

# Control HVAC

For variable-primary-flow systems and the secondary side of primary-secondary-flow systems



<b>1. Product description</b>	<b>3</b>
Introduction	3
Applications	3
Product range	4
Benefits	4
Features	4
Energy-optimized control	5
Sequence of operation	5
<b>2. Construction</b>	<b>7</b>
Main cabinet	7
Subcabinets	7
<b>3. System configuration</b>	<b>8</b>
Pumps	8
Bypass valve	8
Sensors	8
<b>4. Installation</b>	<b>9</b>
Location	9
Mechanical installation	9
Electrical installation	9
<b>5. Control functions</b>	<b>10</b>
Operating modes	10
System monitoring	11
<b>6. Product range</b>	<b>12</b>
Type key	12
Options	12
<b>7. Technical data</b>	<b>13</b>
Inputs and outputs	13
Dimensions	13
Materials	13

# 1. Product description

## Introduction

The Control HVAC is designed to optimize pump operation in a variable-primary-flow\* system being part of an air-conditioning system. The controller controls speed-controlled pumps and can control a bypass valve positioned between the flow and return pipes of the air-handling zones.

According to the demand of the air-handling zones, the controller operates the pumps in the most efficient way. Additionally, when the demand is low, the controller can adjust the opening of the bypass valve to ensure a minimum flow through the operating chillers.

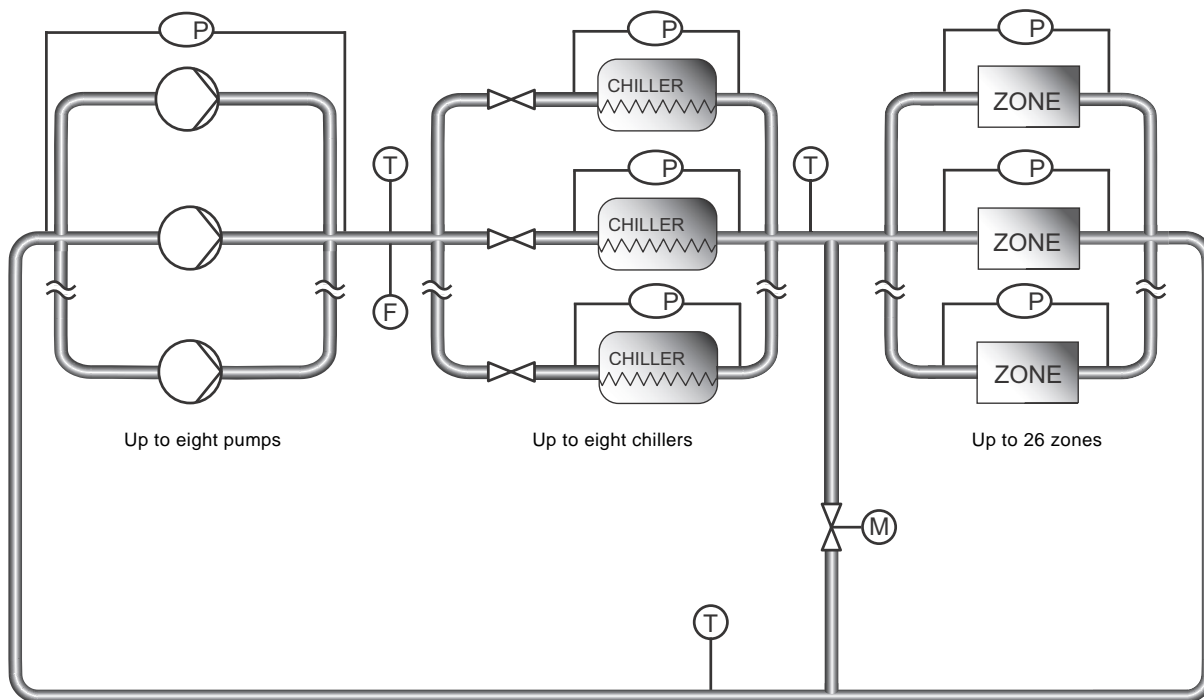
The controller can be connected to up to eight pumps, eight chillers and 26 air-handling zones.

## Applications

The Grundfos Control HVAC is suitable for new as well as existing systems in large buildings, such as:

- airports
- large hotels
- office buildings
- shopping malls
- hospitals
- universities.

\* The Control HVAC can be adapted to variable primary-secondary-flow systems, and can be used as a variable secondary application.



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**Fig. 1** Example of a variable-primary-flow system with the devices that can be connected to the Control HVAC

Pos.	Description	Pos.	Description	Pos.	Description
	Temperature sensor		Bypass valve (optional)		Chiller
	Flow sensor		Isolating valve		Air-handling zones: air-handling units, fan coils, etc.
	Differential-pressure sensor		Speed-controlled pump		

## Product range

There are four standard variants of the Control HVAC:

- Control HVAC for up to four Grundfos E-pumps or pumps with a Grundfos CUE frequency converter
- Control HVAC for up to four pumps with a variable frequency drive
- Control HVAC for up to eight Grundfos E-pumps or pumps with a Grundfos CUE frequency converter
- Control HVAC for up to eight pumps with a variable frequency drive

For a detailed description of the range, accessories and available options, see [Product range](#), page 12.

## Benefits

### Energy-optimized control

- Supply-to-demand philosophy.
- Reduced energy consumption without compromising comfort.
- Pumps are connected in parallel and operate in the most efficient way.
- Can handle up to eight pumps, up to eight chillers and up to 26 air-handling zones.
- Can control a bypass valve to ensure minimum flow through chillers.
- Monitors active chiller(s) DP to protect active chiller(s) by maintaining minimum differential pressure.

### High quality

- High system stability
- durability.

### Simplicity

- Intuitive user interface
- easy commissioning
- easy system configuration
- integration into any building management system (BMS)
- standard-packaged system.

### Adapted to your application

- Can be customized to several applications.
- Several options are available.

## Features

### Control

- Designed for variable-primary-flow systems
- speed and cascade control of pumps
- two operating modes for the system:
  - Auto/Remote
  - Manual/Local.
- three operating modes for pumps:
  - Auto
  - Manual
  - Off.
- three operating modes for the bypass valve:
  - Auto
  - Manual
  - Off.

### Hardware

- Main cabinet with user interface
- subcabinets for additional air-handling zones
- inputs for flow, differential-pressure and temperature sensors
- alarm outputs.

### User interface

- 11.6" color touchscreen
- selector switches for system and pumps.

### Remote management (optional)

- Possible integration into building management systems and SCADA systems via standard protocols BACnet IP and Modbus TCP
- possible integration with Grundfos Remote Management (GRM).

## Energy-optimized control

Grundfos Control HVAC is designed to optimize pump operation, regardless of the demand of the air-handling zones. Chillers can only operate correctly within a specific flow range. If the controller controls the bypass valve, it ensures that this requirement is met at all times.

### System requirements

In order for the Control HVAC to operate correctly, the following requirements must be met:

- Pumps, chillers and air-handling zones must be connected in parallel.
- The pump system must have a differential-pressure sensor.
- Each chiller must have a differential-pressure sensor.
- At least one differential-pressure sensor must be placed between the inlet and outlet of all the zones. Up to 26 differential-pressure sensors can be placed in critical zones in the system.
- Isolating valves with an electric contact must be placed at the outlet of every chiller.
- The bypass valve, if any, must be placed between the flow and the return pipes of the zones.

### System control

The air-handling zones, chillers and isolating valves must be controlled by an external building management system. The Control HVAC controls the pumps and can control the bypass valve, if any, based on the feedback from the sensors and chiller isolating valves.

The cooling load of the air-handling zones determines the number of chillers in operation. According to the number of chillers in operation, the controller adjusts the pump operation to maintain a differential pressure across the chillers within the permissible range.

The controller then adjusts the pump operation further in order to meet the demand of the air-handling zone with the highest differential pressure.

If the flow rate is lower than the minimum flow rate required through the chillers, the controller opens the bypass valve and thus maintains a minimum flow rate across the chillers. This requires that a bypass valve is connected to the controller.

## Sequence of operation

All pumps must be set in auto mode for the plant to work properly. However, any individual pumps can be set to manual or off mode. Any pump in manual or off mode won't be operated by the automatic sequencing of the plant in any mode of operation. Any pump placed in manual mode will start immediately as long as set to on.

### The Control HVAC in auto mode

- The performance is adjusted to the demand through cutting pumps in or out and through parallel control of the pumps in operation.
- The Control HVAC maintains a constant differential pressure through continuous adjustment of the speed of the pumps.
- Pump changeover is automatic and depends on load, operating hours and fault detection.
- All pumps in operation run at the same speed.
- The number of pumps in operation also depends on the energy consumption of the pumps. If only one pump is required, two pumps will run at a lower speed if this results in a lower energy consumption.

#### 1. Auto

The pumping system shall start upon the start contactor from the BAS (Building Automation System)/ CPM (Chiller Plant Manager) when the controller is configured in "Remote" mode.

#### 2. Manual

If the controller is configured in "Local" mode, the system is started manually via the "HMI" or local switches at the panel (depends on ordered configuration)

#### 3. Pump start on chiller request

If the controller is configured in "Auto" mode, and a contactor of isolation valve of chiller/ chiller plant manager give a start signal, the system starts with one pump running at minimum speed. The minimum pump speed is based on the minimum pressure required by the chiller.

#### 4. Pump speed adjustment according to load

The controller calculate the needed speed setpoint for pumps depending on largest deviation of measured differential pressure of active zones vs their individual given setpoints.

### 5. Cut-in of next pump

If the measured differential pressure drops below setpoint, the controller will increase the speed of lead pump. If one pump is not enough, the cascade-controller will cut in the next pump with the given minimum speed and control all pumps according to the demand needs. The active pumps run with same speed.

### 6. Cut-in of more pumps

Cut-in of more pumps follow same procedure as item 4.

### 7. Cut-out of pump

If the controller indicates that the pressure rises above setpoint, the controller will decrease the speed of pumps, cut out the pump with the highest operation time, and control all pumps according to the demand needs. The active pumps will run at the same speed.

### 8. Cut out of more pumps

Cut-out of more pumps follow same procedure as item 6.

### 9. By-pass control

If control of bypass valve is activated the controller will adjust the opening of a modulated bypass valve. The controller takes the characteristics of the bypass valves into account when controlling the valve position. This ensures smooth and accurate adjustment of the valve at all times to ensure a minimum flow through the active chiller at very low zone load.

### Pump cascade control

The Control HVAC is designed to control Grundfos E-pumps and CUE frequency converters, as well as other types of pumps with variable frequency drives (VFD).

- The performance is adjusted to the demand through cutting pumps in or out and through parallel control of the pumps in operation.
- The Control HVAC maintains a constant differential pressure through continuous adjustment of the speed of the pumps.
- Pump changeover is automatic and depends on load, operating hours and fault detection.
- All pumps in operation run at the same speed.
- The number of pumps in operation also depends on the energy consumption of the pumps. If only one pump is required, two pumps will run at a lower speed if this results in a lower energy consumption.

Examples of operation with one and with three E-pumps:

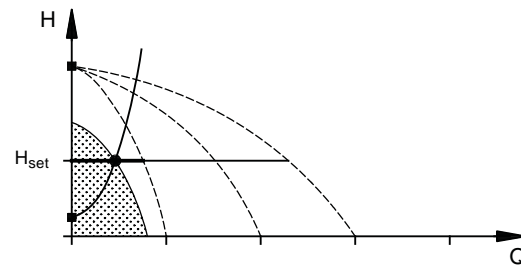


Fig. 2 One E-pump in operation

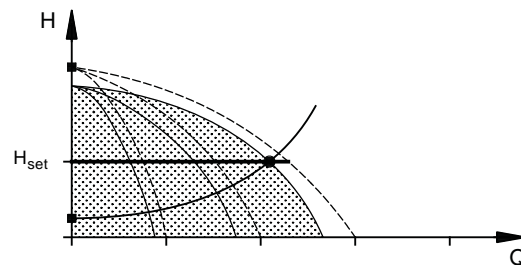


Fig. 3 Three E-pumps in operation

### Bypass valve control

If there is a bypass valve in the system, it can be controlled by the controller.

The controller takes the characteristics of the bypass valves into account when controlling the valve position. This ensure smooth and accurate adjustment of the valve at all times.

## 2. Construction

### Main cabinet

The main cabinet hosts the controller, the user interface and the input and output terminals for the pumps, bypass valve, sensors, etc.



Fig. 4 Front panel of the main cabinet

### Front panel with touchscreen

The front panel of the cabinet hosts the controller, which has an embedded color touchscreen. It allows the user to configure the system and to monitor and control the operation.

The color touchscreen is 11.6".



Fig. 5 Controller and touchscreen

### Terminals

The main cabinet is equipped with terminals which are connected to all the devices of the system. The terminals have status indicator lights.

For more information, see [Technical data](#), page 13.

### Selector switches



Pos.	Description
1	System selector switch Positions: Auto/Remote, Manual/Local, Off
2	Main disconnect
3	Pump selector switches (one of each pump) Positions: Auto, Manual, Off

### Subcabinets

When more than two air-handling zones are to be connected to the controller, up to three subcabinets supporting eight air-handling zones each can be connected to the main cabinet via an EtherCat cable.

## 3. System configuration

### Pumps

The Control HVAC is designed for Grundfos E-pumps, Grundfos pumps with a CUE frequency converter and other pumps with a variable frequency drive (VFD).

#### Grundfos E-pumps

The following Grundfos pumps are compatible with the Control HVAC:

- end-suction pumps:
- vertical in-line volute pumps:
- horizontal split case pump:

#### Variable frequency drive

The control HVAC can control VFD's with 0-10 V control signal and 4-20 mA feedback signal.

### Bypass valve

As standard, the Control HVAC can control a bypass valve with a control signal of 4-20 mA. On request, the Control HVAC can be adapted for a bypass valve with a control signal of 0-10 V.

The Control HVAC has an input for feedback of the bypass valve position.

The control of the bypass valve can be disabled during commissioning.

### Sensors

#### Pump sensor

The pump system requires a differential-pressure sensor with a signal of 4-20 mA.

We recommend the Grundfos differential-pressure sensor.

#### Chiller sensors

The chillers require a differential-pressure sensor with a signal of 4-20 mA.

We recommend differential-pressure sensors with a short response time such as the Grundfos differential-pressure sensor.

#### Sensors for air-handling zones

The zones require differential-pressure sensors with a signal of 4-20 mA.

We recommend the Grundfos differential-pressure sensor.

#### Flow sensor

An additional flow sensor with a signal of 4-20 mA can be placed in the system and monitored via the controller screen.

The calculation of the specific energy requires a flow sensor.

#### Temperature sensors

Three temperature sensors with a signal of 4-20 mA can be placed in the system and monitored via the controller screen.



## 4. Installation

### Location

#### Main cabinet

The main cabinet must be installed in a well-ventilated room to ensure sufficient cooling of its components.

**Note:** The main cabinet is not designed for outdoor installation and must not be exposed to direct sunlight.

#### Subcabinets

The subcabinets must be installed in a well-ventilated room to ensure sufficient cooling of the system.

The first subcabinet must be installed a maximum of 328 feet (100 meters) from the main cabinet. Each subsequent subcabinet must be installed 328 feet (100 meters) from each other.

**Note:** The subcabinets are not designed for outdoor installation and must not be exposed to direct sunlight.

### Mechanical installation

The main cabinet and subcabinets can be mounted on a wall.

### Electrical installation

The electrical installation must be carried out by authorized staff in accordance with local regulations and the wiring diagram supplied with the product. The electrical installation must be according to enclosure UL Type 12.

The voltage and frequency of the power supply for the Control HVAC must correspond to the model delivered.

The devices of the system connect fast and easily to the terminals in the cabinets.

## 5. Control functions

### Operating modes

In automatic mode, the system operates according to the signals from the sensors, chillers, pumps and the bypass valve.

For maintenance or fault-finding purposes, it is, however, possible to control the system, pumps and valve manually from the controller, or to disconnect them individually from the controller.

#### Pumps

The pump operation is a combination of the pump bank mode and the pump mode.

The operating mode of the pump bank can be set to "Manual" or "Auto" by means of the display.

The operating mode of each pump can be set to "Manual", "Auto" or "Off" by means of the selector switches on the cabinet.

Pump bank mode	Pump mode	Operation
Auto	Auto	The pump is controlled by the internal pump controller and operates as part of the pump cascade system.
	Manual	The pump operates according to the settings set in the pump menu. It can either start at a selected speed or stop. It is not controlled by the internal pump controller and therefore runs independently of the pump cascade system.
	Off	The pump is switched off. It cannot be started via the display nor the remote management system.
Manual	Auto	The pump operates according to the settings set in the pump bank menu. It can either start at a selected speed or stop. All pumps in automatic mode operate at the same speed.
	Manual	The pump operates according to the settings set in the pump menu. It can either start at a selected speed or stop.
	Off	The pump is switched off. It cannot be started via the display nor the remote management system.

#### System

The operating mode of the system can be set to "Remote", "Local" or "Off" by means of a selector switch on the cabinet.

Mode	Description
Auto/Remote	The controller controls the pump bank and bypass valve, if any, according to the data collected from the HVAC system. The controller can be controlled and monitored via the remote management system.
Manual/Local	The communication to the remote management system is disabled. The controller operates according to the user input set via the display. The user can start and stop the pump bank and set the speed.
Off	The controller is switched off. It cannot be activated via the display nor by the remote management system. The display is still on and settings can be changed.

#### Bypass valve

The control of the bypass valve can be set to "Auto", "Manual" or "Off" via the display.

Mode	Description
Auto	The valve is controlled by the controller.
Manual	The valve is not controlled by the controller, and its position can be changed manually via the display.
Off	The valve cannot be operated by the controller

#### Fault indications

The Control HVAC can show the following fault indications:

- sensor fault
- valve fault
- pump fault
- controller fault
- communication fault (between main cabinet and subcabinets).

#### Functions

##### Autotuning

With the autotuning function, the controller calculates automatically the gain and integration time. In other words, it determines the response time that fits your system configuration best, and hence it ensures stability in the system.

## System monitoring

To facilitate monitoring and testing of the system, the display shows information about each device connected to the controller.

### Pumps

- Status: on, off or fault
- speed as percentage of maximum speed
- reference pressure of the pump system
- specific energy.

### Chillers

- Status: on or off
- minimum differential pressure required across the chiller in focus, that is the one with the greatest deviation between the minimum differential pressure required and the actual differential pressure.
- differential pressure measured across the chiller in focus.

### Air-handling zones

- Differential pressure of each zone
- setpoint of the zone infocus, that is the zone in operation with the greatest deviation between its setpoint and its actual differential pressure
- differential pressure measured across the zone in focus.

### Bypass valve

- Position as percentage of maximum opening angle.

### Temperature

- Temperature at the pump system outlet
- temperature at the chiller outlet
- temperature at the zone outlet.

### Flow rate

- Flow rate at the pump system outlet.

**Note:** Monitoring of temperature and flow rate requires sensors in the system.

## 6. Product range

### Type key

Example: Control HVAC E3 x 15 Hp 3 x 460 V

	Explanation
Control HVAC E 3 x 15 Hp 3 x 460 V	Type range
Control HVAC E 3 x 15 Hp 3 x 460 V	E = Geni; EF = VFD
Control HVAC E 3 x 15 Hp 3 x 460 V	Number of pumps
Control HVAC E 3 x 15 Hp 3 x 460 V	Pump power (Hp)
Control HVAC E 3 x 15 Hp 3 x 460 V	Supply voltage

### Options

#### 0-10 V control and feedback of bypass valve position

All standard models are equipped with a 4-20 mA terminal for the control and feedback of the bypass valve position.

Optionally, it can be ordered with a 0-10 V terminal. See [Subcabinets](#), page 7.

#### Data communication

The Control HVAC can be monitored and controlled by Grundfos Remote Management using GENIbus communication. It can also support other types of building management systems using BACnet IP and Modbus TCP.

This option must be ordered with the Control HVAC as it is configured during production.

Grundfos Remote Management requires a separate contract with Grundfos which hosts the Grundfos Remote Management database and servers.

#### Selector switches for pumps

All standard models are equipped with selector switches for pumps on the front panel. See [Selector switches](#), page 7.

On request, it can be ordered without pump selector switches. In this case, the pump control is done entirely via the display.

## 7. Technical data

### Inputs and outputs

The main cabinet has the following inputs and outputs.

Type	Signal	Connection	Comments
Analog inputs	4-20 mA	Differential-pressure sensors of pumps	
		Differential-pressure sensors of chillers	
		Differential-pressure sensors of the first two zones	
		Temperature sensors	Option
		Feedback of bypass valve position	
		Flow sensor	Option
		Feedback of VFD power consumption	VFD model
	0-10 V	Feedback of bypass valve position	Option
Analog outputs	4-20 mA	Control signal for bypass valve	
		Control signal for VFD	VFD model
	0-10 V	Control signal for bypass valve	Option
Digital inputs		On/off switch	
		Selector switch for pump operating mode: Auto, Manual, Off.	
		Selector switch for system operating mode: Remote, Local, Off.	
		Status of chiller isolating valve: open/closed, i.e. chiller on/off	
		VFD status: ready, on/off, fault	VFD model
		External emergency switch for system	
		External emergency switches for pumps	
Digital outputs		Start/stop of VFD	VFD model
		Alarm signal (BMS)	
		System status on/off (BMS)	
RS 485 interface		GENIbus from Grundfos E-pumps or CUE frequency converter	GENIbus model
RJ45 LAN 1		GRM, Modbus TCP, BACnet IP	Option
RJ45 EtherCAT		Subcabinets	More than two zones

### Dimensions

	Width		Height		Depth	
	[mm]	[inch]	[mm]	[inch]	[mm]	[inch]
Main cabinet	600	23.63	600	23.63	250	9.84
Subcabinet	380	14.96	380	14.96	210	8.26

The dimensions shown in the table above are standard. They can vary slightly depending on the local regulations and the cabinet builder. Please ask for confirmation of the dimensions when ordering.

### Materials

The main cabinet and subcabinets are made of powder-coated steel.

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ECM: 1244990
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