

Air handling with focus on LCC

Operation and maintenance instructions

ThermoCooler HP



Reversible heat pump ThermoCooler HP 100–980

Order number :

Project :

Original instructions

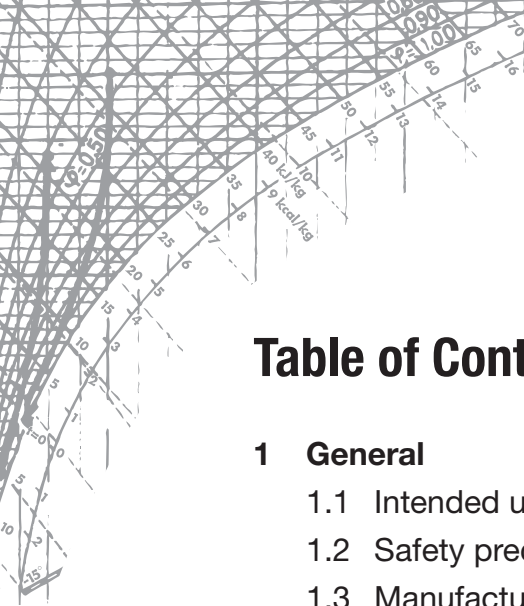


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Air handling with the focus on LCC

1 General

1.1 Intended use

The ThermoCooler HP reversible heat pump is intended to be used to cool and heat supply air in properties. The unit is designed to be installed together with IV Produkt AB air handling units.

The reversible heat pump should not be used as a standalone unit.

1.2 Safety precautions

Safety precautions for ThermoCooler HP installed together with ventilation units can be found in the **Operation and Maintenance Instructions** and the **Assembly Instructions** for Envistar Flex.


1.3 Manufacturer

The ThermoCooler HP reversible heat pump is manufactured by:

IV Produkt AB
 Sjöuddevägen 7
 SE-350 43 VÄXJÖ

1.4 Designations

The details of the reversible heat pump can be found on the model identification label placed on the front cover.

IV PRODUKT		Reversible heat pump ThermoCooler HP	
Ordernumber	<input type="text"/>		
Code Key	<input type="text"/>		
Model	<input type="text"/>		
Name of project	<input type="text"/>		
Date of manufacture	<input type="text"/>		
PS Max allowable press.	<input type="text"/>	bar (e)	
PT Test pressure	<input type="text"/>	bar (e)	
TS Temperature range	<input type="text"/>	°C	
Protection level - low	<input type="text"/>	bar (e)	
Protection level - high	<input type="text"/>	bar (e)	
Refrigerant, Fluid group	<input type="text"/>		
GWP	<input type="text"/>		
Code	<input type="text"/>		
Refrigerant charge	Circuit 1	<input type="text"/>	kg CO ₂ e
	Circuit 2	<input type="text"/>	kg CO ₂ e
	Circuit 3	<input type="text"/>	kg CO ₂ e
		 0409	
<small>Contains fluorinated greenhouse gases covered by the Kyoto protocol. Art. No. 19121-0009_00</small>			

Typical model identification label

1.5 CE marking and EU Declaration of Conformity

ThermoCooler HP is CE-marked, which means that upon delivery, it conforms to applicable provisions in EU Machinery Directive 2006/42/EC as well as to the EU Directives applicable to the type of unit, e.g. Pressure Equipment Directive (PED) 2014/68/EU. As certification confirming that the requirements have been met, we provide an EU Declaration of Conformity, which is available at ivprodukt.com.

The declaration of conformity only applies under the condition that the air handling unit is installed in accordance with IV Produkt AB's assembly, operation and maintenance instructions, and that no modifications are made to the product. If e.g. the control equipment/electrical system is divided during transport, this must be reset and inspected by an qualified electrician.

1.6 Maintenance

Regular maintenance of reversible heat pumps should be performed by a qualified cooling engineer.

1.7 Handling of refrigerant

The following information summarises the requirements and guidelines for handling the refrigerant used in cooling units. For further information, see the F-gas Regulations (517/2014) and the Refrigerant Regulations (SFS 2016:1128). The purpose of the regulations is to contribute to achieving EU goals for reduced climate impact in accordance with the Kyoto Protocol.

Operator responsibilities

Generally speaking, the unit operator must:

- Minimise and prevent leakage
- Take corrective action to remedy any leakage that arises
- Ensure that the service and repair of the refrigerant circuit is carried out by a certified refrigeration technician
- Ensure that refrigerant is handled in an environmentally secure manner and in accordance with national regulations.

We refer to the European Parliament's definition of an operator as: "...the natural or legal person exercising actual power over the technical functioning of the equipment and systems...".

The levels for the various actions to be taken for a system are calculated using carbon dioxide equivalents, CO₂e(tonnes). This figure is calculated by multiplying the refrigerant's GWP value (Global Warming Potential) by the filling amount in kilos. GWP for R410a is 2088. A filling amount of 5.0 kg R410a therefore corresponds to $(5.0 \times 2088) / 1000 = 10.44$ CO₂e(tonnes).

Leakage inspection and registration

The following applies for one-piece units with 5 CO₂e(tonnes) refrigerant content or more per circuit:

- **Leakage inspection** must be carried out by a certified refrigeration technician:
 - When installing/commissioning the unit
 - Periodically at least once per 12 months, i.e. no more than 12 months between inspections
 - within one month of any work being performed (e.g. sealing a leak, replacing a component).
- The operator must **record** events, such as the volume and type of refrigerant topped up, refrigerant taken into possession, results of inspections and work done, person and company who carried out service and maintenance.

If the total refrigerant content of the ventilation system exceeds 14 CO₂e(tonnes), the result of the inspections (inspection report) must be sent to the regulatory authorities and be in their possession no later than 31 March of the following year.

For a unit that will contain 14 CO₂e(tonnes) or more, the intended operator must inform the supervisory authority of the installation well in advance.

1.8 Extended warranty

In cases in which the equipment delivered falls under a 5-year warranty, in accordance with ABM 07 with supplement ABM-V 07 or in accordance with NL 01 with supplement VU03, the IV Produkt Service and Warranty Manual is supplied with the product.

In order to lay claim to an extended warranty, a complete, documented and signed IV Produkt Service and Warranty Manual must be presented.

1.9 Spare parts

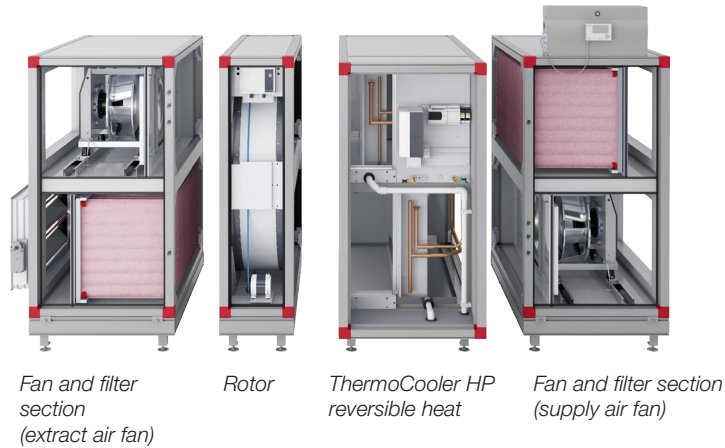
Spare parts and accessories for this unit are ordered from your nearest IV Produkt sales representative. When ordering, state the order number and designation. These are stated on a data label, affixed to each component. A separate spare parts list is supplied with the unit.

1.10 Dismantling and decommissioning

When an air handling unit is to be dismantled, separate instructions must be followed, see [Air handling unit, dismantling and decommissioning](#) under Documentation at ivprodukt.com.

2 Technical description

2.1 Reversible heat pump ThermoCooler HP



ThermoCooler HP is a series of integrated speed-controlled reversible heat pumps with stepless cooling and heating power. The units are intended to be used to cool or heat supply air in properties.

ThermoCooler HP is designed to be installed together with IV Produkt AB air handling units. The reversible heat pump should not be used as a standalone unit. The heating pump function takes the heat content of the extract air and reuses it, supplying the same heat to the ventilation unit's supply air.

Cooling circuit function

Cooling mode

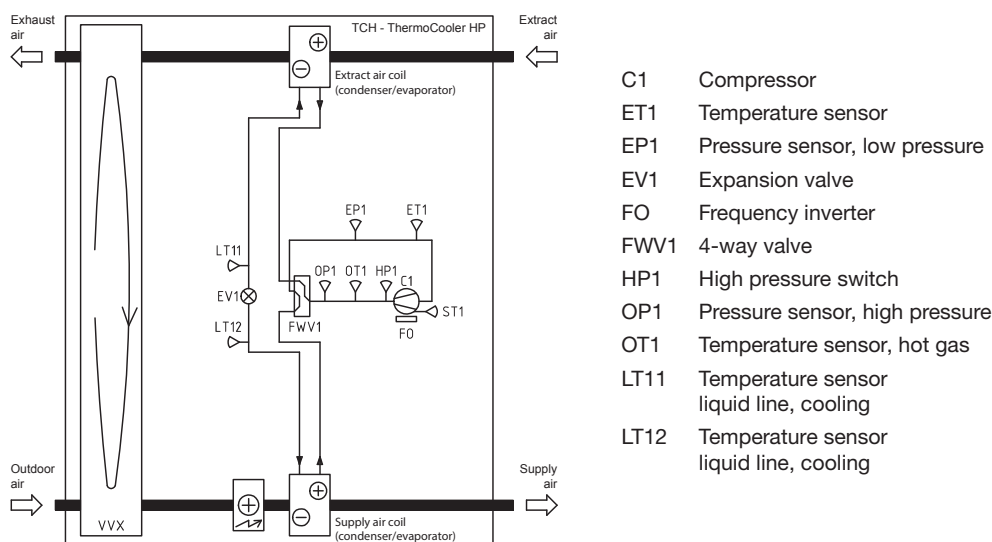
The cooling function moves the heat content of the outdoor air to the exhaust air, where it can be emitted.

From the compressor (C1), the refrigerant is pushed as hot gas to the condenser (the extract air coil) where the heat is emitted. The refrigerant condenses from gas to liquid when it is cooled by the extract air.

The refrigerant passes the pressure reducing expansion valve (EV1) and undergoes a phase transformation in the evaporator from liquid to gas (the refrigerant evaporates).

Inside the evaporator (the supply air coil), the refrigerant absorbs the heat required for phase transformation. The heat is taken from the supply air which is thus cooled.

The cold refrigerant in gaseous form is drawn back into the compressor (C1) where it is compressed and thus heated. The gas is also used for cooling the compressor's electric motor. The refrigerant now contains the heat from the supply air, the compressor's motor heat and the compression heat.



Flow chart for refrigerant system ThermoCooler HP (size 100-240)

Heating mode

The function of heating mode is similar to that of cooling mode. The difference between the cooling and heating modes is that the 4-way valve is in the heating position. This means that the extract air coil, which was a condenser in cooling mode, is now an evaporator. Conversely, the supply air coil becomes a condenser.

The extract air is the heat pump's energy source. When the extract air meets the extract air coil, it is cooled since the coil functions as an evaporator. From the evaporator, the refrigerant moves to the compressor, where it is compressed. The refrigerant then moves to the supply air coil, where the energy from the extract air and the compressor is released. The energy remaining downstream of the heat pump is then recovered in the rotor.

These two recovery systems combined give a very high degree of efficiency. Since the rotor requires less energy to run than the compressor system, this will be in the first instance. The compressor will only start when the rotor's energy recovery is insufficient to heat the supply air.

Compressor

ThermoCooler HP is equipped with a speed-controlled PM scroll compressor. Depending on its size, ThermoCooler HP may also be equipped with a fixed compressor that is step-linked to the speed-controlled compressor. In the event of an increased power requirement, the frequency inverter will increase the speed of the compressor.

When there is more than one compressor, the speed-controlled compressor will start at minimum speed, which will then increase in parallel with the power requirement up to the maximum speed. If further power is required, the fixed compressor will start up as the speed-controlled compressor lowers the speed before then increasing to maximum speed again.

The function is reversed where less cooling is needed.

Compressor protection

In the event of an alarm initiated by the control equipment or the safety circuit, the compressor stops and an alarm indication is given. The alarm can be read on the Climatix display or the Carel unit on the unit's circuit board.

In the event of an alarm, correct the fault and then reset the alarm. If alarm trips repeatedly, an authorised refrigeration service company must be called in.

The reversible heat pump will primarily trip alarms for the following errors:

- High pressure in the system, manual reset on pressure control HP1
- Low pressure in the system
- Alarm from frequency inverter
- Incorrect phase sequence (size 600-980).

Function

ThermoCooler HP is interlocked across the ventilation unit. If any of the fans stop, the reversible heat pump will also stop. The ThermoCooler HP unit will not start unless the minimum flow is achieved. The same applies if there is auxiliary heating.

The interlock and demand signal is sent via Modbus.

Circuit board

The circuit board for the unit contains:

- Main switch
- Fuses
- Control unit
- Any control unit for expansion valve next to fixed compressor.

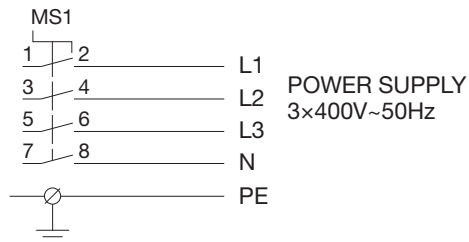
The circuit board is installed inside the unit and is internally prewired and tested at the factory.

3 Wiring instructions

3.1 ThermoCooler HP

Power supply

ThermoCooler HP is powered separately as shown in the diagram below.
 For recommended external fuse “7 Technical data” page 17.



NB:

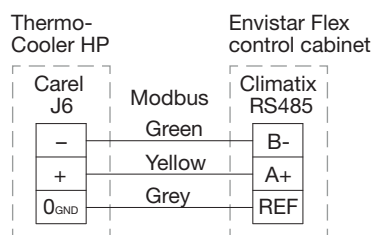
A residual current circuit breaker should not be used since the unit has a built-in frequency inverter.

In the event that the decision is nevertheless made to use a residual current circuit breaker, we recommend a 300 mA, type B residual current circuit breaker specially adapted for the frequency converter.

A 300 mA, type B residual current circuit breaker offers fire protection – not personal protection.

Communication with Climatix

Communication with the AHU (Envistar Flex) Climatix control system is via Modbus. The connection between Carel and Climatix is done with preinstalled quick connector.



Principle of communication between Carel and Climatix via Modbus

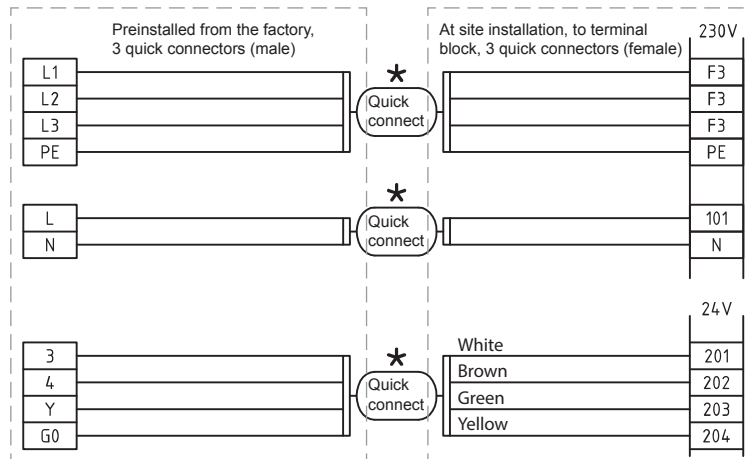
Trim heater (optional)

Electric battery for trim heating is optional. It is delivered integrated and prewired with quick connectors if chosen when ordering ThermoCooler HP.



Quick connectors for trim heater

If the trim heater is retrofitted, the following connection instructions apply. All connections are made internally in ThermoCooler HP.



3.2 Envistar Flex unit parts

Quick connectors

Connection between unit parts in the air handling unit is carried out by connecting the preinstalled quick connectors using the markings on the cables for guidance.

Setting Climatix

The following settings for Climatix are made at the factory.

Main menu / Configuration / Configuration 1

Heat recovery	Wheel
Heating	TCHP
Electrical heating	TCHP
Cooling	TCHP

Main menu / Configuration / Configuration 2

Hrec clg recovery	No
Tmp start	No
Temp start/osstp blk	None
Htg frost protect	No
Heating pump	No
Htg pump alarm	No

Main menu / Configuration / Integration

Cooler type, Modbus	Carel
No. of compressors	1 or 2
High pressure sensor	Yes
Adv. communication	Yes

Main menu / Configuration / Basic data

Pwr Elc before Sply.Fan	(value dependent on output variant)
-------------------------	-------------------------------------

4 Operation

4.1 Commissioning rules

Commissioning may only be carried out by competent personnel and in accordance with the following checklist. The validity of the product warranty is conditional on the system having been correctly commissioned.

No modifications to the cooling circuit may be made during the warranty period without the approval of IV Produkt. Follow the troubleshooting instructions in the troubleshooting chart before contacting a service representative for servicing a unit under warranty. This will prevent any unnecessary service calls.

The unit was designed and manufactured based on given operation cases that must comply with the unit's use for optimal function and a good operating economy.

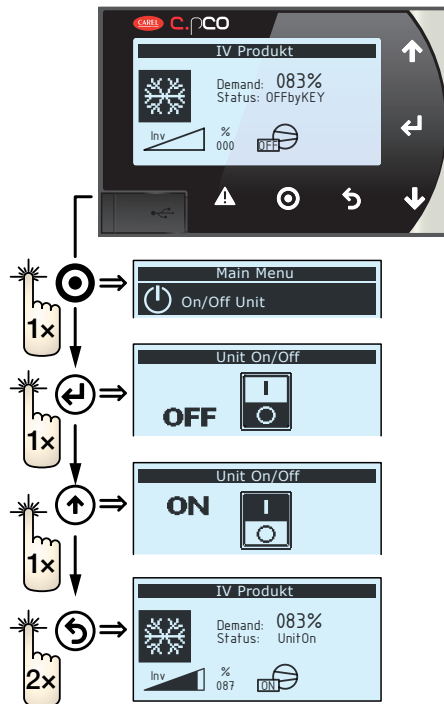
External circumstances should not be changed without checking that such changes are within the unit's intended area of operation.

4.2 Checklist commissioning ThermoCooler HP

The reversible heat pump must not be put into operation until all the items in the checklist have been checked off.

1. Visually inspect the cooling unit for damage after transport and assembly.
2. Check that the cooling unit is correctly positioned and that the open space in front of the unit for servicing is sufficient (1.5 x depth of the unit, min. 1200 mm).
For more information, see the separate assembly instructions for each unit series.
3. Check that the two drainage connections (evaporation water drains) are connected for drainage via separate water traps. Check that the drainage pipe slopes correctly to the drains. For more information, see separate Envistar Flex assembly instructions.
4. Check that the incoming supply voltage, zero and earth are connected (see Section 3).
5. Check that control cables are connected (see chapter 3).
6. Check that the automatic circuit breakers are set to the ON position and switch on the voltage.
7. It is important that the oil inside the speed-controlled compressor crankcase is warm before starting the unit. The crankcase heating must be switched on long enough before the unit begins operating so that the oil maintains a temperature of at least 30°C. The maximum warm-up time is approximately 2–3 hours. The temperature can be measured externally at the bottom of the compressor.
8. Start the air handling unit (supply and extract air fans).

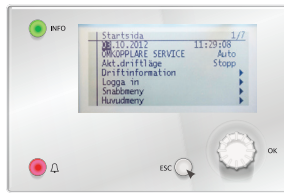
9. Check that there are supply and extract air flows and that they have been adjusted and recorded.
10. Test all control functions according to the air handling unit's functional description.
11. Start the cooling unit via the control unit according to the following menu sequence:



For units in size 600-980 (2-circuit), the compressor for the second circuit is dependent on the **correct phase sequence**. After 30 seconds, compressor 2 will start for a short while to check the phase sequence. Check whether the alarm is displayed. If necessary, switch two of the incoming phases.

12. Check that the start and cooling signal is shown in the display. Status should be UnitOn and Demand should show a percentage value. If UnitOn is not displayed and Demand is less than 10 per cent, the setpoint should be temporarily changed to make start possible. Use Climatix hand controller and go to Quick menu -> Setpoints/Settings -> Setp.conf.heat. Adjust setpoint until ThermoCooler starts.
13. Check that the unit indicates a temperature change in the supply air, note the operating data and check that no alarms are displayed.
15. Reset the setpoint and allow the unit to operate until it stops as per the intended control function for the air handling unit.
 NB: The time until restart should be at least 10 minutes.
16. Make sure that an inspection to detect leakage is carried out and that an inspection report is drawn up; see "1.7 Handling of refrigerant" page 3.

4.3 Cooling status



Status information can be read on the Climatix display under Main menu/Unit/Cooling. The following will be presented:

Climatix	Value	Explanation
Unit status	UnitOn	Status of cooling unit
Heating output signal	x%	Heating requirement from Climatix cooling regulator
Cooling output signal	x%	Cooling requirement from Climatix cooling regulator
Inverter signal output	x.x%	Frequency to the compressor
Compr. nbr	Comp1	
Compr. Sum alarm	Normal	
Compr. Gen. alarm	>	The alarm is displayed if there is a fault with the inverter or compressor. In the event of an alarm, see "6.2 Alarm information for inverter and compressor" on page 15 "

Compressor C1 output	On/Off	Compressor operating mode
Suction temp C1	x.x°C	Measured suction gas temp
Evaporation temp C1	x.x°C	Calculated evaporating temp based on low pressure
Low pressure C1	x.x bar	Relative pressure from low pressure sensor
Superheat C1	x.x K	Measured superheating
High pressure C1	x.x bar	Relative pressure from high pressure sensor
Expansion valve 1	x.x%	Expansion valve position
Condensation temp C	x.x°C	
Discharge	x.x°C	Temperature of output from compressor
Liquid line temperature	x.x°C	Temperature downstream of condenser
Subcooling	x.x°C	Measured supercooling

5 Maintenance instructions

5.1 Service schedule

For service schedule, see operation and maintenance instructions for air handling unit Envistar Flex.

5.2 Periodic inspection

The purpose of the maintenance instructions is to describe periodic inspection of the unit and to show some simple checks that you can perform before calling in support in the event of a fault.

Leakage inspection and registration

For information on the operator's responsibility with regards to leakage inspection and registration, see "1.7 Handling of refrigerant" page 3.

Visual check

Check:

1. The fins on the condenser/evaporator to detect mechanical deformations
2. The drip tray and drain with water trap (clean if necessary)
3. That the water trap (without non-return valve) is filled with water.

Cleaning

If the fins are fouled, they should be vacuumed from the inlet side. Alternatively, you can blow them clean with compressed air from the outlet side. If they are severely fouled, you can clean them with warm water mixed with dishwashing detergent that will not corrode aluminium.

For more information, see [Cooling coil, cleaning](#) under Documentation at ivprodukt.com.

Check function

Check that the reversible heat pump in the air handling unit is operating as it should by temporarily lowering/increasing the temperature setting (setpoint).

6 Alarm management and troubleshooting

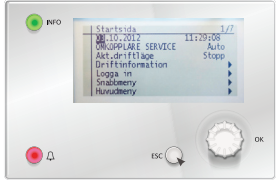
6.1 Troubleshooting in the event of an alarm


The alarms for the cooling circuits are presented on the control unit display. To ascertain what has caused the alarm, follow the procedure below.

Inspection	Possible cause	Corrective action
Has the high pressure switch tripped?	YES ⇒ No or too low air flow across the condenser	Check the air flow across the condenser. Rest the pressure switch manually.
	Defective high pressure switch	Check/replace
NO ↓		
Is the alarm "118 Compr 1, Low evaporation pressure" or "176 Compr 2, LowEvap-Pressure" displayed?	YES ⇒ Insufficient refrigerant volume	Look for leakage, seal the leak and top up with refrigerant
	No or too low air flow across evaporator	Check/adjust the flow
	Defective expansion valve	Check/replace
NO ↓		
Is the LED flashing red on the frequency inverter?	YES ⇒ Phase failure/voltage failure	Check the 3-phase supply, measure the incoming voltage. Reset the frequency inverter by switching off the voltage for 1 minute or more. Check that the compressor is running without dissonance.
	Overload/defective stepless compressor	Reset the frequency inverter by switching off the voltage for 1 minute or more. Check that the compressor is running without dissonance.
NO ↓		
Is the alarm "189 Phase Rotation order" displayed?	YES ⇒ Incorrect phase sequence for supply voltage	Shut off voltage and switch two of the incoming phases
NO ↓		
Is the alarm "94 Drive offline" displayed?	YES ⇒ ThermoCooler HP does not have supply voltage 3×400V	Connect supply voltage

6.2 Alarm information for inverter and compressor

Alarm information is shown on the Climatix display (Main menu / Unit / Cooling / Alarm) or the Carel display (press on the alarm symbol to show the alarm).

 Alarm Climatix	Explanation and corrective action
Cooling unit	
Sum alarm	Sum alarm, check alarm in Carel, see table below.
Alarm C1 R. pressure switch	High pressure switch tripped or alarm for frequency inverter.
Alarm C1 EEV motor fault	Fault on electrical connection to expansion valve.
Alarm C1 low pressure sensor	Power cut or short circuit to low pressure sensor. Check EVD, cabling and sensor.
Alarm C1 suction gas sensor	Power cut or short circuit to suction gas sensor. Check EVD, cabling and sensor.
Alarm C1 high pressure sensor	Power cut or short circuit to high pressure sensor. Check EVD, cabling and sensor.
Alarm C1 low overheating	Compressor stoppage caused by low overheating.
Alarm C1 LOP	Compressor stoppage caused by low evaporation temperature.
Alarm C1 MOP	Compressor stoppage caused by high evaporation temperature.
Alarm C1 communication EVD	Fault on communication to EVD (expansion valve control).
Alarm C1 low suction gas temp	Low suction gas temperature.

 Alarm Carel	Explanation and corrective action
76 Drive MainsPhaseLoss	Check that all three phases are connected to the frequency inverter.
81 Drive U_phaseLoss	
82 Drive V_phaseLoss	
83 Drive W_phaseLoss	
94 Drive offline	No communication with the frequency inverter. Check that the frequency inverter is energised with 3-phase 400V.
118 Compr 1, Low evaporation pressure	Circuit 1, low evaporation temp/pressure. Check leakage in cooling circuit.
121 Compr 1, High pressure switch	Circuit 1, high pressure switch tripped. Check air flow and fire damper.
172 Compr 2, Motor protector	Circuit 2, motor protection alarm
174 Compr 2, High pressure switch	Circuit 2, high pressure switch tripped. Check air flow and fire damper.
176 Compr 2, LowEvapPressure	Circuit 2, low evaporation temp/pressure. Check leakage in cooling circuit.
180 Compr 1, High pressure switch	Circuit 1, high pressure switch tripped. Check air flow and fire damper.
189 Phase rotation order	Incorrect phase sequence gives incorrect rotation direction. Switch two of the incoming phases.

6.3 Troubleshooting via symptoms

Symptom	Possible cause	Corrective action
Low cooling power - too high temperature in the cooled object	The power supply has been interrupted	Check the control/safety switches and fuses.
	Separate supply not connected	Connect supply
	None or too low air flow across evaporator	Check that nothing inhibits the air flow
Compressor is not operating	The power supply has been interrupted.	Check the control/safety switches and fuses
	Incorrect phase sequence (compressor 2)	Switch two of the incoming phases
	Compressor has opened a safety circuit	Check and reset, if needed
Frost on the evaporator	Defective compressor	Check/replace
	Expansion valve is defective	Check/replace
	Insufficient refrigerant volume	Look for leakage, seal the leak and top up with refrigerant
	Low supply air flow	Adjust the flow

6.4 Alarm reset

In the event of an alarm initiated by the frequency inverter or the safety circuit, the compressor stops and the sum alarm relay is energised. The alarm is displayed in the control unit menus “Operating information, compressors” and “Status: Alarm”.

In the event of an alarm, take corrective action to correct the fault, and then press the “Alarm reset” button on the control unit for at least 3 seconds. If the safety circuit alarm trips repeatedly, an authorised refrigeration service company must be called in.



Reset alarm

Operating status, compressor

7 Technical data

7.1 Table air flow, cooling power, operating current, etc.

	Size	100	150	190	240	300	360	480	600	740	850	980
Air flow min ^(a)	m ³ /s	0.25	0.38	0.50	0.58	0.68	0.85	0.85	1.34	1.71	1.98	2.38
Air flow max ^(a)	m ³ /s	0.95	1.61	2.12	2.48	2.91	3.64	4.61	5.75	7.34	8.47	10.05
Max cooling power ^(b)	kW	13.2	21.3	27.1	29.1	40.1	48.3	65.1	81.7	99.5	113	129
No. of compressors	units	1	1	1	1	1	1	1	2	2	2	2
Max operating current	A	7.6	11	15	15	21	24	33	44	52	63	65
External fuse protection ^(c)	A	10	16	20	20	25	32	40	50	63	80	80
Refrigerant R410a	kg	2.8	4.6	5.8	7.0	8.2	10.1	13.2	10.4+5.8	14.0+6.0	14.0+9.0	17.4+12.6

a) For units with dampers, F7 filter supply air, M5 filter extract air, SFPv values with NP rotor, supply air temp 20°C and duct pressure 200 Pa (170+30 Pa). Max air flow calculated with a minimum 10% spare capacity for fans.

b) With outdoor temp 26°C, 50% RH and extract air temp 22°C.

c) Regarding reversible heat pump at 3×400V+N 50 Hz. Fuses with type C characteristics. The ventilation unit is fused separately and the fuse protection size varies depending on selection of fan variants.

8 Ordering keys

8.1 Reversible heat pump

TCH -a-b-c-1-e-00 Reversible heat pump ThermoCooler HP

a - Size 100, 150, 190, 240, 300, 360, 480, 600, 740, 850, 980

b - Casing
 AA = Standard (class T3)
 PA = ThermoLine low energy (class T2)
 BA = Insulation to fire resistance rating EI 30

c - Output variant 2V = 2

e - Voltage 40 = 3×400V+N, 50Hz

8.2 Trim heater

TCHT-EV -a-0-c Electric heater trim heating

a - Size 100, 150, 190, 240, 300, 360, 480, 600, 740, 850, 980

c - Voltage 40 = 3×400V+N, 50Hz

Change history

DSTCHP.170418.01.EN First version



Air handling with focus on LCC

You are welcome to contact us

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