INSTALLATION GUIDE

# EM4

Accessory for domestic brine/water heat pumps

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The English language is used for the original instructions.
Other languages are a translation of the original instructions.
(Directive 2006/42/EC)

# Table of Contents

# 1 Important information/Safety instructions

## 1.1 Safety precautions

**Danger**

Hazardous electrical voltage! The terminal blocks are live and may cause death through electrical shock. All power supplies must be isolated before electrical installation is started.

**Warning**

Before making any electrical work, turn off the power supply connected to the heat pump.

**Warning**

Electrical installation may only be carried out by an authorized electrician and must follow applicable local and national regulations (IEC 60335-2-40).

**Warning**

Risk of personal injury! Children are not permitted to play with the product.

## 1.2 About the document

This manual is only intended for professional and trained installers and electricians with prior experience in installing heat pumps & accessories. Industrial standards, common branch practice and local regulations must always be followed, even if not explicitly stated in this document.

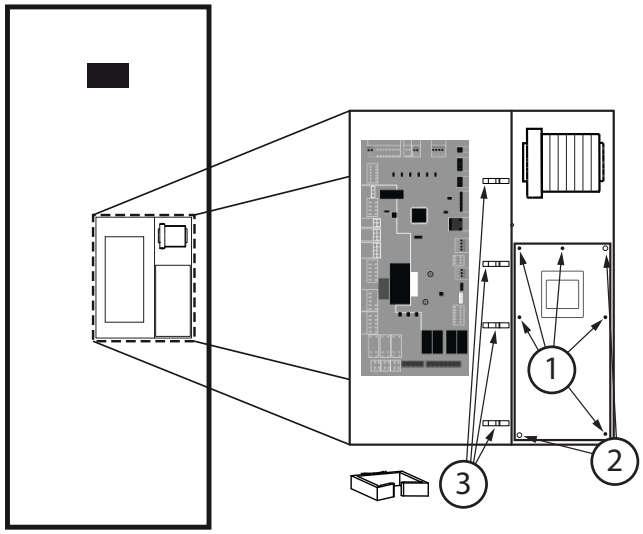
# 2 Installation

## 2.1 Delivery content

Included in the delivery:

| Item | Article number | Pcs. |
|---|---|---|
| Expansion card Domestic | 365243 | 1 |
| Wide wire saddle | 362596 | 4 |
| Cable EM-BM Modbus Domestic | 344481 | 1 |
| Circuit card support 48-904-22 | 334673 | 5 |
| Screw DIN 7985A M4X6 FZB | 344482 | 2 |
| Label sheet EM4 | 369943 | 1 |
| 230V cable BM-EM4 | 366876 | 1 |

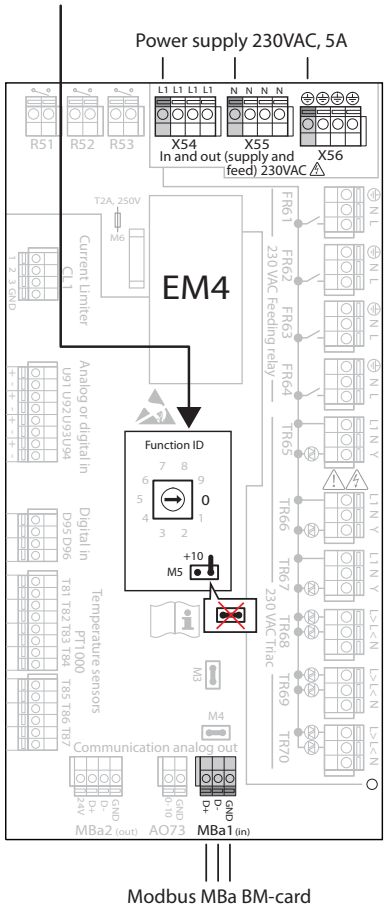
## 2.2 Internal installation




1. PCB spacers. Put in place before mounting the EM4 card.
2. PCB grounding screw. Screw in place after mounting the EM4 card on the spacers.
3. Wide wire saddles. Push them in place in their designated holes in the plate.

Make sure that the function switch in the center of the EM4-card is set to the 0 (default) position and that the jumper next to it is set to open position (jumper is NOT mounted on both pins).

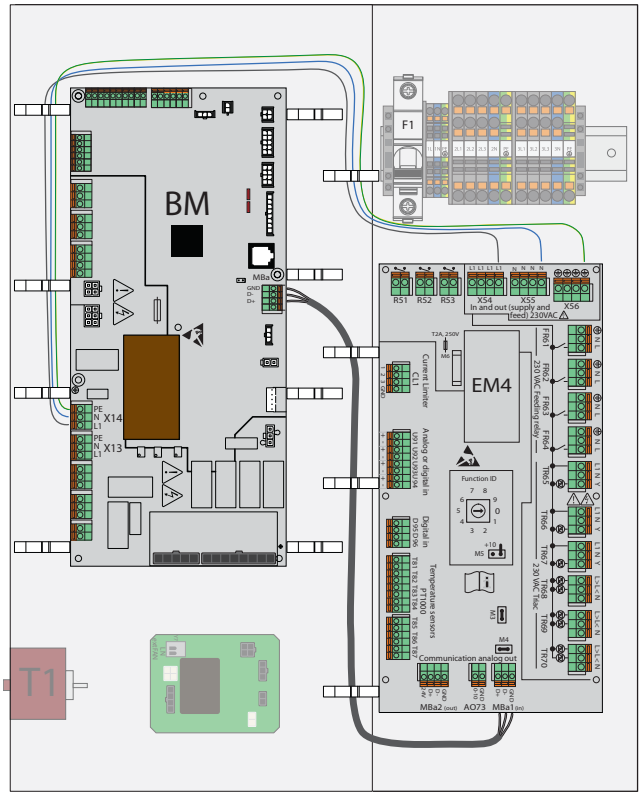
**Function switch**



IMPORTANT! Make sure that main power supply to the heat pump is off before installing EM4.

Connect the power cables from the BM card (X14, or X13) to the **X54, X55 and X56** terminals on the EM4 card, as shown in the picture below.

Continue by connecting the Modbus cables between the **MBa1** terminals on the expansion card to the **MBa** terminal on the BM card, see picture below.



# 3 Supported functions

The table below gives a quick overview of which functions that can be utilized with EM4. See the respective chapter for further details.

| Function |
|---|
| Distribution circuit 2 |
| Distribution circuit 3 |
| Passive/active cooling |
| Pool |
| External brine pump |
| Sum alarm (output) |
| External alarm (input) |
| Current limiter |

**Technical information:**

- Only one EM4 expansion card may be installed per installation
- Temperature sensor type: PT1000 (not included)
- 230V supply for reversing valves and circulation pumps[1)]
- Potential free relays[1)] (with terminals to enable e.g. 230V supply)
- Input by open/closed loop (digital in)
- Output by open/closed loop (relay)
- 230V shunt control (CW=open, CCW=closed)

[1)] Max load on 230V feeding relays (marked "FR..") or potential free relays (marked "R..") is 230W with normal motors. Max 850W with soft starting loads.

Max total load on EM4 is 5A.

Max load on TRIAC output (marked "TR") = 10VA.

**IMPORTANT!** Please note that a restart of the control system is required for the installation to establish communication between the heat pump and the Expansion module (There is only need to restart once, regardless of number of functions added at the same time). This is indicated by the following icon in the display top bar (the same symbol is used in "Operating mode" in the display to execute a restart):

Glossary for abbreviations printed on the EM-card:

- **X:** Power supply (in and out, 230VAC)
- **R:** Potential free relay
- **FR:** Feeding relay (230VAC)
- **TR:** TRIAC output (230VAC)
- **MBa1:** ModBus communication in
- **MBa2:** Modbus communication out
- **AO:** N/A
- **CL:** Current limiter
- **U:** Universal input (analogue/digital)
- **D:** Digital input
- **T:** Temperature sensor input (PT1000)
- **Function ID:** ID selector
- **MBa TERM:** Termination jumper

**Suggested accessories:**

- Temperature sensor PT1000: 334572 PT-1000 4m
- Reversing valves (including actuator): 200773 LK 230V (22 & 28mm)
- Mixing valve actuators: 202751 ESBE ARA671 3P230V 240s, 200590 ESBE ARA661 3P 230V 120s
- Mixing valve housings: 200746 3-way mixing valve VRG131 DN20-KVS 6,3
- Mixing valve housings: 200747 3-way mixing valve VRG131 DN25-KVS 10
- Circulation pumps: 230V circulation pump max 230W
- Ring transformer TR3025-S 334973 (3 pcs needed)

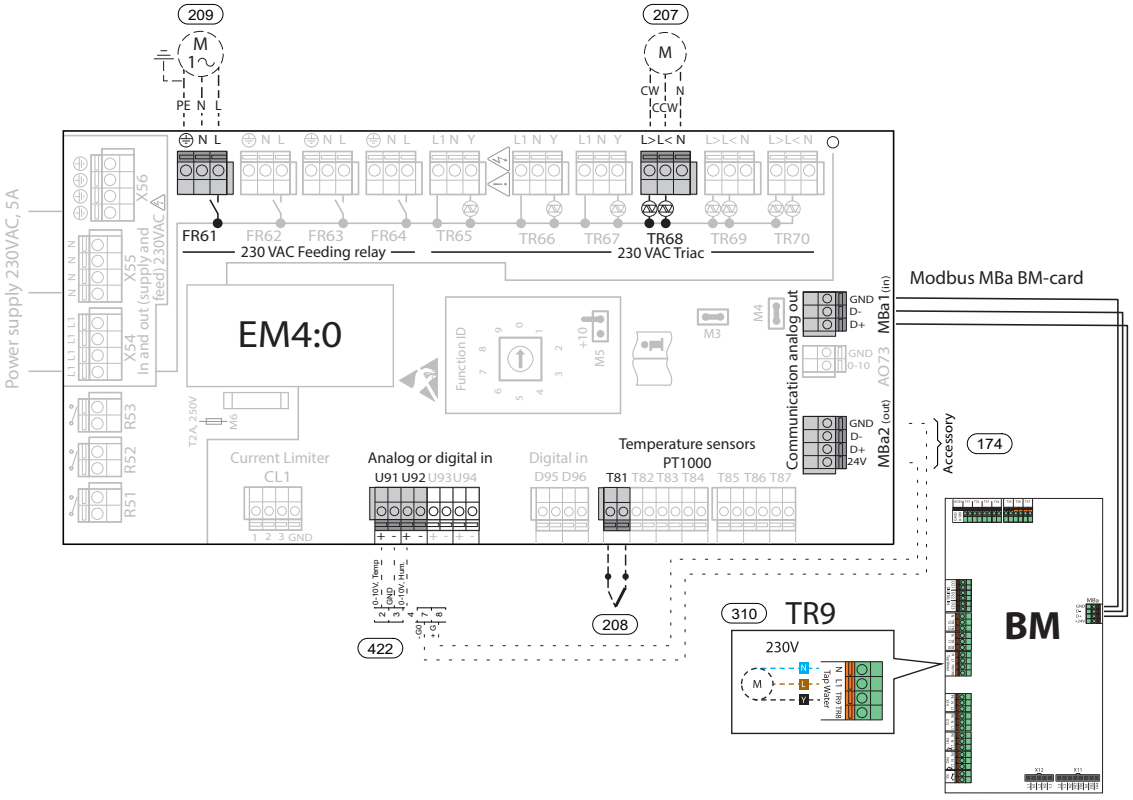
## 3.1 Function ID:0, Domestic

### 3.1.1 Distribution circuit 2

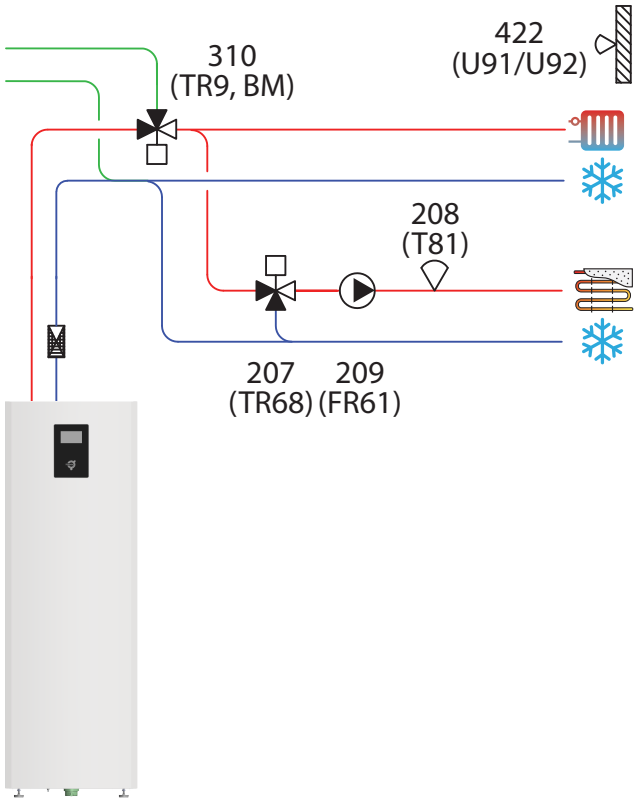
In heating systems where there is a need of a separately controlled heating/cooling circuit (in addition to the open main circuit) with a lower heat curve, it is possible to control a separate circuit (mixing valve, temperature sensor and circulation pump) with a lower set heat curve.

When using the cooling function it is recommended to install and enable (activate in heat pump display) the Dew Point sensor (422) on EM4, in order to mitigate condensation. The Reversing valve heating/cooling (310), located on the BM card, may also be used in order to switch the source of the mix valve between a cooling- or heating source.

The supply line temperature for Distribution circuit 2 is determined from the Temperature sensor (208), and is used to regulate the mixing valve actuator (207). The circulation pump (209) is running when the heat pump is in heating season.




| Position number | Terminal | Description |
|---|---|---|
| 209 | FR61 | Distribution circuit 2 circulation pump |
| 207 | TR68 | Distribution circuit 2 mix valve |
| 208 | T81 | Distribution circuit 2 supply line sensor |
| | **Terminals used for cooling functionality** | |
| 422 | U91 | Dew point sensor cooling circuit 2 (0-10V temp) |
| 422 | U92 | Dew point sensor cooling circuit 2 (0-10V humidity) |
| 310 | TR9 (BM card) | Reversing valve heating/cooling (on BM card) |




Commissioning after installation:

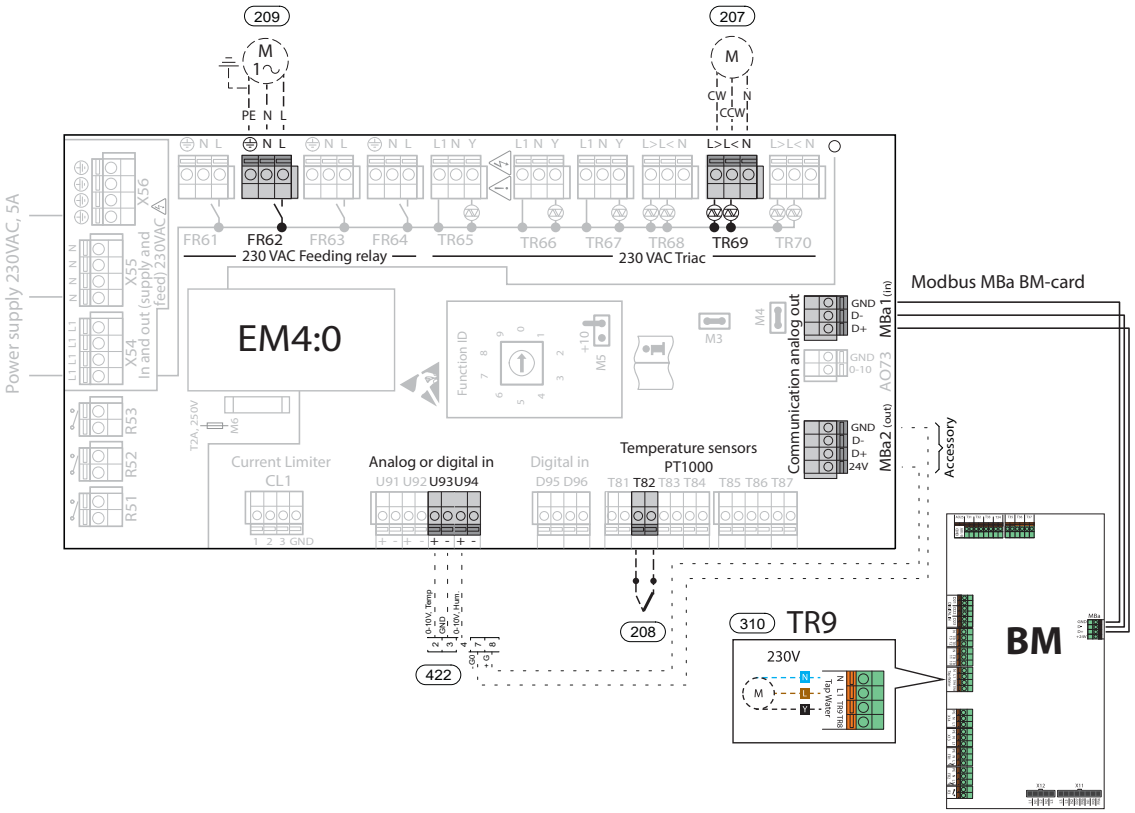
1. Login: press padlock, 607080 and confirm
2. Go to SETTINGS/INSTALLATION, navigate to Distribution circuit 2, select EM4 and press ✓
3. Go to SETTINGS/MIX VALVES/DISTRIBUTION CIRCUIT 2 and turn on function
4. Make desired changes and confirm
5. Restart the heat pump and check functionality

### 3.1.2 Distribution circuit 3

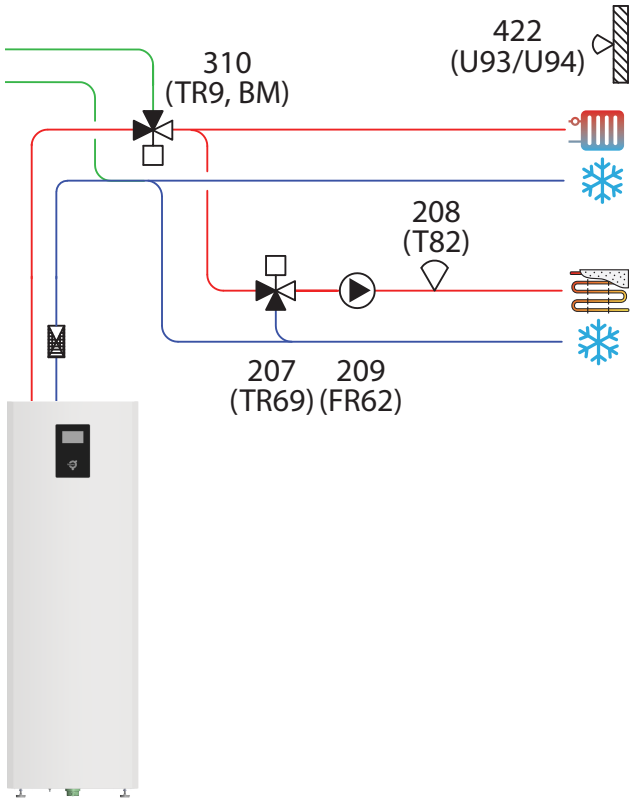
In heating systems where there is a need of a separately controlled heating/cooling circuit (in addition to the open main circuit) with a lower heat curve, it is possible to control a separate circuit (mixing valve, temperature sensor and circulation pump) with a lower set heat curve.

When using the cooling function it is recommended to install and enable (activate in heat pump display) the Dew Point sensor (422) on EM4, in order to mitigate condensation. The Reversing valve heating/cooling (310), located on the BM card, may also be used in order to switch the source of the mix valve between a cooling- or heating source.

The supply line temperature for Distribution circuit 3 is determined from the Temperature sensor (208), and is used to regulate the mixing valve actuator (207). The circulation pump (209) is running when the heat pump is in heating season.




| Position number | Terminal | Description |
|---|---|---|
| 209 | FR62 | Distribution circuit 3 circulation pump |
| 207 | TR69 | Distribution circuit 3 mix valve |
| 208 | T82 | Distribution circuit 3 supply line sensor |
| | **Terminals used for cooling functionality** | |
| 422 | U93 | Dew point sensor cooling circuit 3 (0-10V temp) |
| 422 | U94 | Dew point sensor cooling circuit 3 (0-10V humidity) |
| 310 | TR9 (BM card) | Reversing valve heating/cooling (on BM card) |




Commissioning after installation:

1. Login: press padlock, 607080 and confirm
2. Go to SETTINGS/INSTALLATION, navigate to Distribution circuit 3, select EM4 and press ✓
3. Go to SETTINGS/MIX VALVES/DISTRIBUTION CIRCUIT 3 and turn on function
4. Make desired changes and confirm
5. Restart the heat pump and check functionality

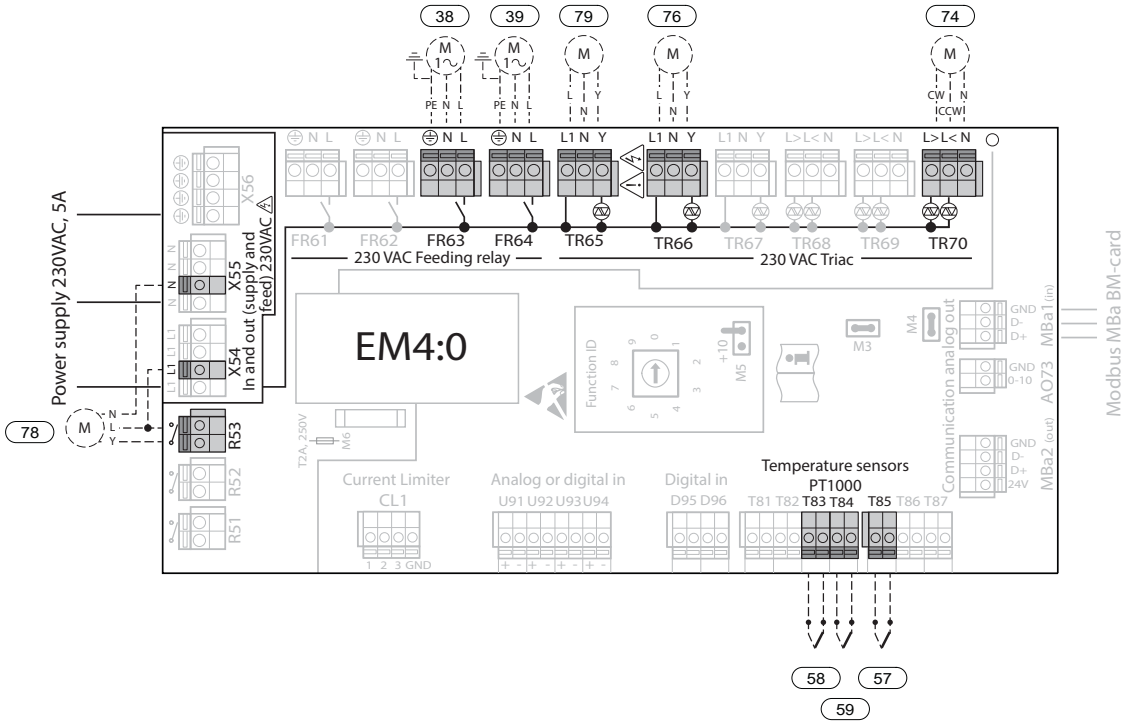
### 3.1.3 Passive/active cooling

With the passive/active cooling function, the heat pump can control and produce passive cooling when the brine temperatures are sufficiently low, but also actively use the compressor to produce active cooling (and dump excess heat to brine if no other heat demand is active).

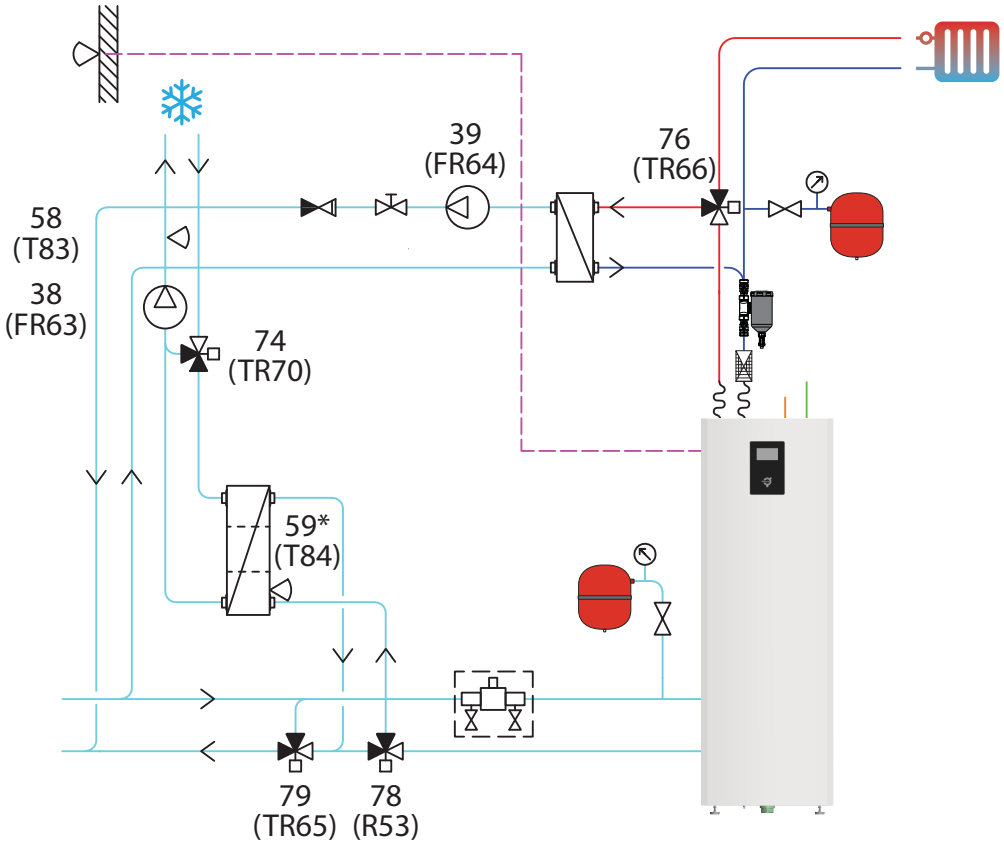
When Passive/active cooling is desired due to e.g. high outdoor temperatures, leading to high indoor temperatures, it is possible to control and regulate a separate circuit to a fixed cooling temperature set point with EM4 consisting of:

- Cooling circulation pump
- Shunt valve cooling circuit
- Cooling supply line temperature sensor
- Circulation pump for heat dump
- Reversing valve heat dump
- Reversing valve active cooling
- (Heat exchangers)

**NOTE! Cooling introduces a risk of condensation!** All pipes, pumps, heat exchangers and cooling tanks connected to the cooling circuit must be properly insulated in order to avoid condensation and potential water damage.




| Position number | Terminal | Description |
|---|---|---|
| 38 | FR63 | Cooling circulation pump |
| 39 | FR64 | Heat dump circulation pump |
| 57 | T85 | Cooling tank return sensor |
| 58 | T83 | Cooling supply line sensor |
| 59 | T84 | Cooling tank/demand sensor (See system solution image below for correct placement) |
| 74 | TR70 | Cooling shunt valve |
| 76 | TR66 | Heat dump reversing valve |
| 78 | R53 | Cooling tank/demand reversing valve |
| 79 | TR65 | Disconnect borehole reversing valve |




### Cooling Season:

The mixing valve and **Cooling circuit circulation pump (38)** is active when the heat pump is in cooling season (which is determined by the cooling integral and settings made for seasonal cooling temp).

### Cooling Demand:

*** Cooling tank/demand sensor (59)** must be located on the bottom third on the face of the heat exchanger, in order to prevent the risk of freezing (see system solution image above). It is used for regulating the **Cooling tank/demand reversing valve (78)** and **Disconnect borehole reversing valve (79)**. When the passive cooling is not sufficient, and active cooling will start, it is determined by the cooling start and stop temperatures in the cooling menu.

### Dissipate excess heat:

**Heat dump reversing valve (76)** and **Heat dump circulation pump (39)** becomes active when Tap water and Pool demands have been satisfied and active cooling is still required.

### Cascade specific:

**Cooling tank return sensor (57)**, Cascade solution only, improves demand calculation when multiple heat pumps are able to produce active cooling.

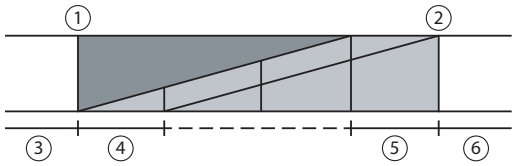
### Mixed cooling supply:

By default the temperature reading from the **Supply line sensor cooling circuit (58)** is used for regulating the **Cooling shunt valve (74)** (mixing valve). May be disabled in the cooling settings if not installed. If dew point protection is needed, mixing valve 2 or 3, with their intended dew point sensors, may be used in order to mitigate condensation on the mixed supply.

When cooling is produced, the internal brine pump is running and the cooling circulation pump is running. The mixing valve will strive to keep desired cooling supply line temperature to the set value (desired cooling temp) in the controller. When active cooling is produced, the heat dump circulation pump and reversing valve will be engaged.

### Start/stop temperatures:

The start temperature for **passive cooling** and the stop temperature for **active cooling** are calculated automatically depending on the setting of start/stop temperature. This is done even if only passive cooling or only active cooling is activated.




1. Stop temperature, cooling
2. Start temperature, cooling
3. Stop, passive
4. Stop, active
5. Start, passive
6. Start, active

Commissioning after installation:

1. Login: Press padlock, 607080 and confirm
2. Go to SETTINGS/INSTALLATION and activate cooling
3. Go to SETTINGS/COOLING and enable passive cooling AND active cooling
4. Make desired changes, e.g.
   Seasonal cooling temp = what outdoor temperature the seasonal cooling integral shall calculate from
   Desired cooling temp = set target for the regulation of cooling supply line temperature
5. Restart the heat pump and check functionality

### 3.1.4 Pool

The purpose of this function is to control and maintain a constant temperature for swimming pool or similar.

The heat pump will determine the need for pool heating by the pool return line sensor (60). When the pool heating starts, the reversing valve (101) will direct the flow towards the pool heat exchanger and the heat pump will then produce pool heating. Pool heating will stop when the temperature read value has increased with the pool hysteresis value (or when the pool time is exceeded).

**Required connections:**

- 230V reversing valve
- 2 PT1000 temp sensors, Pool return line sensor is used for pool control
- Pool equipment (e.g. heat exchanger, pumps etc.)

**Optional accessories:**

- PT1000 temp sensor for pool supply (183). Not used for control, only a read value in the display
- Optional external "pool off" function (342), controlled via digital input from e.g. circuit breaker (normally open)

**Settings description:**

**Desired pool return temperature:** Target (median) temperature from pool return sensor.

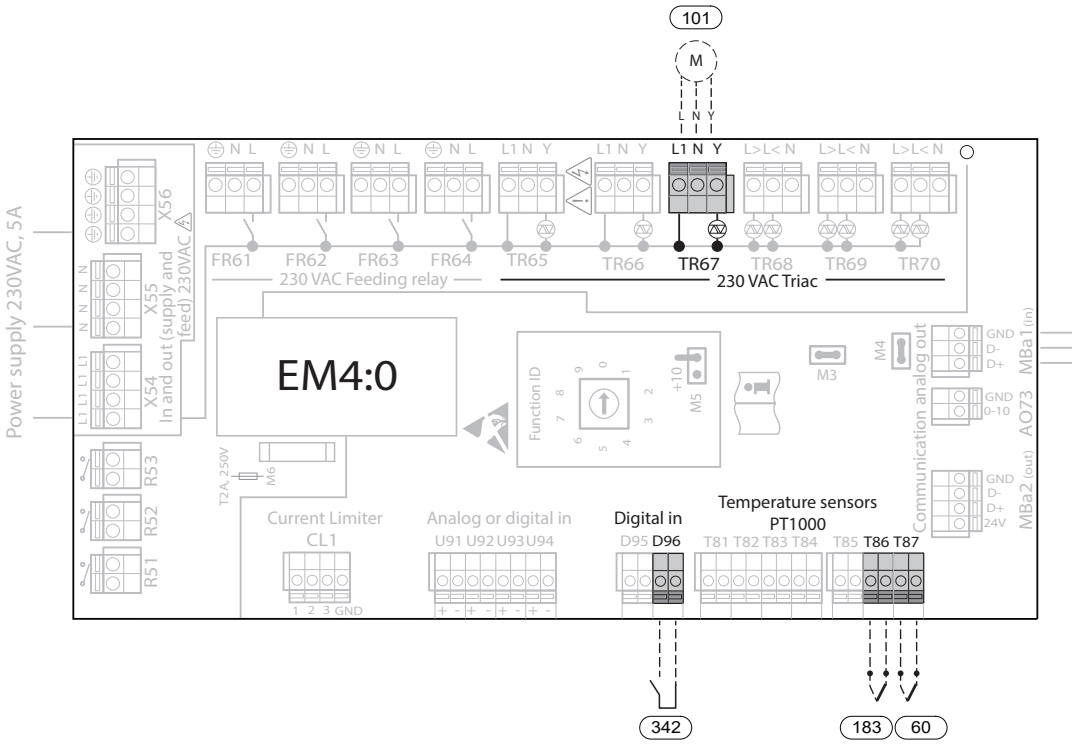
**Pool hysteresis:** Total permitted deviation for start/stop heating (offset from desired pool temperature.)

**Desired charge temp:** Target temperature for heat pump supply line. (Calculation/selection of compressor speed is based on heat pump supply line temperature.)

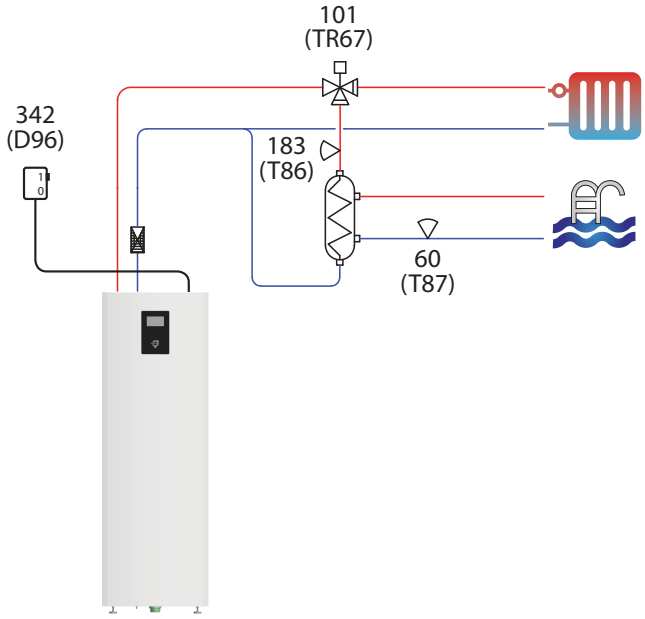
**Compressor max/min gear:** Compressor speed range permitted for pool, may be used to optimize performance.

**Pool time:** Max pool time when other conflicting demands arises (such as heating/hot water demands), in heating season max 3,5 hours.

**Gear shift delay:** Delay time for changing compressor speed.




| Position number | Terminal | Description |
|---|---|---|
| 101 | TR67 | Pool reversing valve |
| 342 | D96 | External pool off |
| 183 | T86 | Pool supply line sensor |
| 60 | T87 | Pool return line sensor |



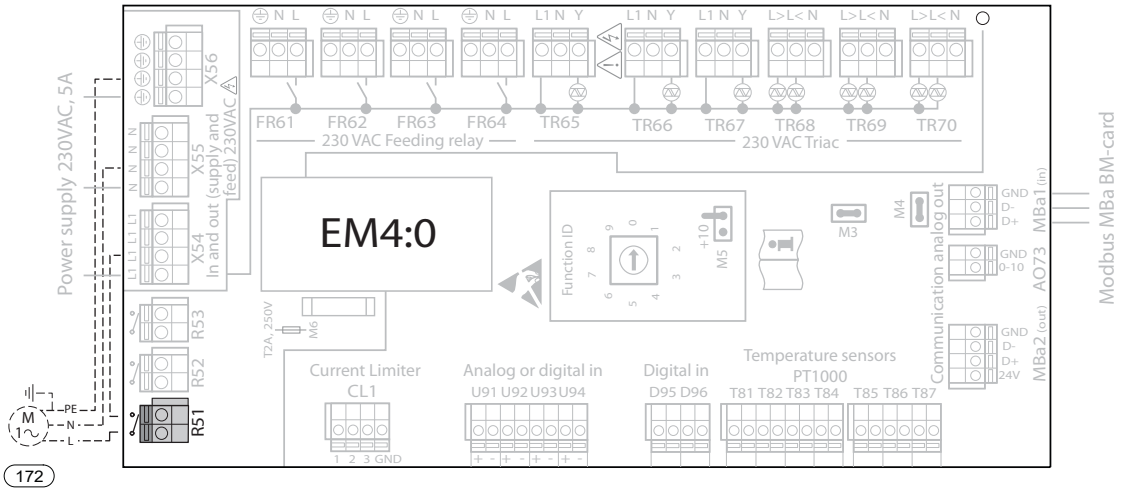

Commission after installation:

1. Login: press padlock, 607080 and confirm
2. Go to SETTINGS/INSTALLATION, navigate to Pool, select EM4 and press ✓
3. Go to SETTINGS/POOL and turn on function
4. Make desired changes and confirm
5. Restart the heat pump and check functionality

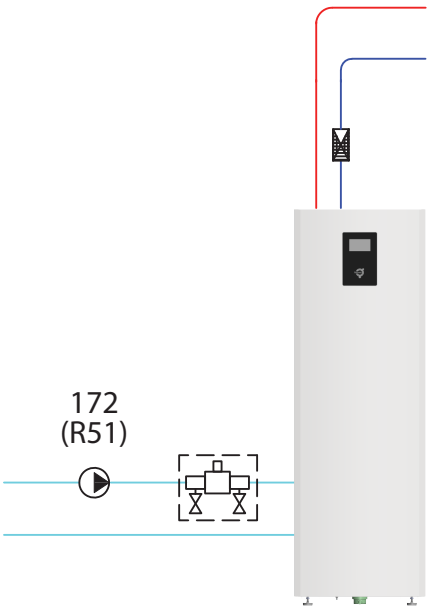
### 3.1.5 External brine pump

This function is used when an external brine pump or ground water pump needs to be controlled. The external signal (230V on/off) is active when the internal brine pump is active. If continuous operation of the brine pump is activated, the external brine pump also operates continuously.

The relay is potential free, so if 230V signal is desired, connect one relay input to X54 and use X55 for Neutral and X56 for PE connection.




| Position number | Terminal | Description |
|---|---|---|
| 172 | R51 | External brine pump |




Commissioning after installation:

1. Login: press padlock, 607080 and confirm
2. Go to SETTINGS/INSTALLATION, navigate to External brine pump, select EM4 and press ✓
3. Restart the heat pump and check functionality

### 3.1.6 Sum alarm (output)

With the sum alarm function, it is possible to make alarms trigger a relay output signal that can be connected to for example a strobe light.

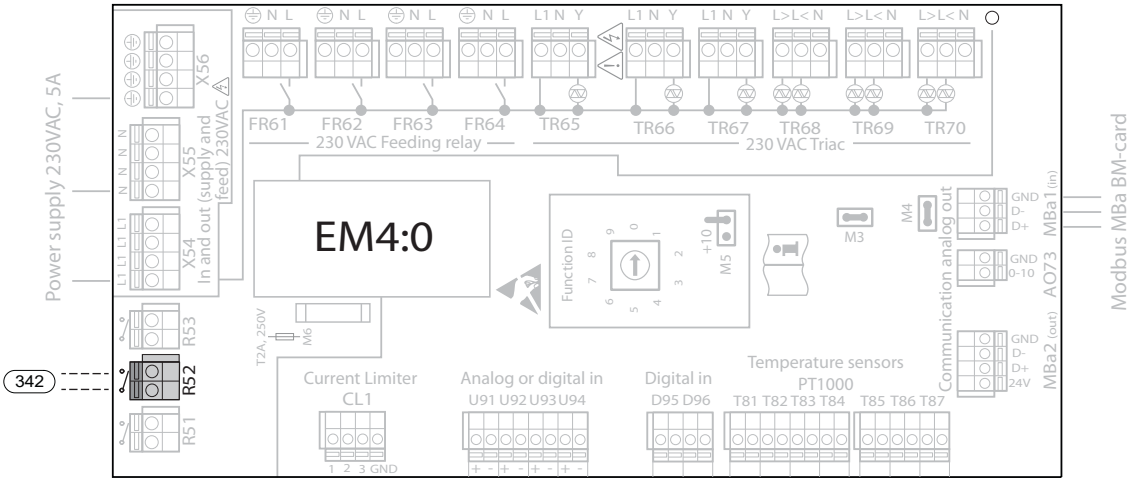
It is possible to set the alarm level that shall activate the signal in 3 levels:

Alarms class A+B+C (= all alarms)

Alarms Class A+B (=only alarms that may affect function etc.)

Alarms Class A (=only alarms that stops compressor etc.)

For connection, see wiring diagram "Alarm relay" (342). Relay is potential free, so if 230V signal is desired, connect one relay input to X54 and use X55 and X56 for supply.




| Position number | Terminal | Description |
|---|---|---|
| 342 | R52 | Alarm relay |

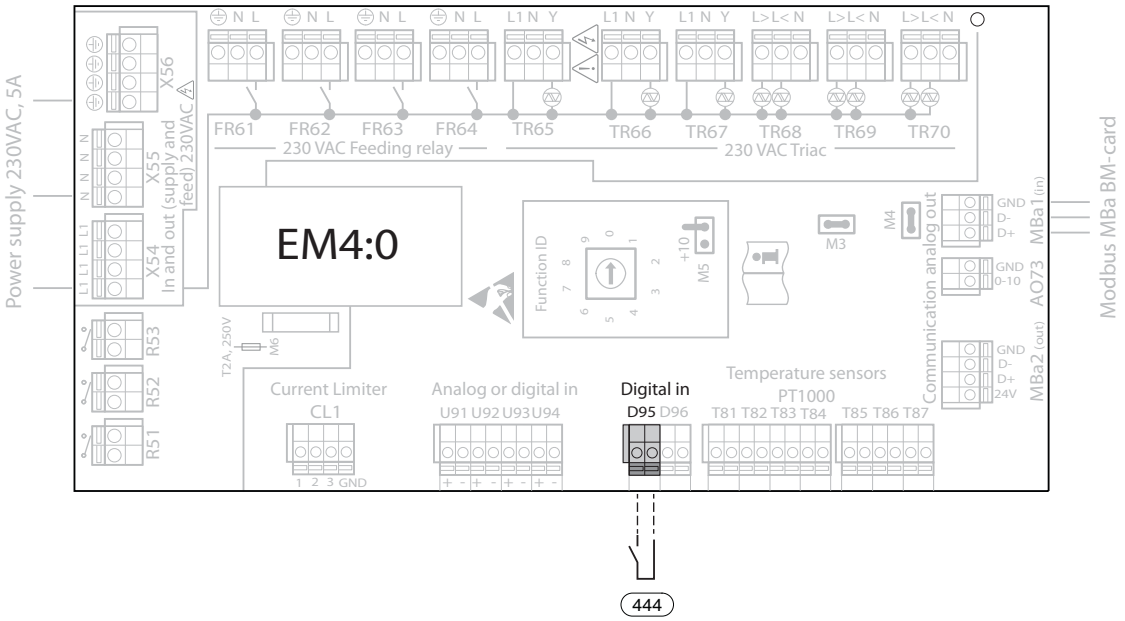
Commissioning after installation:

1. Login: press padlock, 607080 and confirm
2. Go to SETTINGS/INSTALLATION, navigate to Sum alarm, select EM4 and press ✓
3. Go to SETTINGS/ALARM CONTROL/SUM ALARM. Activate Sum alarm by selecting desired alarm level to trigger the external signal. Confirm
4. Restart the heat pump and check functionality

### 3.1.7 External alarm (input)

With the external alarm (input) function it is possible for the heat pump to detect and inform about alarms from external sources via the heat pump display when active and Online. External alarms are treated as level C alarms (notification/ automatic reset) and will not stop the heat pump.

For connection, see wiring diagram "External Alarm" (444). Digital input (open/closed loop).




| Position number | Terminal | Description |
|---|---|---|
| 444 | D95 | External alarm |

Commissioning after installation:

1. Login: press padlock, 607080 and confirm
2. Go to SETTINGS/INSTALLATION, navigate to External alarm, select EM4 and press ✓
3. Go to SETTINGS/ALARM CONTROL/EXTERNAL ALARM. Activate External alarm
4. Restart the heat pump and check functionality

### 3.1.8 Connection of additional Modbus accessories

In cases where additional Modbus accessories (such as room sensor) should be installed, an extra connection for Modbus accessories is available on EM4. See wiring diagram ("MBA2 (out)"). Note that activation of connected accessory & restart of the controller in the menu is required to establish communication. See installation manual for the connected accessory.

# 4 Wiring diagram

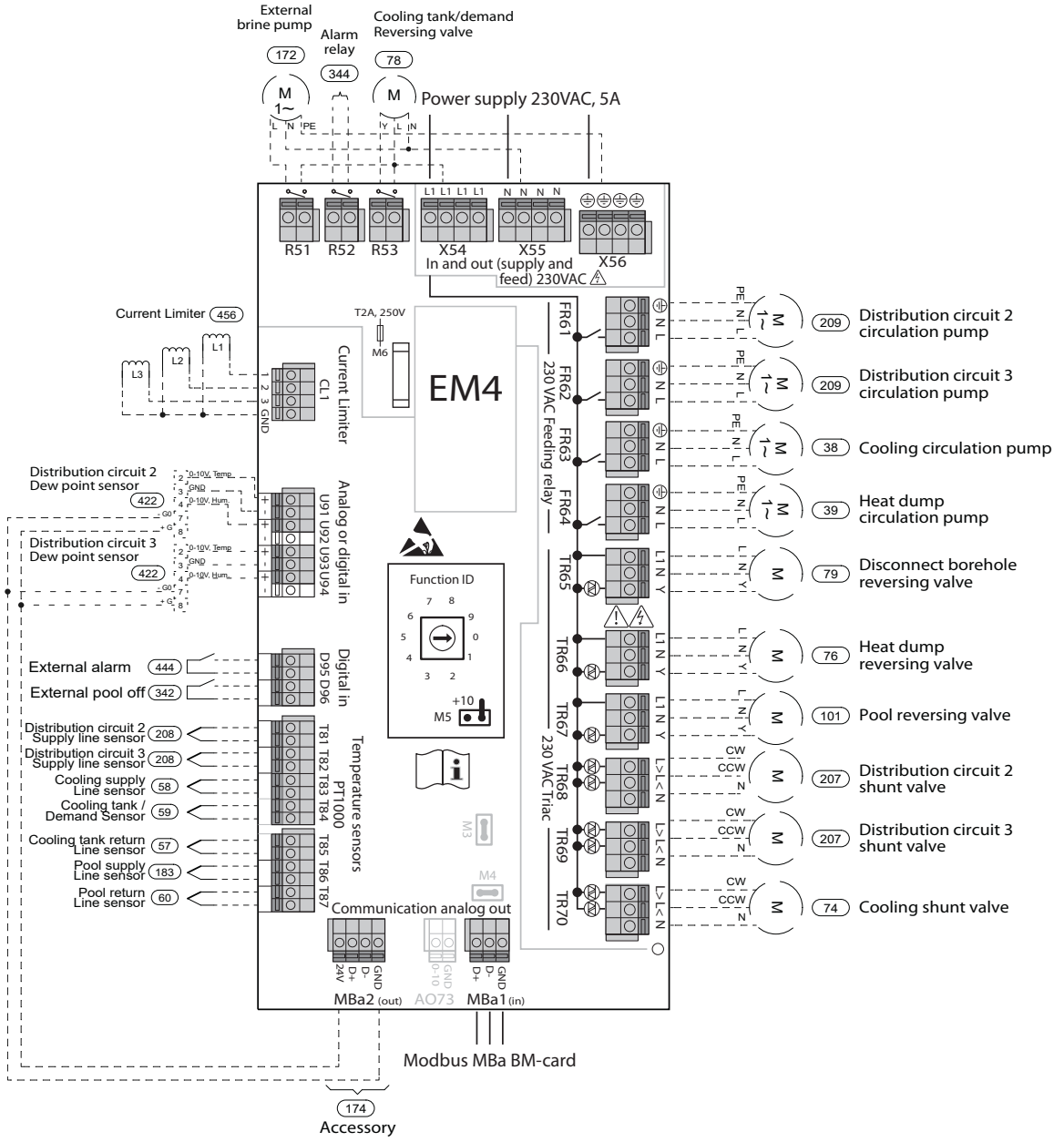
## 4.1 Table item number



The following terminal in- and outputs are used for the heat pump. Which terminals are used depends on the heat pump model.

| Position number | Terminal | Description |
|---|---|---|
| 208 | T81 | Distribution circuit 2 supply line sensor |
| 208 | T82 | Distribution circuit 3 supply line sensor |
| 58 | T83 | Cooling supply line sensor |
| 59 | T84 | Cooling tank/demand sensor |
| 57 | T85 | Cooling tank return line sensor |
| 183 | T86 | Pool supply line sensor |
| 60 | T87 | Pool return line sensor |
| 422 | U91 | Dew point sensor cooling circuit 2 |
| 422 | U92 | Dew point sensor cooling circuit 2 |
| 422 | U93 | Dew point sensor cooling circuit 3 |
| 422 | U94 | Dew point sensor cooling circuit 3 |
| 444 | D95 | External alarm |
| 342 | D96 | External pool off |
| N/A | AO73 | N/A |
| 172 | R51 | External brine pump |
| 344 | R52 | Alarm relay |
| 78 | R53 | Cooling tank/demand reversing valve |
| 209 | FR61 | Distribution circuit 2 circulation pump |
| 209 | FR62 | Distribution circuit 3 circulation pump |
| 38 | FR63 | Cooling circulation pump |
| 39 | FR64 | Heat dump circulation pump |
| 79 | TR65 | Disconnect borehole reversing valve |
| 76 | TR66 | Heat dump reversing valve |
| 101 | TR67 | Pool reversing valve |
| 207 | TR68 | Distribution circuit 2 shunt valve |
| 207 | TR69 | Distribution circuit 3 shunt valve |
| 74 | TR70 | Cooling shunt valve |
| 456 | CL1 | Current limiter |

## 4.2 Wiring diagram



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