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   4.3.1 Fixed Fan Speed Control
   4.3.2 High / low speed operation
   4.3.3 Air Flow Control
   4.3.4 High / low air flow operation
   4.3.5 Supply Duct Pressure Control
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   4.4.2 High Supply Air Temperature Monitoring
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5.3 Water Coil Frost Protection (TA01)

5.4 Warm Up at Unit Start Up

5.5 Unit Frost Protection

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   5.8.3 Water Coil Frost Protection (TA05)
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   5.8.6 Unit Frost Protection
   5.8.7 Defrost of heat-pump
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5.10 Electrical pre-heating Coil
   5.10.1 Heat Recovery Frost Protection
   5.10.2 Overheating protection (TA03)
   5.10.3 Cool down at unit stop

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   5.11.1 Heat Recovery Frost Protection
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   5.11.3 Warm Up at Unit Start Up
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The manufacturer reserves the right to change the specifications without prior notice.
Graphics and photos are for illustration purposes only and not contractually binding.
1 SAFETY CONSIDERATIONS

1.1 General

Installation, start-up and servicing of equipment can be hazardous if certain factors particular to the installation are not considered: operating pressures, presence of electrical components and voltages and the installation site (elevated plinths and built-up up structures). Only properly qualified installation engineers and highly qualified installers and technicians, fully trained for the product, are authorized to install and start-up the equipment safely. During all servicing operations all instructions and recommendations which appear in the installation and service instructions for the product, as well as on tags and labels fixed to the equipment and components and accompanying parts supplied separately, must be read, understood and followed.

- Apply all standard safety codes and practices.
- Wear safety glasses and gloves.
- Use the proper tools to move heavy objects. Move units carefully and set them down gently.

1.2 Avoid Electrocution

Only personnel qualified in accordance with IEC (International electro technical Commission) recommendations may be permitted access to electrical components. It is particularly recommended that all sources of electricity to the unit be shut off before any work is begun. Shut off the main power supply at the main circuit breaker or isolator.

1.3 Abbreviations used

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHU</td>
<td>Air Handling Unit</td>
</tr>
<tr>
<td>AI</td>
<td>Analog Input</td>
</tr>
<tr>
<td>AO</td>
<td>Analog Output</td>
</tr>
<tr>
<td>CHO</td>
<td>Change Over Coil</td>
</tr>
<tr>
<td>CWC</td>
<td>Cold Water Coil</td>
</tr>
<tr>
<td>DI</td>
<td>Digital Input</td>
</tr>
<tr>
<td>DO</td>
<td>Digital Output</td>
</tr>
<tr>
<td>EAT</td>
<td>Extract Air Temperature</td>
</tr>
<tr>
<td>HWC</td>
<td>Hot Water Coil</td>
</tr>
<tr>
<td>IAT</td>
<td>Inlet Air Temperature (Sensor placed just before heat recovery exchanger)</td>
</tr>
<tr>
<td>OAT</td>
<td>Outdoor Air Temperature</td>
</tr>
<tr>
<td>RAM</td>
<td>Random Access Memory (volatile memory)</td>
</tr>
</tbody>
</table>
HHFlex controller is an electronic control system to regulate Air Handling Units. The control system consists of two controllers which are described hereafter.

### 2.1 Overview

Controller Overview

<table>
<thead>
<tr>
<th>Port 1</th>
<th>Port 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS485</td>
<td>RS485</td>
</tr>
</tbody>
</table>

- **P1 RxTx** Yellow/Green: Port 1: Receiving/transmitting
- **P2 RxTx** Yellow/Green: Port 2: Receiving/transmitting
- **TCP/IP** Green/Yellow: Fixed green: Link  
  Flashing green: Traffic  
  Flashing yellow: Identification
- **P/B** Green/Red: Power supply / Low battery level

Port 2 and TCP/IP are only available on the main controller.

### 2.2 Power Supply

Each controller operates at 24 VDC and has a power consumption of 4 VA (without load, without display). In the event of a power supply interrupt, the unit restarts automatically without the need for an external command. However, any faults active when the supply is interrupted are saved and may in certain cases prevent unit from restarting.

### 2.3 Battery

The resources and the program are stored in RAM. To ensure that they are not lost and that the hardware clock continues to run when there is a power failure, the controller is equipped with a buffer battery. The buffer time is at least 5 years. The buffer battery is a 3V lithium battery (CR2032). The battery voltage is monitored. When battery is low the P/B Indication LED lights red.

### 2.4 Indications

The upper left corner of each controller contains four LEDs which give the status indication of the controller.

<table>
<thead>
<tr>
<th>Designation</th>
<th>Colour</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1 RxTx</td>
<td>Yellow/Green</td>
<td>Port 1: Receiving/transmitting</td>
</tr>
<tr>
<td>P2 RxTX</td>
<td>Yellow/Green</td>
<td>Port 2: Receiving/transmitting</td>
</tr>
</tbody>
</table>
| TCP/IP      | Green/Yellow | Fixed green: Link  
  Flashing green: Traffic  
  Flashing yellow: Identification |
| P/B         | Green/Red    | Power supply / Low battery level                 |
### 2.5 Mapping of Inputs/Outputs

<table>
<thead>
<tr>
<th><strong>EcoCompact C201T/3Master</strong></th>
<th><strong>EcoCompact C201T Slave 1</strong></th>
<th><strong>PDT10C</strong></th>
<th><strong>Pressure drop supply filters</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 G</td>
<td>Supply voltage 24 AC/DC</td>
<td>1 G</td>
<td>Supply voltage 24 AC/DC</td>
</tr>
<tr>
<td>2 D8</td>
<td></td>
<td>2 D8</td>
<td></td>
</tr>
<tr>
<td>3 PE</td>
<td>EMV ground</td>
<td>3 B</td>
<td>EXOline connection</td>
</tr>
<tr>
<td>4 +C</td>
<td>+24 VDC, reference for digital inputs DI</td>
<td>4 A</td>
<td>EXOline connection</td>
</tr>
<tr>
<td>9 DOO</td>
<td>Reference for digital outputs DO</td>
<td>9 DDO</td>
<td>Reference for digital outputs DO</td>
</tr>
<tr>
<td>11 DO1</td>
<td>Release DO-act</td>
<td>11 DDO</td>
<td>Poli electricoge heating coil</td>
</tr>
<tr>
<td>12 DO2</td>
<td>Pump pre-heating coil</td>
<td>12 DO3</td>
<td>Pump booster coil</td>
</tr>
<tr>
<td>13 DO3</td>
<td>Pump booster coil</td>
<td>13 DO3</td>
<td>Humidifier</td>
</tr>
<tr>
<td>14 DO4</td>
<td>Pump cooling/heating</td>
<td>14 DO6</td>
<td>Heat demand</td>
</tr>
<tr>
<td>15 DO5</td>
<td>Outdoor air damper + Exhaust air damper</td>
<td>15 DO5</td>
<td>Cold demand</td>
</tr>
<tr>
<td>16 DO6</td>
<td>Enc/exit air damper + Supply air damper</td>
<td>16 DO6</td>
<td>Alert, service needed</td>
</tr>
<tr>
<td>17 DO7</td>
<td>Alarm, go to unit</td>
<td>17 DO7</td>
<td>Recirculation air damper or Run-a-round pump</td>
</tr>
<tr>
<td>39 Aged</td>
<td>Reference pole for analogue inputs AI</td>
<td>39 Aged</td>
<td>Reference pole for analogue inputs AI</td>
</tr>
<tr>
<td>41 A11</td>
<td>Supply air temperature</td>
<td>41 A11</td>
<td>Supply air temperature</td>
</tr>
<tr>
<td>38 A12</td>
<td>Supply air temperature</td>
<td>38 A12</td>
<td>Pressure drop extract fans</td>
</tr>
<tr>
<td>34 A13</td>
<td>Room temperature</td>
<td>34 A13</td>
<td>Pressure drop to heat recovery</td>
</tr>
<tr>
<td>35 A14</td>
<td>Room, setpoint/offset</td>
<td>35 A13</td>
<td>Room air humidity</td>
</tr>
<tr>
<td>43 Aged</td>
<td>Reference pole for universal inputs UI</td>
<td>43 Aged</td>
<td>Reference pole for universal inputs UI</td>
</tr>
<tr>
<td>41 U1</td>
<td>Deist static pressure</td>
<td>41 U1</td>
<td>Mixing air temperature</td>
</tr>
<tr>
<td>42 U2</td>
<td>Room air quality</td>
<td>42 U2</td>
<td>Run-a-round temperature</td>
</tr>
<tr>
<td>43 Aged</td>
<td>Reference pole for universal inputs UI</td>
<td>43 Aged</td>
<td>Reference pole for universal inputs UI</td>
</tr>
<tr>
<td>44 U3</td>
<td>Pressure drop supply fans</td>
<td>44 U3</td>
<td>Pressure drop to exhaust fans</td>
</tr>
<tr>
<td>45 U4</td>
<td>Int. temp. upstream DO1 Supply temp. after unit</td>
<td>45 U4</td>
<td>Deist static exhaust pressure</td>
</tr>
<tr>
<td><strong>FL/M</strong></td>
<td>TCP/IP port: BACon/FP</td>
<td><strong>FL/M</strong></td>
<td>Not available</td>
</tr>
<tr>
<td>59 B</td>
<td>Port 1, EXOline connection</td>
<td>59 B</td>
<td></td>
</tr>
<tr>
<td>60 N</td>
<td></td>
<td>60 N</td>
<td></td>
</tr>
<tr>
<td>59 A</td>
<td></td>
<td>59 A</td>
<td></td>
</tr>
<tr>
<td>60 N</td>
<td>Port 2, Modbus (RS485)</td>
<td>60 N</td>
<td>Not available</td>
</tr>
<tr>
<td>61 E</td>
<td></td>
<td>61 E</td>
<td></td>
</tr>
<tr>
<td>62 N</td>
<td></td>
<td>62 N</td>
<td></td>
</tr>
<tr>
<td>63 E</td>
<td></td>
<td>63 E</td>
<td></td>
</tr>
<tr>
<td><strong>4P4C</strong></td>
<td>Connection for external display</td>
<td><strong>4P4C</strong></td>
<td>Not used</td>
</tr>
<tr>
<td>71 D8</td>
<td>Supply fan failure</td>
<td>71 D8</td>
<td>Humidifier alarm</td>
</tr>
<tr>
<td>72 D9</td>
<td>Frost</td>
<td>72 D9</td>
<td>Max. humidity</td>
</tr>
<tr>
<td>73 D10</td>
<td>Change-over coil status (cold/warm)</td>
<td>73 D10</td>
<td>Mixture, heat booster heater</td>
</tr>
<tr>
<td>74 D11</td>
<td>Occupancy input 1 out of hours override</td>
<td>74 D11</td>
<td>Low speed input</td>
</tr>
<tr>
<td>75 D12</td>
<td>Pump cooling/heating failure</td>
<td>75 D12</td>
<td>Recirculations allow</td>
</tr>
<tr>
<td>76 D13</td>
<td>Frost protection</td>
<td>76 D13</td>
<td>Heat exchanger failure</td>
</tr>
<tr>
<td>77 D14</td>
<td>Service IP</td>
<td>77 D14</td>
<td>CO2 Ext. fan failure</td>
</tr>
<tr>
<td>78 D15</td>
<td>Fire alarm</td>
<td>78 D15</td>
<td>Mixture, heat booster heating</td>
</tr>
<tr>
<td>93 Aged</td>
<td>Reference pole for analogue outputs AO</td>
<td>93 Aged</td>
<td>Reference pole for analogue outputs AO</td>
</tr>
<tr>
<td>94 AO1</td>
<td>Supply fan command</td>
<td>94 AO1</td>
<td>Enc/exit fan command</td>
</tr>
<tr>
<td>92 AO2</td>
<td>Outdoor air damper</td>
<td>92 AO2</td>
<td>Heat recovery command</td>
</tr>
<tr>
<td>93 AO3</td>
<td>Control valve Cooling / Heating</td>
<td>93 AO3</td>
<td>Exhaust air damper</td>
</tr>
<tr>
<td>94 AO4</td>
<td>Control valve pre-heating</td>
<td>94 AO4</td>
<td>Mixing air damper</td>
</tr>
<tr>
<td>95 AO5</td>
<td>Control valve booster heater</td>
<td>95 AO5</td>
<td>Humidifier command</td>
</tr>
</tbody>
</table>
2.6 Technical data

### 2.6.1 Common Data Controller

Supply voltage: 24 VAC ±15%, 50...60 Hz or 20...36 VDC
Power consumption: 4 VA (without load, without display)
BTL approval: EXOreal 3.1-1-02 or later
+C output: +24 V DC, 0.15 A, short-circuit proof
Operating system: EXOreal C
Battery backup: Memory and real-time clock, at least 5 years
Ambient temperature: 0...50°C
Storage temperature: -20...+70°C
Relative humidity (non-condensing): Max. 95%
Dimensions (WxHxD): 149 x 121 x 60 mm
DIN controller width: 8 ½

**EMC emissions and immunity standard:** This product conforms to the requirements of the EMC Directive 2004/108/EC through product standards EN 61000-6-1 and EN 61000-6-3.

**RoHs:** This product conforms to the Directive 2011/65/EU of the European Parliament and of the Council.

### 2.6.2 Communication

Serial: RS485 (EXOline or Modbus with automatic detection/change over)
TCP: EXOline-TCP, BACnet/IP, Modbus/IP (requires EXOreal 3.1.1-01 or later)
Modbus: 8 bits, 1 or 2 stop bits. Odd, even (Fs) or no parity.
Speed (Port 1 and Port 2): adjustable 1200-38400 bps

### 2.6.3 Casing

Protection class: IP20
Mounting: DIN-rail mounting or mounting in cabinet
Plastic: Polycarbonate, PC

### 2.6.4 Inputs

Analogue inputs, AI: 0(4)...20 mA, 0...10 V, 0...200 mV, PT-1000, DIN Ni1000, LGNi1000, 12 bits A/D
Digital inputs, DI: Potential-free contact, 24 V DC, configurable for pulse input
Universal inputs. UI: AI or DI (see above)

### 2.6.5 Outputs

Analogue outputs, AO: 0...10 V DC, 5 mA, 12 bit D/A, short circuit-protected
Digital outputs, DO: Mosfet 24 V AC/DC, 2 A. Max 8 A in total.
24 V DC output: 0.15 A, short circuit-protected

### 2.6.6 External display

Models: E3-DSP, ED9200 or ED-RU
Connection: 4P4C modular connector.
Max. cable length: 100 m

### 2.6.7 TCP/IP port

Connection: RJ45, 10Base-T/100Base-TX auto-negotiation
Cable length: Max. 100 m (min Cat 5)
Power consumption: + 1 VA in addition to basic consumption.
3 HUMAN MACHINE INTERFACE

3.1 E-DSP External display unit

3.2 Overview

The display menu system is accessed using seven buttons:

- View alarms
- Left
- Confirm choices
- Erase
- Red LED
- Yellow LED
- Up
- Right
- Down

The LEDs have the following functions:

<table>
<thead>
<tr>
<th>Designation</th>
<th>Function</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Bell Icon]</td>
<td>There are one or more unacknowledged alarm(s)</td>
<td>Flashing red</td>
</tr>
<tr>
<td>![Bell Icon]</td>
<td>There are one or more remaining, acknowledged alarm(s)</td>
<td>Fixed red</td>
</tr>
<tr>
<td>![Pen Icon]</td>
<td>You are in a dialogue box where it is possible to switch to change mode</td>
<td>Flashing yellow</td>
</tr>
<tr>
<td>![Pen Icon]</td>
<td>Change mode</td>
<td>Fixed yellow</td>
</tr>
</tbody>
</table>

3.3 Log in

The standard passwords are 3333 for basic level with the lowest access (guest) and 2222 for level giving more access (operator). Menu tree external display
3.4 Menu tree external display

- **ACTUAL / SETPOINTS**
  - **ACTIVATE OUT OF HOUR**
  - **OUT OF HOURS OVERRIDE TIME**
  - **TEMPERATURE**
  - **HUMIDITY**
  - **DE-HUMIDITY**
  - **AIR VOLUME / FAN SPEED**
  - **DUCT PRESSURE**
  - **INDOOR AIR QUALITY**
  - **FILTER SENSOR**
  - **HEAT RECOVERY UNIT**
  - **CONFIGURATION**

- **INPUTS/OUTPUTS**
  - **MAIN CONTROLLER**
  - **SLAVE 1 CONTROLLER**
  - **SLAVE 2 CONTROLLER**

- **TIME SCHEDULE**
  - **RUN SCHEDULE**
  - **LOW SPEED**
  - **NIGHT COOLING**
  - **RECIRCULATION**
  - **PUMP TEST**
  - **HOLIDAYS**

- **SETTINGS**
  - **RUNTIME**
  - **ADJUST TIME / DATE**
  - **COMMUNICATION**
  - **MODBUS CONFIG**
  - **BACNET IP CONFIG**
  - **ALARMS**
  - **FILTER SENSOR**
  - **PRESSURE FAILURE**
  - **SUPPLY TEMPERATURE**

- **FACTORY**
  - **MAIN CONTROLLER**
  - **SLAVE 1 CONTROLLER**
  - **SLAVE 2 CONTROLLER**

- **ACCESS RIGHTS**
  - **LOG ON**
  - **LOG OFF**
  - **CHANGE PASSWORD**

- **DEFAULT SCREEN**
  - **SOFTWARE VERSION**

- **ALARM LOG**
  - **MAIN CONTROLLER**
  - **SLAVE 1 CONTROLLER**
  - **SLAVE 2 CONTROLLER**

- **RUNMODE**
  - **TEMPERATURE CONTROL**
  - **HUMIDITY CONTROL**
  - **FAN CONTROL**
  - **OUTDOOR COMPENSATION**
  - **NIGHT COOLING**
  - **FIRE ALARM SETTINGS**

- **RUNTIME**
  - **ELECTRIC FROST HEATER**
  - **ELECTRIC BOOSTER HEATER**
  - **AHU ON**
  - **HEAT DEMAND**
  - **COLD DEMAND**
  - **RELEASE DX**
  - **PUMP PREHEATER**
  - **PUMP BOOSTER HEATER**
  - **PUMP COOLER/CHANGE-OVER**
  - **PUMP RUN-A-ROUND COIL**

- **HUMIDIFIER**
  - **MAIN CONTROLLER**
  - **SLAVE 1 CONTROLLER**
  - **SLAVE 2 CONTROLLER**

- **DEFAULT SCREEN**
  - **SOFTWARE VERSION**

- **ALARM LOG**
  - **MAIN CONTROLLER**
  - **SLAVE 1 CONTROLLER**
  - **SLAVE 2 CONTROLLER**

- **RUNMODE**
  - **TEMPERATURE CONTROL**
  - **HUMIDITY CONTROL**
  - **FAN CONTROL**
  - **OUTDOOR COMPENSATION**
  - **NIGHT COOLING**
  - **FIRE ALARM SETTINGS**

- **RUNTIME**
  - **ELECTRIC FROST HEATER**
  - **ELECTRIC BOOSTER HEATER**
  - **AHU ON**
  - **HEAT DEMAND**
  - **COLD DEMAND**
  - **RELEASE DX**
  - **PUMP PREHEATER**
  - **PUMP BOOSTER HEATER**
  - **PUMP COOLER/CHANGE-OVER**
  - **PUMP RUN-A-ROUND COIL**

- **HUMIDIFIER**
  - **MAIN CONTROLLER**
  - **SLAVE 1 CONTROLLER**
  - **SLAVE 2 CONTROLLER**
3.5 Access levels external display

<table>
<thead>
<tr>
<th>Access Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visible for everyone</td>
<td>No changes can be made</td>
</tr>
<tr>
<td>Visible for everyone</td>
<td>Users logged in as guest (3333) or higher can make changes</td>
</tr>
<tr>
<td>Visible for everyone</td>
<td>Users logged in as operator (2222) or higher can make changes</td>
</tr>
<tr>
<td>Only visible for users logged in as factory</td>
<td></td>
</tr>
</tbody>
</table>

3.6 Web panel

Access to the data of HHFlex can be done thanks to a PC with Google Chrome.

3.7 Connection to the unit

To access the HHFlex controller, enter the IP address of the unit in the address bar of the web browser. The controller has two IP addresses, one service IP address and one user IP address.

The controller is working in service IP address mode when Digital Input DI7 of the main controller is closed (connect +24VDC to DI7) and is working in user IP address mode when DI7 is open.

The default service IP and user IP address of the unit is 169.254.24.1.

The user IP address can be changed in the “Settings” menu when operating in service IP address mode or with the E-DSP under Service => Communication.

The service IP address can’t be changed.

The IP address of the PC, directly connected to the unit should be in the same group as the IP address of the unit (169.254.*.*).

Minimum web browser configuration:
- Google Chrome

Many users can be connected at the same time. There is no priority between users; last modification is taken into account. Language of the web browser must be set in English, France or Dutch.
3.8 Login Screen

There are three login levels:

- Basic level with the lowest access;
  - Login: Guest
  - Password: 1111

- Level giving more access;
  - Login: Operator
  - Password: 2222

- Level with full access, for manufacturer purpose only

Klick on the login button
3.9 Overview Screen
Displays the process diagram and status of the unit.
This is a read only folder. No settings can be made.

3.10 Dashboard screen
Displays relevant modes and actual values.
All values written in blue can be changed. As soon as a value has been changed and you have pressed enter, the value is downloaded to the HHFlex controller.
Users logged in as Operator can make changes on this pages.
3.11 Actual/Setpoint screen

Displays relevant setpoints and actual values. All values written in blue can be changed. As soon as a value has been changed and you have pressed enter, the value is downloaded to the HHFlex controller. Users logged in as Guest can make changes on this pages.

3.12 Alarm Status screen

Shows actual Alarms and Status of the unit. Alarms can acknowledged, blocked or unblocked. Users logged in as Guest or Operator can make changes.

BE CAREFUL: Blocking Alarm can lead to unsafe situations.

3.13 Inputs/Output screen

Shows actual values for all inputs and outputs. This is a read only folder. No settings can be made.
3.14 Analog Inputs screen
Shows actual values for all analog inputs. For testing purpose only all functions can manually set here to a certain value. Only users logged in as Operator can make changes.

BE CAREFUL: All settings which are made here will be executed. Protections like frost protection, max temperature electric heater and minimum airflow electric heater will be ignored.

3.15 Analog Outputs screen
Shows actual values for all analog outputs. For testing purpose only all functions can manually set here to a certain value. Only users logged in as Operator can make changes.

BE CAREFUL: All settings which are made here will be executed. Protections like frost protection, max temperature electric heater and minimum airflow electric heater will be ignored.
3.16 Digital Inputs screen
Shows actual values for all digital inputs.
For testing purpose only all functions can manually set here to a certain value.
Only users logged in as Operator can make changes.

BE CAREFUL: All settings which are made here will be executed.
Protections like frost protection, max temperature electric heater and minimum airflow electric heater will be ignored.

3.17 Digital Outputs screen
Shows actual values for all digital outputs.
For testing purpose only all functions can manually set here to a certain value.
Only users logged in as Operator can make changes.

BE CAREFUL: All settings which are made here will be executed.
Protections like frost protection, max temperature electric heater and minimum airflow electric heater will be ignored.
### 3.18 Time Program screen

Here you can set the time programs:

- Run schedule.
- Low Speed schedule. (Run schedule must be active)
- Night cooling schedule.
- Recirculation schedule.
- Pump test schedule.
- Holiday program

All values written in blue can be changed by users logged in as Guest or Operator. As soon as a value has been changed and you have pressed enter, the value is downloaded to the HHFlex controller.

The day begins at 00.00 hours and ends at 24.00 hours.
3.19 Settings screen
All values written in blue can be changed by users logged in as Operator. As soon as a value has been changed and you have pressed enter, the value is downloaded to the HHFlex controller. Only users logged in as Operator can make changes.

BE CAREFUL: Bad PID parameters can lead to unstable control.

3.20 Factory Screen
For manufactory purpose only, data can be read but changed only by manufactory.
4 HHFlex – BASIC CONTROL FUNCTIONS

4.1 Temperature Control

4.1.1 Temperature control in occupied mode
The HHFlex AHU controller can control either:
- the supply air temperature (TT02)
- or the extract air temperature (TT03) (cascade control of the supply air temperature)
- or the room air temperature (TT05) (cascade control of the supply air temperature)
The selection of the temperature controlled is made in the menu Configuration (menu Actual/Setpoint).
To save energy, HHFlex controller offers the possibility to correct the setpoint based on the actual outdoor temperature.
All setpoints are configurable in the menu Actual/Setpoint.

4.1.2 Supply air temperature (TT02) control
To activate this function select supply air temp. in the configuration menu.

If OAT correction is selected there is compensation on the supply air temperature according the graph:

4.2 Economy mode based on OAT (TT06)
If the option “Eco mode on Outdoor Temp” is selected in the configuration menu (Actual/Setpoint) then mechanical heating/cooling can be disabled between 2 OAT values. Heat recovery device can also be stopped during this “economy mode” thanks to a configuration parameter.
4.2.1 Room air temperature (TT05) control

To activate this function select room temp. in the configuration menu.

If OAT (TT06) correction is selected there is outdoor compensation on setpoint according the graph:
4.2.2 Extract air temperature (TT03) control

To activate this function select Extract air temp. in the configuration menu.

If OAT (TT06) correction is selected there is outdoor compensation on setpoint according the graph:

The temperature is fine controlled only in occupied mode. In non-occupied mode, the unit is normally stopped but can be restarted for special functions described hereafter.

4.2.3 Temperature control in non-occupied mode

- Minimum Room Temperature (TT05) Surveillance: Restart unit with mechanical heating if room temperature drops below threshold.
- Maximum Room Temperature (TT05) Surveillance: Restart unit with mechanical cooling if room temperature rises above threshold.

These functions are available only for control on room temperature or when night cooling is selected. To set the parameters for this function, go to the menu Actual/Setpoint Room Temperature.

- Summer Night Ventilation – Free Cooling: Restart unit to pre-cool the room only with outdoor fresh air.

These function is available only when night cooling is selected in the configuration menu. To set the parameters for this function, go to the menu Actual/Setpoint Nightcooling.
4.3 Fan speed control

Different options for ventilation control can be selected:

- Fixed fan speed control (low or high speed)
- Air flow control (low or high airflow)
- Supply duct pressure control
- Supply and exhaust duct pressure control
- Indoor air quality control

4.3.1 Fixed Fan Speed Control

To activate this function, set Fan control to Fixed (on/off) or Fixed (high/low) in the configuration menu. Setpoints for this function are available in the menu Actual/Setpoint.

Supply and extract fan are ‘On’ or ‘Off’. Supply and extract air volumes or pressures are not closed loop controlled and vary with airside resistance.

This setting is mainly intended for commissioning, inspection and maintenance, but can also be selected in the fan speed control menu.

In the frequency inverter the maximum motor speed limit is set on the design fan speed x 1.05. To run the unit on design duty, the setpoints for fixed fan speed are set to 95%.

4.3.2 High / low speed operation

For certain applications two different setpoints fixed speed operation can be selected within the controller. The setpoints for high/low speed will be the rated speed of the fans in the air handling unit. The setpoints for low speed shall be entered as a percentage of the design speed performances of the supply and extract fan. For each fan a different percentage can be inputted.

High and low speed operation can be programmed in the internal clocktimer (See Time Program menu). To activate this function, set Runmode to Internal clock.

As an option low speed operation can also be selected with a remote contact on a digital input of the controller! To activate this function, set Runmode to Contacts.

4.3.3 Air Flow Control

To activate this function, set Fan control to Flow or Flow (high/low) in the configuration menu. Setpoints for this function are available in the menu Actual/Setpoint, flow supply fan and flow extract fan.

Supply and extract air are maintained at the desired airflow rate independent of the actual airside resistance. Supply fan and extract fan are controlled by separate setpoints.

4.3.4 High / low air flow operation

For certain applications two different setpoints for fixed flow operation can be selected within the controller. One setpoints for normal operation and one setpoint for low speed. For each fan a different air volume can be inputted.

Normal and low speed operation can be programmed in the internal clocktimer (See Time Program menu). To activate this function, set Runmode to Internal clock.

As an option high/low speed operation can also be selected with remote contacts on digital inputs of the controller! To activate this function, set Runmode to Contacts.

4.3.5 Supply Duct Pressure Control

To activate this function, set Fan control to Constant pressure in the configuration menu. Setpoint for this function is available in the menu Actual/Setpoint, Static duct pressure.

The actual supply airflow rate is measured, while the pressure in the supply duct is controlled at the required setpoint. The extract airflow is controlled in order to maintain the correct flow ratio between supply and extract air flow.

The pressure sensor is not pre-assembled, but delivered in a cardboard box in the unit and has to be mounted at an appropriate location in the ductwork.
4.3.1 Supply and exhaust Duct Pressure Control
To activate this function, set Fan control to Constant pressure in the configuration menu.
Setpoint for this function is available in the menu Actual/Setpoint, Static duct pressure.
The actual supply airflow rate is measured, while the pressure in the supply and exhaust duct is controlled at the required setpoint. The pressure sensor is not pre-assembled, but delivered in a cardboard box in the unit and shall be mounted at an appropriate location in the ductwork.

4.3.2 Indoor Air Quality Control
To activate this function, set Fan control to Air quality in the configuration menu.
Setpoint for this function is available in the menu Actual/Setpoint, Room air quality.
The CO2 concentration in the room is controlled. A minimum supply fan speed setpoint can be set in the Settings menu when measured concentration is lower than setpoint.
The supply fan is controlled to always have a CO2 concentration below the setpoint.
The extract airflow is controlled in order to maintain the correct flow ratio between supply and extract air flow.
The air quality sensor is not pre-assembled, but delivered in a cardboard box in the unit and shall be mounted at an appropriate location in the room.

4.4 Heat Recovery Monitoring

4.4.1 Low Supply Air Temperature Monitoring
Parameters for this function are available in the menu Settings.
When the supply temperature differs more than -3 K (by default) from the actual setpoint, an internal timer is started.
After an elapsed time of 10 minutes (by default), the unit is switched off and a low temperature alarm is generated in the controller. The auto reset function starts the unit again after 50 minutes (by default). If the low temperature condition still exists the cycle is repeated; if not the unit continues to run. If a low temperature alarm has occurs the alert service alarm will be activated which has to be reset manually.

4.4.2 High Supply Air Temperature Monitoring
Parameters for this function are available in the menu Settings.
When the supply temperature differs more than +3 K (by default) from the actual setpoint, an internal timer is started.
After an elapsed time of 10 minutes (by default), a high temperature alarm is generated in the controller. The unit keeps running during this alarm.

4.4.3 Frost Protection without Pre-Heating
To activate this function, set Anti freeze protection to present in the configuration menu (Actual/Setpoint).
Parameters for this function are available in the menu Factory.
A differential pressure sensor across the heat recovery device is required.
Based on pressure drop increase due to frost forming on the exchanger surface, the performance of the heat recovery device will be reduced (opening of bypass damper plate heat exchanger or reducing rotor speed) to allow defrosting of plate exchanger or rotor

\[ \Delta p_{\text{pressure drop limit}} = \text{frostmul} \times d_{\text{sgndrop}} \times \left( \frac{\text{actual air flow}}{\text{design air flow}} \right)_{\text{exp}} \]

\[ *_{\text{exp}} = \]
- "crhr_exp" for Cross Flow Heat Exchanger
- "rohr_exp" for rotary heat exchanger
- "cohr_exp" for Counter Flow Heat Exchanger
4.5 Filter Monitoring equipped with a pressure sensor
Parameters for this function are available in the menu Settings.

The supply (PT01) and extract (PT02) filter section is equipped with a pressure sensor connected to EXOline connected to the controller. If the pressure drop across the filter exceeds the preset value an internal timer is started. After an elapsed time of 60 minutes (by default) a service alert is generated. Alarm level will be adjusted on the “Human machine interface” or “web browser”. On the supply pressure sensor (PT01) are the inlet air temperature (TT01) / humidity sensor (MT01) connected. On the exhaust pressure sensor (PT02) are the exhaust air temperature (TT03) / humidity sensor (MT03) connected.

To avoid possible false maintenance alarms caused by water droplets arrested in the (inlet air) filters during foggy weather conditions, the pressure drop monitoring is only active between 12:00 and 18:00 h (by default).

4.1 Dry outdoor filter control equipped with a pre-heater
For the Maintenance and lifespan of an outdoor filter the pre-heater must be placed before the filter. The pre-heater keeps the filter free of bacterial growth and a guaranteed air quality.

The following modes of operation can be selected:
- Temperature controlled
- Humidity controlled
- Both temperature and humidity controlled

Default setpoint for inlet temperature is set at 5°C.
Default setpoint for inlet humidity is set at 90%.

4.2 Occupancy Management
Occupancy can be monitored internally (stand alone mode) or externally (remote mode). The mode of operation must be selected in the web browser under runmode in the Actual/Setpoint screen or with the external display under Runmode.

The following modes of operation can be selected:
- Manual Off
- Manual On
- Contacts
- Internal clock
- A push button connected to the controller
- Bus Communication

Unit is always in unoccupied mode.
Unit is always running in occupied mode.
An on/off input is used to activate the occupied/unoccupied mode.
Internal clock program is used to set occupied/unoccupied mode.
Occupied/unoccupied mode is externally set by Modbus or BACnet.

4.3 Stand alone mode

4.3.1 Internal Clock
Occupancy information comes from internal schedules. See Time Program menu description.

4.3.2 Operation Time Extension
HHFlex has a digital input for an operation time extension (OW01) pulse contact. If the input is activated by an external pulse contact the unit will start to run or resume in normal mode operation.
If the pulse contact is used during normal operation time an additional operation time extension is effectuated (default 1 min). Multiple activation of the contact will have no effect on the duration of the additional operation time.
If the pulse contact is used during unoccupancy operation the units starts to run for the additional default value.
The value for out of hours override time extension is configurable in Actual/Setpoint.

4.4 Remote mode
Occupancy information comes from the on/off input; closed contact = occupied mode.
4.5 Building Fire Management
Parameters for this function are available in the Configuration menu Extra settings. The controller has a digital input for a fire alarm coming from the building system. When a ‘fire alarm’ is detected (generated by the BMS), the unit will start to run in Fire mode according the selected fire scenario. The variable speed controlled motors will run at an adjustable percentage of the maximum speed. Pre selectable fire scenarios are:

- Supply-fan (SF01) off, Extract-fan (EF01) off (default)
- Supply-fan (SF01) on, Extract-fan (EF01) on
- Supply-fan (SF01) on, Extract-fan (EF01) off
- Supply-fan (SF01) off, Extract-fan (EF01) on

Except thermal motor failure all other possible alarms will not prevent the fans from running during fire mode. When the fire alarm reset is set to manual (default) the fire mode will remain active, even when the alarm is no longer present. Termination of the fire mode is only possible after disabling the fire alarm followed by a general reset (RS01). When the fire alarm reset is set to automatic the fire mode will terminate automatic when the alarm is no longer present.

Note: For units with electrical heaters, the fans may stop with a short delay to evacuate heat from the unit.

5 HHFlex – OPTIONAL CONTROL FUNCTIONS

5.1 Air Dampers
Parameter for this function is available in the menu Actual/Setpoint extract fan supply fan. The exhaust (CD05) opening, extract (CD02) opening, supply (CD04) opening and fresh air intake (CD01) opening can be equipped with dampers. If a start command for the unit is initiated, the actuators on the dampers receive an open command and after an adjustable delay (60 seconds by default) the start command to the fans will follow. When the unit is stopped, the open command is interrupted with an adjustable time delay (60 seconds by default) and the dampers will be automatically closed.

Note: If unit is equipped with electrical heaters, the closing of the dampers may be delayed to allow a cool down of the heaters.

5.2 Hot-water reheating Coil
Parameters for this function are available in the menu Actual/ setpoint and Settings.

Temperature Control
If heat recovery (XC01) is not enough to control temperature, the Hot Water Coil is basically controlled as shown in the sketch below.

A PID controller is used. Tuning of the PID controller is possible in the menu Settings (Advanced User).
5.3 Water Coil Frost Protection (TA01)

A switching frost thermostat (TA01) is located downstream the hot water coil in order to prevent it from freezing in case of insufficient hot water supply. Capillary temperatures over a length of 300mm below the predefined alarm level generate a frost alarm and the unit will go into frost mode. The frost mode will initiate the following actions:
1. Ventilation is stopped and air dampers are closed (if applicable)
2. All control valves will be forced to 80% open.
3. All pumps are started and heat demand command is on
A frost alarm shall be considered as an urgent alarm and has to be reset in the electrical panel of the air handling unit. The frost thermostat itself resets automatically if the temperature rises sufficiently above the alarm level.
If the unit is also equipped with a frost coil with frost protection thermostat, the frost thermostat on the heating coil downstream the heat recovery device is omitted.
The default hardware setting for the frost thermostat alarm is +5°C.

5.4 Warm Up at Unit Start Up

This function is not active when indoor unit is selected
To avoid unintentional frost alarm, a startup delay mode for winter operation is programmed.
If the outdoor temperature is below a preset value (default +5°C), the fans will only be started after a fixed preset time delay (5 min) in order to pre-heat the heating coil. During this time delay the hot water control valve is opened at a preset value (default 100%). Heat demand and pump on signal are generated simultaneously.
For this purpose an outdoor temperature sensor for wall mounting (not duct sensor) is mandatory!

5.5 Unit Frost Protection

This function is not active when indoor unit is selected
To secure outdoor units against unintentional frost alarm during unoccupied mode, a hot water flow across the heating coil is created if the outdoor temperature is below the preset value (default +7°C), the hot water control valve is opened at a preset value (default 50%). Heat demand and pump on signal are generated simultaneously.

5.6 Chilled-water Cooling Coil

5.6.1 Temperature Control

If heat recovery is not enough to control temperature, the cold water coil will be basically controlled as shown in the sketch below.
5.8 Change-over water Coil for Heating and Cooling

Parameters for this function are available in the menu Actual/Setpoint and Settings.
For systems with heat pump, a single coil for heating and cooling is used. This coil has to operate as a change-over coil to perform the heating function or cooling function in the AHU.

5.8.1 Heat/Cool Thermostat (TS01)

In such a system there is no link between heating or cooling demand of the unit and heating or cooling mode of the heat pump system. This could create a situation that in case of heat demand only chilled water is available and vice versa. That's why a thermostat on the water supply pipe evaluates the water temperature. The thermostat is not pre-assembled but delivered in a cardboard box in the unit and shall be mounted on a location in the pipe system where there is a (continuous) flow with a temperature representing the water supply temperature of the system; independent of the position of the control valve. If the measured temperature conflicts with the actual thermal demand of the unit, the control valve will be closed until a supply water temperature is measured that suits the thermal demand!
A wrong mounting location of the water supply temperature thermostat will definitely lead to malfunctioning of the temperature control system!

Default settings to establish heat pump mode
• heating mode if water temperature is above 28°C
• cooling mode if water temperature is below 18°C
If the temperature is between the above mentioned settings, the last monitored thermal mode is maintained until the preset value of the other mode is exceeded!

5.8.2 Temperature Control

If heat recovery is not enough to control temperature, the Cold Water Coil will be basically controlled as shown in the sketch below.

5.8.3 Water Coil Frost Protection (TA05)

A switching frost thermostat is located downstream the hot water coil in order to prevent it from freezing in case of insufficient hot water supply. Capillary temperatures over a length of 300mm below the predefined alarm level generate a frost alarm and the unit will go into frost mode. The frost mode will initiate the following actions:
1. Ventilation is stopped and air dampers are closed (if applicable)
2. All control valves will be forced to 80% open.
3. All pumps are started and heat demand command is on

A frost alarm shall be considered as an urgent alarm and has to be reset in the electrical panel of the air handling unit. The frost thermostat itself resets automatically if the temperature rises sufficiently above the alarm level.
If the unit is also equipped with a frost coil with frost protection thermostat, the frost thermostat on the heating coil downstream the heat recovery device is omitted.
The default hardware setting for the frost thermostat alarm is +5°C.
5.8.5 Warm Up at Unit Start Up
This function is not active when indoor unit is selected.
To avoid unintentional frost alarm, a startup delay mode for winter operation is programmed.
If the outdoor temperature (TT06) is below a preset value (default +5°C), the fans will only be started after a fixed preset time delay (5 min) in order to pre-heat the heating coil. During this time delay the hot water control valve (CV01) is opened at a preset value (default 100%). Heat demand (WV01) and pump (CP02) on signal are generated simultaneously.
For this purpose an outdoor temperature (TT06) sensor for wall mounting (not duct sensor) is mandatory!

5.8.6 Unit Frost Protection
This function is not active when indoor unit is selected.
To secure outdoor units against unintentional frost alarm during unoccupied mode, a hot water flow across the heating coil is created if the outdoor temperature is below the preset value (default +7°C), the hot water control valve (CV02) is opened at a preset value (default 50%). Heat demand (WV01) and pump (CP02) on signal are generated simultaneously.

5.8.7 Defrost of heat-pump
During periods of defrost of the heat pump, the heat pump should be able to activate the recirculation (XX02) mode via third party cabling.
Note: The defrosting heat shall not be extracted from the recirculating air, but must be injected or buffered in the hydraulic system between heat pump and air handling unit.
During this mode, the supply fan is controlled like in occupied mode. The extract fan is off.

5.8.8 Backup electric heater
The application of a change-over water coil involves a greater risk on unavailability of heating capacity when required. This situation occurs for instance when there is no warm water available because the heat pump is in cooling- or defrosting mode.
If a backup electric heater is selected to secure heating at all times, it will only be used if the change-over coil is not capable to deliver any heating capacity at that time. It cannot be used to compensate performance deficiency of the change-over coil!
When a backup electric heater is comprised in the air handling unit the pulse signal output, designated for an electric booster heater, will be used to control the heating performance.
If there is a control demand for heating by the change-over coil and the contact of recirculation request is enabled, an equivalent pulse control signal from the appropriate output on the controller will be sent to the back-up heater, to take over the temperature control.
Sufficient air flow shall be detected to enable heating performance.
The safety thermostats will be connected in series on the alarm input, intended for the electric frost coil. If this alarm input is already used for the frost coil, all four safety thermostats will be wired in series to this digital alarm input.
Default settings for back-up electric heater
- heating enabled if no hot water detected and flow signal above threshold and control signal > 10%
- heating disabled if hot water detected or flow signal below threshold or control signal < 5%
5.9 Electrical reheating Coil

Parameters for this function are available in the menu Actual/setpoint and Settings.

5.9.1 Temperature Control

If heat recovery is not enough to control temperature, the electrical booster heater is basically controlled as shown in the sketch below.

A PID controller is used. Tuning of the PID controller is possible in the menu Settings (Advanced User). The modulating control signal to the electric heater creates a fully proportional performance variation of the electric heater.

For information: The solid state relays use integral cycle control which is a technique to vary the amount of complete AC-half cycles of load current (switch in the zero current passage); hence a resistive load without creating electrical noise. Proportional control is achieved with solid state relays, integrated in the terminal box of the electric heater. Depending on the heating capacity, the rods of the heater are split into one or more groups of rods. Each group is equipped with 2 solid state relays. All solid state relays simultaneously receive the quasi-modulating pulse signal generated by the controller. During each voltage pulse period the solid state relays are activated and give power supply to the heating rods. The pulse signal is basically an on/off voltage signal, but due to its switching frequency, a proportional performance operation of the electric heater is achieved. The pulse control signal operates on all groups simultaneously.

5.9.2 Overheating protection (TA04)

To avoid overheating, heating command is limited by actual air flow (QV04). Very low air flow will set heat signal at zero. As an additional safeguard against overheating, the electric heater is equipped with 2 safety thermostats:

- maximum temperature thermostat (TA04) with fixed temperature setting at 82°C and auto reset.
- fire thermostat with fixed setpoint at 128°C and manual reset on the thermostat in the terminal box of the heater.

Both thermostats are connected in series as a digital alarm input (normally closed) on the controller. An activated alarm results in:

- fans running at design speed
- heat signal at zero

5.9.3 Cool down at unit stop

When unit stops and if electrical heaters was active, the fans are running for an adjustable delay (default 180s) and the dampers (if applicable) remains opened during this delay.
5.10 Electrical pre-heating Coil

Parameters for this function are available in the menu Actual/Setpoint and Settings.

5.10.1 Heat Recovery Frost Protection

The temperature entering the heat recovery exchanger is controlled as shown in the sketch below.

A PID controller is used. Tuning of the PID controller is possible in the menu Settings (Advanced User).

The modulating control signal to the electric heater creates a fully proportional performance variation of the electric heater.

For information: The solid state relays use integral cycle control which is a technique to vary the amount of complete AC-half cycles of load current (switch in the zero current passage); hence a resistive load without creating electrical noise.

Proportional control is achieved with solid state relays, integrated in the terminal box of the electric heater.

Depending on the heating capacity, the rods of the heater are split into one or more groups of rods.

Each group is equipped with 2 solid state relays. All solid state relays simultaneously receive the quasi-modulating pulse signal generated by the controller. During each voltage pulse period the solid state relays are activated and give power supply to the heating rods. The pulse signal is basically an on/off voltage signal, but due to its switching frequency, a proportional performance operation of the electric heater is achieved. The pulse control signal operates on all groups simultaneously.

5.10.2 Overheating protection (TA03)

To avoid overheating, heating command is limited by actual air flow (QV04). Very low air flow will set heat signal at zero. As an additional safeguard against overheating, the electric heater is equipped with 2 safety thermostats:

- maximum temperature thermostat (TA03) with fixed temperature setting at 82°C and auto reset.
- fire thermostat with fixed setpoint at 128°C and manual reset on the thermostat in the terminal box of the heater.

Both thermostats are connected in series as a digital alarm input (normally closed) on the controller.

An activated alarm results in:

- fans running at design speed
- heat signal at zero

5.10.3 Cool down at unit stop

When unit stops and if electrical heaters was active, the fans are running for an adjustable delay (default 180s) and the dampers (if applicable) remains opened during this delay.
5.11 Hot water pre-heating Coil

Parameters for this function are available in Actual/setpoint and Settings.

5.11.1 Heat Recovery Frost Protection

The temperature entering the heat recovery exchanger is controlled as shown in the sketch below.

![Sketch of Heat Recovery Frost Protection](image)

A PID controller is used. Tuning of the PID controller is possible in the menu Settings (Advanced User).

5.11.2 Water Coil Frost Protection (TA01)

A switching frost thermostat is located downstream the hot water coil in order to prevent it from freezing in case of insufficient hot water supply. Capillary temperatures over a length of 300mm below the predefined alarm level generate a frost alarm (TA01) and the unit will go into frost mode. The frost mode will initiate the following actions:

1. Ventilation is stopped and air dampers are closed (if applicable)
2. All control valves will be forced to 80% open.
3. All pumps are started and heat demand command is on

A frost alarm shall be considered as an urgent alarm and has to be reset in the electrical panel of the air handling unit. The frost thermostat itself resets automatically if the temperature rises sufficiently above the alarm level.

If the unit is also equipped with a frost coil with frost protection thermostat, the frost thermostat on the heating coil downstream the heat recovery device is omitted.

The default hardware setting for the frost thermostat alarm is +5°C.

5.11.3 Warm Up at Unit Start Up

This function is not active when indoor unit is selected

To avoid unintentional frost alarm, a startup delay mode for winter operation is programmed.

If the outdoor temperature (TT06) is below a preset value (default +5°C), the fans will only be started after a fixed preset time delay (5 min) in order to pre-heat the heating coil. During this time delay the hot water control valve (CV03) is opened at a preset value (default 100%). Heat demand (WV01) and pump (CP03) on signal are generated simultaneously.

For this purpose an outdoor temperature (TT06) sensor for wall mounting (not duct sensor) is mandatory!

5.11.4 Unit Frost Protection

This function is not active when indoor unit is selected

To secure outdoor units against unintentional frost alarm during unoccupied mode, a hot water flow across the heating coil is created if the outdoor temperature (TT06) is below the preset value (default +7°C), the hot water control valve (VC03) is opened at a preset value (default 50%). Heat demand (WV01) and pump (CP03) on signal are generated simultaneously.
5.12 Direct-expansion coil
Cooling/Heating can be ensured by an R410A direct-expansion coil (DX01), connected to a cooling only condensing unit or a reversible unit. The AHU with a direct-expansion coil is supplied with an additional air temperature (TT04) sensor located upstream of the coil.

5.12.1 Condensing unit/reversible unit with staged capacity
The units with staged capacity cannot be directly controlled by the HHFlex controller. They must be controlled independently, based on the indoor air temperature (TT05) or the extract air temperature (TT03). The HHFlex controller controls the temperature (TT04) upstream of the coil as if this was the supply air. The air that is actually supplied at the end of the AHU can be monitored by the outside control.

Using a coil of this type requires a minimum air flow. If this minimum airflow has been reached, an on/off output (DX01) allows operation of the outdoor unit compressors. The minimum air flow is pre-configured based on the AHU size, but can be adjusted in the Factory menu.

5.12.2 Condensing unit/reversible unit with variable capacity
If the capacity variations is small enough to prevent significant supply air temperature (TT020 variations, HHFlex controller can directly control the required cooling/heating level. The HHFlex controller does not control anything else. An external controller is required to ensure operation of other functions, like the defrost function.

Using a coil of this type requires a minimum air flow. If this minimum airflow has been reached, an on/off output allows operation of the outdoor unit compressors, if a cooling or heating demand exists. The minimum air flow is pre-configured based on the AHU size, but can be adjusted in the Factory menu.

5.13 Water pump anti-blocking system
To avoid rotor blocking, the pump receives a periodic run command, pre-configured every Monday from 10:00 to 10.02 h, this time can be adjusted in the Time Program menu.
This function works for all pumps connected to the controller. The standard pump delay stop time of 3 minutes is now not active.

5.14 Recirculation air damper (CD06)
A recirculation air damper (CD06) can be placed between the extract air (TT03) and the supply air (TT02). It can either be joined to the rotary heat exchanger or integrated with the plate heat exchanger.
The recirculation air damper (CD06) is always used together with the exhaust air damper (CD05) and an outdoor air damper (CD01). It has two positions: open or closed. It is normally closed by a spring return mechanism.

If the recirculation air damper (CD06) is open:
- The outdoor air (CD01) and exhaust air (CD05) dampers are closed.
- The extract fan (EF01) is off.

Air recirculation can be used to ensure:
- Fast building temperature warm-up/cool-down before an occupied period,
- Correct operation of chilled beams during unoccupied periods,
- A minimum supply air temperature during the defrost cycle of a heat pump connected to the air handling unit,
- Fast warm-up if the room temperature falls below a certain threshold during an unoccupied period.
- In the defrost period of a heat pump.

The parameters for the control of the recirculation air damper (CD06) are available in the Actual/ Setpoint menu.
5.15 Mixing Box management

A mixing box (3-damper arrangement) can be used to modulate the air recirculation from extract to supply duct.

5.15.1 ON/OFF recirculation

This mode uses the logic defined as recirculation damper.

5.15.2 Modulated recirculation as heating/cooling capacity

In this mode the signal for heat recovery system is split between HR command and mix command:

Then the mixing section is enabled only when primary heat recovery system is fully loaded.

5.15.3 Minimum fresh air threshold

The mix command can be clamped by the minimum fresh air threshold value.

For example, if minfreshair = 20%, then the maximum allowed value for mix command is (100% - 20%) = 80%.

The primary heat recovery system shall be turned off when the recirculation is 100%.
5.15.5 Modulated recirculation using CO2 sensor
This control mode uses the logic of the heatcool modulation corrected by the requested fresh air value.

Minimum fresh air threshold
The minimum fresh air threshold value is now calculated using PI loop, based on co2PID parameters used for CO2 fancontrol, controlling the recirculation ratio with the CO2/IAQ sensor feedback.
The heatcool mix request is calculated as in the previous paragraph.

The Mix command is then evaluated as below:

\[ \text{Mix}_\text{req} = \min(\text{hc}_\text{mix}_\text{req}, 100 - \text{fresh}_\text{air}_\text{req}) \]

5.15.6 Modulated recirculation as heating/cooling capacity with fresh air calculation
In some condition, such as duct pressure airflow control, the airflow may vary in great proportion. Indeed, the amount of fresh air cannot be fixed considering only the recirculation damper opening.
Thus, the fresh air rate can be estimated using Mixing Air Temperature method. To do this an additional temperature sensor is needed after the mixing section and before the heating/cooling stage. (for the supply only units, it is the intake sensor).

Then we have:

\[ \%\text{fresh}_\text{air} = \frac{(\text{EAT} - \text{IAT})}{(\text{EAT} - \text{OAT})} \]

This method cannot be used when \( \text{EAT} = \text{OAT} \), but in these conditions, recirculation is not needed.

Then the minimum fresh air threshold can be driven using a PID, using \( \%\text{fresh}_\text{air} \) as control input value, \( \%\text{min}_\text{fresh} \) as setpoint value, and \( \text{mix}_\text{cmd} \) as control output value.
5.17 Fast building temperature warm-up/cool-down before an occupied period

This function can only be used if the HHFlex controller is configured to control the room temperature (TT05) or the extract air temperature (TT03).

If the OAT (TT06) is below a certain threshold and the temperature controlled is offset by more than 2K compared to the setpoint, temperature warm-up/cool-down will be activated.

The duration of the temperature warm-up/cool-down is based on the OAT (TT06). This function is configurable to take into account the thermal inertia of the building.

NOTE: To have a realistic value of the extract air temperature (TT03), the AHU operates for 5 minutes at the beginning of a temperature warm-up/cool-down period. If the offset between the value and the setpoint is less than 2K (configurable), the AHU shuts down and will only restart at the beginning of the occupied period.

5.18 Operation of chilled beams during unoccupied periods

In an unoccupied period the BMS can force operation of the AHU in recirculation mode. This allows bringing in sufficient air flow for the operation of the chilled beams.

This override is only possible if the HHFlex controller is configured to control the supply air temperature (TT02).

During this mode supply air temperature control can be deactivated, but ventilation will be controlled as in the occupied period.

5.19 Heat pump defrost

In the defrost period of a heat pump connected to the AHU, the recirculation mode can be forced. This ensures that no cold air is introduced during the period when the hot water is no longer available.

During this period the supply fan (SF01) is normally controlled and the extract fan (EF01) is shut down.

NOTE: During the defrost period, heat must not be drawn from the air flow, but to an intermediate source between the heat pump and the AHU.

5.20 Minimum/maximum room temperature in an unoccupied period

If minimum room temperature monitoring has been configured and is active, the recirculation mode will be triggered if the extract air temperature (TT03) is higher than the outdoor air temperature (TT06).

If maximum room temperature monitoring has been configured and is active, the recirculation mode will be triggered if the extract air temperature (TT03) is lower than the outdoor air temperature (TT06).

During this period the supply air fan (SF01) is controlled at the setpoint of the unoccupied mode except when the supply duct pressure is controlled. The extract air fan (EF01) is shut down.
5.21 Humidification control

If the duct system comprises a humidifier suitable for modulating performance control, the AHU controller is programmed to control the minimum humidity of the air in the building.

The humidity can be controlled on the basis of relative humidity of the supply air (MT02), extract air (MT03), or relative humidity in a (representative) room (MT05).

Setpoints for all humidity scenarios are adjustable and can be set in the controller.

An automatically shifting setpoint, as a function of the measured outdoor temperature (TT06), can be selected for supply air humidity (MT02) or extract (MT03) or room humidity (MT05).

In case of extract- or room humidity control, a sequence control (cascade or master-slave) on humidity in the supply air (MT02) will be applied.

The control algorithm of such a control system is shown in the sketch below.

5.21.1 Description control algorithm

- the humidity in the extract air (MT03) or in the room (MT05) is measured
- the actual setpoint is derived from the outdoor temperature compensation (if activated)
- depending on offset (actual setpoint – measured value) a master control signal will determine the actual setpoint of the supply air humidity control loop
- actual humidity in supply air is measured
- depending on offset, the slave control signal to the humidifier adjusts the performance for the momentary demand
- the set limitations for supply air humidity will limit the control signals to a maximum or minimum value if required

All sensors for humidity control are combined temperature/humidity sensors (except outdoor temperature sensor), with active (0 – 10Vdc) moisture signal.

The supply air humidity sensor will be delivered in a cardboard box in the unit and shall be mounted downstream the humidifier at a location in the duct that is representative for the average relative humidity!
5.21.2 Default settings for relative humidity control

- humidifier enabled if flow signal above minimum and control signal > 25%
- humidifier disabled if flow signal below minimum or control signal < 10%
- setpoint humidity supply air 40%
- setpoint humidity extract air 40%
- setpoint humidity in room 40%
- setpoint minimum humidity supply air 20%
- setpoint maximum humidity supply air 60%

Outdoor compensation on extract/room (master) humidity setpoint according to graph

Outdoor compensation on supply humidity setpoint according to graph below

Default settings are based on steam humidifiers and will in general be appropriate for comfort installations. Outdoor compensation on extract (MT03)/room (MT05) humidity may be selected to avoid condensation in the building structure.

Outdoor compensation on supply air humidity (MT02) can only be activated if this control scenario is selected. Default values for outdoor compensation on supply air have been based on decreasing supply temperature at rising outdoor temperature (TT06) (e.g. outdoor temperature rising from −10°C to +20°C causes a supply temperature shifting from 22°C to 16°C).

Attention: For every unit it shall be checked if the default values are suitable for the actual application (humidification process and moisture demand in the building). Correct parameter settings for humidification require basic knowledge of psychometrics and humidifier characteristics!

A normally closed failure contact, generated by the humidifier, can be connected as a digital input on the controller. In series with this failure contact, a contact (normally closed) from a maximum humidistat (installed downstream the humidifier) can be connected. An activated failure alarm has the following course of actions:

- humidification failure alarm displayed in alarm menu
- service alert on digital output of controller
- humidification disabled, until root cause is resolved and alert has been reset in the electrical panel
- unit continues to run in restricted operation mode
5.23 Dehumidification control

The software in the controller is pre-programmed to control the maximum humidity in the air. The unit configuration however shall be suited for this application if this control scenario is selected. Dehumidification control requires a re-heater downstream the cooling coil. To protect the coil against freezing at low outdoor temperature and/or a failing heat recovery system, a water glycol fluid in the cooling system is mandatory (or DX cooling coil). The humidity can be controlled on the basis of moisture content in the supply air (AT02), extract air (AT03), or in a (representative) room (AT05).

Setpoints for all humidity scenarios are adjustable and can be set in the controller. In case of extract- or room humidity control, a sequence control (cascade or master-slave) on moisture content in the supply air will be applied. The control algorithm of such a control system is shown in the sketch below.

5.23.1 Description control algorithm

- the humidity and temperature in the extract air or in the room are measured
- the controller software calculates the matching moisture content
- the actual setpoint for maximum moisture content is compared to the calculated value
- depending on offset (setpoint – calculated value) a master control signal will determine the actual setpoint of the supply air humidity control loop
- actual humidity and temperature in supply air are measured
- the controller software calculates the matching moisture content
- depending on offset, the slave control signal to the cooling coil adjusts the dehumidification performance for the momentary demand
  - a peak value selector within the controller will always transmit the highest control signal (generated by cooling/dehumidification demand) to the cooling coil
- the set limitations for supply air humidity will limit the control signals to a maximum or minimum value if required.

All sensors for humidity control are combined temperature/humidity sensors, with active (0–10Vdc) humidity signal. The supply air humidity sensor will be delivered in a cardboard box in the unit and shall be mounted downstream the reheater at a location in the duct that is representative for the average relative humidity!

5.23.2 Default settings for relative humidity control

- cooling for dehumidification enabled if control signal (programmed) > 25%
- cooling for dehumidification disabled if control signal demand < 10%
- setpoint moisture content supply air 10 g/kg
- setpoint moisture content extract air 11 g/kg
- setpoint moisture content in room 11 g/kg
- setpoint minimum moisture content supply air 8 g/kg
- setpoint maximum moisture content supply air 14 g/kg
6 DIAGNOSTICS & TROUBLESHOOTING

6.1 General
The HHFlex control system has many fault tracing aid functions. The web interface and its various menus give access to all unit operating conditions. If an operating fault is detected, an alarm is activated and an alarm message is displayed in the alarm list available in the Alarm Status menu.

6.2 Displaying Alarms

6.2.1 E-DSP External display unit
A click on the red button gives direct access to the current alarm(s)
To see the alarm history (latest 40 alarms) go to SERVICE => ALARM LOG
• A flashing red LED shows that there are one or more unacknowledged alarms.
• A fixed red LED shows alarm shows that there are one or more remaining, acknowledged alarms.

6.2.2 Web Panel
Alarms are displayed in de Alarm Status screen

6.3 Alarm report
To permit alarm and alert reporting on LEDs or on the building management system, two outputs are available on the customer terminal strip:
• A digital 24 VDC output to report alarms
• A digital 24 VDC output to report service alerts

6.4 Resetting Alarms
When the cause of the alarm has been corrected the alarm can be reset, depending on the type, either automatically on return to normal, or manually when action has been taken on the unit. Alarms can be reset even if the unit is running. This means that an alarm can be reset without stopping the machine. In the event of a power supply interrupt, the unit restarts automatically without the need for an external command. However, any faults active when the supply is interrupted are saved and may in certain cases prevent the unit from restarting.
A manual reset must be run from the push button of the electrical cabinet.
## 6.5 Alarms List

<table>
<thead>
<tr>
<th>Alarm Description</th>
<th>Reset Type</th>
<th>Probable cause</th>
<th>Action taken by the control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Supply Air Temperature Alarm</td>
<td>Automatic</td>
<td>Unit with heat recovery only During 10 minutes, SAT &lt; SAT controlled point – 3 K</td>
<td>Unit is stopped for 50 minutes then restarted.</td>
</tr>
<tr>
<td>High Supply Air Temperature Alarm</td>
<td>Automatic</td>
<td>Unit with heat recovery only During 10 minutes, SAT &gt; SAT controlled point + 3 K</td>
<td>Warning.</td>
</tr>
<tr>
<td>Heat Exchanger Failure</td>
<td>Manual</td>
<td>Input of the controller activated</td>
<td>Warning only, control signal to rotor is cancelled</td>
</tr>
<tr>
<td>Extract Fan failure</td>
<td>Manual</td>
<td>Input of the controller activated</td>
<td>Unit stopped</td>
</tr>
<tr>
<td>Supply Fan failure</td>
<td>Manual</td>
<td>Input of the controller activated</td>
<td>Unit stopped</td>
</tr>
<tr>
<td>Electrical pre-heater maximum temp alarm</td>
<td>Manual</td>
<td>Input of the controller activated</td>
<td>Electrical pre-heaters are stopped and unit stopped after cool down delay</td>
</tr>
<tr>
<td>Electrical heater, maximum temp alarm</td>
<td>Manual</td>
<td>Input of the controller activated</td>
<td>Electrical heaters are stopped and unit stopped after cool down delay</td>
</tr>
<tr>
<td>Frost protection of preheat hot water coil</td>
<td>Manual</td>
<td>Input of the controller activated</td>
<td>Unit stopped, valves opened at 80% &amp; heat demand/pumps activated</td>
</tr>
<tr>
<td>Frost protection of booster hot water coil</td>
<td>Manual</td>
<td>Input of the controller activated</td>
<td>Unit stopped, valves opened at 80% &amp; heat demand/pumps activated Same reaction with change over water coil</td>
</tr>
<tr>
<td>Extract Filter High Delta P Alert</td>
<td>Manual</td>
<td>Input of the controller activated</td>
<td>Warning.</td>
</tr>
<tr>
<td>End Filter High Delta P Alert</td>
<td>Manual</td>
<td>Input of the controller activated</td>
<td>Warning.</td>
</tr>
<tr>
<td>Supply Pressure Filter Failure</td>
<td>Manual</td>
<td>Defective sensor or installation fault</td>
<td>Warning.</td>
</tr>
<tr>
<td>Exhaust Pressure Filter Failure</td>
<td>Manual</td>
<td>Defective sensor or installation fault</td>
<td>Warning.</td>
</tr>
<tr>
<td>Pressure End Filter Failure</td>
<td>Manual</td>
<td>Defective sensor or installation fault</td>
<td>Warning.</td>
</tr>
<tr>
<td>Inlet Air Temperature Sensor Failure</td>
<td>Automatic</td>
<td>Defective sensor or installation fault</td>
<td>Warning, no more pre-heater control and heat recovery at 100%</td>
</tr>
<tr>
<td>Supply Air Temperature Sensor Failure</td>
<td>Automatic</td>
<td>Defective sensor or installation fault</td>
<td>Configurable in Actual/Setpoint Config. menu - Derated mode: Warning, boosters stopped &amp; heat recovery at 100%</td>
</tr>
<tr>
<td>Extract Air Temperature Sensor Failure</td>
<td>Automatic</td>
<td>Defective sensor or installation fault</td>
<td>Configurable in Actual/Setpoint Config. menu - Derated mode: Warning &amp; go to SAT control with heat recovery at 100% - Unit stopped</td>
</tr>
<tr>
<td>Room Sensor Temperature Failure</td>
<td>Automatic</td>
<td>Defective sensor or installation fault</td>
<td>Configurable in Actual/Setpoint Config. menu - Derated mode: Warning, go to SAT control, no more summer night ventilation and room temp surveillance - Unit stopped</td>
</tr>
<tr>
<td>Outdoor Air Temperature Sensor Failure</td>
<td>Automatic</td>
<td>Defective sensor or installation fault</td>
<td>Warning &amp; no more OAT compensation, no more summer night ventilation - Unit stopped</td>
</tr>
<tr>
<td>Supply Air Pressure Sensor Failure</td>
<td>Automatic</td>
<td>Defective sensor or installation fault</td>
<td>Configurable in Actual/Setpoint Config. menu - Derated mode: Warning, go to SAT control, no more summer night ventilation and room temp surveillance - Unit stopped</td>
</tr>
<tr>
<td>Alarm Description</td>
<td>Reset Type</td>
<td>Probable cause</td>
<td>Action taken by the control</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>---------------</td>
<td>----------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Supply Fan Pressure Failure</td>
<td>Manual</td>
<td>Defective sensor or installation fault</td>
<td>Unit stopped</td>
</tr>
<tr>
<td>Exhaust Fan Pressure Failure</td>
<td>Manual</td>
<td>Defective sensor or installation fault</td>
<td>Unit stopped</td>
</tr>
<tr>
<td>Pressure Drop across Heat Exchanger Sensor Failure</td>
<td>Automatic</td>
<td>Defective sensor or installation fault</td>
<td>Configurable in Actual/Setpoint Config. menu</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Derated mode: Warning and frost protection deactivated</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Unit stopped</td>
</tr>
<tr>
<td>Room Pollution Sensor Failure</td>
<td>Automatic</td>
<td>Defective sensor or installation fault</td>
<td>Configurable in Actual/Setpoint Config. menu</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Derated mode: Warning &amp; Go to low fixed speed fan control</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Unit stopped</td>
</tr>
<tr>
<td>External Fire</td>
<td>Manual / Automatic configurable in the extra settings menu</td>
<td>Input of the controller activated</td>
<td>Configurable in Actual/Setpoint Extra settings</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Supply-fan off, Extract-fan off (default)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Supply-fan on, Extract-fan on</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Supply-fan on, Extract-fan off</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Supply-fan off, Extract-fan on</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>When “on” is selected, fan is running at a configurable fixed fan speed</td>
</tr>
<tr>
<td>Battery low or missing, Change it quickly</td>
<td>Automatic</td>
<td>Internal monitoring</td>
<td>Warning</td>
</tr>
<tr>
<td>Pump Collective Failure</td>
<td>Automatic</td>
<td>Input of the controller activated</td>
<td>Warning</td>
</tr>
<tr>
<td>Supply Air Humidity Sensor Failure</td>
<td>Automatic</td>
<td>Defective sensor or installation fault</td>
<td>Configurable in Actual/Setpoint Config. menu</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Derated mode: humidifier disabled</td>
</tr>
<tr>
<td>Extract Air Humidity Sensor Failure</td>
<td>Automatic</td>
<td>Defective sensor or installation fault</td>
<td>Configurable in Actual/Setpoint Config. menu</td>
</tr>
<tr>
<td>Room Sensor Humidity Failure</td>
<td>Automatic</td>
<td>Defective sensor or installation fault</td>
<td>Configurable in Actual/Setpoint Config. menu</td>
</tr>
<tr>
<td>Maximum humidity</td>
<td>Manual</td>
<td>Input of the controller activated</td>
<td>Humidifier stopped</td>
</tr>
</tbody>
</table>
7 BUS COMMUNICATION

7.1 General
The HHFlex controller is capable of communicating via RS485 (Modbus) and TCP/IP (BACnet/IP)

7.2 Modbus
Modbus communication takes place via RS485 (port 2, main controller) or via IP (IP port, main controller).

7.2.1 Communication Settings
The Modbus communication settings can be configured in the web panel in the Settings menu or with the external display unit under Settings => Modbus Config
Address (0-255)
Baudrate (300, 600, 1200, 2400, 4800, 9600, 14400 or 19200)
Parity (None, Odd or Even)
Stop bits 1 (not configurable)

7.2.2 Modbus type
The Modbus types of the signals:
1 = Coil Status Register (Modbus function = 1, 5 and 15)
2 = Input Status Register (Modbus function = 2)
3 = Holding Register (Modbus function = 3, 6 and 16)
4 = Input Register (Modbus function = 4)
2 and 4 are read-only, while 1 and 3 are read-write.

7.2.3 Modbus functions
The Modbus master uses different Modbus functions in its query, depending on whether to read or write values. A function also describes what signal type it is meant for.
Supported Modbus functions:
1 = Read Coils
2 = Read Discrete Input
3 = Read Holding Register
4 = Read Input Register (Direct 16 Bit)
5 = Write Single Coil
6 = Write Single Register
15 = Write Multiple Coils
16 = Write Multiple Registers

7.2.4 Max. 47 registers
Max. 47 registers can be read in one message.

7.2.5 Communication limits
The Modbus master must wait for a minimum of 3.5 character times (4 ms at 9600 bps) between two messages. When the Modbus master communicates with more than one HHFlex controller on the same communication line (RS485), the Modbus master must wait for a minimum of 14 character times (16 ms at 9600 bps) between the answer and the first question for the next controller.
In the HHFlex controller there is a limit of 10 fast communications in every half minute, the other communications will have a delayed answer of approximately 1 s.

7.2.6 Scale factor
Real signals have scale factor 1 except temperature signals that have scale factor 10 for Modbus communication.
Integer, Index and Logic always have scale factor 1.
7.3 BACnet IP

BACnet communication takes place via IP (IP port, main controller).
### Standard Object Types Supported

<table>
<thead>
<tr>
<th>Object type</th>
<th>Supported</th>
<th>Creatable</th>
<th>Deleteable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog Input</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Analog Output</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Analog Value</td>
<td>•</td>
<td></td>
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<tr>
<td>Binary Input</td>
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<td></td>
<td></td>
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<tr>
<td>Binary Output</td>
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<td></td>
<td></td>
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<tr>
<td>Binary Value</td>
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<tr>
<td>Calendar</td>
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<tr>
<td>Command</td>
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<td></td>
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<tr>
<td>Device</td>
<td>•</td>
<td></td>
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<tr>
<td>Event Enrollment</td>
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<tr>
<td>File</td>
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<tr>
<td>Group</td>
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<tr>
<td>Loop</td>
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<tr>
<td>Multi-State Input</td>
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<tr>
<td>Multi-State Output</td>
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<tr>
<td>Multi-State Value</td>
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<td>Notification Class</td>
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<tr>
<td>Schedule</td>
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<td>Averaging</td>
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<tr>
<td>Trend Log</td>
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<tr>
<td>Life Safety Point</td>
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<tr>
<td>Life Safety Zone</td>
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<tr>
<td>Accumulator</td>
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<td></td>
<td></td>
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<tr>
<td>Pulse Converter</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Object type</td>
<td>Optional properties supported</td>
<td>Writeable properties (not otherwise required by the standard)</td>
<td>Range restrictions</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------------</td>
<td>-------------------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Analog Input</td>
<td>Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reliability</td>
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<tr>
<td>Analog Value</td>
<td>Present_Value</td>
<td>Writeable</td>
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<tr>
<td></td>
<td>Description</td>
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<tr>
<td>Binary Input</td>
<td>Description</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Reliability</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Inactive_Text</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Active_Text</td>
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</table>
Data Link Layer Options

☑ BACnet IP, (Annex J)
☑ BACnet IP, (Annex J), Foreign Device
☐ ISO 8802-3, Ethernet (Clause 7)
☐ ATA 676.1, 2.5 Mb. ARCNET (Clause 8)
☐ ATA 676.1, EIA-485 ARCNET (Clause 8), baud rate(s) ____________
☐ MS/TP master (Clause 9), baud rate(s): ________________
☐ MS/TP slave (Clause 9), baud rate(s): ________________
☐ Point-To-Point, EIA 232 (Clause 10), baud rate(s): ________________
☐ Point-To-Point, modem, (Clause 10), baud rate(s): ________________
☐ LonTalk, (Clause 11), medium: ________________
☐ BACnet/ZigBee (ANNEX O)
☐ Other: _______________________

Device Address Binding

Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.) ☐ Yes ☐ No

Networking Options

☐ Router, Clause 6 - List all routing configurations, e.g., ARCNET-Ethernet, Ethernet-MS/TP, etc.
☐ Annex H, BACnet Tunneling Router over IP
☐ BACnet/IP Broadcast Management Device (BBMD)

Does the BBMD support registrations by Foreign Devices? ☐ Yes ☐ No
Does the BBMD support network address translation? ☐ Yes ☐ No

Network Security Options

☑ Non-secure Device – is capable of operating without BACnet Network Security
☑ Secure Device – is capable of using BACnet Network Security (NS-SD BIBB)
   ☐ Multiple Application-Specific Keys:
   ☐ Supports encryption (NS-ED BIBB)
   ☐ Key Server (NS-K3 BIBB)
Character Sets Supported

Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

- ISO 10646 (UTF-8)  ✔ IBM®/Microsoft® DBCS  □ ISO 8859-1
- ISO 10646 (UCS-2)  □ ISO 10646 (UCS-4)  □ JIS X 0208

If this product is a communication gateway, describe the types of non-BACnet equipment/networks(s) that the gateway supports:

N/a