	Oilon	Oilon	Oilon	Oilon
supplier's model identifier	supplier's model identifier			Junior ECO 4 03 Junior GT 4 03 Cube 4 03 Cube House 4 03	Junior ECO 6 03 Junior GT 6 03 Cube 6 03 Cube House 6 03	Junior ECO 8 03 Junior GT 8 03 Cube 8 03 Cube House 8 03	Junior ECO 10 03 Junior GT 10 03 Cube 10 03 Cube House 10 03	Junior ECO 13 03 Junior GT 13 03 Cube 13 03	Junior ECO 17 03 Junior GT 17 03	Junior ECO 21 03 Junior GT 21 03
air-to-water heat pump	Air-to-water heat pump			-	-	-	-	-	-	-
water-to-water heat pump	Water-to-water heat pump			✓	✓	✓	✓	✓	✓	✓
brine-to-water heat pump	Brine-to-water heat pump			✓	✓	✓	✓	✓	✓	✓
equipped with a supplementary heater	equipped with a supplementary heater			✓	✓	✓	✓	✓	✓	✓
heat pump combination heater	Combination heater			Cube: Cube House: Junior ECO: - Junior GT: -	Cube: Cube House: Junior ECO: - Junior GT: -	Cube: Cube House: Junior ECO: - Junior GT: -	Cube: Cube House: Junior ECO: - Junior GT: -	Cube: Cube House: Junior ECO: - Junior GT: -	Cube: Junior ECO: - Junior GT: -	Cube: Junior ECO: - Junior GT: -
MEDIUM-TEMPERATURE APPLICATION (BRINE 0/−3 °C, WATER 47/55 °C), AVERAGE CLIMATE CONDITIONS	AVERAGE TEMPERATURE APPLICATION (BRINE 0/−3 °C, WATER 47/55 °C), AVERAGE CLIMATE CONDITIONS									
rated heat output	rated heat output	P_{rated}	kW	4	5	7	9	12	15	19
seasonal space heating energy efficiency	seasonal space heating energy efficiency	η_s	%	141	145	150	157	157	156	159
bivalent temperature	bivalent temperature	T_{biv}	°C	-	-	-	-	-	-	-
cycling interval capacity	cycling interval capacity for heating	P_{cych}	kW	-	-	-	-	-	-	-
degradation co-efficient	Degradation coefficient	*Cdh*	-	0.9	0.9	0.9	0.9	0.9	0.9	0.9
DECLARED CAPACITY AND COEFFICIENT OF PERFORMANCE FOR PART LOAD AT INDOOR TEMPERATURE 20 °C AND SPECIFIED OUTDOOR TEMPERATURE BELOW (BRINE 0/−3 °C)	DECLARED CAPACITY FOR HEATING AND THE HEATING COEFFICIENT FOR PARTIAL LOAD AT AN INDOOR TEMPERATURE OF 20 °C AND THE OUTSIDE TEMPERATURES AND FLOW TEMPERATURES GIVEN BELOW (BRINE 0/-3 °C)									
−7 °C	Outside temperature −7 °C, flow 52 °C	*Pdh*	kW	4.3	5.2	6.9	9.3	11.8	15.6	19.4
+2 °C	Outside temperature 2 °C, flow 42 °C	*Pdh*	kW	4.5	5.4	7.2	9.7	12.4	16.4	20.4
+7 °C	Outside temperature 7 °C, flow 36 °C	*Pdh*	kW	4.7	5.6	7.3	10.0	12.7	16.9	21.0
+12 °C	Outside temperature 12 °C, flow 30 °C	*Pdh*	kW	4.8	5.7	7.5	10.2	13.0	17.4	21.6
−7 °C	Outside temperature −7 °C, flow 55 °C	*Pdh*	kW	4.3	5.1	6.8	9.1	11.7	15.4	19.1
bivalent temperature	bivalent temperature	T_{biv}	°C	-	-	-	-	-	-	-
operating limit temperature	operating limit temperature (outside temperature)	*TOL*	°C	-	-	-	-	-	-	-
DECLARED COEFFICIENT OF PERFOR-MANCE FOR PART LOAD AT INDOOR TEMPERATURE 20 °C AND SPECIFIED OUTDOOR TEMPERATURE (BRINE 0/−3 °C)	DECLARED HEATING COEFFICIENT FOR PARTIAL LOAD AT AN INDOOR TEMPER-ATURE OF 20 °C AND THE OUTSIDE TEMPERATURE GIVEN BELOW (BRINE 0/−3 °C)									
−7 °C	Outside temperature −7 °C, flow 52 °C	*COPd*	-	2.82	2.88	2.96	3.10	3.08	3.10	3.20
+2 °C	Outside temperature 2 °C, flow 42 °C	*COPd*	-	3.61	3.70	3.80	3.97	3.99	3.96	4.05
+7 °C	Outside temperature 7 °C, flow 36 °C	*COPd*	-	4.17	4.29	4.46	4.63	4.65	4.59	4.67
+12 °C	Outside temperature 12 °C, flow 30 °C	*COPd*	-	4.83	4.97	5.34	5.41	5.41	5.34	5.38
−7 °C	Outside temperature −7 °C, flow 55 °C	*COPd*	-	2.61	2.67	2.75	2.87	2.85	2.88	2.98
bivalent temperature	bivalent temperature	T_{biv}	°C	-	-	-	-	-	-	-
operating limit temperature	operating limit temperature (outside temperature)	*TOL*	°C	-	-	-	-	-	-	-
POWER CONSUMPTION	POWER CONSUMPTION									
off mode	when the device is in OFF mode	P_{OFF}	kW	0.00	0.00	0.00	0.00	0.00	0.00	0.00
thermostat off mode	when the thermostat is not requesting heat	P_{TO}	kW	0.01	0.01	0.01	0.01	0.01	0.01	0.01
standby mode	on standby	P_{SB}	kW	0.01	0.01	0.01	0.01	0.01	0.01	0.01
crankcase heater mode	in crankcase heating mode	P_{CK}	kW	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUPPLEMENTARY HEATER	SUPPLEMENTARY HEATER									
rated heat output	rated heat output		kW	-	-	-	-	-	-	-
type of energy input	type of energy input		-	-	-	-	-	-	-	-
OTHER ITEMS	OTHER ITEMS									
variable capacity control	capacity control		-	✓	✓	✓	✓	✓	✓	✓

	sound power level	sound power level	L_{WA}	dB(A)	Junior ECO 40 Junior GT 40 Cube 40 Cube House 40	Junior ECO 40 Junior GT 40 Cube 40 Cube House 40	Junior ECO 44 Junior GT 44 Cube 44 Cube House 44	Junior ECO 45 Junior GT 45 Cube 45 Cube House 45	Junior ECO 47 Junior GT 47 Cube 47 Cube House 47	Junior ECO 48 Junior GT 48	Junior ECO 46 Junior GT 46
	rated brine flow (brine 0/−3 °C, water 47/55 °C)	brine volume flow (brine 0/−3 °C, brine water-ethanol 30 m-%, water 47/55 °C)		m3/h	0.8	1.0	1.3	1.8	2.3	3.1	3.9
	WATER HEATER	WATER HEATER									
	declared load profile	declared load profile		-	Cube: XL Cube House: XL	Cube: XL Cube House: XL	Cube: XL Cube House: XL	Cube: XL Cube House: XL	Cube: XL Cube House: XL		
	daily electricity consumption	daily electricity consumption	Q_{elec}	kWh/d	Cube: 7,307 Cube House: 7,307	Cube: 7,142 Cube House: 7,142	Cube: 6,935 Cube House: 6,935	Cube: 6,645 Cube House: 6,645	Cube: 6,691 Cube House: 6,691		
	water heating energy efficiency	water heating energy efficiency	η_{wh}	-	Cube: 104 Cube House: 104	Cube: 107 Cube House: 107	Cube: 110 Cube House: 110	Cube: 115 Cube House: 115	Cube: 114 Cube House: 114		
	NAME AND ADDRESS OF THE MANU-FACTURER:	NAME AND ADDRESS OF THE MANU-FACTURER									
	Oilon, Metsä-Pietilänkatu 1, Lahti, Finland	Oilon, Metsä-Pietilänkatu 1, Lahti, Finland									

1) Specific precautions that shall be taken when the space heater is assembled, installed or maintained: Pay attention to the safety, when tilting, lifting, carrying and moving the device. Always pay attention to electrical safety, when working with or near electrical components. Turn off power at the main switch and always ensure that the device is de-energized before carrying out any electrical work. Pay attention to the safety, when handling refrigerant and compressor oil. The weight of the device, electricity, refrigerant and refrigeration oil can cause a serious injury.

Disassembly, recycling, and/or handling after use: Recover the refrigerant and the compressor oil, and recycle or dispose of them as required by the legislation. Recycle and dispose of other components also in compliance with the valid legislation.

The values are rounded to the nearest integer in accordance with the regulation.

The values in the table apply only when calculation rules and assumptions for the ecodesign and energy labelling regulation are used. The values for the actual building may differ considerably from those presented here.

*The highest valid seasonal space heating energy efficiency class is A++ and the highest water heating energy efficiency class is A in the regulation before 26.9.2019. Space heating class A+++ and domestic water heating class A+ come into effect on September 26, 2019.

1) Specific precautions that shall be taken when the space heater is assembled, installed or maintained: Be careful when tilting, lifting, carrying and moving the unit. Be careful when working with or near electrical components. Always switch off electricity using the main switch and ensure that the device is de-energized before doing any electrical work. Be careful when working with the refrigerant or with the compressor oil. The weight of the unit, electricity, refrigerant and refrigerant oil can cause a serious injury.

Information relevant for disassembly, recycling and/or disposal at end-of-life: Recycle and dispose the refrigerant, compressor oil and all other fluids and components according to legislation.

Values have been rounded to the nearest integer as required by the regulation.

The values presented are based on the conditions and calculation rules presented in the regulation. The performance in a real system may differ from the values presented.

*The highest valid seasonal space heating energy efficiency class is A++ and the highest water heating energy efficiency class is A in the regulation before 26.9.2019. Space heating class A+++ and water heating class A+ come into force 26.9.2019.

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	COMMISSION DELEGATED REGULATION (EU) No 811/2013 ANNEX IV	COMMISSION DELEGATED REGULATION (EU) No 811/2013 ANNEX IV								
	PRODUCT FICHE, SPACE HEATERS	**PRODUCT FICHE, SPACE HEATERS**								
a	supplier’s name or trademark	supplier's name or trademark			Oilon	Oilon	Oilon	Oilon	Oilon	Oilon
b	supplier’s model identifier	supplier's model identifier			RE 04 28 HT	RE 04 28	RE 04 33	RE 04 38	RE 04 42	RE 04 48
	STANDARD RATING CONDITIONS (BRINE 0/−3 °C, WATER 47/55 °C), AVERAGE CLIMATE CONDITIONS	RATED CONDITIONS (BRINE 0/−3 °C, WATER 47/55 °C), AVERAGE CLIMATE CONDITIONS								
c	seasonal space heating energy efficiency class (starting from 26/9/2016), water 47/55 °C	energy efficiency class in building space heating (starting 26.9.2016), water 47/55 °C			A++	A++	A++	A++	A++	A++
c	seasonal space heating energy efficiency class (starting from 26/9/2019*), water 47/55 °C	energy efficiency class in building space heating (starting 26.9.2019*), water 47/55 °C			A++	A+++	A+++	A+++	A+++	A+++
d	total rated heat output of heat pump and supplementary heater	combined rated heat output of the heat pump and electric immersion heater	$P_{rated} + P_{sup}$	kW	25 + 0	28 + 0	34 + 0	38 + 0	42 + 0	49 + 0
e	seasonal space heating energy efficiency	seasonal space heating energy efficiency	η_s	%	150	165	163	160	163	162
f	annual electricity consumption to space heating	space heating energy consumption per year	Q_{HE}	kWh	13366	13572	16530	18956	20775	24204
g	sound power level	sound power level	L_{WA}	dB(A)	68					
h	specific precautions that shall be taken when the space heater is assembled, installed or maintained	specific precautions that shall be taken when the space heater is assembled, installed or maintained			1)	1)	1)	1)	1)	1)
	STANDARD RATING CONDITIONS (BRINE 0/−3 °C, WATER 47/55 °C), COLDER AND WARMER CLIMATE CONDITIONS	RATED CONDITIONS (BRINE 0/−3 °C, WATER 47/55 °C), COLDER AND WARMER CLIMATE CONDITIONS								
j	total rated heat output of heat pump and supplementary heater under colder climate conditions	combined rated heat output of the heat pump and electric immersion heater in colder climate conditions	$P_{rated} + P_{sup}$	kW	25 + 0	28 + 0	34 + 0	38 + 0	42 + 0	49 + 0
j	total rated heat output of heat pump and supplementary heater under warmer climate conditions	combined rated heat output of the heat pump and electric immersion heater in warmer climate conditions	$P_{rated} + P_{sup}$	kW	25 + 0	28 + 0	34 + 0	38 + 0	42 + 0	49 + 0
k	seasonal space heating energy efficiency under colder climate conditions	seasonal space heating energy efficiency in colder climate conditions	η_s	%	154	170	168	164	168	167
k	seasonal space heating energy efficiency under warmer climate conditions	seasonal space heating energy efficiency in warmer climate conditions	η_s	%	152	167	165	161	165	164
l	annual electricity consumption to space heating under colder climate conditions	space heating energy consumption per year in colder climate conditions	Q_{HE}	kWh	15581	15722	19170	22036	24124	28132
l	annual electricity consumption to space heating under warmer climate conditions	space heating energy consumption per year in warmer climate conditions	Q_{HE}	kWh	8564	8679	10576	12142	13294	15490

	COMMISSION REGULATION (EU) No 813/2013 ANNEX II TABLE 2	**COMMISSION REGULATION COMMISSION REGULATION (EU) No 813/2013 ANNEX II TABLE 2**								
	Information requirements for heat pump space heaters and heat pump combination heaters	**Information requirements for heat pump space heaters and heat pump combination heaters**								
	supplier’s name or trademark	supplier's name or trademark			Oilon	Oilon	Oilon	Oilon	Oilon	Oilon
	supplier’s model identifier	supplier's model identifier			RE 04 28 HT	RE 04 28	RE 04 33	RE 04 38	RE 04 42	RE 04 48
	air-to-water heat pump	Air-to-water heat pump			-	-	-	-	-	-
	water-to-water heat pump	Water-to-water heat pump			✓	✓	✓	✓	✓	✓
	brine-to-water heat pump	Brine-to-water heat pump			✓	✓	✓	✓	✓	✓
	equipped with a supplementary heater	equipped with a supplementary heater			-	-	-	-	-	-
	heat pump combination heater	Combination heater			-	-	-	-	-	-
	MEDIUM-TEMPERATURE APPLICATION (BRINE 0/−3 °C, WATER 47/55 °C), AVERAGE CLIMATE CONDITIONS	AVERAGE TEMPERATURE APPLICATION (BRINE 0/−3 °C, WATER 47/55 °C), AVERAGE CLIMATE CONDITIONS								
	rated heat output	rated heat output	P_{rated}	kW	25	28	34	38	42	49
	seasonal space heating energy efficiency	seasonal space heating energy efficiency	η_s	%	150	165	163	160	163	162
	bivalent temperature	bivalent temperature	T_{biv}	°C	-	-	-	-	-	-
	cycling interval capacity	cycling interval capacity for heating	P_{cych}	kW	-	-	-	-	-	-
	degradation co-efficient	Degradation coefficient	*Cdh*	-	0.9	0.9	0.9	0.9	0.9	0.9
	DECLARED CAPACITY AND COEFFICIENT OF PERFORMANCE FOR PART LOAD AT INDOOR TEMPERATURE 20 °C AND SPECIFIED OUTDOOR TEMPERATURE BELOW (BRINE 0/−3 °C)	DECLARED CAPACITY FOR HEATING AND THE HEATING COEFFI-CIENT FOR PARTIAL LOAD AT AN INDOOR TEMPERATURE OF 20 °C AND THE OUTSIDE TEMPERATURES AND FLOW TEMPERA-TURES GIVEN BELOW (BRINE 0/-3 °C)								
	−7 °C	Outside temperature −7 °C, flow 52 °C	*Pdh*	kW	25.4	27.8	33.4	37.5	41.9	48.6
	+2 °C	Outside temperature 2 °C, flow 42 °C	*Pdh*	kW	26.7	27.7	32.8	36.9	41.6	48.1
	+7 °C	Outside temperature 7 °C, flow 36 °C	*Pdh*	kW	27.6	27.6	32.4	36.6	41.5	47.8
	+12 °C	Outside temperature 12 °C, flow 30 °C	*Pdh*	kW	28.5	27.6	32.0	36.1	41.5	47.4
	−7 °C	Outside temperature −7 °C, flow 55 °C	*Pdh*	kW	25.0	27.9	33.6	37.7	42.1	48.8
	bivalent temperature	bivalent temperature	T_{biv}	°C	-	-	-	-	-	-
	operating limit temperature	operating limit temperature (outside temperature)	*TOL*	°C	-	-	-	-	-	-
	DECLARED COEFFICIENT OF PERFORMANCE FOR PART LOAD AT INDOOR TEMPERATURE 20 °C AND SPECIFIED OUTDOOR TEMPERATURE (BRINE 0/−3 °C)	DECLARED HEATING COEFFICIENT FOR PARTIAL LOAD AT AN INDOOR TEMPERATURE OF 20 °C AND THE OUTSIDE TEMPERA-TURE GIVEN BELOW (BRINE 0/−3 °C)								
	−7 °C	Outside temperature −7 °C, flow 52 °C	*COPd*	-	3.20	3.34	3.32	3.31	3.37	3.36
	+2 °C	Outside temperature 2 °C, flow 42 °C	*COPd*	-	3.83	4.20	4.16	4.08	4.16	4.13
	+7 °C	Outside temperature 7 °C, flow 36 °C	*COPd*	-	4.28	4.81	4.74	4.59	4.69	4.66
	+12 °C	Outside temperature 12 °C, flow 30 °C	*COPd*	-	4.80	5.51	5.38	5.17	5.26	5.25
	−7 °C	Outside temperature −7 °C, flow 55 °C	*COPd*	-	3.03	3.11	3.10	3.10	3.15	3.16
	bivalent temperature	bivalent temperature	T_{biv}	°C	-	-	-	-	-	-
	operating limit temperature	operating limit temperature (outside temperature)	*TOL*	°C	-	-	-	-	-	-
	POWER CONSUMPTION	POWER CONSUMPTION								
	off mode	when the device is in OFF mode	P_{OFF}	kW	0.00	0.00	0.00	0.00	0.00	0.00
	thermostat off mode	when the thermostat is not requesting heat	P_{TO}	kW	0.01	0.01	0.01	0.01	0.01	0.01
	standby mode	on standby	P_{SB}	kW	0.01	0.01	0.01	0.01	0.01	0.01
	crankcase heater mode	in crankcase heating mode	P_{CK}	kW	0.00	0.00	0.00	0.00	0.00	0.00
	SUPPLEMENTARY HEATER	SUPPLEMENTARY HEATER								
	rated heat output	rated heat output		kW	-	-	-	-	-	-
	type of energy input	type of energy input		-	-	-	-	-	-	-
	OTHER ITEMS	OTHER ITEMS								
	variable capacity control	capacity control		-	✓	✓	✓	✓	✓	✓
	sound power level	sound power level	L_{WA}	dB(A)	60	to be declared	to be declared	to be declared	to be declared	to be declared
	rated brine flow (brine 0/−3 °C, water 47/55 °C)	brine volume flow (brine 0/−3 °C, brine water-ethanol 30 m-%, water 47/55 °C)		m3/h	5.1	5.8	7.0	7.8	8.8	10.2
	WATER HEATER	WATER HEATER								
	declared load profile	declared load profile		-						
	daily electricity consumption	daily electricity consumption	Q_{elec}	kWh/d						
	water heating energy efficiency	water heating energy efficiency	η_{wh}	-						
	NAME AND ADDRESS OF THE MANUFACTURER:	NAME AND ADDRESS OF THE MANUFACTURER								
	Oilon, Metsä-Pietilänkatu 1, Lahti, Finland	Oilon, Metsä-Pietilänkatu 1, Lahti, Finland								

1) Specific precautions that shall be taken when the space heater is assembled, installed or maintained: Pay attention to the safety, when tilting, lifting, carrying and moving the device. Always pay attention to electrical safety, when working with or near electrical components. Turn off power at the main switch and always ensure that the device is de-energized before carrying out any electrical work. Pay attention to the safety, when handling refrigerant and compressor oil. The weight of the device, electricity, refrigerant and refrigeration oil can cause a serious injury.

Disassembly, recycling, and/or handling after use: Recover the refrigerant and the compressor oil, and recycle or dispose of them as required by the legislation. Recycle and dispose of other components also in compliance with the valid legislation.

The values are rounded to the nearest integer in accordance with the regulation.

The values in the table apply only when calculation rules and assumptions for the ecodesign and energy labelling regulation are used. The values for the actual building may differ considerably from those presented here.

*The highest valid seasonal space heating energy efficiency class is A++ and the highest water heating energy efficiency class is A in the regulation before 26.9.2019. Space heating class A+++ and domestic water heating class A+ come into effect on September 26, 2019.

1) Specific precautions that shall be taken when the space heater is assembled, installed or maintained: Be careful when tilting, lifting, carrying and moving the unit. Be careful when working with or near electrical components. Always switch off electricity using the main switch and ensure that the device is de-energized before doing any electrical work. Be careful when working with the refrigerant or with the compressor oil. The weight of the unit, electricity, refrigerant and refrigerant oil can cause a serious injury.

Information relevant for disassembly, recycling and/or disposal at end-of-life: Recycle and dispose the refrigerant, compressor oil and all other fluids and components according to legislation.

Values have been rounded to the nearest integer as required by the regulation.

The values presented are based on the conditions and calculation rules presented in the regulation. The performance in a real system may differ from the values presented.

*The highest valid seasonal space heating energy efficiency class is A++ and the highest water heating energy efficiency class is A in the regulation before 26.9.2019. Space heating class A+++ and water heating class A+ come into force 26.9.2019.