Grundfos CUE

Frequency converters for pump control
50/60 Hz

GRUNDFOS

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1. Introduction

Grundfos CUE

The CUE is a series of frequency converters designed for speed control of a wide range of Grundfos pumps.

Grundfos CUE solutions

Built-in E-pump functionality

The CUE solution contains the same control functionality as the Grundfos E-pumps and is thus a supplement to the E-pump range.

Supply voltage	Power P2	
[V]	[kW]	[hp]
3 × 525-690	11-315	15-450
3 × 525-600	0.75 - 90	1-125
3 × 380-500	0.55 - 560	0.75 - 750
3 × 200-240	0.75 - 45	1-60
1 × 200-240	1.1 - 7.5	1.5 - 10

Designed for Grundfos pumps

The CUE can be used in both new and existing installations, but the pump and motor must be suitable for use with frequency converters.

The list below includes the Grundfos pump types for which the CUE is designed.

Pump type
AFG, SFG
AMG, SMG
BM
BMShs, BMShp
CM
CMV
CR, CRI, CRN, CRT
CRK
DP, EF
DPK, DWK
HS
KPL, KWM, KPG
LC, LF
MTH, MTR
MTB
MTS
NB, NK
NBG, NKG
S
SE, SEV, SL, SLV
SP,SP-G, SP-NE
SPK
SRG
TP series 100
TP series 200
TP series 300
VL
VLS

2. Applications

Overview

The CUE is a multi-purpose frequency converter suitable for a variety of applications demanding reliable and cost-efficient pump operation.

The CUE is used in five main fields of application:

Water supply and pressure boosting

Besides general water supply in municipal and industrial waterworks, the CUE is used for the following specific applications:

- water supply
- pressure boosting
- washing.

The typical control modes are constant pressure or constant flow rate. Stop functions are used for stopping the pump when the water flow is low.

Heating and air-conditioning

Liquid transfer:

- heating applications
- cooling and air-conditioning applications.

The typical control modes are proportional pressure or constant temperature.

Process and sanitary applications

Liquid transfer:

- breweries and dairies
- pure-water applications
- process applications
- purification applications.

The CUE is typically controlled by an external controller. The typical control mode is open loop.

Groundwater

Typical applications:

- groundwater supply to waterworks
- irrigation in horticulture and agriculture
- dewatering.

The typical control modes are constant pressure, constant flow rate or constant level control.

Wastewater

Transfer of water:

- wastewater
- effluent
- drainage water
- process water.

The typical control mode is constant level function (emptying function).

3. Features and benefits

User interface

The user interface offers several possibilities:

- local operation via an operating panel with graphic display
- remote operation via external signals, for instance, via digital inputs or communication port
- monitoring of operating status via indicator lights and signal relays
- display of alarms or warnings and logging.

Inputs and outputs

The CUE is equipped with a number of inputs and outputs:

- 1 RS485 serial communication port:
  - Genibus
  - Modbus RTU
  - BACnet MS/TP
- 1 USB serial communication port
- 1 analog input, 0-10 V, 0/4-20 mA
  - external setpoint
- 1 analog input, 0-10 V, 0/4-20 mA
  - sensor input, feedback sensor
- 1 analog output, 0/4-20 mA (depends on the output signal)
- 6 digital inputs
  - 2 inputs can be changed to digital outputs
  - all digital inputs and outputs are programmable
- 2 signal relays (C/NO/NC)
  - programmable.

Accessories

Grundfos offers a number of accessories for the CUE.

MCB 114 sensor input module

The MCB 114 is an option offering additional analog inputs for the CUE:

- 1 analog input, 0/4-20 mA
- 2 inputs for Pt100/Pt1000 temperature sensors.

MCO 101 multipump module

The MCO 101 is an option offering a cascade of multiple CUEs.

- Expands 3 additional relay outputs. In multi-pump control applications, this allows control of additional 3 fixed-speed pumps.

Output filters

The output filters are used primarily for protecting the motor against overvoltage and increased operating temperature. However, output filters can also be used for reducing acoustic motor noise.

Grundfos provides two types of output filter as accessories for the CUE:

- sine-wave filters
- dU/dt filters.

Floor mounting option

The CUE is installed on the wall by default. The enclosures D1h and D2h can also be installed on the floor on a pedestal designed for that purpose.

IP21/NEMA1 option

An IP20 enclosure can be upgraded to the IP21/NEMA1 by using the IP21/NEMA1 option. The power terminals (mains and motor) are covered.

Related information

Main dimensions and weights, SI units

Main dimensions and weights, US units

4. Product range

Overview

The below tables show an overview of the different enclosure classes based on typical motor power and and mains supply ranges.

Typical shaft power P2		Mains supply and enclosure class																
		1 x 200-240 V (S2)				3 x 200-240 V (T2)			3 x 380-500 V (T5)					3 x 525-600 V (T6)		3 x 525-690 V (T7)			
[kW]	[hp]	IP20	IP21	IP55	IP66 (US only)	IP20	IP55	IP66 (US only)	IP20	IP21	IP54	IP55	IP66 (US only)	IP20	IP55	IP20	IP21	IP54	IP55
0.55	0.75								•			•	•						
0.75	1					•	•	•	•			•	•	•	•				
1.1	1.5	•		•		•	•	•	•			•	•	•	•	•			
1.5	2		•	•	•	•	•	•	•			•	•	•	•	•			
2.2	3		•	•	•	•	•	•	•			•	•	•	•	•			
3	4		•	•	•	•	•	•	•			•	•	•	•	•			
3.7	5		•	•		•	•	•											
4	5								•			•	•	•	•	•			
5.5	7.5		•	•	•	•	•	•	•			•	•	•	•	•			
7.5	10		•	•	•	•	•	•	•			•	•	•	•	•			
11	15					•	•	•	•			•	•	•	•		•		•
15	20					•	•	•	•			•	•	•	•		•		•
18.5	25					•	•	•	•			•	•	•	•		•		•
22	30					•	•	•	•			•	•	•	•		•		•
30	40					•	•	•	•			•	•	•	•		•		•
37	50					•	•	•	•			•	•	•	•		•		•
45	60					•	•	•	•			•	•	•	•		•		•
55	75								•			•	•	•	•		•		•
75	100								•			•	•	•	•		•		•
90	125								•			•	•	•	•		•		•
110	150								• [1)]	•	•						•	•	
132	200								• [1)]	•	•						•	•	
160	250								• [1)]	•	•						•	•	
200	300								• [1)]	•	•						•	•	
250	350								• [1)]	•	•						•	•	
315	450								• [1)]	•	•						•	•	
355	500									•	•								
400	550									•	•								
450	600									•	•								
500	650									•	•								
560	750									•	•								

1) Available only in China

For further information, see the section about selection tables.

Related information

Selection tables

5. Identification

Nameplate

The CUE can be identified by the nameplate or the packaging label.

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Example of a nameplate

Designation	Description
Prod. no	Product number
T/C	Product name
S/N	Serial number, the last three digits indicating the production date
1.1 kW (1.5 hp)	Typical shaft power of the motor
IN	Supply voltage, frequency and maximum input current
OUT	Motor voltage, frequency and maximum output current [2)]
Open Type/IP20	Enclosure class
$T_{amb.}$	Maximum ambient temperature
FRAME	Enclosure size

2) The maximum output frequency usually depends on the pump type

6. Functions

Operating modes

The following operating modes can be selected with the CUE:

- Normal
- Stop
- Minimum curve
- Maximum curve
- User curve.

The operating modes are set on the operating panel using the **Favourites** menu. The operating modes can be set without changing the setpoint setting.

Normal

The pump operates in the control mode selected.

The control modes are different ways of controlling the pump speed when the operating mode is set to **Normal**.

Stop

The pump is stopped by the user.

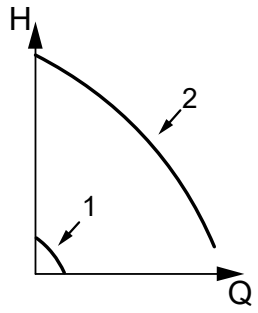
Minimum curve

The pump is running at a set minimum speed value. See the figure about the minimum and maximum curves.

For instance, this operating mode can be used during periods with very small flow requirement.

Maximum curve

The pump is running at a set maximum speed value.



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Minimum and maximum curves

Pos.	Description
1	Minimum
2	Maximum

User curve

The pump is running at a user-defined speed.

Control modes

The CUE has a built-in PID controller that provides closed-loop control of the value you want to control. The CUE can also be set to open-loop control where the setpoint represents the desired pump speed. The control modes are set on the operating panel in the startup guide, or changed using the **Favourites** menu.

Pump-specific functions

Control modes for centrifugal pumps

The CUE has a wide range of pump-specific functions:

- **Open loop**: The speed is kept at a set value in the range of the minimum and maximum speed.
- **Proportional differential pressure**: The differential pressure is reduced at a falling flow rate and increased at a rising flow rate.
- **Constant differential pressure**: The differential pressure is kept constant, independently of the flow rate.
- **Constant pressure**: The pressure is kept constant, independently of the flow rate.
- **Constant level**: The liquid level is kept constant, independently of the flow rate.
- **Constant flow rate**: The flow rate is kept constant, independently of the head.
- **Constant temperature**: The liquid temperature is kept constant, independently of the flow rate.
- **Constant other value**: Any other value is kept constant.
- **Sensorless constant differential pressure**: The differential pressure of the pump is kept constant, independently of the flow rate, without the use of a physical sensor to measure the pressure.
- **Sensorless proportional differential pressure**: The differential pressure of the pump is reduced at falling flow rate and increased at rising flow rate, without the use of a physical sensor to measure the pressure.

Startup guide

The CUE has a startup guide that launches at the first startup. Here, a number of parameters are set automatically based on pump type. Other parameters are set manually on the basis of the data on the motor and pump nameplates. The startup guide can be repeated, if necessary. Thanks to the startup guide, the installer can quickly set central parameters and put the CUE into operation.

Direction of rotation test

During the startup guide, the CUE automatically tests and sets the correct direction of rotation without changing the cable connections if a pressure or flow sensor is connected. The direction of rotation test is performed manually if no sensor is connected.

Duty/standby

The duty/standby function is used to alternate between two pumps. Each pump is connected to a CUE. The primary task is to start the standby pump if the duty

pump is stopped due to an alarm, and to alternate the two pumps at least every 24 hours. The duty/standby operation increases the security of supply and ensures that the standby pump does not get stuck.

Multi-master cascade

The Multi-master cascade function is used for cascading additional pumps. Each pump is connected to a CUE. The cascade control ensures that the performance of the pumps is automatically adapted to consumption by switching the pumps on or off, and by changing the speed of the pumps in operation. The system runs as energy-efficiently as possible with a limited number of pumps. When more than one pumps are running in steady state, the pumps run at the same speed and are controlled by the PI controller of the master pump. As standard, the pump with the lowest number is the master pump.

Dry-running protection

To protect the pump, select the dry-running function together with an external sensor so that lack of inlet pressure or water shortage can be detected.

Low-flow stop function

In constant pressure or constant level control mode, the stop function is used for changing between on/off operation at low flow rate and continuous operation at high flow rate. The low-flow stop function protects the pump and saves energy.

Monitoring of lubrication of motor bearings

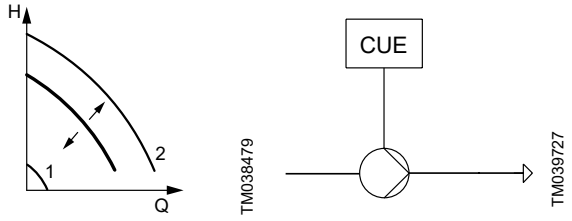
When the bearing monitoring function is active, a warning appears in the display when the motor bearings are to be relubricated or replaced.

Overview

Pump type	Open loop	Proportional differential pressure	Constant differential pressure	Constant pressure	Constant level	Constant flow rate	Constant temperature	Constant other value
AFG, SFG	•				•	•		•
AMG, SMG	•				•	•		•
BM	•			•	•	•		•
BMShs, BMShp	•			•	•	•		
CM, CMV	•			•	•	•		•
CR, CRI, CRN, CRT	•			•	•	•		•
CRK	•			•	•	•	•	•
DP, EF	•			•	•	•		•
DRK, DWK	•				•	•		•
HS	•		•	•		•	•	•
KPL, KWM, KPG	•				•	•		•
LC, LF	•		•	•		•	•	•
MTH, MTR	•			•	•	•	•	•
MTS	•			•		•		•
MTB	•			•	•	•	•	•
NB, NK	•		•	•	•	•	•	•
NBG, NKG	•		•	•	•	•	•	•
S	•			•	•	•		•
SE, SEV, SL, SLV	•			•	•	•		•
SMD	•				•	•		•
SP, SP-G, SP-NE	•			•	•	•	•	•
SPK	•			•	•	•		•
SRG	•					•	•	•
TP series 100	•	•	•	•	•	•	•	•
TP series 200	•	•	•		•	•	•	•
TP series 300	•	•	•		•	•	•	•
VL	•			•	•	•	•	•
VLS	•	•	•		•	•		•

Open loop

The speed is kept at a set value in the range between the minimum and maximum curves.



Open loop, constant curve

Pos.	Description
1	Minimum
2	Maximum

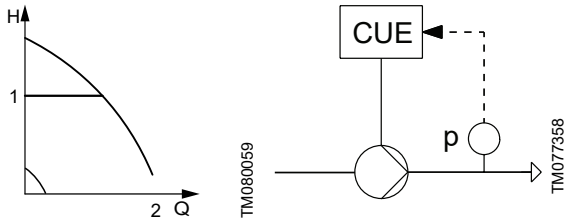
In **Open loop** control mode, the setpoint is set in percentage of the nominal speed. The setting range is between the minimum and maximum curves.

Operation on constant curve can, for instance, be used for pumps with no sensor connected.

This control mode is typically used in connection with an overall control system such as the Control MPC or another external controller.

Constant pressure

The outlet pressure is kept constant, independently of the flow rate.

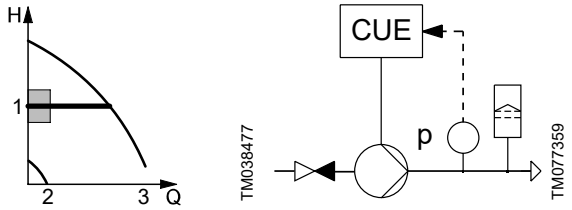


Pos.	Description
1	H_{set}
2	Q_{max}

Constant pressure

The pump is controlled according to a constant pressure measured after the pump. This means that the pump offers a constant pressure in the Q-range of 0 to Q_{max}, represented by the horizontal line in the QH diagram.

The outlet pressure is kept constant at high flow rate (Q > Q_{min}). There is on/off operation at low flow rate.



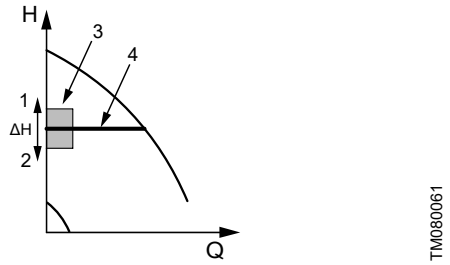
Pos.	Description
1	H_{set}
2	Q_{min}
3	Q_{max}

Constant pressure with stop function

The pump is controlled according to a constant pressure measured after the pump. This means that the pump offers a constant pressure in the Q-range of Q_{min} to Q_{max}, represented by the horizontal line in the QH diagram.

The Stop function is activated by default for constant pressure, but can be deactivated in parameter 200-19 **Stop function**.

The purpose of the Stop function is to stop the pump when low or no flow is detected. When low flow is detected, the pump is in on/off operation. If there is flow, the pump continues to operate according to the setpoint.



Constant pressure with stop function, difference between start and stop pressures (ΔH)

Pos.	Description
1	Stop pressure [3]
2	Start pressure [4]
3	On/off operation
4	Continuous operation

3) Stop pressure = Setpoint x (1+ ΔH x 201-43)

4) Start pressure = Setpoint x (1-ΔH x (1-201-43))

Note: ΔH=Setpoint x 201-42

Low flow can be detected in two different ways:

- with the built-in low-flow detection function
- with a flow switch connected to a digital input.

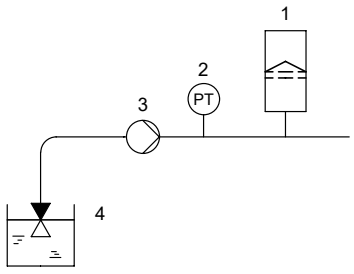
The low-flow detection function checks the flow regularly by reducing the speed for a short time. No or only a small change in pressure means that there is low flow.

When a flow switch detects low flow, the digital input is activated.

It is only possible to use the stop function if the system incorporates the following components:

- a pressure sensor
- a non-return valve
- a diaphragm tank.

The non-return valve must always be installed before the pressure sensor.



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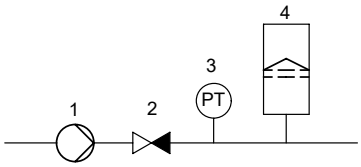
Position of the non-return valve and pressure sensor in a system with suction lift

Pos.	Description
1	Diaphragm tank
2	Pressure sensor
3	Pump
4	Non-return valve



TM038583

Position of the non-return valve and pressure sensor in a system with positive inlet pressure

Pos.	Description
1	Pump
2	Non-return valve
3	Pressure sensor
4	Diaphragm tank

The stop function requires a diaphragm tank of a certain minimum size. The tank must be installed as close as possible after the pump, and the precharge pressure must be the 70 % of actual setpoint.

Recommended diaphragm tank sizes:

Rated flow rate of pump [m^3/h (gpm)]	Typical diaphragm tank size [litres (gallons)]
0-6 (0-26)	8 (2)
7-24 (26-110)	18 (5)
25-40 (110-180)	50 (13)
41-70 (180-310)	120 (32)
71-100 (310-440)	180 (48)

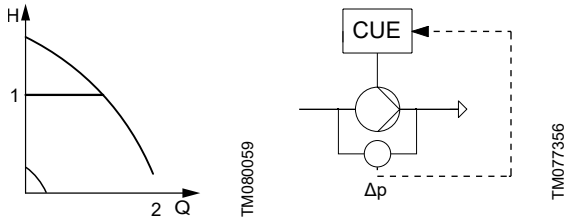
If a diaphragm tank of the above size is installed in the system, the factory setting of ΔH is the correct setting. If the tank installed is too small, the pump starts and stops too often.

The stop function is activated by default in constant pressure applications. If not desired, it can be deactivated in the parameter 200-19 **Stop function**.

Constant differential pressure

Pump

The differential pressure of the pump is kept constant, independently of the flow rate.



TM080059

TM077356

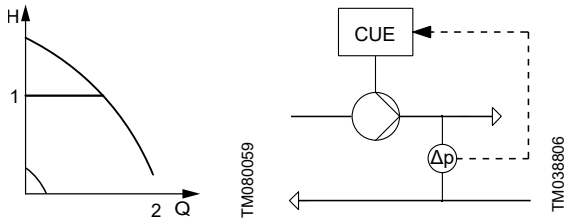
Pos.	Description
1	H_{set}
2	Q_{max}

Constant differential pressure, pump

The pump is controlled according to a constant differential pressure measured across the pump. This means that the pump system offers constant differential pressure in the Q-range of 0 to Q_{max}, represented by the horizontal line in the QH diagram.

System

The differential pressure of the system is kept constant, independently of the flow rate.



TM080059

TM038806

Pos.	Description
1	H_{set}
2	Q_{max}

Constant differential pressure, system

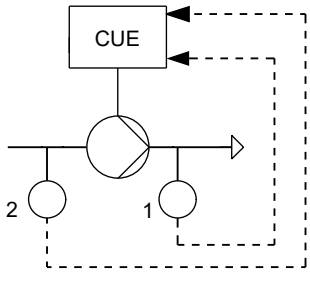
The pump is controlled according to a constant differential pressure measured across the system. This means that the pump offers constant differential pressure of the system in the Q-range of 0 to Q_{max}, represented by the horizontal line in the QH diagram.

Differential pressure from two sensors

This function is for making differential pressure control possible by using measurements from two separate pressure sensors. It can be used in the following control modes:

- proportional differential pressure
- constant differential pressure.

The function requires an MCB 114 sensor input module.



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Differential pressure from two sensors

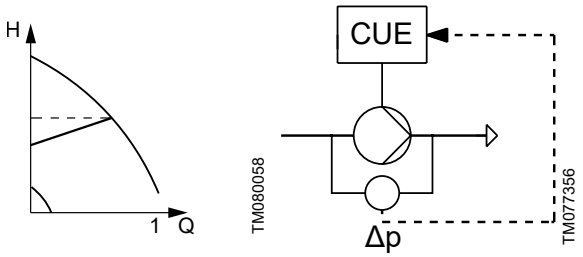
Pos.	Description
1	Sensor 1
2	Sensor 2

The sensor 1 is connected to the sensor input 1.

The sensor 2 is connected to the sensor input 2 of an MCB 114 sensor input module.

Proportional differential pressure

The differential pressure of the pump is reduced at falling flow rate and increased at rising flow rate.



TM080058

TM077356

Proportional differential pressure

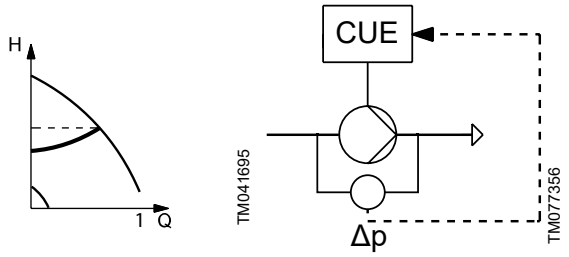
Pos.	Description
1	Q_{max}

The pump is controlled according to a differential pressure measured across the pump. This means that the pump system offers a proportional differential pressure in the Q-range of 0 to Q_{max}, represented by the sloping line in the QH diagram.

The proportional differential pressure can be selected with one of the following flow dependencies:

- linear, default
- quadratic.

When the flow dependency is selected as quadratic, the differential pressure of the pump is reduced with a quadratic curve at falling flow rate and increased at rising flow rate.



TM041695

TM077356

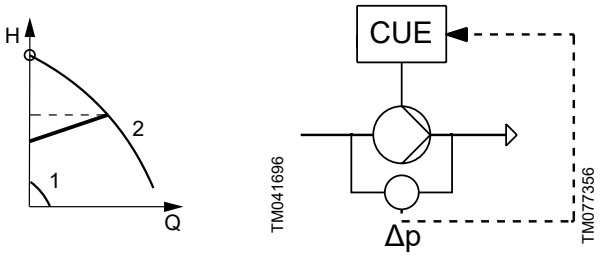
Proportional differential pressure, quadratic curve

Pos.	Description
1	Q_{max}

The pump is controlled according to a differential pressure measured across the pump. This means that the pump system offers a flow-compensated differential pressure in the Q-range of 0 to Q_{max} represented by the quadratic curve in the QH diagram.

H_{max} update

This function can be used in connection with the control mode Proportional differential pressure. The purpose is to find the actual value of the maximum head at no flow and rated pump speed.



TM041696

TM077356

Pos.	Description
1	Minimum
2	Maximum

Proportional differential pressure, H_{max} update

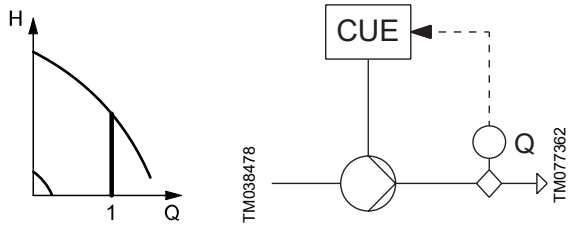
The function can be activated in parameter 200-27 and it consists of two steps:

1. The speed must be ramped up to rated speed.
2. The H_{max} must be measured for 20 seconds at the rated speed.

Valves must be closed so that the pump is operating without flow.

Constant flow rate

The flow rate is kept constant, independently of the head.



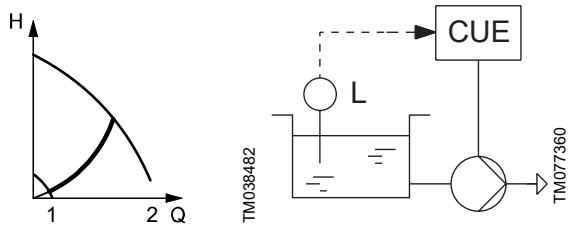
Constant flow rate

Pos.	Description
1	Q_{set}

The pump is controlled according to a constant flow rate, represented by the vertical line in the QH diagram.

Constant level

The liquid level is kept constant, independently of the flow rate.



Constant level

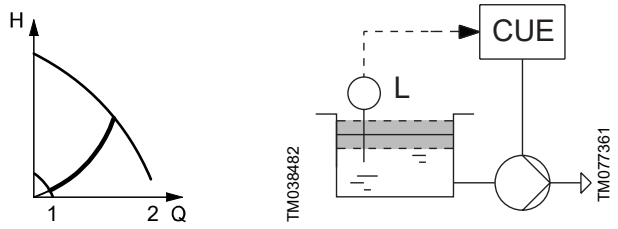
Pos.	Description
1	Q_{min}
2	Q_{max}

The pump is controlled according to a constant liquid level. This means that the pump offers a constant level in the Q-range of Q_{min} to Q_{max}, represented by the quadratic line in the QH diagram.

The function is an emptying function by default.

Constant level with stop function

The liquid level is kept constant at high flow rate. On/off operation is at low flow rate.



Constant level with stop function

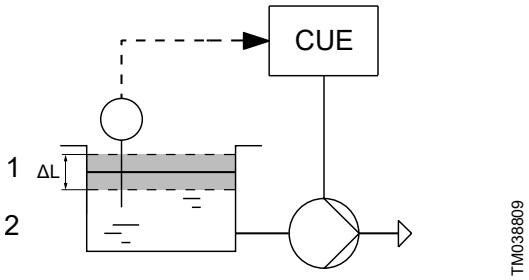
Pos.	Description
1	Q_{min}
2	Q_{max}

The pump is controlled according to a constant liquid level. This means that the pump offers a constant level in the Q-range of Q_{min} to Q_{max}, represented by the quadratic line in the QH diagram.

The function is an emptying function by default.

The stop function is deactivated by default for constant level control, but can be activated in parameter **200-19 Stop Function**.

The purpose of the stop function is to stop the pump when low or no flow is detected. When low flow is detected, the pump is in on/off operation. If there is flow, the pump continues to operate according to the setpoint.



Constant level with stop function, difference between start and stop levels (ΔL)

Pos.	Description
1	Start level
2	Stop level

When the **Stop function** is activated, the user will be guided to perform a **No-Flow Power Tuning**. During this process, the user will be asked whether the low and high limits of the output speed have been set, and will also be instructed to close the outlet valve. Once completed, the measured data will be stored in parameter group **22-3x No-Flow Power Tuning**.

Low flow can be detected in two different ways:

- with the built-in low-flow detection function
- with a flow switch connected to a digital input.

When a flow switch detects low flow, the digital input is activated.

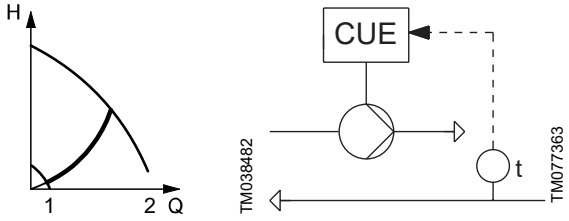
It is only possible to set constant level with stop function if the system incorporates a level sensor, and all valves can be closed.

Related information

Limit exceed

Constant temperature

The liquid temperature is kept constant, independently of the flow rate.



Constant temperature

Pos.	Description
1	Q_{min}
2	Q_{max}

The pump is controlled according to a constant temperature. This means that the pump offers a variable flow rate in the Q-range of Q_{min} to Q_{max}, represented by the quadratic line in the QH diagram.

Constant other value

Any other sensor signals that can be read through the terminal AI54 can be utilized as the object of the PID controller. The CUE calculates an output based on the deviation between the desired setpoint and the actual measured value, to control the motor speed and make the actual measured value follow the setpoint.

Sensorless control modes

The sensorless functions are based on the relationship between frequency, flow, head and power. The drive requires pump, frequency and power data as inputs for the calculation. Pump data directly affects the accuracy and effectiveness of the control. Grundfos recommends controlling variable-speed pumps by using sensor feedback for optimal performance over the lifetime of the pump.

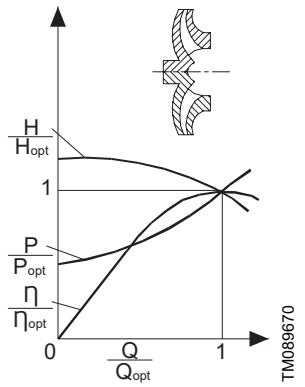
There are two types of sensorless control modes:

- **Sensorless constant differential pressure**: the differential pressure of the pump is kept constant, independently of the flow rate, without a physical sensor to measure the pressure.
- **Sensorless proportional differential pressure**: the differential pressure of the pump is reduced at falling flow rate and increased at rising flow rate, without a physical sensor to measure the pressure.

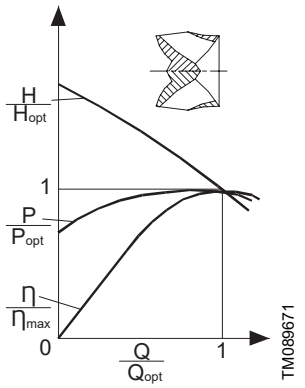
Note that the sensorless functions have limitations:

- There must be a clear one-to-one relation between power and flow, that is, only one P-value to one Q-value and vice versa.
- Sensorless control is limited to non-compressible liquids such as water.
- Sensorless control is recommended only in closed systems.
- Pump measurements and final operation should only be performed in **Variable Torque Mode**. Set parameter 1-03 to **1 - Variable Torque Mode**.
- Sensorless functions can only be used with centrifugal pumps that have radial impeller.
  - On pumps with mixed flow impellers, use is limited as the power curve is typically flat at high flow rates.
  - A centrifugal pump with axial impeller cannot be controlled with sensorless control due to the particular shape of the head curve.

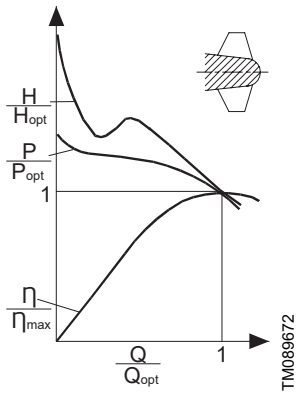
The figures below show typical characteristics for the different pump types.



Radial impeller
n_q=20 rpm
Possible



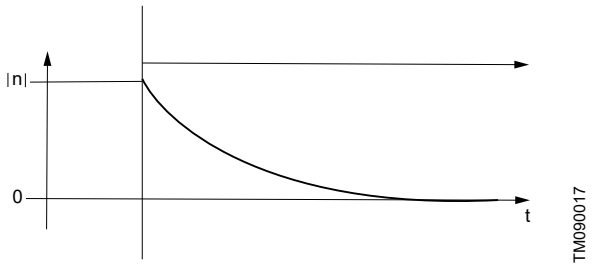
Mixed flow impeller
n_q=80 rpm
Limited



Axial impeller
n_q=200 rpm
Not possible

Safe Torque Off (STO)

The Safe Torque Off is an optional built-in safety function for the CUE. The STO is the required base for drive-based functional safety as defined per the EN IEC 61800-5-2, as the STO function brings the drive safely to a no-torque state. The STO is typically used for preventing an unexpected start-up (EN 1037) of the machinery, or for an emergency stop fulfilling the stop category 0 (EN 60204-1). When the STO is activated, it immediately switches off the drive output to the motor. The motor speed then coasts to a stop.



Motor speed coasting to stop after activating the STO

Setpoints

The setpoint is normally set in the startup guide and changed via the **Favourites** menu on the CUE operating panel. If needed, the setpoint can be influenced via the external setpoint input.

The CUE offers the following setpoint possibilities:

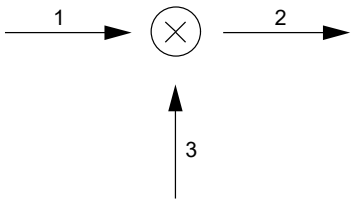
- external setpoint
- predefined setpoints
- communication bus setpoint.

The setpoint range depends on the selected control mode:

- In **Open loop** control mode, the setpoint is set in percentage corresponding to the required speed. The setting range is between the minimum and maximum curves in percentage of the nominal frequency. The related parameters are the following:
  - 200-82: **User Defined Minimum Frequency**
  - 200-83: **User Defined Maximum Frequency**.
- In **Proportional differential pressure** control mode, the setting range is equal to 25 % to 90 % of maximum head. For 25 % the related parameters are the following:
  - 200-62: **Proportional Pressure Minimum Setpoint**
  - 200-63: **Proportional Pressure Maximum Setpoint**
  - 200-22: $\mathbf{H_{max}}$.
- In all other control modes, the setting range is equal to the sensor measuring range. The parameters related to this range are the following:
  - 06-24: **Terminal 54 Low Ref./Feedback Value**
  - 06-25: **Terminal 54 High Ref./Feedback Value**.

External setpoint influence

The setpoint can be influenced by connecting an analog signal to the external setpoint input and is activated in the startup guide.



Setpoint, CUE menu and external setpoint signal

Pos.	Description
1	Setpoint, CUE menu
2	Actual setpoint
3	External setpoint signal

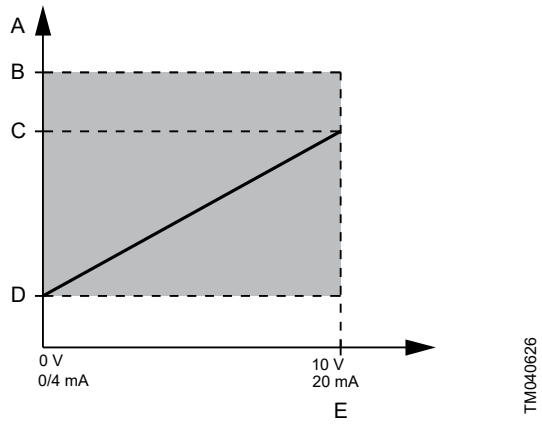
The signal can influence the actual setpoint by the following possibilities of the function:

- External setpoint, default
- Inverse external setpoint
- External setpoint with stop
- External setpoint based on a reference table.

The external setpoint signal is used for calculating the actual setpoint. The minimum signal is the minimum setpoint, and the maximum signal is the normal setpoint.

External setpoint, default

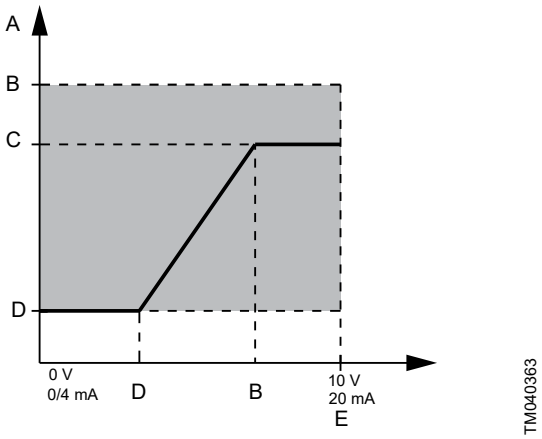
The actual setpoint is a linear function of the external setpoint signal.



External setpoint

Pos.	Description
A	Actual setpoint
B	Maximum
C	Setpoint, CUE menu
D	Minimum
E	External setpoint signal

The minimum and maximum values of the external setpoint signal are default within the full scale of 0 to 10 V (0/4-20 mA), but can be set in the parameters 200-11 to 200-14 within 20-1x **Setpoint Handling**.

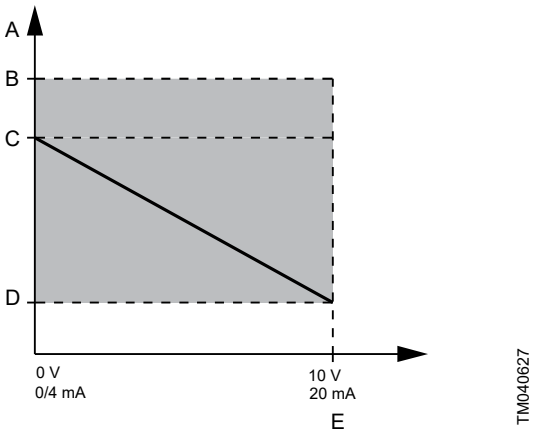


Reduced external setpoint signal

Pos.	Description
A	Actual setpoint
B	Maximum
C	Setpoint, CUE menu
D	Minimum
E	External setpoint signal

Inverse external setpoint

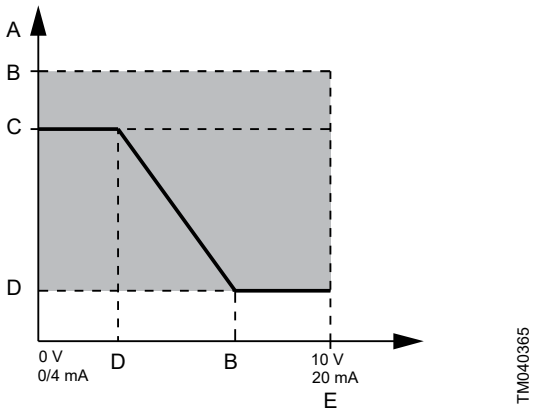
The actual setpoint is an inverse linear function of the external setpoint signal and is activated in the **Main** menu parameter 200-10 **External setpoint**.



Inverse external setpoint signal

Pos.	Description
A	Actual setpoint
B	Maximum
C	Setpoint, CUE menu
D	Minimum
E	External setpoint signal

The maximum and minimum values of the external setpoint signal are default within the full scale of 0 to 10 V (0/4-20 mA), but can be set in the parameters 200-11 to 200-14 within 20-1x **Setpoint Handling**.

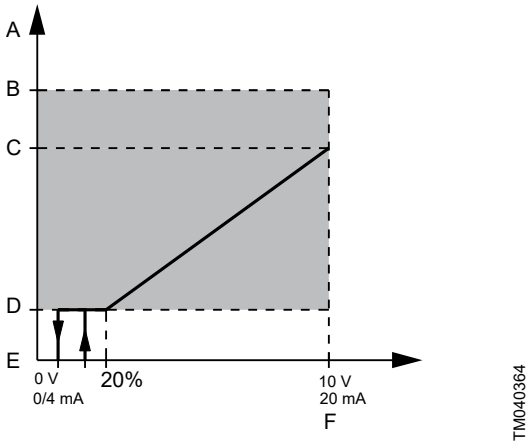


Reduced inverse external setpoint signal

Pos.	Description
A	Actual setpoint
B	Maximum
C	Setpoint, CUE menu
D	Minimum
E	External setpoint signal

External setpoint with stop function

The actual setpoint with stop is a linear function of the external setpoint signal above 20 % signal and on/off operation below 20 % signal. Linear with stop is selected in the **Main** menu, parameter 200-10 **External setpoint**.



External setpoint with stop function

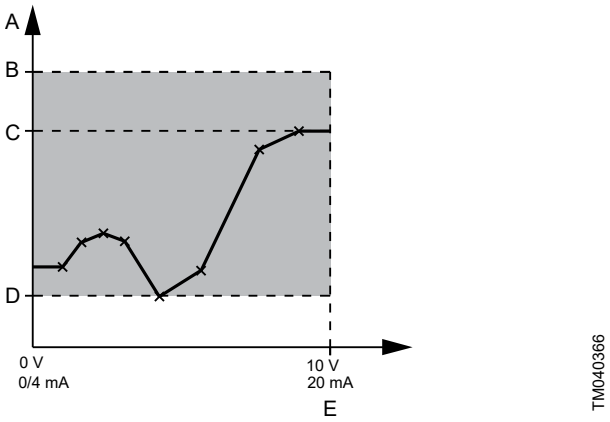
Pos.	Description
A	Actual setpoint
B	Maximum
C	Setpoint, CUE menu
D	Minimum
E	Stop
F	External setpoint signal

When the external setpoint signal is below 10 %, the operating mode is **Stop**.

When the external setpoint signal is above 15 %, the operating mode is **Normal**.

External setpoint based on a reference table

The actual setpoint is a piecewise linear function of the external setpoint signal and is activated in the **Main** menu, parameter 200-10 **External setpoint**.



External setpoint based on a reference table

Pos.	Description
A	Actual setpoint
B	Maximum
C	Setpoint, CUE menu
D	Minimum
E	External setpoint signal

The linear function is defined as an interpolation between the points in a table. The table has up to eight points that are adjustable in the **Main** menu, group 200-1x **Setpoint Handling**.

The parameters of the eight points are the following:

- 200-15: **Number of reference influence table points**
- 200-16: **Reference Influence, input value**
- 200-17: **Reference Influence, output value**.

Predefined setpoints

This function makes it possible to select up to seven predefined setpoints using one to three digital inputs.

The setpoints are selected as a binary coding of the digital inputs as shown in the table below. The predefined setpoints are adjustable in the **Main** menu, parameter 03-10 **Preset Reference**.

Predefined setpoint	DI 2	DI 3	DI 4
15 %	x	-	-
30 %	-	x	-
45 %	x	x	-
60 %	-	-	x
75 %	x	-	x
90 %	-	x	x
100 %	x	x	x

x = Closed contact

If none of the digital inputs are activated, the operating mode can be configured to Stop or to being controlled according to a setpoint set via the **Main** menu, parameter 200-18 **Predefined Setpoint Zero Function**.

If the Min., Max. or Stop in the parameter 200-06 operating model is selected via the operating panel, the predefined setpoints are overruled.

Predefined setpoints cannot be influenced by the external setpoint input.

Communication setpoint

If the CUE is remote-controlled via the communication input, the setpoint is set via the bus.

The communication setpoint cannot be influenced by the external setpoint signal.

PID controller

The CUE has a built-in PID controller for speed control of the pumps. The factory setting of gain (K_p) and integral time (T_i) are automatically adjusted to suggested settings based on the control mode chosen. The values can easily be changed in the operating panel. The parameter group of the PID controller is 20-9x.

The controller can operate in both normal and inverse mode and is selected in parameter 20-81 **PID Normal/ Inverse Control**.

Normal mode

Normal mode is used in systems in which an increase in pump performance results in a rise in the value measured at the feedback sensor. This is typically the case in most CUE applications.

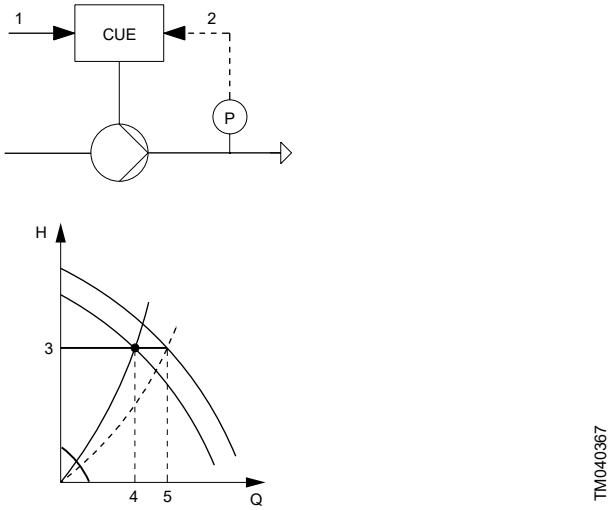
Inverse mode

Inverse mode is used in systems in which an increase in pump performance would result in a drop in the value measured at the feedback sensor. This mode is typically used for constant level operation (emptying tank) and for constant temperature operation in cooling systems.

Negative K_p value corresponds to inverse mode.

Description

The PID controller compares the required setpoint (p_{set}) with the actual value (p) measured by the transmitter (P).

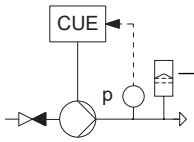
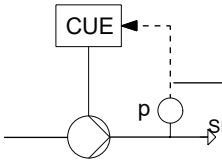
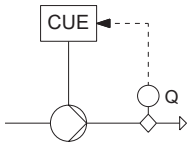
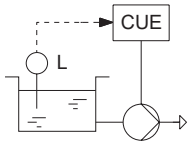
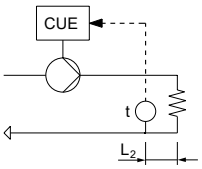
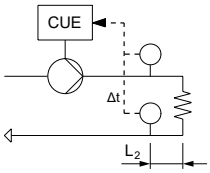
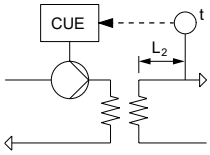
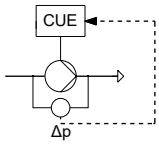
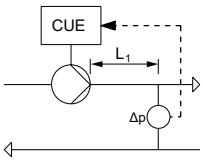


Constant pressure control

Pos.	Description
1	Setpoint p_{set}
2	Measured value p
3	P_{set}
4	Q
5	Q_{max}

If the measured value is higher than the required setpoint, the PID controller reduces the speed and the performance of the pump until the measured value is equal to the required setpoint.

Suggested controller settings

System/ application	K_p		T_i
	Heating system [5]	Cooling system [6]	
	0.2		0.5
	SP, SP-G, SP-NE: 0.5		0.5
	0.2		0.5
	SP, SP-G, SP-NE: 0.5		0.5
	0.2		0.5
	-2.5		100
	0.5	-0.5	$10 + 5L_2$ [7]
	0.5		$10 + 5L_2$
	0.5	-0.5	$30 + 5L_2$
	0.5		0.5
	0.5		L_1 [8] < 5 m (16 ft): 0.5 L_1 > 5 m (16 ft): 3 L_1 > 10 m (32 ft): 5

5) Heating systems are systems in which an increase in pump performance results in a rise in temperature at the sensor.

6) Cooling systems are systems in which an increase in pump performance results in a drop in temperature at the sensor.

7) L_2 = Distance in m (ft) between heat exchanger and sensor.

8) L_1 = Distance in m (ft) between pump and sensor.

The setting of gain (K_p) and integral time (Ti) can be manually changed in the operating panel via the **Main** menu group 20-9x **PID Controller**.

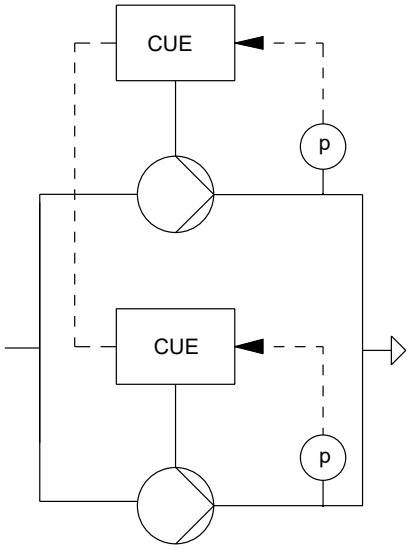
Duty/standby, multi-master cascade

Use the startup guide for setting the multi-pump system with the following options:

- No (used for CUE controlling single pumps)
- Variable and fixed speed
- Variable speed only.

Duty/standby

The built-in duty/standby function applies to **Variable speed only** pumps connected in parallel to ensure the reliability of supply.



TM040368

Two pumps connected in parallel and controlled via the Modbus RTU

The duty/standby function is set by choosing **Variable speed only** in the startup guide, then by setting the desired function to **Alternation** or **Back-up**.

The primary purposes of the function are the following:

- to let one pump run at a time
- to start the standby pump if the duty pump stops due to an alarm
- to alternate the pumps at least every 24 hours, only if alternation function is selected.

The two pumps are electrically connected by the Modbus RTU protocol on the serial communication port.

The two pumps running duty/standby in this way cannot use the serial communication port for remote communication. The two pumps use their own local operating mode. See the section about operating modes.

Both pumps must have the same control mode. See the section about control modes.

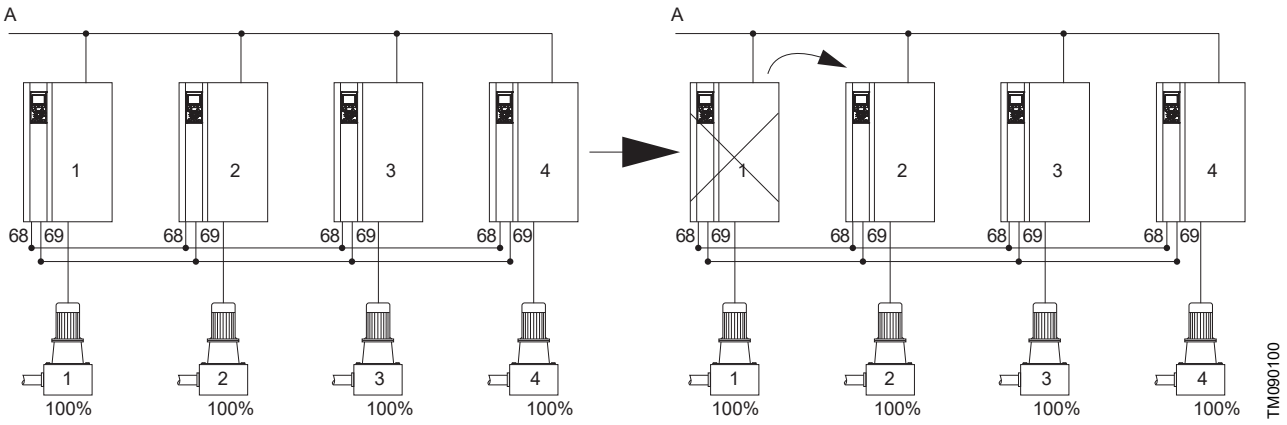
Related information

Operating modes

Control modes

Multi-master cascade

The **Multi-master cascade** functions are used for cascading additional variable speed pumps. Each pump is connected to a CUE. All pumps must be of the equal size. The system can support a maximum of 8 pumps in the cascade configuration.



TM090100

The line supply (A) of four pumps connected in parallel and controlled via the Modbus RTU

The master driver determines the sequence of pump start and stop based on the running time of each pump. If the currently running pump is unable to maintain the pressure, the next pump is activated. In case of master drive failure, the system automatically reallocates the master functionality.

The master driver needs to be changed when the following occurs on the primary master:

- The supply power is turned off.
- There is a control card defect.
- There is a warning, Live Zero error.

The entire system shuts down when the master driver detects any of the following alarms:

- Alarm 68: **Safe Stop Activated**
- Alarm 94: **End of Curve**
- Alarm 92: **No Flow Alarm**
- Alarm 93: **Dry Pump Alarm**
- Alarm 60: **External Interlock**.

Follower drivers operate when the primary master driver stops:

- any other alarm
- LCP status: M:X F:D F:D F:D.

The CUE uses the on-board RS485 communication terminals, and the communication protocol is the Modbus RTU that requires an absolute minimum setup of parameters. The startup guide makes this configuration easy.

The cascade control ensures that the performance of the pumps is automatically adapted to consumption by switching pumps on or off and by changing the speed of the pumps in operation. This makes the system run as energy-efficiently as possible with a limited number of pumps.

Setting the master drivers

To configure the **Multi-master cascade** function, first select **Variable Speed Only** in the startup guide. Then set the desired function to **Multi Pump Cascade** and specify the total number of pumps in the system.

Setting the follower drivers

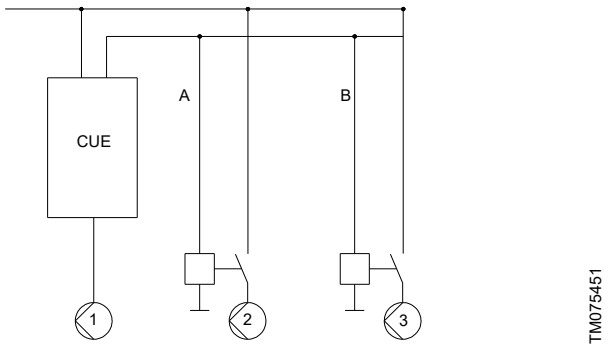
Set the control mode to **Open loop** then confirm that the pump is an assist pump in a **Multi-master cascade** system.

Setting the drivers' addresses

If there are multiple master drivers, the master status is determined by parameter **8–31 Address** where the lowest assigned is the **Primary Master**. All back-up master drivers power up as assigned follower drivers as they do not have the lowest address. The ID of the drive must be ordered from 1 to 8 and should be sequential.

Fixed-speed cascade

The fixed-speed cascade function is used for cascading additional fixed-speed pumps. Only one duty pump is connected to a CUE.



One duty pump connected with two fixed-speed pumps controlled via relays

Pos.	Description
A	Relay 1
B	Relay 2

The fixed-speed cascade function is set by selecting **Variable and Fixed speed** in the startup guide, then setting the total number of pumps in the system. When **Variable and Fixed speed** is selected, this pump runs as a duty pump in the fixed-speed cascade system. The following steps must be performed:

- For a two-pump setup: The Relay 1 is automatically set to activate/deactivate one fixed-speed pump based on pressure demand
- For a three-pump setup: The Relay 1 and Relay 2 are automatically set to activate/deactivate one additional fixed-speed pump at the same time based on pressure demand.

The primary purposes of the function are the following:

- to let the duty pump run all the time (except if low flow stop is activated)
- to start the fixed-speed pumps if the system pressure decreases below 90 % of the sensor range
- to stop the fixed-speed pumps if the system pressure increases above 110 % of the sensor range.

The cascade control ensures that the performance of the pumps is automatically adapted to consumption by switching pumps on or off and ,by changing the speed of the duty pump in operation.

Dry running

This function protects the pump against dry running. When lack of inlet pressure or water shortage is detected, the pump is stopped before being damaged.

Lack of inlet pressure or water shortage can be detected in three ways:

- with a switch connected to a digital input configured to dry-running protection
- the CUE checks if the shaft power is below a dry-pump limit for a configurable time
- the CUE checks if the pressure cannot be reached at full speed for a configurable time.

Note that the dry-running function requires a sensor. This means that the function does not work in **Open loop**.

The following conditions must be present to activate the dry-running alarm:

- The power consumption must be below a certain level (set by the parameters).
- The pump must run at full speed (handled by the control mode and the sensor).

The CUE increases the speed to maximum if no water is present. Without a sensor, it does not work.

Setting the dry-running protection based on a switch connected to a digital input

Using a digital input requires an accessory, such as:

- a Grundfos LiqTec® dry-running switch
- a pressure switch installed on the suction side of the pump
- a float switch installed on the suction side of the pump.

See the section about accessories for more information on the required sensors. The pump cannot restart if the input is activated. Restart may be delayed by up to 30 minutes, depending on the pump family.

The digital inputs of the CUE (terminals, 18, 19, 27, 29, 32, 33) can be set individually to different functions in the **Main** menu, parameter group 5-1x **Digital Inputs**.

Select dry running to activate the detection based on a switch.

Setting the dry-running protection based on a shaft power

The use of shaft power requires an actual power reading at two frequencies.

Procedure without pump curve

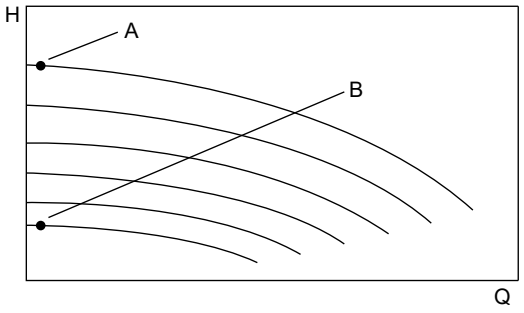
After completing the startup guide, do the steps:

1. Close the valve. No flow is required during the test.
2. Press **Hand on** and set the speed to 50 % (30 Hz or equivalent RPM). The CUE starts the pump.
3. Go to the **Main** menu parameter 16-10 **Power [kW]** and read the input power. Make a note of the low limit value.
4. Press **Home** to return to the status screen.
5. Press **Hand on** and set the speed to 90 % (54 Hz or equivalent RPM). The CUE starts the pump.
6. Go to the **Main** menu parameter 16-10 **Power [kW]** and read the input power. Make a note of the high limit value.
7. Stop the CUE and open the valve.

Procedure with pump curve

Go to the Grundfos Product Center and enter the part number for your pump:

1. Enter **Show advanced options**.
2. Go to the **Hydraulic layout** and set variable speed to **Yes**.
3. Click on the pump curve to set the duty point as close to f_{min} and enter Q to 0.1 as the **Operating point**.
4. Read output power (P2) and speed (n) as low limit values.
5. Click on the pump curve to set the duty point as close to 90 % speed and enter Q to 0.1 as **Operating point**.
6. Read output power (P2) and speed (n) as high limit values.



QH curve for variable speed pump for choosing low flow operating points

Pos.	Description
A	90 % of f_{max}
B	f_{min}

QP curve for variable speed pump for reading P2 at low flow

The data must be entered in the **Main** menu parameter group 22-3x **No-flow Power Tuning** as follows:

- 22-32 **Low Speed [RPM]** or 22-33 **Low Speed [Hz]** = 30 Hz
- 22-34 **Low Speed Power [kW]** = the power readout at Low limit in previous procedure
- 22-36 **High Speed [RPM]** or 22-37 **High Speed [Hz]** = 54 Hz
- 22-38 **High Speed Power [kW]** = the power readout at High limit in previous procedure.

Activate the desired protection function, for example an alarm, in the **Main** menu parameter 22-26 **Dry Pump Function**.

The dry-running stop function is now set correctly. The time setting is 10 seconds from no-flow delay (22-24) with additional 10 seconds from dry-running detection delay (22-27), adding up to a total of 20 seconds.

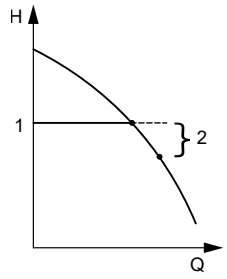
Setting the dry-running protection based on an end of the curve

By default, the CUE issues an alarm at end of the curve. This also occurs under the dry-running conditions of water shortage and no flow.

In constant pressure control mode, the end of curve is detected if the pressure is below a 20 % tolerance of the sensor range of the setpoint and the pump is running at maximum speed for a 10-second delay. The pump cannot build up the setpoint pressure due to water shortage.

The end of curve tolerance, delay and protection function can be adjusted in the **Main** menu, parameter group 22-5x **End of Curve**.

Example: A constant pressure system with a 0-16 bar sensor and setpoint at 11.75 bar (120 m head) gives an end of curve alarm if the pressure is below 11.75 bar minus 20 % of 16 bar, that is, 8.55 bar, and the pump is running at maximum speed.



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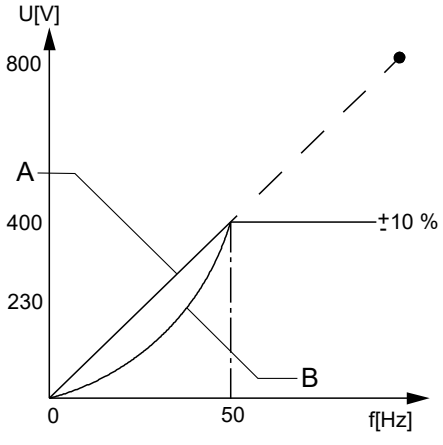
Pos.	Description
1	H_{set}
2	H tolerance

Dry-running detection based on the end of curve also gives an alarm, if there is actual water and the system head curve shifts to high flow range, which means that the function may need to be adjusted to work properly in the high flow area.

Pump torque

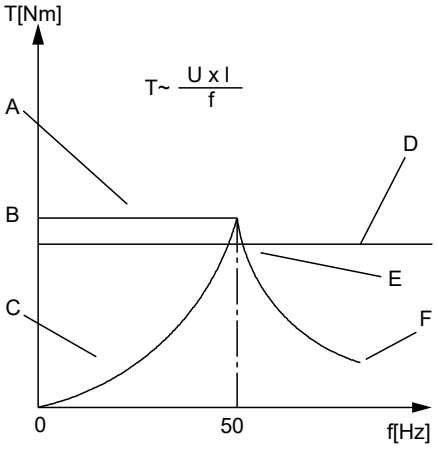
The CUE can provide torque for different load characteristics, constant and variable torque, as well as an automatic energy optimising function.



TM075471

U/f characteristic control (ideal)

Pos.	Description
A	Constant torque
B	Variable torque



TM075472

T/n characteristic control (ideal)

Pos.	Description
A	Constant torque
B	$T_{nominal}$
C	Variable torque
D	T_{load}
E	The torque is inversely proportional to the frequency
F	T_{motor}

The torque characteristic is normally set to variable torque for centrifugal pumps, where it provides a voltage optimized for a squared torque load characteristic of the motor.

In the constant torque characteristics, the CUE provides a voltage optimized for constant torque pump applications:

- axial pumps
- positive displacement pumps.

When selecting the pump type in the CUE startup guide, the torque characteristic is automatically set according to the typical applications for the pump:

Pump type	Torque characteristic	Automatic derate
AFG, SFG	Constant	
AMG, SMG	Constant	
BM	Variable	•
BMShs, BMShp	Variable	•
CM, CMV	Variable	•
CR, CRI, CRN, CRT	Variable	•
CRK	Variable	•
DP, EF	Constant	
DPK, DWK	Constant	
HS	Variable	•
KPL, KWM, KPG	Constant	
LC, LF	Variable	•
MTH, MTR	Variable	•
MTS	Constant	•
MTB	Variable	•
NB, NK	Variable	•
NBG, NKG	Variable	•
Other	Variable	•
S	Constant	
SE, SEV, SL, SLV	Constant	
SMD	Constant	
SP, SP-G, SP-NE	Variable	•
SPK	Variable	•
SRG	Constant	
TP Series 100	Variable	•
TP Series 200	Variable	•
TP Series 300	Variable	•
VL	Variable	•
VLS	Variable	•

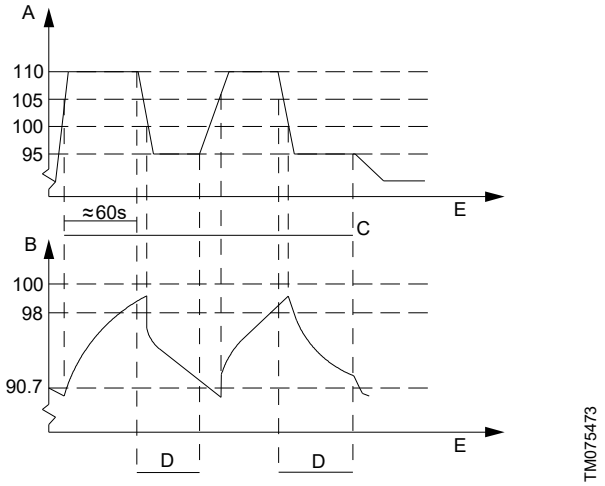
The CUE can be set for optimal energy-efficient speed control of centrifugal pumps, where it provides a voltage optimized for the torque load characteristic of the motor, in addition, the AEO feature adapts the voltage exactly to the current load situation, reducing energy consumption and audible noise from the motor.

To obtain optimal performance, set the motor power factor correctly. This value is set in the **Main** menu, parameter 14-43 **Motor Cosphi**, but this is automatically adjusted with the automatic motor adaptation (AMA) function. See the CUE Installation and operating instructions.

The torque characteristic can be manually set in the **Main** menu, parameter 1-03 **Torque Characteristic**.

Automatic derate output for not tripping at overload

In some pump systems, the CUE has not been sized properly to yield the current needed at all points of the operational QH characteristic. At these points, the pump needs a current higher than the rated current of the frequency converter. The CUE can normally yield 110 % of its rated current continuously for 60 seconds. If still overloaded, the CUE normally gives an alarm.



Output current in overload condition

Pos.	Description
A	Percentage of rated current
B	Inverter load counter
C	Desired current > 100 %
D	Warning
E	Time

The CUE automatically reduces pump speed until the output current is below 100 % of the rated current.

The CUE estimates the load on the power section with an inverter load counter, which causes a warning at 98 % and a reset of the warning at 90 %. At the value 100 %, the CUE trips and issues an alarm. Status for the counter can be read in the **Main** menu, parameter 16-35 **Inverter Thermal**.

If this function is manually disabled in the **Main** menu, parameter 14-61 **Function at Inverter Overload**, the CUE trips instead.

If the parameter 14-61 **Function at Inverter Overload** is set to **1 - Derate**, the motor speed is reduced when the counter exceeds 98 %, and stays reduced until the counter drops below 90.7 %. If the parameter 14-62 **Inverse Overload Derate Current** is set to, for example 95 %, a steady overload causes the pump speed to fluctuate between values corresponding to 110 % and 95 % of the rated output current for the drive.

High overload for waste water applications

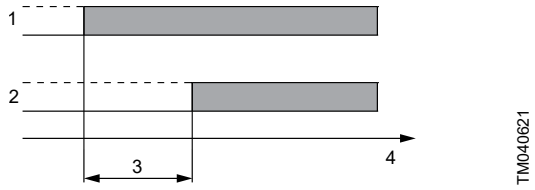
In waste water and other high overload applications, a higher starting torque may be required, therefore, it is recommended for these applications to install an oversize CUE and set the overload mode to **High overload**. This allows the CUE to yield 160 % of its high overload rated current continuously for 60 seconds.

This can be set in the **Main** menu, parameter 1-04 **Overload Mode**.

Start adjustments

Start delay

The start delay after power-on is a delay between power being applied and the pump starting.



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Start delay after power-on

Pos.	Description
1	Power-on
2	Start CUE
3	Start delay
4	Time

The purpose is to allow the remote-control equipment to start up before the pump.

The start delay is deactivated if a remote command is received via communication port.

This can be set in the **Main** menu, parameter 1-71 **Start Delay**.

Flying start

This function makes it possible to catch a motor that is spinning freely due to a mains drop-out. This prevents a high current draw from the CUE by starting on a rotating motor.

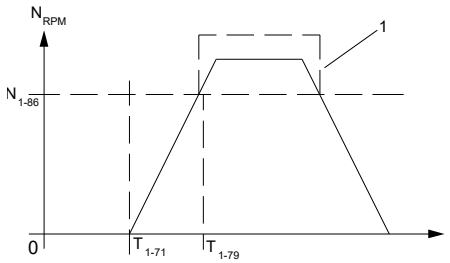
When flying start is enabled, the start delay function is not active.

This can be set in the **Main** menu, parameter 1-73 **Flying Start**.

Blocked pump

Some pumps are sensitive to operating at low speed due to insufficient cooling or lubrication.

If the pump does not reach the speed **Trip speed low (Hz)** within the **Pump Start Max. Time to trip**, the CUE gives an alarm.



TM075474

Advanced minimum speed monitoring

Designation	Description
T_{1-71}	Parameter 1-71 **Start Delay**
T_{1-79}	Parameter 1-79 **Pump Start Max. Time to Trip** (including the time in T_{1-71})
N_{1-86}	Parameter 1-86 **Trip Speed Low [RPM]** If the speed drops below this value during normal operation, the frequency converter drops.
1	Normal operation

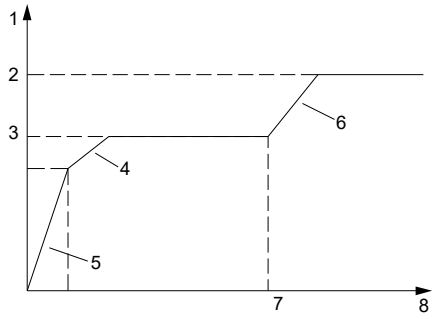
Note that timers for the parameter 1-71 **Start Delay** and the parameter 1-79 **Pump Start Max. Time to Trip** start at the same time when the start command is issued. This entails that if the start delay is more than or equal to the pump start max. time, the CUE never starts.

Pipe fill

This function is used for filling empty pipes with water in a controlled manner. If the function is not activated, pipes are filled at maximum speed. In pressure-controlled systems where pipes are empty at startup, high speed causes water hammer until the speed is reduced to fit the actual demand.

Water hammer can be prevented by introducing a pipe fill sequence before the system is running normal operation. The pipe fill function can limit the speed of the pump when filling pipes, thus reduce water hammer in filled pipes. A time limit or a pressure can be set to deactivate the pipe fill function and turn the CUE into normal operation.

Since pressure in horizontal pipe systems does not climb as the system fills, in such systems, it is necessary to determine a user-specified speed and time to fill the pipes or a user-specified pressure setpoint.

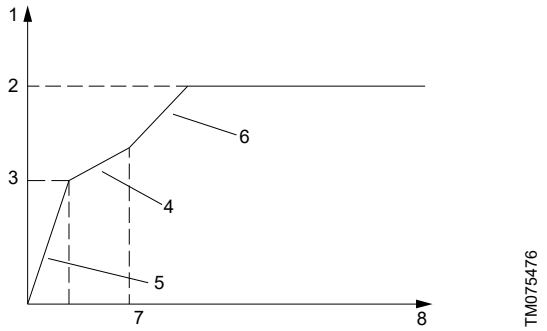


TM075475

Horizontal pipe system

Pos.	Description
1	Speed
2	Maximum speed
3	Minimum speed
4	Normal ramp
5	Initial ramp
6	Closed loop
7	Fill time or filled setpoint
8	Time

In a vertical pipe system it is recommended to use the PID function to ramp the pressure at a user-specified rate between the motor speed low limit and a user-specified pressure.



Vertical pipe system

Pos.	Description
1	Speed
2	Maximum speed
3	Minimum speed
4	Fill rate unit/second
5	Initial ramp
6	Closed loop
7	Filled setpoint
8	Time

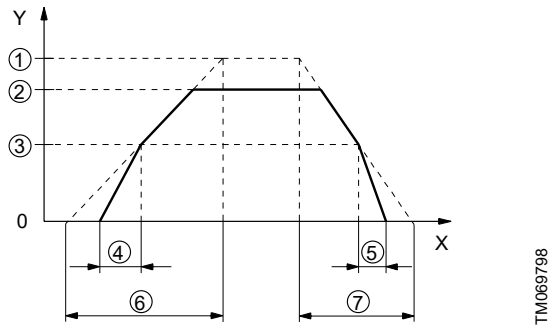
Activation or deactivation is done in the parameter 29-00 **Pipe Fill Enable**.

Operation

Ramps

The CUE startup guide incorporates adjustment of two types of ramp:

- ramp-up and ramp-down
- initial and final ramps.



Ramp-up and ramp-down of the CUE

Pos.	Description
X	Time
Y	Speed
1	Nominal
2	Maximum
3	Minimum
4	Initial ramp
5	Final ramp
6	Ramp-up
7	Ramp-down

The ramp-up and ramp-down are used for protection against overload when starting and stopping the CUE, and the time is defined as acceleration time from 0 rpm to nominal motor speed, and the deceleration time from nominal motor speed to 0 rpm, respectively. The settings are manually set in the parameter 3-41 **Ramp 1 Ramp Up Time** and the parameter 3-42 **Ramp 1 Ramp Down Time** of the operating panel.

The initial and final ramps prevent operation for a longer time than necessary at speeds below the minimum speed.

The setting is done automatically based on the pump family selected in the startup guide.

Operating range

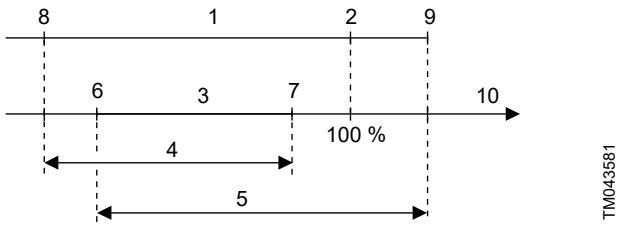
Set the operating range as follows:

1. Set the minimum speed within the range from a pump-dependent minimum speed to the adjusted maximum speed. The factory setting depends on the pump family.
2. Set the maximum speed within the range from the adjusted minimum speed to the pump-dependent maximum speed. The factory setting is equal to 100 %, that is, the speed stated on the pump nameplate.

The area between the minimum and maximum speed is the actual operating range of the pump.

The operating range can be changed by the user within the pump-dependent speed range.

For some pump families, oversynchronous operation (maximum speed above 100 %) is possible. This requires an oversize motor to deliver the shaft power required by the pump during oversynchronous operation.



Setting of the minimum and maximum curves in percentage of the maximum performance

Pos.	Description
1	Pump dependent speed range
2	Nominal speed
3	Actual speed range
4	Minimum speed, adjusted
5	Maximum speed, adjusted
6	Minimum
7	Maximum
8	Minimum speed
9	Maximum speed
10	Speed [%]

The minimum and maximum speed can be manually overwritten in the parameter 4-11 **Motor Speed Low Limit** and the parameter 4-13 **Motor Speed High Limit**, respectively. Note that the maximum speed cannot exceed the maximum output frequency set in the parameter 4-19.

Running outside the pump-dependent minimum and maximum speeds may damage the pumps.

Skip bands

Some systems require that certain output frequencies or speeds are avoided due to resonance problems in the system.

- If the CUE is in **RPM** mode, enter the lower limit of the speeds to be avoided in the parameter 4-60[0] and the upper limit in the parameter 4-62[0].
- If the CUE is in **Hz** mode, enter the lower limit of the speeds to be avoided in the parameter 4-61[0] and the upper limit in the parameter 4-63[0].

A maximum of four frequency or speed ranges can be avoided in rare cases. To add more skip bands, use the index 1, 2 or 3 for the above-mentioned parameters.

Standstill heating

Standstill heating preheats the motor during standstill to avoid condensation within the motor.

When the pump is stopped by a stop command, a current is applied to the motor windings to keep the temperature within the motor above the dew point temperature. No external heater is needed.

The preheating of the motor is especially important when the motor is installed under the following conditions:

- high humidity
- outdoor installation.

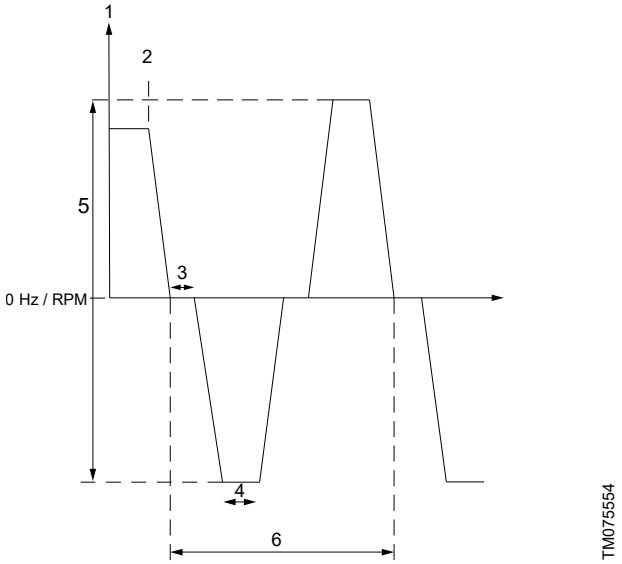
A consequence of condensed moisture within the motor is, for example, corrosion damage to electrical contacts and the bearings of the motor shaft.

This can be activated in the parameter 1-80 **Function at Stop**.

Deragging

The purpose of the deragging feature is to free the pump blade of debris in wastewater applications so that the pump operates normally.

A deragging event is defined as the time when the CUE starts to derag until the deragging finishes. When a deragging is started, the CUE first ramps to a stop and then an off-delay expires before the first cycle begins.



Derag function

Pos.	Description
1	Speed
2	Derag function activated
3	**Derag Off Delay** (parameter 29-15)
4	**Deragging Run Time** (parameter 29-15)
5	+/- **Derag Speed** (parameter 29-13 and 29-14)
6	1 cycle **Number of cycles** (parameter 29-10)

If a derag is triggered while the CUE is at stop, the first off-delay is skipped. The deragging event can be set to a number of cycles. One cycle consists of running in

the reverse direction followed by running in the forward direction. Deragging is considered finished after the specified number of cycles is completed.

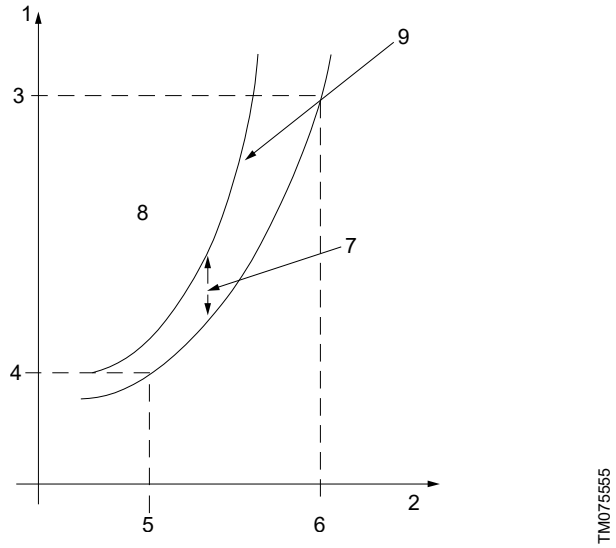
In between rotations, the CUE coasts for an off-delay to let debris in the pump settle.

Do not enable deragging if the pump cannot operate in reverse direction.

Depending on the application, this feature can be used as a preventive or reactive measure and can be triggered by:

- every pump start, parameter 29-11 **Derag at Start/ Stop**
- every pump stop, parameter 29-11 **Derag at Start/ Stop**
- by digital input, parameter group 5-1* **Digital Inputs**
- on high power, parameter group 29-2* **Derag Power Tuning**.

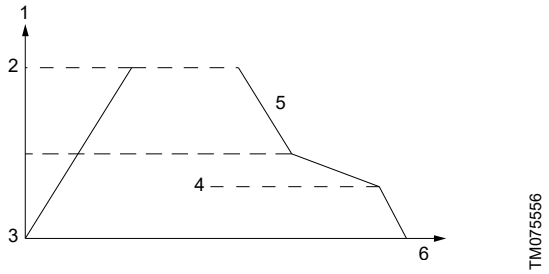
The CUE calculates a derag power curve based on the inputs below, and activates the deragging event if the output power exceeds the expected power.



Derag power tuning

Pos.	Description
1	Power [kW/hp]
2	Speed [Hz/RPM]
3	**High speed power** (parameter 29-30, parameter 29-31)
4	**Low speed power** (parameter 29-26, parameter 29-27)
5	**Low speed** (parameter 29-24, parameter 29-25)
6	**High speed** (parameter 29-28, parameter 29-29)
7	**Derag power factor** (parameter 29-22)
8	Activate derag
9	Calculated power plus the power factor (read-out) (parameter 29-20, parameter 29-21)

Check valve ramps



Check valve ramp

Pos.	Description
1	Speed
2	Motor speed high
3	Motor speed low
4	Check valve end speed
5	Normal ramp
6	Time

To protect ball check valves in a stop situation, the check valve ramp time can be utilised as a temporary slower ramp rate. When the parameter 3-85 **Check Valve Ramp Time** is different from 0 s, the check valve ramp time is effectuated between the motor speed low and the check valve end speed.

Set the check valve end speed where the check valve is expected to be closed and the check valve is no longer active.

Over-voltage control (OVC)

When deceleration is too fast in case of higher inertia, the braking energy can cause an overvoltage in the CUE. This can be overcome by enabling overvoltage control in the **Main** menu parameter 2-17, and the CUE automatically prolongs the deceleration times, that is, normal ramps, final ramps and check valve ramps to stop the CUE without an alarm.

Pump motor protection

Motor temperature

The motor thermal protection can be activated in the **Main** menu, parameter 1-90 **Motor Thermal Protection** and can be implemented using a range of techniques:

- A PTC sensor in the motor windings can be connected to one of the analog or digital inputs, parameter 1-93 **Thermistor Source**.
- The ETR (Electronic Thermal Relay) can be calculated of the thermal load based on the actual load and time. The calculated thermal load is compared with the rated motor current and the rated motor speed. If the parameter 1-91 **Motor External Fan** is set to **Yes**, the motor must have forced cooling and the ETR does not take motor speed into consideration.
- A mechanical thermal switch (Klixon type) can be used, parameter 1-93 **Thermistor Source**.

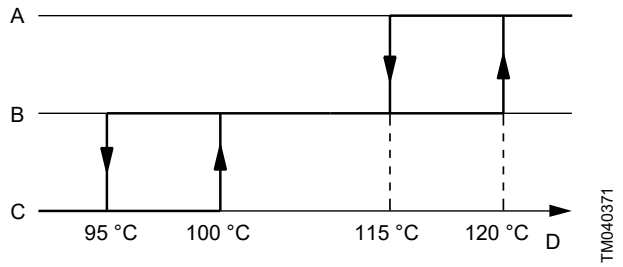
For the North American market: the ETR functions provide class 20 motor overload protection in accordance with the NEC.

Motor bearing monitoring

This function is used for indicating when it is time to relubricate or replace the motor bearings.

The function is based on the running hours of the pump, and shows a notification on the display to lubricate the bearings after 5000 running hours and replace the bearings after 20,000 running hours.

Monitoring of the motor bearing temperature using an MCB 114 sensor input module and Pt100/Pt1000 sensors measuring the bearing temperature can also be used for issuing a warning. An alarm is generated if the bearing temperature gets too high. Warnings and alarms are generated and reset using hysteresis.



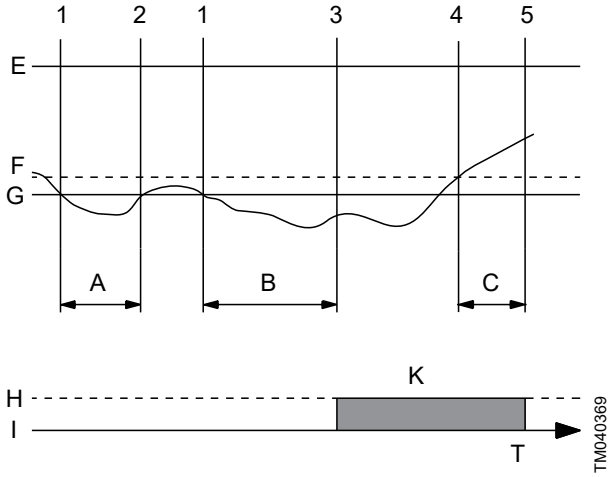
Monitoring of bearing temperature with warning and alarm limits

Pos.	Description
A	Alarm limit
B	Warning limit
C	Normal
D	Temperature

Limit exceed

The CUE has two independent limit-exceed functions.

These are monitoring functions offering information, warning, alarm or change of operating mode when a low or high limit is exceeded.



Example of low limit exceeded

Pos.	Description
E	High limit
F	Hysteresis
G	Low limit
H	On
I	Off
K	Low limit exceeded
T	Temperature

The two limit-exceed functions are set in the **Main** menu, parameter group 201-0x **Limit Exceed**. Parameters are grouped so that **Limit Exceed - 1** is set in index 0 and **Limit Exceed - 2** is set in index 1.

The default setting of this function is **Not active** and is activated in the parameter 201-00. Enabled and Disabled can be set to activate or deactivate the alarm when the limit is exceeded. Enabled with event action and Disabled with event action can be set to activate or deactivate actions, such as Stopping or Minimum speed, after the limit is exceeded.

The function has two timers, a detection delay timer and a reset delay timer, which are adjustable in the parameters 201-06 and 201-07, respectively.

The limits can either be a high or a low limit adjusted in the parameter 201-01, and the actual limit value must be entered in the parameter 201-04.

The detection delay timer starts when a limit is exceeded (1). See the figure above.

- A: If the limit is no longer exceeded (2) when the detection time expires, the timer is reset.
- B: If the limit is still exceeded (3) when the detection time expires, the output of the detector changes to **Limit exceeded**. The reset delay timer starts when the detector output is **Limit exceeded** and the limit is no longer exceeded, and hysteresis (4) applies.

- C: When the delay time has expired (5), the detector output changes to **Limit not exceeded**.

Input possibilities

It is possible to have two limit-exceeded functions in parallel with the following inputs set in the parameter 201-02:

- all analog inputs
- all Pt100/Pt1000 inputs (this requires an MCB 114 sensor input module)
- internal measured values: Power consumption (P2), Motor speed or Motor current.

Output possibilities

There are the following output possibilities:

- signal relay 1 and 2 activated in the parameters 5-40[0] and 5-40[1], respectively
- digital output activated in the parameters 5-30 and 5-31, respectively
- analog output activated in the parameter 6-50.

Event actions

Change of operating mode as event action is set in the parameter 201-03.

- Warning only
- Stop
- Maximum speed
- Minimum speed
- User curve speed.

The default setting of this function is **Not active**.

Digital and Analog I/O

The CUE digital inputs can be configured to either PNP or NPN mode in the **Main** menu, parameter 5-00 **Digital I/O Mode**:

- NPN - Active at 0 V
- PNP - Active at 24 V.

The CUE has six terminals for digital input and output functions:

Terminal No.	Name	Parameter	Default	I/O mode
18	DI 1	5-10	Start	-
19	DI 2	5-11	No operation	-
27	DI/O 1	5-12 for input or 5-30 for output		5-01
29	DI/O 2	5-13 for input or 5-31 for output		5-02
32	DI 3	5-14		-
33	DI 4	5-15		-

Digital input functions

- **Reset**: used for resetting an alarm manually from external signal.
- **Coast**: used for immediately stopping the pump without ramping down. The pump stops free-wheeling.
- **Start**: used for starting the pump manually in **[Auto on]** mode.
- **Reversing**: used for reversing the motor speed. Do not use this function on a pump.
- **Jog**: used for setting the motor speed fixed to **Jog Speed [Hz]** of parameter 3-11.
- **Preset ref bit 0 through 2**: used for setting the pump setpoint fixed to values of parameter 3-10.
- **Freeze output**: used for continuing pump speed at the current speed.
- **Hand/Auto start**: used for selecting hand or auto start. The high signal selects auto-on only, the Low signal selects hand-on only.
- **Hand start**: a signal applied to put the CUE into hand-on mode like pressing **[Hand On]**, and a normal stop command is overridden.
- **Auto start**: a signal applied to put the CUE into auto-on mode like pressing **[Auto On]**, and a normal stop command is overridden.
- **External fault**: If the input is activated for more than 5 seconds, an external fault is indicated.

Note that if the signal is disconnected, the motor stops. To make any other start command valid, assign another digital input to **[54] Auto Start** and apply a signal to this. **[Hand On]** and **[Auto On]** have no impact. **[Off]** overrides local start and auto start. Press either **[Hand On]** or **[Auto On]** to make local start and auto start active again. If there is no signal on either **[53] Hand start** or **[54] Auto start**, the motor stops regardless of any normal start command applied. If a signal is applied to both **[53] Hand start** and **[54] Auto start**, the function is auto start. When pressing **[Off]**, the motor stops regardless of signals on **[53] Hand start** and **[54] Auto start**.

- Min.: changes the operating mode to **Min.**
- Max.: changes the operating mode to **Max.**
- **User curve**: changes the operating mode to **User curve**.

Note that most functions are available with and without inverse. Choose with inverse if you want a specific function to be activated other than the PNP or NPN mode.

Related information

Operating modes

Digital and Relay output functions

- **Control ready**: The control board receives supply voltage.
- **Drive ready**: The CUE is ready for operation and applies a supply signal on the control board.
- **Drive ready/remote control**: The CUE is ready for operation and is in auto-on mode.
- **Standby/no warning**: The CUE is ready for operation. No start or stop command has been given (start/disable). There are no warnings.
- **Running**: The pump is running.
- **Running/no warning**: The pump is running and there are no warnings.
- **Run on reference/no warning**: The motor is running at reference speed.
- **Alarm**: An alarm activates the output.
- **Alarm or warning**: An alarm or a warning activates the output.
- **At torque limit**: The torque limit set in the parameter 4-16 Torque Limit Motor Mode has been exceeded.
- **Torque limit and stop**: It is used in performing a coast stop and in torque limit condition. If the frequency converter receives a stop signal and is at the torque limit, the signal is logic 0.
- **Out of current range**: The motor current is outside the range set in the parameter 4-18 Current Limit.
- **Below current, low**: The motor current is lower than the setting in the parameter 4-50 Warning Current Low.
- **Above current, high**: The motor current is higher than the setting in the parameter 4-51 Warning Current High.
- **Out of speed range**: The output speed is outside the ranges set in the parameter 4-52 Warning Speed Low and the parameter 4-53 Warning Speed High.
- **Below speed, low**: The output speed is lower than the setting in the parameter 4-52 Warning Speed Low.
- **Above speed, high**: The output speed is higher than the setting in the parameter 4-53 Warning Speed High.
- **Out of feedback range**: The feedback is outside the ranges set in the parameter 4-56 Warning Feedback Low and the parameter 4-57 Warning Feedback High.
- **Below feedback low**: The feedback is below the limit set in the parameter 4-56 Warning Feedback Low.
- **Above feedback high**: The feedback is above the limit set in the parameter 4-57 Warning Feedback High.
- **Thermal warning**: The thermal warning turns on when the temperature exceeds the limit in the motor, the CUE or the thermistor.
- **Bus OK**: There is active communication (no timeout) via the serial communication port.
- **Out of ref range**: The reference is outside the ranges set in the parameter 4-54 Warning Reference Low and the parameter 4-55 Warning Reference High.
- **Below reference low**: The reference is below the limit set in the parameter 4-54 Warning Reference Low.
- **Above reference high**: The reference is above the limit set in the parameter 4-55 Warning Reference High.
- **Comparator 0 through 5**: The signal outputs correspond to the logic output of the [Main] menu parameter group 13-1x Comparators.
- **Logic Rule 0 through 5**: The signal outputs correspond to the logic output of the [Main] menu parameter group 13-4x Logic Rules.
- **Running reverse**: The CUE is running counterclockwise.
- **Start command active**: The CUE has received an active start command, for example auto on, and a start command via digital input or bus is active or [Hand On]. It is not necessarily running.
- **Drive in hand mode**: The CUE is in hand-on mode (as indicated by the indicator light above [Hand on]).
- **Drive in auto mode**: The CUE is in auto-on mode (as indicated by the indicator light above [Auto on]).
- **Preventive Maintenance**: One or more of the preventive maintenance events have passed the time for the specified action.
- **Deragging**: The deragging procedure is active.
- **AHF Capacitor Connect**: The automatic control of the AHF capacitor connect at low loads under 20 %.
- **External Fan Control**: The external fan control is active.
- **No-Flow**: A no-flow situation or minimum speed situation has been detected.
- **Dry Pump**: A dry pump condition has been detected.
- **End of Curve**: An end of curve condition has been detected.
- **Sleep Mode**: The CUE has entered sleep mode.
- **Pipe Filling**: It is active when the pipe fill function is operating.

Analog outputs

The analog output (0/4-20 mA) can be set in the **Main** menu, parameter 6-50 to one of the following indications:

- feedback value
- speed
- frequency
- motor current

- external setpoint input
- limit exceeded.

The analog output is set to not active by default.

- **Feedback value**: The output signal is a function of the actual feedback value.
- **Speed**: The output signal is a function of the actual pump speed.
- **Frequency**: The output signal is a function of the actual frequency.
- **Motor current**: The output signal is a function of the actual motor current.
- **External setpoint input**: The output signal is a function of the external setpoint input.
- **Limit exceeded**: The output signal is on/off when the limit is exceeded: Off = 0/4 mA and On = 20 mA.

MCB 114 sensor input module

The MCB 114 sensor input module offers three additional analog inputs for the CUE:

- one analog 0/4-20 mA input for an additional sensor
- two analog Pt100/Pt1000 inputs for temperature sensors.

Sensor 2

The analog 0/4-20 mA input is used for the following functions:

- It monitors the measured value of the sensor 2 (default setting).
- The measured value of the sensor 2 is used for control purpose. This makes differential pressure control possible by using measurements from the sensor 1 and sensor 2 (setting by PC Tool).

Temperature sensors 1 and 2

The analog Pt100/Pt1000 inputs are used for monitoring the following temperatures:

- drive-end motor bearing
- non-drive-end motor bearing
- other liquid 1
- other liquid 2
- motor windings
- pumped liquid
- ambient temperature.

Displays

MCB 114 input	Displays	
	Reading	Setting
Sensor 2	2.5	3.16
Temperature sensor 1	2.12	3.21
Temperature sensor 2	2.13	3.22

7. Installation

Mechanical installation

The CUE is available in five enclosure classes: IP20, IP21, IP54, IP55 and IP66.

The general installation requirements necessitate special considerations as to the following aspects:

- It must be accessible, but only in a cabinet. Enclosure class IP20/21 must not be installed freely.
- Enclosure class IP54/55 must be installed freely accessible, but must not be installed outdoors without additional protection against water and sun.
- The CUE contains a large number of mechanical and electronic components and must therefore not be installed in an environment where the air contains vapor, particles or gasses that may affect and damage the electronic components.

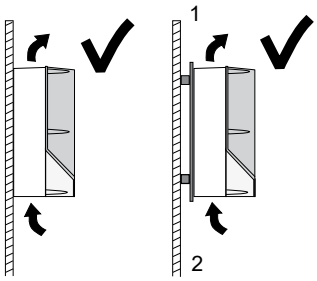
Related information

Selection tables

Space and air circulation

CUEs can be mounted side by side, but as sufficient air circulation is required for cooling, the following requirements must be met:

- Ensure sufficient free space above and below the CUE cabinet.
- Hang the CUE cabinet directly on the wall or fit it with a back plate to secure sufficient air flow for cooling.



CUE hung directly on the wall or fitted with a back plate

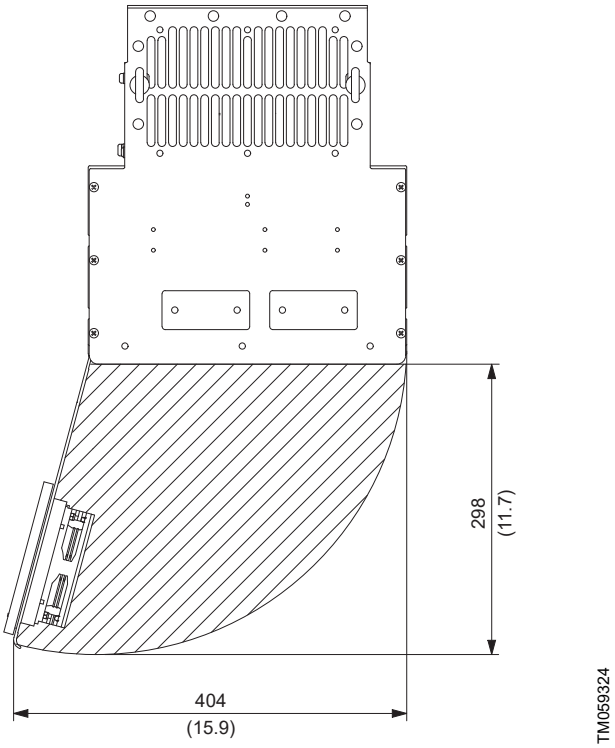
Pos.	Description
1	Outlet temperature
2	Inlet temperature

Required free space above and below the CUE cabinet

Enclosure type	Free space	
	[mm]	[inch]
A2, A3, A4, A5	100	4
B1, B2, B3, B4, C1, C3	200	8
C2, C4, D1h, D2h, D5h, D7h, E1h, E2h	225	9

Required free space in front of CUE

Furthermore, there must be sufficient space in front of the CUE for opening the CUE door.



Free space in front of the CUE enclosures D1h and D2h

Ventilation of a built-in CUE

The CUE can be mounted in a control cabinet if sufficient air circulation is ensured. The quantity of air flow required for cooling the CUE can be calculated in [m^3/h (gpm)] as follows:

$$q_v = \frac{\Sigma p \ x \ 3.1}{\Delta T}$$

Insert ΣP in Watt and ΔT in K.

ΣP is the power loss of all equipment integrated in the same cabinet. Calculate the power loss P for the CUE by the typical shaft power P2 multiplied by the efficiency.

ΔT is the difference between the outlet temperature and the inlet temperature (ambient) of the cooling air.

The inlet and outlet temperatures must not be higher than the values in the table below.

Power P2 [kW] ([hp])	Max. inlet temperature [°C] ([°F])	Max. outlet temperature [°C] ([°F])
0.55 - 90 (0.75 - 125)	50 (122)	55 (131)
110 - 560 (150 - 750)	45 (113)	50 (122)

The average inlet temperature over 24 hours must be 5 °C (41 °F) lower than the maximum inlet temperature.

The outlet from the ventilation must be placed above the highest-mounted CUE. Allowance must be considered for the pressure loss across the inlet filters of the cabinet and for the fact that the pressure drops as the filters get choked.

Example

Calculate the required air flow for cooling of a built-in CUE when the ambient temperature is 27 °C (80 °F). The CUE has a typical shaft power of 11.0 kW (15 hp) and an efficiency of 0.98.

Calculate the power loss of the CUE as follows:

$P = P2 \times efficiency = 11.0 \times (1 - 0.98) \times 1000 = 220 W$

Calculate the required air flow for cooling CUE as follows:

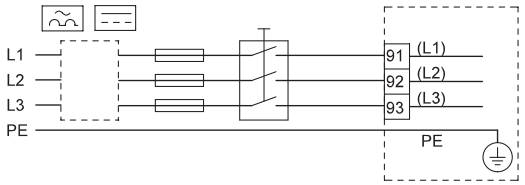
$q_v = (P \times 3.1)/\Delta T = (220 \times 3.1)/(328 - 300) = 5 m3/h$

Related information

Space and air circulation

Electrical installation

Always observe national and local regulations regarding cable cross-section, short-circuit protection and overcurrent when installing the CUE.



Example of three-phase mains connection of the CUE with mains disconnect, backup fuses and additional protection

Electrical protection

Protection against electric shock, indirect contact

Protective conductors must always have a yellow and green (PE) or yellow and green and blue (PEN) colour marking.

Instructions according to the EN IEC 61800-5-1:

- The CUE must be stationary, installed permanently and connected permanently to the mains supply.
- The earth connection must be carried out with duplicate protective conductors or with a single reinforced protective conductor with a cross-section of minimum 10 mm^2.

Protection against short circuit, fuses

The CUE and the supply system must be protected against short circuit.

Grundfos demands that the fuses mentioned in the section about fuses are used for protection against short circuit of the CUE.

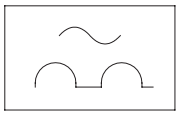
Protection against short circuit on the motor output

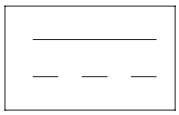
The CUE offers complete short-circuit protection in case of a short circuit on the motor output.

Additional protection

The leakage current to earth exceeds 3.5 mA.

If the CUE is connected to an electrical installation where an earth leakage circuit breaker/residual-current device (ELCB/RCD) is used as additional protection, the ELCB/RCD must be a Type B, marked with the following symbols:





The total leakage current of all the electrical equipment in the installation must be taken into account.

During start and in asymmetrical supply systems, the leakage current can be higher than normal and may cause the ELCB/RCD to trip.

Motor protection

The motor requires no external motor protection. The CUE protects the motor against thermal overloading and blocking.

Protection against overcurrent

The CUE has an internal overcurrent protection for overload protection on the motor output.

Protection against mains voltage transients

The CUE is protected against mains voltage transients according to the EN 61800-3, second environment.

Related information

Inputs and outputs

Total harmonic distortion

A frequency converter takes up a non-sinusoidal current from the mains. A non-sinusoidal current results in increased heat losses in cables and transformers. The total harmonic distortion (THD) is defined as the sum of the higher-order current components compared to the fundamental current components (50 or 60 Hz).

The CUE is equipped with intermediate coils to reduce the total harmonic distortion. The use of coils has a considerable effect on the THD. In addition, the installation site conditions also contribute as influencing factors on the THD.

The typical THD value for the CUE is in the range of 40 to 50 %. The following standards cover the THD:

- IEC EN 61000-3-2, Class A, for three-phase balanced equipment (for professional equipment only up to 1 kW (1.5 hp) total power)
- IEC EN 61000-3-12, Equipment 16 A - 75 A, and professional equipment as from 1 kW (1.5 hp) up to 16 A per phase current.

The CUE complies with the following standards:

- **0 - 0.75 kW / 1 - 1 hp**: 3 × 200 V and 3×380-500 V complying with the IEC EN 61000-3-2.
- **1.1 - 18 kW / 1.5 - 25 hp**: 3 × 200-240 V complying with the IEC/EN 61000-3-12.
- **1.1 - 90 kW / 1.5 - 125 hp**: 3 × 380-500 V complying with the IEC/EN 61000-3-12.
- **110-560 kW / 150 - 750 hp**: 3 × 380-500 V complying with the IEC/EN 61000-3-12.
  The standard originally covers only up to 75 A output current.

Other voltages and power ranges are not covered by standards.

RFI filters

To meet the EMC requirements in the EN 61800-3, the CUE comes with the following types of built-in radio frequency interference filters (RFI):

Supply voltage [V]	Power P2		RFI filter type
	[kW]	[hp]	
1 × 200-240 [9]	1.1 - 7.5	1.5 - 10	C2
3 × 200-240	0.75 - 45	1 - 60	C1
3 × 380-500	0.55 - 90	0.75 - 125	C1
	110 - 560	150 - 750	C3
3 × 525-600	75 - 90	100 - 125	C3
3 × 525-690	11 - 315	15 - 450	C3

9) Single-phase input with three-phase output

The RFI filter types are according to the EN 61800-3.

The C1 is a high-performance filter. The C3 RFI filter types are typically for standard frequency converters.

Description of RFI filter types

C1: for use in domestic areas.

C3: for use in industrial areas with own low-voltage transformer.

Equipment of category C3

- This type of power drive system (PDS) is not intended to be used on a low-voltage public network that supplies domestic premises.
- Radio frequency interference is to be expected if used on such a network.

Output filters

Output filters are used for reducing the voltage stress on the motor windings and the stress on the motor insulation system, as well as for decreasing acoustic noise from the frequency-converter-driven motor.

Grundfos offers two types of output filters as accessories for the CUE:

- sine-wave filters
- dU/dt filters.

The enclosure class of the filter is IP00 and IP20/NEMA1 for the wall-mounted units, IP23 for the floor-mounted units. IP21/NEMA 1 is available for wall-mounted units using separate kits.

Sine-wave filters

Sine-wave filters have a higher degree of filtering, resulting in higher reduction of motor insulation stress and elimination of switching acoustic noise from the motor.

Motor losses are reduced because the motor is fed with a sine-wave voltage. Moreover, the filter eliminates the pulse reflections in the motor cable and thus reduces the losses in the motor.

dU/dt filters

The dU/dt filters reduce the voltage peaks and the dU/dt of the pulses at the motor terminals. The voltage at the motor terminals is still pulse-shaped, the motor current has a sine-wave shape without commutation spikes.

Recommended use of output filters

The table below explains in which cases an output filter is required.

The output filter is recommended for motor cable lengths over 100 m (328 ft). The maximum motor cable length with an output filter is 300 m (1000 ft).

In terms of HF noise emissions from the motor cable, motor insulation stress, motor bearing stress and acoustic switching noise from the motor, the sine-wave filter has a better protection effect than the dU/dt filter. Grundfos recommends the sine-wave filter.

Pump type	Sine-wave filter
SP, BM, BMB with motor voltage from 380 V and higher	0-300 m (0-1000 ft)
Pumps with MG71 and MG80 up to 1.5 kW (2 hp)	0-300 m (0-1000 ft)
Reduction of dU/dt, Upeak and reduced noise emission	0-300 m (0-1000 ft)
Motors operated at 460 V or higher with a motor peak voltage rating less than 1800 V	0-300 m (0-1000 ft)

The lengths stated apply to the screened motor cable.

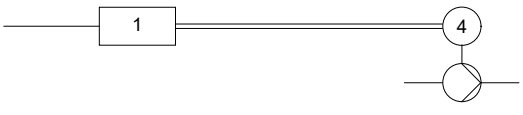
Motor size 225 and larger

Grundfos recommends using insulated bearings in motor size 225 and larger.

125 hp and larger WEG motors used on CR pumps must be upgraded with insulated bearings if no sine-wave filter is being used.

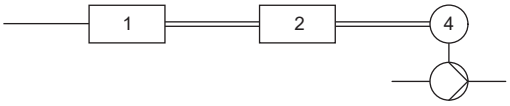
Motor cable

The motor cable must always be a screened cable to comply with the EN 61800-3, no matter if an output filter is installed or not. The mains cable needs not be a screened cable.



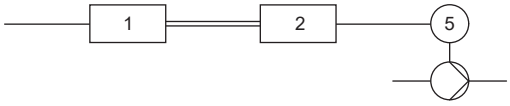
TM044289

Example of installation without filter



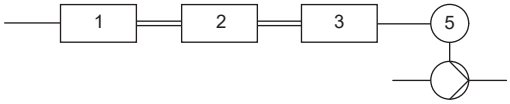
TM044290

Example of installation with filter (the cable between the CUE and filter must be short)



TM044291

Submersible pump without connection box (frequency converter and filter installed close to the well)



TM044292

Submersible pump with connection box and screened cable (frequency converter and filter installed far away from the well)

Symbol	Designation
1	CUE
2	Filter
3	Connection box
4	Standard motor
5	Submersible motor
One line	Unscreened cable
Double line	Screened cable

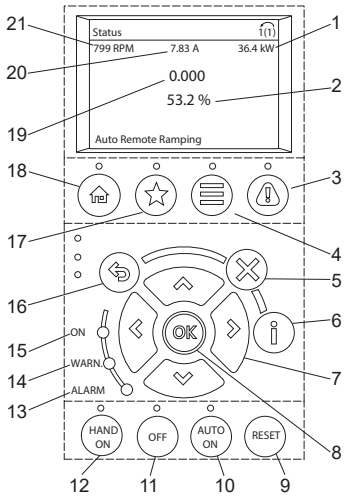
8. Operation/display

The CUE offers a wide range of data readouts representing the operating conditions of the CUE itself, the motor, the pump, and the system. All these data readouts are available by entering the **Main** menu, parameter group 16-xx **Data Readouts**:

- 16-1x **General Status**
- 16-2x **Motor Status**
- 16-3x **Drive Status**
- 16-5x **Setpoint and Feedback**
- 16-6x **Inputs and Outputs**
- 16-8x **Fieldbus and GENI port**
- 19-9x **Diagnostics readouts**.

The CUE **Status** screen shows up to 5 pieces of operational information. These can be adjusted in the **Main** menu parameters 0-2x.

Pos.	Parameter	Default
21	0-20 Display line 1.1 Small	External setpoint
20	0-20 Display line 1.2 Small	Actual setpoint
1	0-20 Display line 1.3 Small	Speed [RPM]
19	0-23 Display Line 2 Large	Operating mode
2	0-23 Display Line 3 Large	Control mode



TM074597

Operating panel

Pos.	Buttons	Description
1		Power [kW]
2		Reference [%]
3		[Alarm log]: a list of current warnings, the last 10 alarms and the maintenance log.
4		[Main menu]: access to all programming settings.
5		[Cancel]: cancelling the last change or command as long as the display mode has not changed.
6		[Info]: definition of the function being displayed.
7		[Up]/[Down]/[Left]/[Right]: navigation between items in the menu.
8	OK	**OK**: access to parameter groups or accepting a selection.
9	RESET	**RESET**: resetting the frequency converter manually after a fault is cleared.
10	AUTO ON	**AUTO ON**: putting the system in remote operating mode. • It responds to an external start command by control terminals or serial communication.
11	OFF	**OFF**: stopping the motor without removing power to the frequency converter.
12	HAND ON	**HAND ON**: starting the frequency converter in local control. • An external stop signal by control input or serial communication overrides the local **HAND ON** function.
13	**ALARM** Red	A fault condition causes the red alarm light to flash, and an alarm text is displayed.
14	**WARN.** Yellow	When warning conditions are met, the yellow warning light comes on and text appears in the display area identifying the problem.
15	**ON** Green	The **ON** light activates when the frequency converter receives power from the mains voltage, a DC bus terminal or an external 24 V supply.
16		[Back]: reverting to the previous step or list in the menu structure.
17		[Favourites]: access to programming parameters for initial setup instructions and many detailed application instructions.
18		[Status]: operating information.
19		Frequency
20		Motor current
21		Speed, RPM

Password protection

Password numbers can be used for protecting the **Main** and **Favourites** menus as well as operating keys **Hand on**, **Off**, **Auto On** and **Reset**.

Restricted access is set for the **Main** menu in the parameter 0-61 and for **Favourites** menu in the parameter 0-66. Select **Full access - 0** to disable the password defined in parameters 0-60 and 0-65, respectively. Select **Read only - 1** to prevent unauthorized editing of the parameters. Select **No access - 2** to prevent unauthorized viewing and editing of the parameters.

Restricted use of operating keys **Hand on**, **Off**, **Auto On** and **Reset** is set in the parameter group 0-4x. Select **Disabled - 0** to avoid accidental use of the key. Select **Password - 2** to avoid unauthorized use of the key.

9. Auto/manual restart after alarm

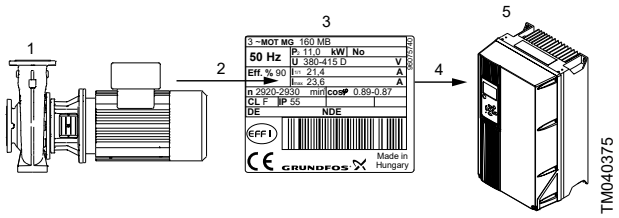
In case of an alarm, the CUE stops the pump. Pump operation resumes when the cause of the alarm is remedied and the alarm is reset automatically or manually.

The CUE can be configured to activate and deactivate automatic restart in the **Main** menu, parameter 14-20, and in case of automatic reset the delay between reset attempts is adjustable in the **Main** menu parameter 14-21.

10. CUE selection

The rating of the CUE is determined quickly and precisely based on the maximum motor current.

The power size, which is the typical shaft power P2, is only an approximate value and cannot be used for selecting the nominal size of the CUE.



Selection of the CUE based on the maximum motor current

Pos.	Description
1	Pump
2	Maximum motor current
3	Motor nameplate
4	Maximum output current
5	CUE

Selecting a CUE

When you have selected the pump, follow the following steps to select a CUE:

1. Select the voltage range of the CUE. It must fit the motor voltage and the mains supply at the installation site.
2.
   a. For IEC motor applications outside of North America, find the maximum motor current on the motor nameplate or in the data sheet of the selected motor. Select the first CUE that is able to deliver the maximum motor current.
   b. For NEMA motor applications inside of North America, use the full load/rated motor current stated on the motor nameplate or in the data sheet of the selected motor. Select the first CUE that is able to deliver the full load motor current.
3. Confirm that the output power rating (kW/hp) as a minimum corresponds to the value stated on the motor nameplate.
4. Select the enclosure class. Choose IP20/21 for panel mounting and IP54/55 for wall mounting.
   Select standard gland holes for CUEs used outside the USA and Canada.
   Select imperial gland holes for CUEs used in the USA and Canada.
5. Check if an output filter is required. Select the output filter according to the table in the section about output filters.
6. Select the accessories required for the application. It could be sensors or additional input modules.
   Selecting the different accessories may require additional steps.
   The actual motor current must always be less or equal to the motor current selected in the CUE operating panel.
   If not, the CUE reduces the maximum speed when the maximum limit is reached during operation.
7. If the CUE is mounted on railings or uneven surface, or it stands free, a backplate is necessary.

Example:

When selecting the appropriate CUE in GPC, the product description helps you to quickly understand the attributes of each product.

CUE3×380-500V IP55 45KW STO DC

Designation	Description
CUE	Product name
3×380-500V	AC line voltage
IP55	Enclosure class
45KW	Power size
STO	CUE comes with an STO function
DC	CUE comes with a mains disconnect function

Related information

Output filters
10. CUE selection
Selection tables

Special conditions

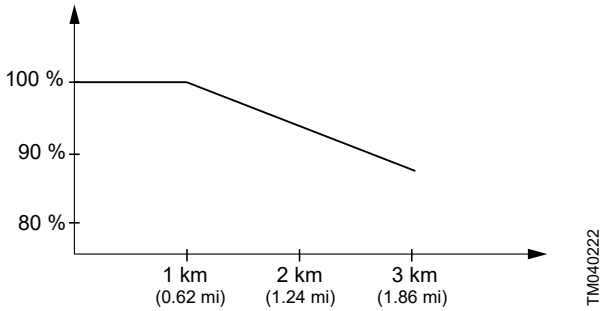
As derating must be taken into account, Grundfos recommends an oversize CUE if the following conditions apply:

- low air pressure (altitude)
- installations with long motor cables
- cables with a large cross-section
- high ambient temperature.

Low air pressure

At low air pressure, the cooling capability of air is reduced.

At altitudes above 1000 m (3280 ft), the maximum output current must be derated in accordance with the diagram below.



Derating of output current at low air pressure

At altitudes above 2000 m (6561 ft), the PELV (Protective Extra Low Voltage) requirements cannot be met.

An alternative is to lower the ambient temperature at high altitudes and thereby ensure 100 % output current.

Example

At an altitude of 2000 m (6561 ft), the output current 24.0 A of the selected CUE in example 1 must be derated to 92 % according to the diagram above. This equals 22.1 A, and is lower than the maximum motor current 23.6 A. The selection is not valid.

Data of the newly selected CUE:

Max. output current	32.0 A
Typical shaft power	15.0 kW (20 hp)
Product number (IP20)	96754695

Calculation of the derated current at an altitude of 2000 m (6561 ft):

$$Maximum\ \ output\ \ current = 32.0 \times 0.92 = 29.4A$$

This is higher than the maximum motor current 23.6 A, so the new selection is valid.

High ambient temperature

If the output current is reduced to 80 % of the rated output current of the CUE in question, the ambient temperature may be 5 °C (9 °F) higher.

The other possibility is to use a unit one size bigger. For higher temperature increases, bigger units are required. The efficiency of the CUE is, however, reduced at higher temperatures.

If the CUE gets too hot, it reduces the switching frequency.

Note that the nominal temperature rating depends on the enclosure type.

Related information

Surroundings

Selection tables

Mains supply 1 x 200-240 V (output 3 x 200-240 V)

Typical shaft power P2		Maximum output current [A]	Maximum input current [A]	Enclosure class				Maximum conductor cross-section		Efficiency
[kW]	[hp]	3 x 200-240 V	1 x 200-240 V	IP20	IP21	IP54	IP55	[mm^2]	AWG	
1.1	1.5	6.6	12.5	A3	-	-	A5	4	10	0.96
1.5	2	7.5	15	-	B1	-	B1	10	7	0.96
2.2	3	10.6	20.5	-		-		10	7	0.96
3	4	12.5	24	-		-		10	7	0.96
3.7	5	16.7	32	-		-		10	7	0.96
5.5	7.5	24.2	46	-	B1	-	B1	10	7	0.98
7.5	10	30.8	59	-	B2	-	B2	35	2	0.98

CUEs with single-phase input always have three-phase output.

Part numbers for IP rating and recommended output filters

Typical shaft power P2		CUE			Output filter IP20	
[kW]	[hp]	IP20/21	IP55	IP55 (US)	dU/dt	Sine-wave
1.1	1.5	99616601	99616618	99616625	-	96754973
1.5	2	99616602	99616619	99616626	-	96754973
2.2	3	99616613	99616620	99616627	-	96754976
3	4	99616614	99616621	99616628	-	96754976
3.7	5	99616615	99616622	99616629	-	96754976
5.5	7.5	99616616	99616623	99616630	-	96754977
7.5	10	99616617	99616624	99616631	-	96754978

Mains supply 3 x 200-240 V

Typical shaft power P2		Maximum output current [A]	Maximum input current [A]	Enclosure class				Maximum conductor cross-section		Efficiency
[kW]	[hp]	3 x 200-240 V	3 x 200-240 V	IP20	IP21	IP54	IP55	[mm^2]	AWG	
0.75	1	4.6	4.1	A2	-	-	A4	4	10	0.95
1.1	1.5	6.6	5.9		-	-		4	10	0.96
1.5	2	7.5	6.8		-	-		4	10	0.96
2.2	3	10.6	9.5		-	-		4	10	0.96
3	4	12.5	11.3	A3	-	-	A5	4	10	0.96
3.7	5	16.7	15		-	-		4	10	0.96
5.5	7.5	24.2	22	B3	-	-	B1	10	7	0.96
7.5	10	30.8	28		-	-		10	7	0.96
11	15	46.2	42		-	-		10	7	0.96
15	20	59.4	54	B4	-	-	B2	35	2	0.96
18.5	25	74.8	68		-	-	C1	50	1/0	0.96
22	30	88	80	C3	-	-		50	1/0	0.97
30	40	115	104		-	-		50	1/0	0.97
37	50	143	130	C4	-	-	C2	95	4/0	0.97
45	60	170	154		-	-		120	250 MCM	0.97

Part numbers for IP rating and recommended output filters

Typical shaft power P2		CUE					Output filter IP20	
[kW]	[hp]	IP20	IP20 with STO	IP55	IP55 with STO/DC	IP55 (US)	dU/dt	Sine-wave
0.75	1	99616636	99616651	99616666	99616681	99660285	-	96754973
1.1	1.5	99616637	99616652	99616667	99616682	99660287	-	96754973
1.5	2	99616638	99616653	99616668	99616683	99660289	-	96754973
2.2	3	99616639	99616654	99616669	99616684	99660290	-	96754976
3	4	99616640	99616655	99616670	99616685	99616696	-	96754976
3.7	5	99616641	99616656	99616671	99616686	99616697	-	96754976
5.5	7.5	99616642	99616657	99616672	99616687	99616698	97669799	96754977
7.5	10	99616643	99616658	99616673	99616688	99616699	97669799	96754978
11	15	99616644	99616659	99616674	99616689	99616700	97669869	96755019
15	20	99616645	99616660	99616675	99616690	99616701	97669869	96755021
18.5	25	99616646	99616661	99616676	99616691	99616702	97669869	96755032
22	30	99616647	99616662	99616677	99616692	99616703	97669869	97774436
30	40	99616648	99616663	99616678	99616693	99616704	97669902	97774436
37	50	99616649	99616664	99616679	99616694	99616705	97669902	97775142
45	60	99616650	99616665	99616680	99616695	99616706	97669902	97775142

Mains supply 3 x 380-500 V

For higher overload protection, select a CUE with a higher kW size.

Typical shaft power P2		Maximum output current [A]		Maximum input current [A]		Enclosure class				Maximum conductor cross-section		Efficiency
[kW]	[hp]	3 x 380-440 V	3 x 441-500 V	3 x 380-440 V	3 x 441-500 V	IP20	IP21	IP54	IP55	[mm^2]	AWG	
0.55	0.75	1.8	1.6	1.6	1.4	A2	-	-	A4	4	10	0.95
0.75	1	2.4	2.1	2.2	1.9		-	-		4	10	0.96
1.1	1.5	3	2.7	2.7	2.7		-	-		4	10	0.96
1.5	2	4.1	3.4	3.7	3.1		-	-		4	10	0.97
2.2	3	5.6	4.8	5	4.3		-	-		4	10	0.97
3	4	7.2	6.3	6.5	5.7		-	-		4	10	0.97
4	5	10	8.2	9	7.4		-	-		4	10	0.97
5.5	7.5	13	11	11.7	9.9	A3	-	-	A5	4	10	0.97
7.5	10	16	14.5	14.4	13		-	-		4	10	0.97
11	15	24	21	22	19	B3	-	-	B1	10	7	0.98
15	20	32	27	29	25		-	-		10	7	0.98
18.5	25	37.5	34	34	31		-	-		10	7	0.98
22	30	44	40	40	36	B4	-	-	B2	35	2	0.98
30	40	61	52	55	47		-	-		35	2	0.98
37	50	73	65	66	59		-	-	C1	50	1/0	0.98
45	60	90	80	82	73	C3	-	-		50	1/0	0.98
55	75	106	105	96	95		-	-		50	1/0	0.98
75	100	147	130	133	118	C4	-	-	C2	95	4/0	0.98
90	125	177	160	161	145		-	-		120	250 MCM	0.99
110	150	212	190	204	183	-	D1h	D1h	-	2 x 70	2 x 2/0	0.98
132	200	260	240	251	231	-			-	2 x 70	2 x 2/0	0.98
160	250	315	302	304	291	-			-	2 x 185	2 x 350 MCM	0.98
200	300	395	361	381	348	-	D2h	D2h	-	2 x 185	2 x 350 MCM	0.98
250	350	480	443	463	427	-			-	2 x 185	2 x 350 MCM	0.98
315	450	588	535	567	516	-			-	2 x 185	2 x 350 MCM	0.98
355	500	658	590	634	569	-	E1h	E1h	-	2 x 185	2 x 350 MCM	0.98
400	600	745	678	718	653	-			-	2 x 186	2 x 350 MCM	0.98
450	600	800	730	771	704	-			-	2 x 187	2 x 350 MCM	0.98
500	650	880	780	848	752	-	E2h	E2h	-	2 x 185	2 x 350 MCM	0.98
560	750	990	890	954	858	-			-	2 x 185	2 x 350 MCM	0.98

Part numbers for IP rating and recommended output filters

Typical shaft power P2		CUE					Output filter IP20	
[kW]	[hp]	IP20/IP21	IP20/IP21 with STO	IP54/IP55	IP54/IP55 with STO/DC	IP54/IP55 (US)	dU/dt	Sine-wave
0.55	0.75	99616707	99616731	99616756	99616781	99660291	-	96754941
0.75	1	99616708	99616733	99616757	99616782	99660292	-	96754941
1.1	1.5	99616709	99616734	99616758	99616783	99660293	-	96754972
1.5	2	99616710	99616735	99616759	99616784	99660294	-	96754972
2.2	3	99616711	99616736	99616760	99616785	99660295	-	96754973
3	4	99616712	99616737	99616761	99616786	99660296	-	96754973
4	5	99616713	99616738	99616762	99616787	99660297	-	96754974
5.5	7.5	99616714	99616739	99616763	99616788	99616805	-	96754976
7.5	10	99616715	99616740	99616764	99616789	99616806	-	96754976
11	15	99616716	99616741	99616765	99616790	99616807	97669799	96754977
15	20	99616717	99616742	99616766	99616791	99616808	97669799	96754978
18.5	25	99616718	99616743	99616767	99616792	99616809	97669799	96754978
22	30	99616719	99616744	99616769	99616793	99616810	97669799	96755019
30	40	99616720	99616745	99616770	99616794	99616811	97669869	96755021
37	50	99616721	99616746	99616771	99616795	99616812	97669869	96755032
45	60	99616722	99616747	99616772	99616796	99616813	97669869	97774436
55	75	99616723	99616748	99616773	99616797	99616814	97669896	97774436
75	100	99616724	99616749	99616774	99616798	99616815	97669902	97775142
90	125	99616725	99616750	99616775	99616799	99616816	97669902	97775142
110	150	99616726	99616751	99616776	99616800	99616817	97669905	97775146
132	200	99616727	99616752	99616777	99616801	99616818	97669905	97775146
160	250	99616728	99616753	99616778	99616802	99616819	97669905	97775148
200	300	99616729	99616754	99616779	99616803	99616820	97669906	97775148
250	350	99616730	99616755	99616780	99616804	99616821	97669906	97775149
315	450	99929257	99929258	99929260	99929261	99929262	97689248	93303174
355	500	93021201	93021206	93021211	93021216	-	97689248	93303174
400	600	93021202	93021207	93021212	93021217	-	93303173	93303175
450	600	93021203	93021208	93021213	93021218	-	93303173	2x97775149
500	650	93021204	93021209	93021214	93021219	-	93303173	2x97775149
560	750	93021205	93021210	93021215	93021220	-	93303173	2x93303174

Mains supply 3 x 525-600 V

Typical shaft power P2		Maximum output current [A]		Maximum input current [A]	Enclosure class				Maximum conductor cross-section		Efficiency
[kW]	[hp]	3 x 525-550 V	3 x 550-600 V	3 x 525-600 V	IP20	IP21	IP54	IP55	[mm^2]	AWG	
0.75	1	1.8	1.7	1.7	A3	-	-	A5	4	10	0.97
1.1	1.5	2.6	2.4	2.4		-	-		4	10	0.97
1.5	2	2.9	2.7	2.7		-	-		4	10	0.97
2.2	3	4.1	3.9	4.1		-	-		4	10	0.97
3	4	5.2	4.9	5.2		-	-		4	10	0.97
4	5	6.4	6.1	5.8		-	-		4	10	0.97
5.5	7.5	9.5	9	8.6		-	-		4	10	0.97
7.5	10	11.5	11	10.4		-	-		4	10	0.97
11	15	19	18	17.2	B3	-	-	B1	10	1/0	0.97
15	20	23	22	20.9		-	-		10	1/0	0.97
18.5	25	28	27	25.4		-	-		10	1/0	0.97
22	30	36	34	32.7	B4	-	-	B2	35	1/0	0.97
30	40	43	41	39		-	-		35	1/0	0.97
37	50	54	52	49		-	-	C1	35	1/0	0.97
45	60	65	62	59	C3	-	-		50	1/0	0.97

Typical shaft power P2		Maximum output current [A]		Maximum input current [A]	Enclosure class				Maximum conductor cross-section		Efficiency
[kW]	[hp]	3 x 525-550 V	3 x 550-600 V	3 x 525-600 V	IP20	IP21	IP54	IP55	[mm²]	AWG	
55	75	87	83	79	C4	-	-	C2	50	1/0	0.97
75	100	105	100	95		-	-		150	1/0	0.97
90	125	137	131	124		-	-		150	1/0	0.97

Part numbers for IP rating and recommended output filters

Typical shaft power P2		CUE		Output filter IP20
[kW]	[hp]	IP20	IP55 (US)	Sine-wave
0.75	1	99616827	99616845	97775161
1.1	1.5	99616828	99616846	97775161
1.5	2	99616829	99616847	97775161
2.2	3	99616830	99616848	97775161
3	4	99616831	99616849	97775161
4	5	99616832	99616850	97775161
5.5	7.5	99616833	99616851	97775161
7.5	10	99616834	99616852	97775161
11	15	99616835	99616853	97775162
15	20	99616836	99616854	97775162
18.5	25	99616837	99616855	97775162
22	30	99616838	99616856	97775163
30	40	99616839	99616857	97775163
37	50	99616840	99616858	97775164
45	60	99616841	99616859	97775164
55	75	99616842	99616860	97775165
75	100	99616843	99616861	97775165
90	125	99616844	99616862	97775166

Mains supply 3 x 525-690 V

UL approval up to 600 VAC mains

Typical shaft power P2		Maximum output current [A]		Maximum input current [A]		Enclosure class				Maximum conductor cross-section		Efficiency
[kW]	[hp]	3 x 550 V	3 x 575-690 V	3 x 550 V	3 x 575-690 V	IP20	IP21	IP54	IP55	[mm²]	AWG	
11	15	14	13	15	15	-	B2	-	B2	35	1/0	0.98
15	20	19	18	19.5	19.5	-		-		35	1/0	0.98
18.5	25	23	22	24	24	-		-		35	1/0	0.98
22	30	28	27	29	29	-		-		35	1/0	0.98
30	40	36	34	36	36	-		-		35	1/0	0.98
37	50	43	41	49	49	-	C2	-	C2	95	1/0	0.98
45	60	54	52	59	59	-		-		95	1/0	0.98
55	75	65	62	71	71	-		-		95	1/0	0.98
75	100	87	83	87	87	-		-		95	1/0	0.98
90	125	105	100	99	99	-		-		95	1/0	0.98
110	150	137	131	130	126	-	D1h	D1h/D5h	-	2 x 95	2 x 3/0	0.98
132	200	162	155	158	149	-			-	2 x 95	2 x 3/0	0.98
160	250	201	192	198	185	-			-	2 x 95	2 x 3/0	0.98
200	300	253	242	245	233	-	D2h	D2h/D7h	-	2 x 185	2 x 350 MCM	0.98
250	350	303	290	299	279	-			-	2 x 185	2 x 350 MCM	0.98
315	450	360	344	347	332	-		D7h	-	2 x 185	2 x 350 MCM	0.98

Part numbers for IP rating and recommended output filters

Typical shaft power P2		CUE					Output filter IP20		
[kW]	[hp]	IP20/IP21	IP20/IP21 with STO	IP54/IP55	IP55 with STO/DC	IP55 (US)	dU/dt	Sine-wave	
								3 x 525-600 V	3 x 525-690 V
11	15	99616863	99616878	99616893	99616909	99616924	97669799	97775162	97775162
15	20	99616864	99616879	99616894	99616910	99616925	97669799	97775162	97775162
18.5	25	99616865	99616880	99616895	99616911	99616926	97669799	97775162	97775162
22	30	99616866	99616881	99616896	99616912	99616927	97669799	97775163	97775162
30	40	99616867	99616882	99616897	99616913	99616928	97669869	97775163	97775163
37	50	99616868	99616883	99616899	99616914	99616929	97669869	97775164	97775163
45	60	99616869	99616884	99616900	99616915	99616930	97669869	97775164	97775164
55	75	99616870	99616885	99616901	99616916	99616931	97669896	97775164	97775164
75	100	99616871	99616886	99616902	99616917	99616932	97669896	97775164	97775165
90	125	99616872	99616887	99616903	99616918	99616933	97669902	97775166	97775165
110	150	99616873	99616888	99616904	99616919	99616919	97669905	97775166	97775166
132	200	99616874	99616889	99616905	99616920	99616920	97669905	97775167	97775166
160	250	99616875	99616890	99616906	99616921	99616921	97669906	97775167	97775167
200	300	99616876	99616891	99616907	99616922	99616921	97669906	97775168	97775167
250	350	99616877	99616892	99616908	99616923	99616921	97689248	97775168	97775168
315	450	99929273	99929274	99929275	99929276		97689248	97775168	93303177

11. Technical data

Main dimensions and weights, SI units

Enclosure	Height [mm]		Width [mm]		Depth [mm]		Screw holes [mm]				Weight [kg]
	A	a	B	b	C	C [10)]	c	Ød	Øe	f	
A2	268	257	90	70	205	219	8	11	5.5	9	4.9
A3	268	257	130	110	205	219	8	11	5.5	9	6.6
A4	420	398	200	171	178	178	7	12.6	6.5	9	9.2
A5	420	402	242	215	200	200	8.25	12	6.5	6.5	14
B1	480	454	242	210	260	260	12	19	9	9	23
B2	650	624	242	210	260	260	12	19	9	9	27
B3	399	380	165	140	248	262	8	12	6.8	7.9	12
B4	518	495	231	200	242	242	-	-	8.5	15	23.5
C1	685	648	308	272	311	311	12.5	19	9	9.8	45
C2	767	739	371	334	335	335	12.5	19	9	9.8	61.9
C3	550	521	308	270	334	334	-	-	8.5	17	35
C4	660	631	370	330	334	334	-	-	8.5	17	50
D1h	901	844	325	180	378	-	20	11	11	25	62
D2h	1107	1051	325	280	378	-	20	11	11	25	125
D3h	909	844	250	180	375	-	20	11	11	25	62
D4h	1027	1051	375	280	375	-	20	11	11	25	125
D5h	1324	1276	325	276/180	381	-	20	11	11	25	99
D7h	1978	1953	420	374/280	386	-	-	-	11	25	185
E1h	2043	-	602	412	513	-	-	-	-	-	295
E2h	2043	-	698	508	513	-	-	-	-	-	318

[10)] Depth with MCB 114 option

Shipping dimensions of D1h and D2h: height x width x length = 650 x 570 x 1730 mm.

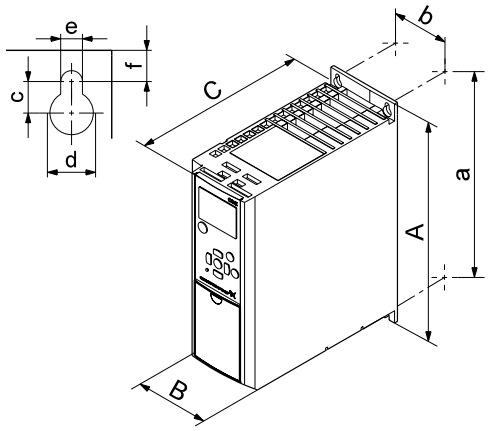
Main dimensions and weights, US units

Enclosure	Height [inch]		Width [inch]		Depth [inch]		Screw holes [inch]				Weight [lb]
	A	a	B	b	C	C [11)]	c	Ød	Øe	f	
A2	10.5	10.1	3.5	2.8	8.1	8.6	0.3	0.43	0.22	0.35	10.8
A3	10.5	10.1	5.1	4.3	8.1	8.6	0.3	0.43	0.22	0.35	14.5
A4	16.5	15.7	7.8	6.7	7.0	7.0	0.2	0.49	0.25	0.35	20.3
A5	16.5	15.8	9.5	8.7	7.8	7.8	0.32	0.47	0.25	0.25	30.8
B1	18.9	17.8	9.5	8.2	10.2	10.2	0.47	0.75	0.35	0.35	50.7
B2	25.6	24.5	9.5	8.2	10.2	10.2	0.47	0.75	0.35	0.35	59.5
B3	15.7	14.9	6.5	5.5	9.7	10.3	0.3	0.47	0.26	0.31	26.4
B4	20.3	19.5	9.1	7.8	9.5	9.5	-	-	0.33	0.59	51.8
C1	26.9	25.5	12.1	10.7	12.2	12.2	0.49	0.75	0.35	0.4	99.2
C2	30.2	29.0	14.6	13.1	13.2	13.2	0.49	0.75	0.35	0.4	136.5
C3	21.6	20.5	12.1	10.6	13.1	13.1	-	-	0.33	0.67	77.1
C4	25.9	24.8	14.5	12.9	13.1	13.1	-	-	0.33	0.67	110.2
D1h	35.5	33.2	12.8	7.1	14.9	-	0.8	0.4	0.4	1	137
D2h	43.6	41.4	12.8	11	14.9	-	0.8	0.4	0.4	1	27
D3h	35.8	33.2	9.8	7.1	14.8	-	0.8	0.4	0.4	1	137

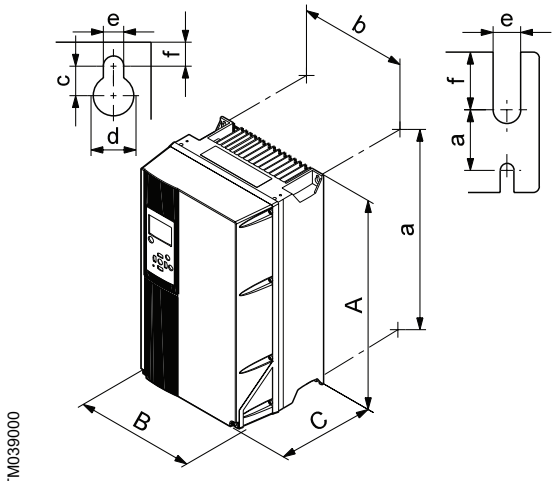
Enclosure	Height [inch]		Width [inch]		Depth [inch]		Screw holes [inch]				Weight [lb]
	A	a	B	b	C	C [11)]	c	Ød	Øe	f	
D4h	40.4	41.4	14.8	11	14.8	-	0.8	0.4	0.4	1	276
D5h	52.1	50.2	12.8	10.9 7.1	15	-	0.8	0.4	0.4	1	218
D7h	77.9	76.9	16.5	14.7 11	15.2	-	-	-	0.4	1	408
E1h	80.4	-	23.7	16.2	20.2	-	-	-	-	-	650
E2h	80.4	-	20.2	20	20.2	-	-	-	-	-	700

11) Depth with MCB 114 option

Shipping dimensions of D1h and D2h: height x width x length = 25.6 x 22.4 x 68 inches.



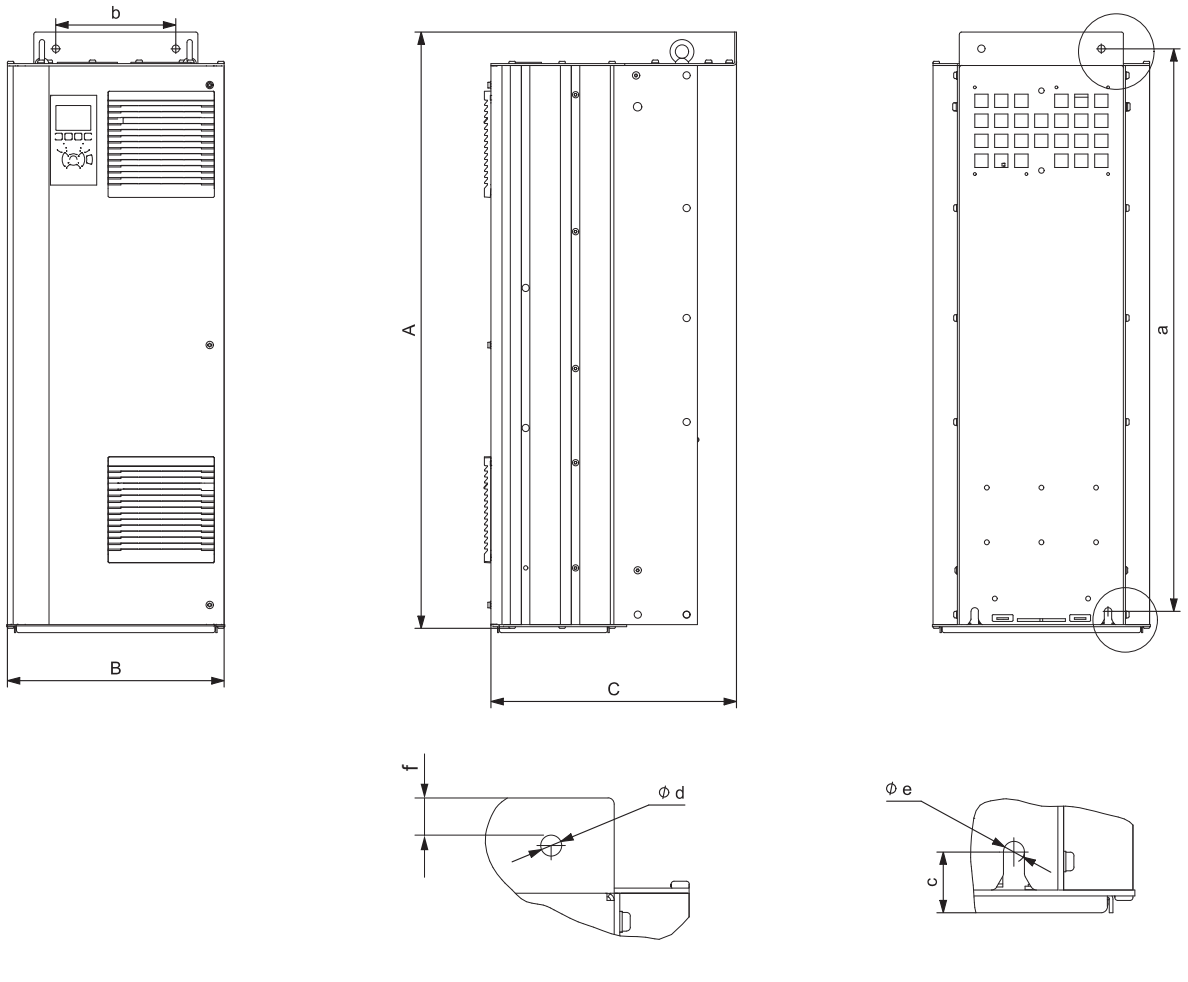
Enclosures A2, A3 and B3



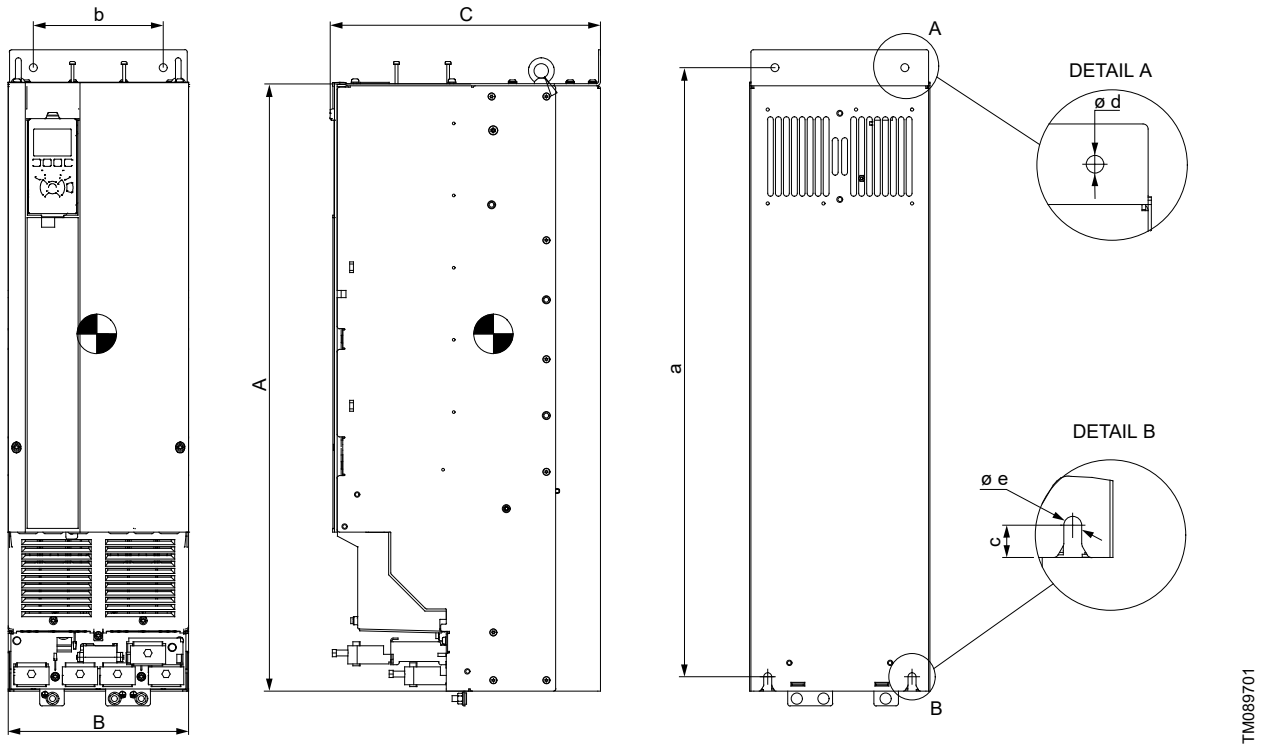
TM039000

TM039002

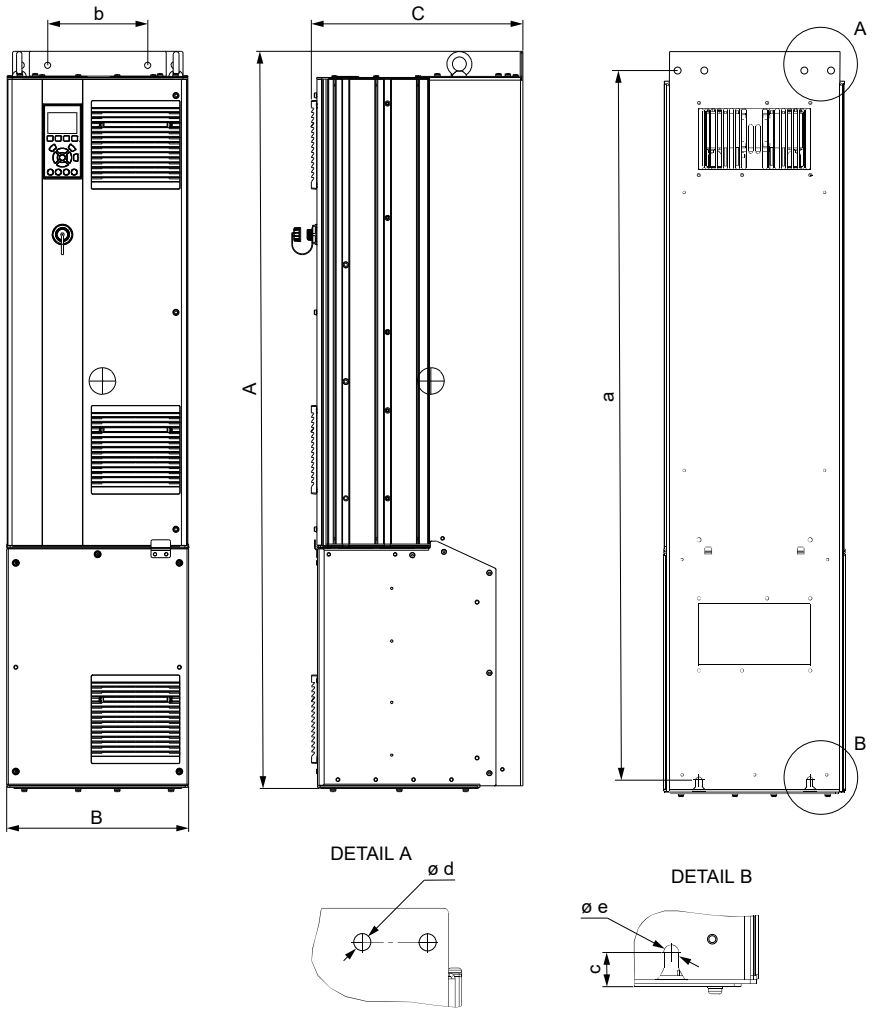
Enclosures A5, B1, B2, C1 and C2



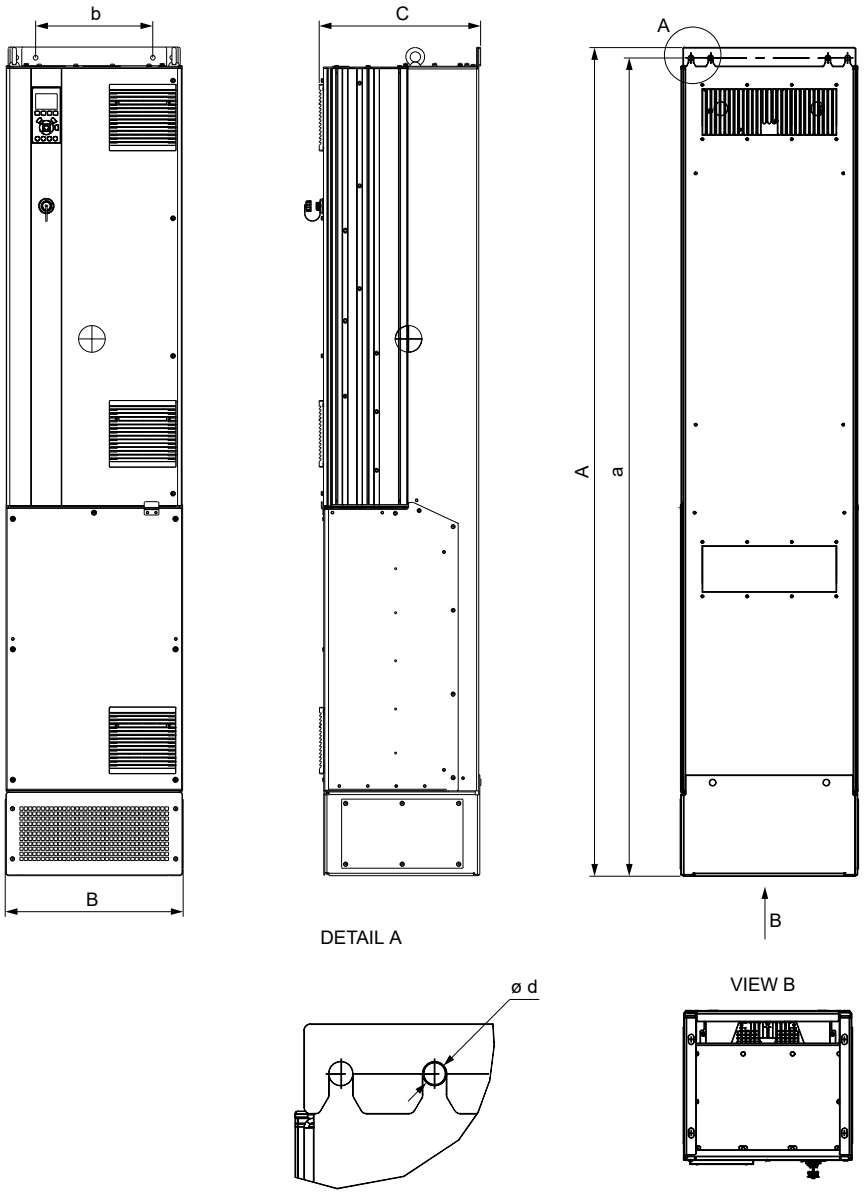
Dimension for the enclosures D1h and D2h



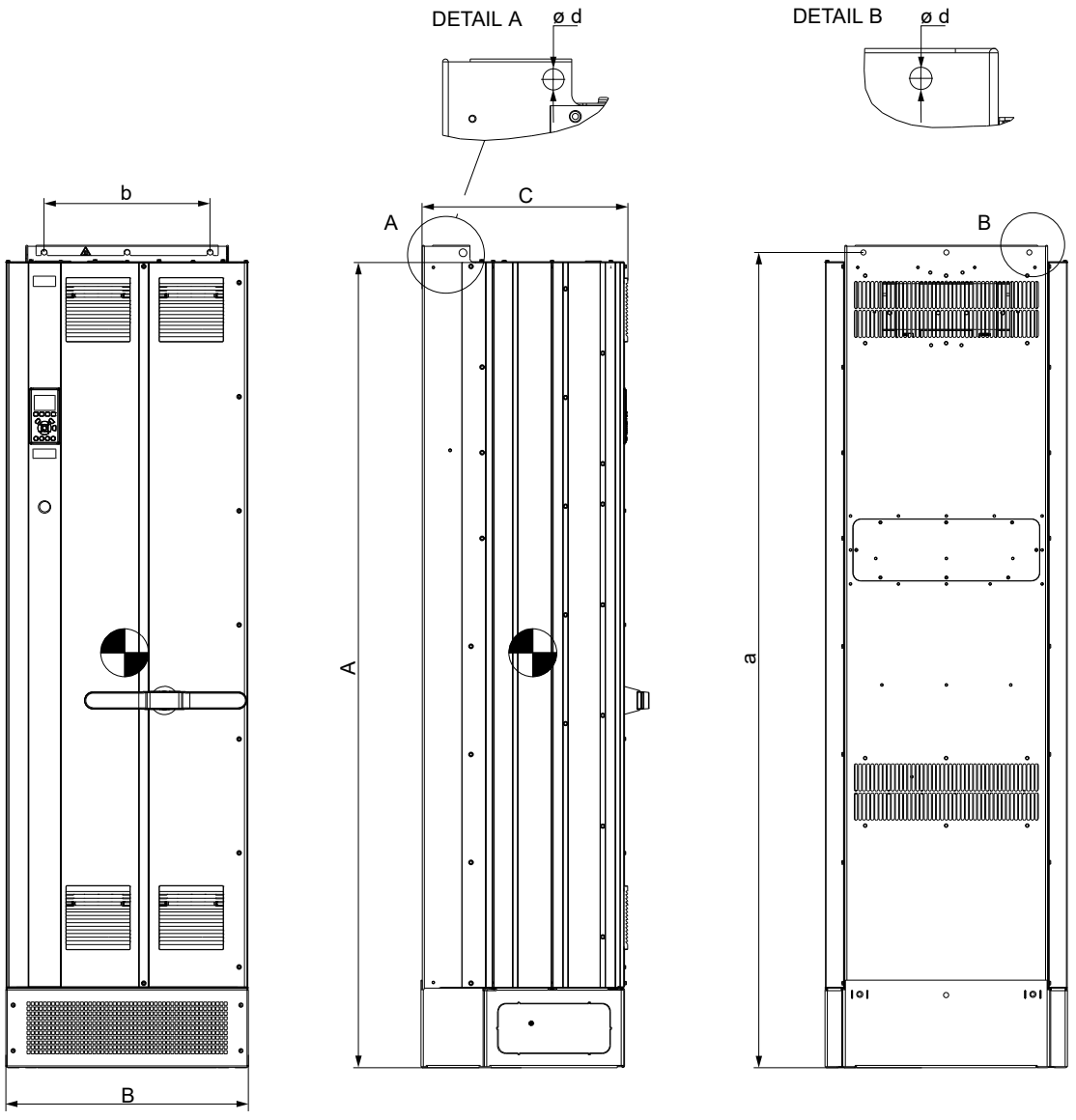
Dimensions for the enclosures D3h and D4h



Dimensions for the enclosure D5h



Dimensions for the enclosure D7h



Dimensions for the enclosures E1h and E2h

Surroundings

Relative humidity	5-95 % RH
Minimum ambient temperature at full operation	0 °C (32 °F)
Minimum ambient temperature at reduced operation	-10 °C (14 °F)
Temperature during storage and transportation	-25 to +65 °C (-13 to 149 °F)
Maximum altitude above sea level with full performance	1000 m (3280 ft)
Maximum altitude above sea level with reduced performance	3000 m (9840 ft)

CUE, 0.55 - 90 kW (0.75 - 125 hp)	
With derating	Max. 55 °C (131 °F)
With full output power of typical EFF2 motors (up to 90 % output current)	Max. 50 °C (122 °F)
With full continuous CUE output current	Max. 50 °C (122 °F)

CUE, 110-560 kW (150-750 hp)	
With derating	Max. 55 °C (131 °F)
With full output power of typical EFF2 motors (up to 90 % output current)	Max. 50 °C (122 °F)
With full continuous CUE output current	Max. 45 °C (113 °F)

The CUE comes in packaging not suitable for outdoor storage.

Sound pressure level

The maximum sound pressure level measured at a distance of one meter from the unit:

Enclosure	Sound pressure level [dB(A)]
A2	60
A3	60
A4	60
A5	63
B1	67
B2	70
B3	63 [12)]
B4	62
C1	62
C2	65
C3	67
C4	71
D1h	73
D2h	75
D3h	73
D4h	75
D5h	73
D7h	75
E1h	80
E2h	80

12) The sound pressure level for the B3 in the 3 x 525-600 V range is 70 dB(A).

The sound pressure level of a motor controlled by a frequency converter may be higher than that of a corresponding motor not controlled by a frequency converter.

Torques for terminals

Enclosure	Tightening torque [Nm] ([ft-lb])		
	Mains, Motor	Earth	Relay
A2, A3, A4, A5	1.8 (1.3)	3 (2.2)	0.5 (0.3)
B1, B3	1.8 (1.3)	3 (2.2)	0.5 (0.3)
B2, B4	4.5 (3.3)	3 (2.2)	0.5 (0.3)
C1, C3	10 (7.4)	3 (2.2)	0.5 (0.3)
C2, C4	14 / 24 (10.3 / 17.7) [13)]	3 (2.2)	0.5 (0.3)

[13)] ⌀ ≤ 95 mm^2 (4/0 AWG) / ⌀ ≥ 95 mm^2 (4/0 AWG)

Enclosure	Tightening torque [Nm] ([ft-lb])				
	Mains, Motor		Earth		Relay
	M10	M12	M8	M10	
D1h, D2h, D3h, D4h, D5h, D7h	19 (14)	37 (28)	9.6 (7)	19 (14)	0.5 (0.3)
E1h, E2h	19 (14)	37 (28)	9.6 (7)	19 (14)	0.5 (0.3)

Cables

Cable length

Maximum length, screened motor cable	100 m (328 ft)
Maximum screened cable length from the CUE to the output filter	2 m (6.56 ft)
Maximum length, signal cable	300 m (1000 ft)

Note that unscreened motor cables are not allowed.

Cable cross-section to signal terminals

Maximum cable cross-section to the signal terminals, rigid conductor	1.5 mm^2 (14 AWG)
Maximum cable cross-section to the signal terminals, flexible conductor	1.0 mm^2 (18 AWG)
Minimum cable cross-section to the signal terminals	0.5 mm^2 (20 AWG)

The CUE is designed for a maximum cable diameter per section.

A motor cable exceeding these maximum diameters may be used on 90 kW (125 hp) and smaller CUEs if the output amps of the CUE is reduced by 5 % for each wire diameter increase.

Related information

Fuses and circuit breakers

Recommended CE fuses and circuit breakers

Recommended UL fuses

Inputs and outputs

Mains supply (L1, L2, L3)

Supply voltage	200-240 V ± 10 %
	380-500 V ± 10 %
	525-600 V ± 10 %
	525-690 V ± 10 %
Supply frequency	50/60 Hz
Maximum temporary imbalance between phases	3 % of rated value
Leakage current to earth	> 3.5 mA
Number of cut-ins, enclosure A	Max. 2 times/min
Number of cut-ins, enclosures B and C	Max. 1 time/min
Number of cut-ins, enclosure D	Max. 1 time/2 min

Do not use the supply voltage for switching the CUE on and off.

Motor output (U, V, W)

Output voltage	0-100 % [14]
Output frequency	0-590 Hz [15]
Switching on output	Not recommended

[14] Output voltage in percentage of supply voltage

[15] Depending on the pump family selected

RS-485 serial connection

Terminal number	68 (A), 69 (B), 61 GND (Y)

The RS-485 circuit is functionally separated from other central circuits, and galvanically separated from the supply voltage (PELV).

Digital inputs

Terminal number	18, 19, 27, 29, 32, 33
Voltage level	0-24 VDC
Voltage level, open contact	> 19 VDC
Voltage level, closed contact	< 14 VDC
Maximum voltage on input	28 VDC
Input resistance, R_i	Approx. 4 kΩ

All digital inputs are galvanically separated from the supply voltage (PELV) and other high-voltage terminals.

Signal relays

Relay 01, terminal number	1 (C), 2 (NO), 3 (NC)
Relay 02, terminal number	4 (C), 5 (NO), 6 (NC)
Maximum terminal load (AC-1) [16]	240 VAC, 2 A
Maximum terminal load (AC-15) [16]	240 VAC, 0.2 A
Maximum terminal load (DC-1) [16]	50 VDC, 1 A
Minimum terminal load	24 VDC, 10 mA 24 VAC, 20 mA

[16] IEC 60947, parts 4 and 5

C:	Common
NO:	Normally open
NC:	Normally closed

The relay contacts are galvanically separated from other circuits by reinforced insulation (PELV).

Analog inputs

Analog input 1, terminal number (external setpoint)	53
Voltage signal	A53 = U [17]
Voltage range	0-10 V
Input resistance	Approx. 10 kΩ
Maximum voltage	± 20 V
Current signal	A53 = I [17]
Current range	0-20, 4-20 mA
Input resistance	Approx. 200 Ω
Maximum current	30 mA
Maximum fault, terminals 53, 54	0.5 % of full scale

Analog input 2, terminal number (sensor 1)	54
Current signal	A54 = I [17]
Current range	0-20, 4-20 mA
Input resistance, R_i	Approx. 200 Ω
Maximum current	30 mA
Maximum fault, terminals 53, 54	0.5 % of full scale

[17] The factory setting is voltage signal U.

All analog inputs are galvanically separated from the supply voltage (PELV) and other high-voltage terminals.

Analog output

Analog output 1, terminal number (sensor 2)	42
Current range	0-20 mA
Maximum load to frame	500 Ω
Maximum fault	0.8 % of full scale

The analog output is galvanically separated from the supply voltage (PELV) and other high-voltage terminals.

MCB 114 sensor input module

Analog input 3, terminal number	2
Current range	0/4-20 mA
Input resistance	< 200 Ω
Analog input 4, terminal number	4, 5
Analog input 5, terminal number	7, 8
Signal type, 2- or 3-wire	Pt100/Pt1000

When using the Pt100 with 3-wire cable, the resistance must not exceed 30 Ω.

Fuses and circuit breakers

The recommended fuses are suitable for use on a circuit capable of delivering not more than 100,000 Arms symmetrical amperes, depending on the voltage rating of the drive. When using the proper fuses, the short-circuit current rating (SCCR) of the drive is 100,000 Arms symmetrical amperes.

Recommended CE fuses and circuit breakers

Enclosures A, B and C

200-240 V

Enclosure	Power		Fuse size	Max. fuse size	Circuit breaker Moeller	Max. trip level [A]
	[kW]	[hp]				
A2	0.75	1	gG-10	gG-32	PKZM0-25	25
	1.1	1.5	gG-10			
	1.5	2	gG-10			
	2.2	3	gG-16			
A3	3	4	gG-16	gG-32	PKZM0-25	25
	3.7	5	gG-20			
A4	0.75	1	gG-10	gG-32	PKZM0-25	25
	1.1	1.5	gG-10			
	1.5	2	gG-10			
	2.2	3	gG-16			
A5	0.75	1	gG-10	gG-32	PKZM0-25	25
	1.1	1.5	gG-10			
	1.5	2	gG-10			
	2.2	3	gG-16			
	3	4	gG-16			
	3.7	5	gG-20			
B1	5.5	7.5	gG-25	gG-80	PKZM4-63	63
	7.5	10	gG-32			
	11	15	gG-32			
B2	15	20	gG-50	gG-100	NZMB1-A100	100
B3	5.5	7.5	gG-25	gG-63	PKZM4-50	50
	7.5	10	gG-25			
	11	15	gG-32			
B4	15	20	gG-50	gG-125	NZMB1-A100	100
	18	25	gG-63			
C1	18	25	gG-63	gG-160	NZMB2-A200	160
	22	30	gG-80			
	30	40	gG-100	aR-160		
C2	37	50	aR-160	aR-200	NZMB2-A250	250
	45	60	aR-200	aR-250		
C3	22	30	gG-80	gG-150	NZMB2-A200	150
	30	40	aR-125	aR-160		
C4	27	50	aR-160	aR-200	NZMB2-A250	250
	45	60	aR-200	aR-250		

3 × 380-500 V

Enclosure	Power		Fuse size	Max. fuse size	Circuit breaker Moeller	Max. trip level [A]
	[kW]	[hp]				
A2	1.1	1.5	gG-10	gG-25	PKZM0-25	25
	1.5	2	gG-10			
	2.2	3	gG-10			
	3	4	gG-10			
	4	5	gG-16			

Enclosure	Power		Fuse size	Max. fuse size	Circuit breaker Moeller	Max. trip level [A]
	[kW]	[hp]				
A3	5.5	7.5	gG-16	gG-32	PKZM0-25	25
	7.5	10	gG-16			
A4	1.1	1.5	gG-10	gG-32	PKZM0-25	25
	1.5	2	gG-10			
	2.2	3	gG-10			
	3	4	gG-10			
	4	5	gG-16			
A5	1.1	1.5	gG-10	gG-32	PKZM0-25	25
	1.5	2	gG-10			
	2.2	3	gG-10			
	3	4	gG-10			
	4	5	gG-16			
	5.5	7.5	gG-16			
	7.5	10	gG-16			
B1	11	15	gG-40	gG-80	PKZM4-63	63
	15	20	gG-40			
	18	25	gG-40			
B2	22	30	gG-50	gG-100	NZMB1-A100	100
	30	40	gG-63			
B3	11	15	gG-40	gG-63	PKZM4-50	50
	15	20	gG-40			
	18	25	gG-40			
B4	22	30	gG-50	gG-125	NZMB1-A100	100
	30	40	gG-63			
	37	50	gG-80			
C1	37	50	gG-80	gG-160	NZMB2-A200	160
	45	60	gG-100			
	55	75	gG-160			
C2	75	100	aR-200	aR-250	NZMB2-A250	250
	90	125	aR-250			
C3	45	60	gG-100	gG-150	NZMB2-A200	150
	55	75	gG-160	gG-160		
C4	75	100	aR-200	aR-250	NZMB2-A250	250
	90	125	aR-250			

3 × 525-600 V

Enclosure	Power		Fuse size	Max. fuse size	Circuit breaker Moeller	Max. trip level [A]
	[kW]	[hp]				
A2	1.1	1.5	gG-10	gG-25	PKZM0-25	25
	1.5	2	gG-10			
	2.2	3	gG-10			
	3	4	gG-10			
	4	5	gG-10			
A3	5.5	7.5	gG-10	gG-32	PKZM0-25	25
	7.5	10	gG-16			
A5	1.1	1.5	gG-10	gG-32	PKZM0-25	25
	1.5	2	gG-10			
	2.2	3	gG-10			
	3	4	gG-10			
	4	5	gG-10			
	5.5	7.5	gG-10			
	7.5	10	gG-16			

Enclosure	Power		Fuse size	Max. fuse size	Circuit breaker Moeller	Max. trip level [A]
	[kW]	[hp]				
B1	11	15	gG-25	gG-80	PKZM4-63	63
	15	20	gG-32			
	18.5	25	gG-40			
B2	22	30	gG-50	gG-100	NZMB1-A100	100
	30	40	gG-63			
B3	11	15	gG-25	gG-63	PKZM4-50	50
	15	20	gG-32			
	18	25	gG-32			
B4	22	30	gG-40	gG-125	NZMB1-A100	100
	30	40	gG-50			
	37	50	gG-63			
C1	37	50	gG-63	gG-160	NZMB2-A200	160
	45	60	gG-100	-		
	55	60	aR-160	aR-250		
C2	75	100	aR-200	aR-250	NZMB2-A250	250
	90	125	aR-200			
C3	45	60	gG-63	gG-150	NZMB2-A200	150
	55	75	gG-100			
C4	75	100	aR-160	aR-250	NZMB2-A250	250
	90	125	aR-200			

3 × 525-690 V

Enclosure	Power		Fuse size	Max. fuse size	Circuit breaker Moeller	Max. trip level [A]
	[kW]	[hp]				
A3	1.1	1.5	gG-6	gG-25	PKZM0-16	16
	1.5	2	gG-6			
	2.2	3	gG-6			
	3	4	gG-10			
	4	5	gG-10			
	5.5	7.5	gG-16			
	7.5	10	gG-16			
B2	11	15	gG-25	gG-63	-	-
	15	20	gG-25			
	18	24	gG-32			
	22	30	gG-32			
C2	30	40	gG-40	gG-80	-	-
	37	50	gG-63	gG-100		
	45	60	gG-63	gG-125		
	55	75	gG-80	gG-160		
	75	100	gG-100			
C3	37	50	gG-100	gG-125	-	-
	45	60	gG-125	gG-160		

Enclosures D1h-D7h

3 × 380-500 V

Power		Recommended fuse size
[kW]	[hp]	
110	150	aR-315
132	200	aR-350
160	250	aR-400
200	300	aR-500
250	350	aR-630
315	450	aR-800

3 × 525-690 V

Power		Recommended fuse size
[kW]	[hp]	
110	150	aR-315
132	200	aR-315
160	250	aR-315
200	300	aR-550
250	350	aR-550
315	450	aR-550

Space heater fuse recommendation

Rating		Bussmann
Current [A]	Supply voltage [V]	
2.5	600	LPJ-21/2SP

Enclosures E1h and E2h

380-500 and 525-690 V

Supply voltage [V]	Bussmann
380-500	170M7309
525-690	170M7342

Space heater fuse recommendation

Rating		Bussmann
Current [A]	Supply voltage [V]	
2.5	600	LPJ-21/2SP

Recommended UL fuses

Enclosures A, B and C

1 × 200-240 V

Power		Max. pre-fuse size [A]	Bussmann						
[kW]	[hp]		JFHR2	RK1	Type J	Type T	Type CC	Type CC	Type CC
1.1	1.5	15	FWX-15	KTN-15	JKS-15	JJN-15	FNQ-R-15	KTK-R-15	LP-CC-15
1.5	2.0	20	FWX-20	KTN-20	JKS-20	JJN-20	FNQ-R-20	KTK-R-20	LP-CC-20
2.2	3.0	30	FWX-30	KTN-30	JKS-30	JJN-30	FNQ-R-30	KTK-R-30	LP-CC-30
3.0	4.0	35	FWX-35	KTN-35	JKS-35	JJN-35	-	-	-
3.7	5.0	50	FWX-50	KTN-50	JKS-50	JJN-50	-	-	-
5.5	7.5	60	FWX-60	KTN-60	JKS-60	JJN-60	-	-	-
7.5	10	80	FWX-80	KTN-80	JKS-80	JJN-80	-	-	-
15	20	150	FWX-150	KTN-150	JKS-150	JJN-150	-	-	-
22	30	200	FWX-200	KTN-200	JKS-200	JJN-200	-	-	-

Power		Max. pre-fuse size [A]	SIBA	Littelfuse	Ferraz Shawmut		
[kW]	[hp]		Type RK1	Type RK1	Type CC	Type RK1	Type J
1.1	1.5	15	5017906-016	KLN-R15	ATM-R15	A2K-15R	HSJ15
1.5	2.0	20	5017906-020	KLN-R20	ATM-R20	A2K-20R	HSJ20
2.2	3.0	30	5017906-032	KLN-R30	ATM-R30	A2K-30R	HSJ30
3.0	4.0	35	-	KLN-R35	-	A2K-35R	HSJ35
3.7	5.0	50	5017906-050	KLN-R50	-	A2K-50R	HSJ50
5.5	7.5	60	5017906-063	KLN-R60	-	A2K-60R	HSJ60
7.5	10	80	5017906-080	KLN-R80	-	A2K-80R	HSJ80
15	20	150	5017906-150	KLN-R150	-	A2K-150R	HSJ150
22	30	200	5017906-200	KLN-R200	-	A2K-200R	HSJ200

3 × 200-240 V

Power		Bussmann						
[kW]	[hp]	JFHR2	RK1	Type J	Type T	Type CC	Type CC	Type CC
0.55	0.75	FWX-10	KTN-R10	JKS-10	JJN-10	FNQ-R-10	KTK-R-10	LP-CC-10
0.75	1.0	FWX-10	KTN-R10	JKS-10	JJN-10	FNQ-R-10	KTK-R-10	LP-CC-10
1.1	1.5	FWX-10	KTN-R10	JKS-10	JJN-10	FNQ-R-10	KTK-R-10	LP-CC-10
1.5	2.0	FWX-15	KTN-R15	JKS-15	JJN-15	FNQ-R-15	KTK-R-15	LP-CC-15
2.2	3.0	FWX-20	KTN-R20	JKS-20	JJN-20	FNQ-R-20	KTK-R-20	LP-CC-20
3.0	4.0	FWX-25	KTN-R25	JKS-25	JJN-25	FNQ-R-25	KTK-R-25	LP-CC-25
3.7	4.0	FWX-30	KTN-R30	JKS-30	JJN-30	FNQ-R-30	KTK-R-30	LP-CC-30
5.5	7.5	FWX-50	KTN-R50	JKS-50	JJN-50	-	-	-
7.5	10	FWX-50	KTN-R50	JKS-50	JJN-50	-	-	-
11	15	FWX-60	KTN-R60	JKS-60	JJN-60	-	-	-
15	20	FWX-80	KTN-R80	JKS-80	JJN-80	-	-	-
18	25	FWX-125	KTN-R125	JKS-125	JJN-125	-	-	-
22	30	FWX-125	KTN-R125	JKS-125	JJN-125	-	-	-
30	40	FWX-150	KTN-R150	JKS-150	JJN-150	-	-	-
37	50	FWX-200	KTN-R200	JKS-200	JJN-200	-	-	-
45	60	FWX-250	KTN-R250	JKS-250	JJN-250	-	-	-

Power		SIBA	Littelfuse		Ferraz Shawmut			
[kW]	[hp]	Type RK1	Type RK1	JFHR2	Type CC	Type RK1	JFHR2	Type J
0.55	0.75	5017906-010	KLN-R-10	-	ATM-R-10	A2K-10-R	-	HSJ-10
0.75	1.0	5017906-010	KLN-R-10	-	ATM-R-10	A2K-10-R	-	HSJ-10
1.1	1.5	5017906-010	KLN-R-10	-	ATM-R-10	A2K-10-R	-	HSJ-10
1.5	2.0	5017906-016	KLN-R-15	-	ATM-R-15	A2K-15-R	-	HSJ-15
2.2	3.0	5017906-020	KLN-R-20	-	ATM-R-20	A2K-20-R	-	HSJ-20
3.0	4.0	5017906-025	KLN-R-25	-	ATM-R-25	A2K-25-R	-	HSJ-25
3.7	4.0	5012406-032	KLN-R-30	-	ATM-R-30	A2K-30-R	-	HSJ-30
5.5	7.5	5014006-050	KLN-R-50	-	-	A2K-50-R	-	HSJ-50
7.5	10	5014006-050	KLN-R-50	-	-	A2K-50-R	-	HSJ-50
11	15	5014006-063	KLN-R-60	-	-	A2K-60-R	-	HSJ-60
15	20	5014006-080	KLN-R-80	-	-	A2K-80-R	-	HSJ-80
18	25	5017906-125	KLN-R-125	-	-	A2K-125-R	-	HSJ-125
22	30	2028220-125	KLN-R-125	-	-	A2K-125-R	-	HSJ-125
30	40	2028220-150	KLN-R-150	L25S-150	-	A2K-150-R	A25X-150	HSJ-150
37	50	2028220-200	KLN-R-200	L25S-200	-	A2K-200-R	A25X-200	HSJ-200
45	60	2028220-250	KLN-R-250	L25S-250	-	A2K-250-R	A25X-250	HSJ-250

3 × 380-500 V

Power		Bussmann						
[kW]	[hp]	JFHR2	RK1	Type J	Type T	Type CC	Type CC	Type CC
-	-	FWH-6	KTS-R-6	JKS-6	JJS-6	FNQ-R-6	KTK-R-5	LP-CC-6
1.1	1.5	FWH-10	KTS-R-10	JKS-10	JJS-10	FNQ-R-10	KTK-R-10	LP-CC-10
1.5	2.0	FWH-10	KTS-R-10	JKS-10	JJS-10	FNQ-R-10	KTK-R-10	LP-CC-10
2.2	3.0	FWH-10	KTS-R-10	JKS-10	JJS-10	FNQ-R-10	KTK-R-10	LP-CC-10
3.0	4.0	FWH-15	KTS-R-15	JKS-15	JJS-15	FNQ-R-15	KTK-R-15	LP-CC-15
4.0	5.0	FWH-20	KTS-R-20	JKS-20	JJS-20	FNQ-R-20	KTK-R-20	LP-CC-20
5.5	7.5	FWH-25	KTS-R-25	JKS-25	JJS-25	FNQ-R-25	KTK-R-25	LP-CC-25
7.5	10	FWH-30	KTS-R-30	JKS-30	JJS-30	FNQ-R-30	KTK-R-30	LP-CC-30
11	15	FWH-40	KTS-R-40	JKS-40	JJS-40	-	-	-
15	20	FWH-50	KTS-R-50	JKS-50	JJS-50	-	-	-
22	30	FWH-60	KTS-R-60	JKS-60	JJS-60	-	-	-
30	40	FWH-80	KTS-R-80	JKS-80	JJS-80	-	-	-
37	50	FWH-100	KTS-R-100	JKS-100	JJS-100	-	-	-
45	60	FWH-125	KTS-R-125	JKS-125	JJS-125	-	-	-

Power		Bussmann						
[kW]	[hp]	JFHR2	RK1	Type J	Type T	Type CC	Type CC	Type CC
55	75	FWH-150	KTS-R-150	JKS-150	JJS-150	-	-	-
75	100	FWH-200	KTS-R-200	JKS-200	JJS-150	-	-	-
90	125	FWH-250	KTS-R-250	JKS-250	JJS-250	-	-	-

Power		SIBA	Littelfuse		Ferraz Shawmut			
[kW]	[hp]	Type RK1	Type RK1	JFHR2	Type CC	Type RK1	JFHR2	Type J
-	-	5017906-006	KLS-R-6	-	ATM-R-6	A6K-6-R	-	HSJ-6
1.1	1.5	5017906-010	KLN-R-10	-	ATM-R-10	A6K-10-R	-	HSJ-10
1.5	2.0	5017906-010	KLN-R-10	-	ATM-R-10	A6K-10-R	-	HSJ-10
2.2	3.0	5017906-010	KLN-R-10	-	ATM-R-10	A6K-10-R	-	HSJ-10
3.0	4.0	5017906-016	KLN-R-15	-	ATM-R-15	A6K-15-R	-	HSJ-15
4.0	5.0	5017906-020	KLN-R-20	-	ATM-R-20	A6K-20-R	-	HSJ-20
5.5	7.5	5017906-025	KLN-R-25	-	ATM-R-25	A6K-25-R	-	HSJ-25
7.5	10	5012406-032	KLN-R-30	-	ATM-R-30	A6K-30-R	-	HSJ-30
11	15	5014006-040	KLS-R-40	-	-	A6K-40-R	-	HSJ-40
15	20	5014006-050	KLN-R-50	-	-	A6K-50-R	-	HSJ-50
22	30	5014006-063	KLN-R-60	-	-	A6K-60-R	-	HSJ-60
30	40	2028220-120	KLN-R-80	-	-	A6K-80-R	-	HSJ-80
37	50	2028220-125	KLN-R-100	-	-	A6K-100-R	-	HSJ-100
45	60	2028220-125	KLN-R-125	-	-	A6K-125-R	-	HSJ-125
55	75	2028220-160	KLN-R-150	-	-	A6K-150-R	-	HSJ-150
75	100	2028220-200	KLN-R-200	L50-S-225	-	A6K-200-R	A50-P-225	HSJ-200
90	125	2028220-250	KLN-R-250	L50-S-250	-	A6K-250-R	A50-P-250	HSJ-250

525-600 V

Power		Bussmann					
[kW]	[hp]	Type RK1	Type J	Type T	Type CC	Type CC	Type CC
0.75	1.5	KTS-R-5	JKS-5	JJS-6	FNQ-R-5	KTK-R-5	LP-CC-5
1.1	1.5	KTS-R-5	JKS-5	JJS-6	FNQ-R-5	KTK-R-5	LP-CC-5
1.5	2.0	KTS-R-10	JKS-10	JJS-10	FNQ-R-10	KTK-R-10	LP-CC-10
2.2	3.0	KTS-R-10	JKS-10	JJS-10	FNQ-R-10	KTK-R-10	LP-CC-10
3.0	4.0	KTS-R-15	JKS-15	JJS-15	FNQ-R-15	KTK-R-15	LP-CC-15
4.0	5.0	KTS-R-20	JKS-20	JJS-20	FNQ-R-20	KTK-R-20	LP-CC-20
5.5	7.5	KTS-R-25	JKS-25	JJS-25	FNQ-R-25	KTK-R-25	LP-CC-25
7.5	10	KTS-R-30	JKS-30	JJS-30	FNQ-R-30	KTK-R-30	LP-CC-30
11	15	KTS-R-35	JKS-35	JJS-35	-	-	-
15	20	KTS-R-35	JKS-35	JJS-35	-	-	-
18	24	KTS-R-45	JKS-45	JJS-45	-	-	-
22	30	KTS-R-50	JKS-50	JJS-50	-	-	-
30	40	KTS-R-60	JKS-60	JJS-60	-	-	-
37	50	KTS-R-80	JKS-80	JJS-80	-	-	-
45	60	KTS-R-100	JKS-100	JJS-100	-	-	-
55	75	KTS-R-125	JKS-125	JJS-125	-	-	-
75	100	KTS-R-150	JKS-150	JJS-150	-	-	-
90	125	KTS-R-175	JKS-175	JJS-175	-	-	-

Power		SIBA	Littelfuse	Ferraz Shawmut	
[kW]	[hp]	Type RK1	Type RK1	Type RK1	Type J
0.75	1.5	5017906-005	KLS-R-005	A6K-5-R	HSJ-6
1.1	1.5	5017906-005	KLS-R-005	A6K-5-R	HSJ-6
1.5	2.0	5017906-010	KLS-R-010	A6K-10-R	HSJ-10
2.2	3.0	5017906-010	KLS-R-010	A6K-10-R	HSJ-10
3.0	4.0	5017906-016	KLS-R-015	A6K-15-R	HSJ-15
4.0	5.0	5017906-020	KLS-R-020	A6K-20-R	HSJ-20

Power		SIBA	Littelfuse	Ferraz Shawmut	
[kW]	[hp]	Type RK1	Type RK1	Type RK1	Type J
5.5	7.5	5017906-025	KLS-R-025	A6K-25-R	HSJ-25
7.5	10	5017906-030	KLS-R-030	A6K-30-R	HSJ-30
11	15	5014006-040	KLS-R-035	A6K-35-R	HSJ-35
15	20	5014006-040	KLS-R-035	A6K-35-R	HSJ-35
18	24	5014006-050	KLS-R-045	A6K-45-R	HSJ-45
22	30	5014006-050	KLS-R-050	A6K-50-R	HSJ-50
30	40	5014006-063	KLS-R-060	A6K-60-R	HSJ-60
37	50	5014006-080	KLS-R-075	A6K-80-R	HSJ-80
45	60	5014006-100	KLS-R-100	A6K-100-R	HSJ-100
55	75	2028220-125	KLS-R-125	A6K-125-R	HSJ-125
75	100	2028220-150	KLS-R-150	A6K-150-R	HSJ-150
90	125	2028220-200	KLS-R-175	A6K-175-R	HSJ-175

525-690 V

Power		Bussmann		
[kW]	[hp]	E52273 RK1/JDDZ	E4273 J/JDDZ	E4273 T/JDDZ
11	15	KTS-R-30	JKS-30	JJS-30
15	20	KTS-R-30	JKS-30	JJS-30
18	25	KTS-R-45	JKS-45	JJS-45
22	30	KTS-R-45	JKS-45	JJS-45
30	40	KTS-R-60	JKS-60	JJS-60
37	50	KTS-R-80	JKS-80	JJS-80
45	60	KTS-R-90	JKS-90	JJS-90
55	75	KTS-R-100	JKS-100	JJS-100
75	100	KTS-R-125	JKS-125	JJS-125
90	125	KTS-R-150	JKS-150	JJS-150

Power		SIBA	Littelfuse	Ferraz Shawmut	
[kW]	[hp]	E180276 RK1/JDDZ	E81895 RK1/JDDZ	E163267/E2137 RK1/ JDDZ	E2137 J/HSJ
11	15	5017906-030	KLS-R-030	A6K-30-R	HST-30
15	20	5017906-030	KLS-R-030	A6K-30-R	HST-30
18	25	5014006-050	KLS-R-045	A6K-45-R	HST-45
22	30	5014006-050	KLS-R-045	A6K-45-R	HST-45
30	40	5014006-063	KLS-R-60	A6K-60-R	HST-60
37	50	5014006-080	KLS-R-75	A6K-80-R	HST-80
45	60	5014006-100	KLS-R-90	A6K-90-R	HST-90
55	75	5014006-100	KLS-R-100	A6K-100-R	HST-100
75	100	2028220-125	KLS-R-150	A6K-125-R	HST-125
90	125	2028220-150	KLS-R-175	A6K-150-R	HST-150

Enclosures D1h-D7h

380-500 V, power/semiconductor fuse options

Power		Bussmann		Littelfuse	
[kW]	[hp]				
110	150	170M2619	FWH-300A	LA50QS300-4	L50S-300
132	200	170M2620	FWH-350A	LA50QS350-4	L50S-350
160	250	170M2621	FWH-400A	LA50QS400-4	L50S-400
200	300	170M4015	FWH-500A	LA50QS500-4	L50S-500
250	350	170M4016	FWH-600A	LA50QS600-4	L50S-600
315	450	170M4017	FWH-800A	LA50QS800-4	L50S-800

Power		Siba		Ferraz Shawmut	
[kW]	[hp]			Europe	North America
110	150	20 189 20.315	A50QS300-4	6,9URD31D08A0315	A070URD31KI0315
132	200	20 189 20.340	A50QS350-4	6,9URD31D08A0350	A070URD31KI0350
160	250	20 189 20.400	A50QS400-4	6,9URD31D08A0400	A070URD31KI0400
200	300	20 189 20.550	A50QS500-4	6,9URD31D08A0550	A070URD31KI0550
250	350	20 189 20.630	A50QS600-4	6,9URD31D08A0630	A070URD31KI0630
315	450	20 189 20.800	A50QS800-4	6,9URD31D08A0800	A070URD31KI0800

525-690 V, power/semiconductor fuse options

Power		Bussmann	Siba	Ferraz Shawmut	
[kW]	[hp]			Europe	North America
110	150	170M2619	20 610 31.315	6,9URD31D08A0315	A070URD31KI0315
132	200	170M2619	20 610 31.315	6,9URD31D08A0350	A070URD31KI0350
160	250	170M2619	20 610 31.315	6,9URD31D08A0400	A070URD31KI0400
200	300	170M4015	20 620 31.550	6,9URD31D08A0550	A070URD31KI0550
250	350	170M4015	20 620 31.550	6,9URD31D08A0630	A070URD31KI0630
315	450	170M4015	20 620 31.550	6,9URD31D08A0800	A070URD31KI080

Space heater fuse recommendation

Rating		Bussmann
Current [A]	Supply voltage [V]	
2.5	600	LPJ-21/2SP

Enclosures E1h and E2h

380-500 and 525-690 V

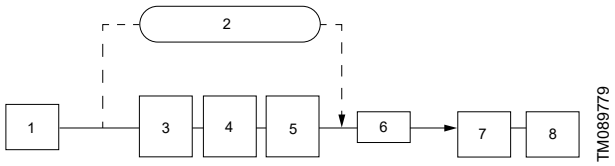
Supply voltage [V]	Bussmann
380-500	170M7309
525-690	170M7342

Space heater fuse recommendation

Rating		Bussmann
Current [A]	Supply voltage [V]	
2.5	600	LPJ-21/2SP

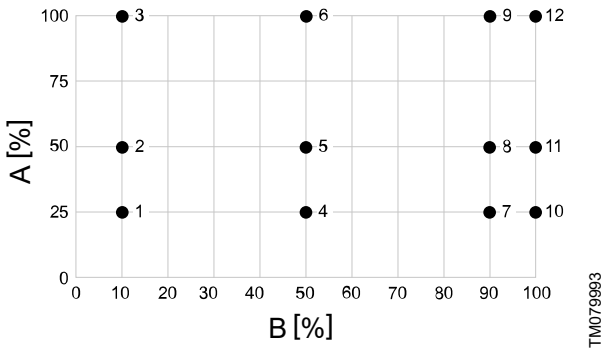
Drive efficiency

The IE classification for the complete drive module (CDM) is based on drive losses. The loss determination is based on factory settings such as the default switching frequency. The efficiency of the CUE drive is determined as efficiency class IE2 according to the EN 50598-2 and IEC 61800-9.



Drive system design

Pos.	Description
1	Mains supply and cabling
2	Motor starter, e.g. contactor, soft-starter
3	Feeding section
4	Auxiliaries
5	Basic Drive Module (BDM)
6	Motor
7	Transmission
8	Load machine



Different operating points of the CUE depending on the relative torque-producing current and the relative motor stator frequency

Pos.	Description
A	Relative torque-producing current
B	Relative motor stator frequency

Efficiencies and standby losses

The CUE drives with STO and/or DC suffixes in their description at the Grundfos Product Center have the same efficiencies as the CUE drives with equivalent power sizes listed below.

3 × 380-500 V

IP20

Power P2		Nom. power	Nom. current	Standby loss	Frequency [%]											
					10	10	10	50	50	50	90	90	90	100	100	100
					Current [%]											
		[kVA]	[A]	[W]	25	50	100	25	50	100	25	50	100	25	50	100
					Operating point											
[kW]	[hp]				1	2	3	4	5	6	7	8	9	10	11	12
					Efficiency [%]											
0.55	0.75	1.3	1.8	12	48.0	62.7	74.0	81.7	89.1	93.1	88.7	94.5	96.5	89.6	94.7	96.8
0.75	1	1.7	2.4	12	52.4	66.8	76.2	83.9	90.3	93.7	89.9	95.0	96.7	90.7	95.4	97.0
1.1	1.5	2.1	3	12	53.6	67.5	75.8	84.6	90.7	93.5	90.4	95.2	96.5	91.2	95.5	96.8
1.5	2	2.8	4.1	12	57.3	70.0	77.0	86.3	91.6	93.9	91.4	95.5	96.7	92.1	96.0	96.9
2.2	3	3.9	5.6	12	60.1	71.9	77.8	87.4	92.1	94.0	92.0	95.8	96.7	92.6	96.2	97.0
3.0	4	5	7.2	12	61.8	73.2	79.5	88.2	92.5	94.2	92.5	95.9	96.8	93.1	96.4	97.1
4.0	5	6.9	10	12	65.0	75.6	79.6	89.5	93.2	94.6	93.4	96.4	97.0	94.0	96.8	97.3
5.5	7.5	9	13	12	68.8	78.2	81.8	91.1	94.0	95.3	94.5	96.8	97.4	94.9	97.2	97.6
7.5	10	11	16	12	71.2	79.7	82.5	92.0	94.5	95.5	95.1	97.0	97.5	95.5	97.4	97.7
11	15	16.6	24	18	73.6	81.8	83.1	92.8	94.9	95.7	95.5	97.2	97.5	95.9	97.5	97.7
15	20	22.2	32	18	76.2	82.7	84.2	93.5	95.4	96.0	96.0	97.4	97.6	96.3	97.7	97.8
18	25	26	37.5	18	78.1	83.8	84.9	94.1	95.7	96.1	96.3	97.5	97.7	96.5	97.8	97.9
22	30	30.5	44	22	80.3	85.1	85.5	94.7	96.1	96.3	96.6	97.6	97.7	96.8	97.9	97.9
30	40	42.3	61	22	81.2	85.4	85.3	94.8	96.0	96.1	96.6	97.6	97.5	96.9	97.8	97.8
37	50	50.6	73	22	81.8	85.6	85.2	94.9	96.0	96.0	96.7	97.5	97.4	96.9	97.7	97.6
45	60	62.4	90	25	83.1	86.1	85.1	95.2	96.1	96.0	96.8	97.5	97.2	97.0	97.7	97.5
55	75	73.4	106	25	83.6	86.4	85.9	95.4	96.2	96.1	96.9	97.5	97.3	97.1	97.8	97.6
75	100	102	147	29	85.0	87.2	87.7	95.9	96.6	96.4	97.2	97.7	97.7	97.4	97.9	97.8
90	125	123	177	29	86.6	88.3	88.2	96.1	96.7	96.5	97.2	97.2	97.6	97.4	97.9	97.7

IP21

Power P2		Nom. power	Nom. current	Standby loss	Frequency [%]											
					10	10	10	50	50	50	90	90	90	100	100	100
					Current [%]											
		[kVA]	[A]	[W]	25	50	100	25	50	100	25	50	100	25	50	100
					Operating point											
[kW]	[hp]				1	2	3	4	5	6	7	8	9	10	11	12
					Efficiency [%]											
110	150	147	212	37	88.3	89.5	88.7	96.3	96.8	96.0	97.2	97.8	97.6	97.4	97.9	97.6
132	200	180	260	37	88.0	89.5	88.6	96.3	96.8	96.5	97.3	97.8	97.7	97.4	98.0	97.7
160	250	218	315	37	84.7	86.7	83.4	95.3	96.1	95.7	96.6	97.5	97.3	96.8	97.8	97.6
200	300	274	395	37	83.3	86.4	84.2	95.1	96.2	96.0	96.7	97.6	97.5	96.9	97.8	97.7
250	350	333	480	37	82.3	86.0	84.9	95.2	96.3	96.2	96.8	97.7	97.7	97.0	97.9	97.9
315	450	407	315	37	80.7	85.3	85.6	95.1	96.3	96.5	97.0	97.8	97.8	97.3	97.9	98.0
355	500	456	658	48	83.9	87.7	88.5	96.1	97.0	97.2	97.7	98.2	98.2	97.9	98.3	98.3
400	550	516	745	48	84.5	87.8	88.3	96.3	97.1	97.1	97.8	98.2	98.1	98.0	98.3	98.2
450	600	554	800	48	84.9	88.0	88.2	96.4	97.1	97.1	97.8	98.2	98.1	97.0	98.3	98.2
500	650	610	880	48	85.3	88.4	88.8	96.5	97.2	97.2	97.9	98.2	98.1	98.1	98.4	98.2
560	750	686	990	48	85.7	88.4	88.5	96.6	97.2	97.1	97.9	98.2	98.1	98.1	98.3	98.2

IP55

Power P2		Nom. power	Nom. current	Standby loss	Frequency [%]											
					10	10	10	50	50	50	90	90	90	100	100	100
					Current [%]											
		[kVA]	[A]	[W]	25	50	100	25	50	100	25	50	100	25	50	100
					Operating point											
[kW]	[hp]				1	2	3	4	5	6	7	8	9	10	11	12
					Efficiency [%]											
0.55	0.75	1.3	1.8	14	48.0	62.7	74.0	81.7	89.1	93.1	88.7	94.5	96.5	89.6	94.7	96.8
0.75	1	1.7	2.4	14	52.4	66.8	76.2	83.9	90.3	93.7	89.9	95.0	96.7	90.7	95.4	97.0
1.1	1.5	2.1	3	14	53.6	67.5	75.8	84.6	90.7	93.5	90.4	95.2	96.5	91.2	95.5	96.8
1.5	2	2.8	4.1	14	57.3	70.0	77.0	86.3	91.6	93.9	91.4	95.5	96.7	92.1	96.0	96.9
2.2	3	3.9	5.6	14	60.1	71.9	77.8	87.4	92.1	94.0	92.0	95.8	96.7	92.6	96.2	97.0
3.0	4	5	7.2	14	61.8	73.2	78.5	88.2	92.5	94.2	92.5	95.9	96.8	93.1	96.4	97.1
4.0	5	6.9	10	14	65.0	75.4	79.3	89.5	93.2	94.6	93.4	96.4	97.0	94.0	96.8	97.3
5.5	7.5	9	13	14	68.8	78.0	81.6	91.1	94.0	95.3	94.5	96.8	97.4	94.9	97.5	97.6
7.5	10	11	16	14	71.2	79.6	82.5	92.0	94.4	95.5	95.1	97.0	97.5	95.5	97.4	97.7
11	15	16.6	24	24	73.5	80.8	82.6	92.8	94.8	95.5	95.5	97.1	97.4	98.9	97.5	97.7
15	20	22.2	32	24	76.2	82.5	83.8	93.5	95.3	95.8	95.9	97.3	97.5	96.2	97.6	97.8
18	25	26	37.5	24	78.0	83.6	84.5	94.0	95.6	96.0	96.2	97.5	97.6	96.5	97.7	97.8
22	30	30.5	44	27	80.3	85.0	85.2	94.7	96.0	96.2	96.6	97.6	97.7	96.8	97.9	97.9
30	40	42.3	61	27	81.1	85.3	85.1	94.8	96.0	96.1	96.6	97.5	97.5	96.9	97.8	97.7
37	50	50.6	73	30	81.8	85.5	84.9	94.9	96.0	96.0	96.6	97.5	97.3	96.9	97.7	97.6
45	60	62.4	90	30	83.0	86.0	84.9	95.2	96.0	95.9	96.8	97.4	97.2	97.0	97.7	97.5
55	75	73.4	106	30	83.6	86.3	85.6	95.4	96.2	96.0	96.9	97.5	97.3	97.1	97.8	97.5
75	100	102	147	41	85.0	87.1	87.5	95.8	96.6	96.4	97.2	97.7	97.6	97.4	97.9	97.7
90	125	123	177	41	86.6	88.2	88.0	96.0	96.7	96.4	97.2	97.7	97.6	97.4	97.9	97.7

IP54

Power P2		Nom. power	Nom. current	Standby loss	Frequency [%]											
					10	10	10	50	50	50	90	90	90	100	100	100
					Current [%]											
		[kVA]	[A]	[W]	25	50	100	25	50	100	25	50	100	25	50	100
					Operating point											
[kW]	[hp]				1	2	3	4	5	6	7	8	9	10	11	12
					Efficiency [%]											
110	150	147	212	37	88.3	89.5	88.7	96.3	96.8	96.5	97.2	97.8	97.6	97.4	97.9	97.6
132	200	180	260	37	88.0	89.5	88.6	96.3	96.8	96.5	97.3	97.8	97.7	97.4	98.0	97.7
160	250	218	315	37	84.7	86.7	83.4	95.3	96.1	95.7	96.6	97.5	97.3	96.8	97.8	97.6
200	300	274	395	37	83.3	86.4	84.2	95.1	96.2	96.0	96.7	97.6	97.5	96.9	97.8	97.7
250	350	333	480	37	82.3	86.0	84.9	95.2	96.3	96.2	96.8	97.7	97.7	97.0	97.9	97.9
315	450	407	588	37	80.7	85.3	85.6	95.1	96.3	96.5	97.0	97.8	97.8	97.3	97.9	98.0
355	500	456	658	48	83.9	87.7	88.5	96.1	97.0	97.2	97.7	98.2	98.2	97.9	98.3	98.3
400	550	516	745	48	84.5	87.8	88.3	96.3	97.1	97.1	97.8	98.2	98.1	98.0	98.3	98.2
450	600	554	800	48	84.9	88.0	88.2	96.4	97.1	97.1	97.8	98.2	98.1	98.0	98.3	98.2
500	650	610	880	48	85.3	88.4	88.8	96.5	97.2	97.2	97.9	98.2	98.1	98.1	98.4	98.2
560	750	686	990	48	85.7	88.4	88.5	96.6	97.2	97.1	97.9	98.2	98.1	98.1	98.3	98.2

IP66

Power P2		Nom. power	Nom. current	Standby loss	Frequency [%]											
					10	10	10	50	50	50	90	90	90	100	100	100
					Current [%]											
		[kVA]	[A]	[W]	25	50	100	25	50	100	25	50	100	25	50	100
					Operating point											
[kW]	[hp]				1	2	3	4	5	6	7	8	9	10	11	12
					Efficiency [%]											
0.55	0.75	1.3	1.8	14	48.0	62.7	74.0	81.7	89.1	93.1	88.7	94.5	96.5	89.6	94.7	96.8
0.75	1	1.7	2.4	14	52.4	66.8	76.2	83.9	90.3	93.7	89.9	95.0	96.7	90.7	95.4	97.0
1.1	1.5	2.1	3	14	53.6	67.5	75.8	84.6	90.7	93.5	90.4	95.2	96.5	91.2	95.5	96.8
1.5	2	2.8	4.1	14	57.3	70.0	77.0	86.3	91.6	93.9	91.4	95.5	96.7	92.1	96.0	96.9
2.2	3	3.9	5.6	14	60.1	71.9	77.8	87.4	92.1	94.0	92.0	95.8	96.7	92.6	96.2	97.0
3.0	4	5	7.2	14	61.8	73.2	78.5	88.2	92.5	94.2	92.5	95.9	96.8	93.1	96.4	97.1
4.0	5	6.9	10	14	65.0	75.4	79.3	89.5	93.2	94.6	93.4	96.4	97.0	94.0	96.8	97.3
5.5	7.5	9	13	14	68.8	78.0	81.6	91.1	94.0	95.3	94.5	96.8	97.4	94.9	97.5	97.6
7.5	10	11	16	14	71.2	79.6	82.5	92.0	94.4	95.5	95.1	97.0	97.5	95.5	97.4	97.7
11	15	16.6	24	24	73.5	80.8	82.6	92.8	94.8	95.5	95.5	97.1	97.4	98.9	97.5	97.7
15	20	22.2	32	24	76.2	82.5	83.8	93.5	95.3	95.8	95.9	97.3	97.5	96.2	97.6	97.8
18	25	26	37.5	24	78.0	83.6	84.5	94.0	95.6	96.0	96.2	97.5	97.6	96.5	97.7	97.8
22	30	30.5	44	27	80.3	85.0	85.2	94.7	96.0	96.2	96.6	97.6	97.7	96.8	97.9	97.9
30	40	42.3	61	27	81.1	85.3	85.1	94.8	96.0	96.1	96.6	97.5	97.5	96.9	97.8	97.7
37	50	50.6	73	30	81.8	85.5	84.9	94.9	96.0	96.0	96.6	97.5	97.3	96.9	97.7	97.6
45	60	62.4	90	30	83.0	86.0	84.9	95.2	96.0	95.9	96.8	97.4	97.2	97.0	97.7	97.5
55	75	73.4	106	30	83.6	86.3	85.6	95.4	96.2	96.0	96.9	97.5	97.3	97.1	97.8	97.5
75	100	102	147	41	85.0	87.1	87.5	95.8	96.6	96.4	97.2	97.7	97.6	97.4	97.9	97.7
90	125	123	177	41	86.6	88.2	88.0	96.0	96.7	96.4	97.2	97.7	97.6	97.4	97.9	97.7

3 × 525-600 V

IP20

Power P2		Nom. power	Nom. current	Standby loss	Frequency [%]											
					10	10	10	50	50	50	90	90	90	100	100	100
					Current [%]											
		[kVA]	[A]	[W]	25	50	100	25	50	100	25	50	100	25	50	100
					Operating point											
[kW]	[hp]				1	2	3	4	5	6	7	8	9	10	11	12
					Efficiency [%]											
0.75	1	1.7	1.7	12	53.9	66.8	74.1	88.6	92.8	94.8	95.5	95.3	96.6	96.4	96.0	97.0
1.1	1.5	2.4	2.4	12	54.6	67.2	74.5	88.6	93.1	95.0	95.2	95.4	96.8	96.1	96.1	97.1
1.5	2	2.7	2.7	12	54.3	67.3	74.8	88.7	93.0	95.0	95.4	95.5	96.8	96.3	96.1	97.2
2.2	3	3.9	3.9	12	54.8	67.5	75.1	88.8	93.1	95.2	95.4	95.5	96.9	96.3	96.1	97.3
3.0	4	4.9	4.9	12	54.5	67.6	75.3	88.8	93.1	95.2	95.5	95.5	96.9	96.4	96.1	97.3
4.0	5	6.1	6.1	12	54.8	67.5	75.4	88.9	93.2	95.3	95.5	95.5	96.9	96.4	96.2	97.3
5.5	7.5	9	9	12	59.5	70.7	77.4	90.6	94.0	95.7	96.2	96.1	97.1	96.9	96.6	97.5
7.5	10	11	11	12	63.2	73.0	77.7	91.8	94.6	95.8	96.7	96.5	97.2	97.3	96.9	97.6
11	15	17.9	18	18	70.3	78.4	81.6	93.4	95.6	96.4	97.0	97.0	97.5	97.4	97.3	97.8
15	20	21.9	22	18	75.1	81.9	84.3	94.3	96.1	96.7	97.1	97.3	97.7	97.5	97.6	97.9
18	25	26.9	27	18	82.3	86.8	87.9	95.6	96.9	97.2	97.3	97.7	97.9	97.5	97.8	98.1
22	30	33.9	34	22	82.8	87.1	87.9	95.7	97.0	97.2	97.4	97.7	97.9	97.6	97.9	98.1
30	40	40.8	41	22	83.4	87.5	88.2	95.9	97.1	97.3	97.5	97.8	98.0	97.7	98.0	98.1
37	50	51.8	52	22	84.3	88.0	88.4	96.2	97.2	97.4	97.7	97.9	98.1	97.9	98.1	98.2
45	60	61.7	62	25	85.5	88.7	88.9	96.5	97.4	97.5	97.9	98.1	98.2	98.1	98.2	98.3

Power P2		Nom. power	Nom. current	Standby loss	Frequency [%]											
					10	10	10	50	50	50	90	90	90	100	100	100
					Current [%]											
		[kVA]	[A]	[W]	25	50	100	25	50	100	25	50	100	25	50	100
					Operating point											
[kW]	[hp]				1	2	3	4	5	6	7	8	9	10	11	12
					Efficiency [%]											
55	75	82.7	83	25	85.5	88.7	88.8	96.5	97.4	97.5	97.9	98.1	98.2	98.1	98.2	98.3
75	100	99.6	100	29	85.5	88.6	88.7	96.5	97.4	97.4	97.9	98.1	98.2	98.1	98.2	98.3
90	125	130.5	131	29	85.5	88.6	88.6	96.5	97.3	97.4	97.9	98.1	98.1	98.1	98.2	98.2

IP55

Power P2		Nom. power	Nom. current	Standby loss	Frequency [%]											
					10	10	10	50	50	50	90	90	90	100	100	100
					Current [%]											
		[kVA]	[A]	[W]	25	50	100	25	50	100	25	50	100	25	50	100
					Operating point											
[kW]	[hp]				1	2	3	4	5	6	7	8	9	10	11	12
					Efficiency [%]											
0.75	1	1.7	1.7	14	53.9	66.8	73.3	88.6	92.8	94.6	95.5	95.3	96.6	96.4	95.9	97.0
1.1	1.5	2.4	2.4	14	54.6	67.2	74.2	88.6	92.9	94.8	95.2	95.4	96.7	96.1	96.1	97.1
1.5	2	2.7	2.7	14	54.3	67.3	74.2	88.7	93.0	94.9	95.4	95.4	96.7	96.3	96.1	97.1
2.2	3	3.9	3.9	14	54.4	67.2	74.8	88.8	93.1	95.1	95.6	95.5	96.8	96.5	96.1	97.2
3.0	4	4.9	4.9	14	54.5	67.4	75.0	88.8	93.1	95.1	95.5	95.5	96.8	96.4	96.1	97.2
4.0	5	6.1	6.1	14	54.8	67.5	75.2	88.9	93.1	95.2	95.5	95.5	96.9	96.4	96.1	97.2
5.5	7.5	9	9	14	59.5	70.7	77.3	90.6	94.0	95.7	95.2	96.1	97.1	96.9	96.6	97.5
7.5	10	11	11	14	63.2	73.0	77.7	91.8	94.6	95.8	96.7	96.5	97.2	97.3	96.9	97.6
11	15	17.9	18	24	70.1	78.2	81.1	93.4	95.5	96.2	96.9	96.9	97.4	97.4	97.3	97.7
15	20	21.9	22	24	75.1	81.7	83.9	94.3	96.1	96.6	97.1	97.3	97.6	97.5	97.5	97.8
18	25	26.9	27	24	82.1	86.6	87.5	95.5	96.8	97.1	97.3	97.6	97.8	97.5	97.8	98.0
22	30	33.9	34	27	82.7	87.0	87.7	95.7	96.9	97.2	97.4	97.7	97.9	97.6	97.9	98.1
30	40	40.8	41	27	83.3	87.3	87.9	95.9	97.0	97.2	97.5	97.8	98.0	97.7	98.0	98.1
37	50	51	52	30	84.2	87.9	88.2	96.2	97.2	97.3	97.7	97.9	98.0	97.9	98.1	98.2
45	60	61.7	62	30	85.5	88.6	88.6	96.5	97.3	97.4	97.9	98.1	98.1	98.1	98.2	98.2
55	75	82.7	83	30	85.5	88.6	88.6	96.5	97.3	97.4	97.9	98.1	98.1	98.1	98.2	98.2
75	100	99.6	100	41	85.5	88.6	88.5	96.5	97.3	97.4	97.9	98.1	98.1	98.1	98.2	98.2
90	125	130.5	131	41	85.4	88.5	88.5	96.5	97.3	97.4	97.9	98.1	98.1	98.1	98.2	98.2

3 × 525-690 V

IP20

Power P2		Nom. power	Nom. current	Standby loss	Frequency [%]											
					10	10	10	50	50	50	90	90	90	100	100	100
					Current [%]											
		[kVA]	[A]	[W]	25	50	100	25	50	100	25	50	100	25	50	100
					Operating point											
[kW]	[hp]				1	2	3	4	5	6	7	8	9	10	11	12
					Efficiency [%]											
1.1	1.5	1.9	1.6	12	46.6	61.3	72.1	80.1	87.8	91.9	87.1	92.7	95.3	88.0	93.4	95.7
1.5	2	2.6	2.2	12	53.9	67.2	76.5	84.4	90.4	93.4	90.0	94.0	96.2	90.8	94.9	96.5
2.2	3	3.8	3.2	12	62.2	73.6	80.7	88.2	92.5	94.6	92.5	95.7	96.9	93.1	96.1	97.2
3.0	4	5.4	4.5	12	68.4	78.2	83.5	90.8	94.0	95.4	94.3	96.5	97.3	94.7	96.8	97.5

Power P2		Nom. power	Nom. current	Standby loss	Frequency [%]											
					10	10	10	50	50	50	90	90	90	100	100	100
					Current [%]											
		[kVA]	[A]	[W]	25	50	100	25	50	100	25	50	100	25	50	100
					Operating point											
[kW]	[hp]				1	2	3	4	5	6	7	8	9	10	11	12
					Efficiency [%]											
4.0	5	6.6	5.5	12	71.8	80.5	84.9	92.0	94.6	95.8	95.0	96.9	97.5	95.4	97.2	97.7
5.5	7.5	9	7.5	12	76.5	83.3	87.3	93.5	95.5	96.5	95.9	97.4	97.9	96.2	97.6	98.1
7.5	10	12	10	12	80.0	85.3	88.4	94.6	96.0	96.8	96.5	97.7	98.1	96.8	97.9	98.2

IP21

Power P2		Nom. power	Nom. current	Standby loss	Frequency [%]											
					10	10	10	50	50	50	90	90	90	100	100	100
					Current [%]											
		[kVA]	[A]	[W]	25	50	100	25	50	100	25	50	100	25	50	100
					Operating point											
[kW]	[hp]				1	2	3	4	5	6	7	8	9	10	11	12
					Efficiency [%]											
11	15	15.5	13	22	64.4	74.2	80.7	87.6	91.7	94.0	91.2	95.1	96.5	91.7	95.6	96.8
15	20	21.5	18	22	69.9	78.0	82.9	90.0	93.1	94.7	93.0	95.9	96.9	93.4	96.3	97.1
18.5	25	26.3	22	22	73.0	79.8	84.0	91.2	93.7	95.1	93.8	96.3	97.0	94.2	96.7	97.3
22	30	32.3	27	22	75.6	81.4	84.9	92.3	94.3	95.4	94.6	96.6	97.2	94.9	96.9	97.5
30	40	40.6	34	22	76.9	82.7	86.1	92.6	94.7	95.7	94.8	96.9	97.4	95.1	97.1	97.6
37	50	49	41	22	79.0	83.9	86.6	93.4	95.0	95.9	95.4	97.1	97.5	95.6	97.6	97.7
45	60	62.1	52	25	87.7	90.3	91.0	96.9	97.5	97.6	98.0	98.5	98.5	98.2	98.6	98.6
55	75	74.1	62	25	88.8	90.8	91.0	97.2	97.6	97.6	98.2	98.5	98.4	98.3	98.6	98.5
75	100	99.2	83	37	87.6	90.0	90.6	96.9	97.5	97.6	98.1	98.5	98.4	98.2	98.6	98.5
90	125	119.5	100	37	86.4	88.7	88.9	96.7	97.2	97.2	98.0	98.3	98.3	98.2	98.5	98.4
110	150	157	131	37	84.6	87.6	88.5	96.4	97.1	97.2	97.9	98.3	98.3	97.1	98.4	98.4
132	200	185	155	37	83.4	86.8	88.0	96.1	97.0	97.2	97.8	98.2	98.3	98.0	98.4	98.4
160	250	229	192	37	84.1	87.3	88.4	96.3	97.1	97.3	97.9	98.3	98.3	98.1	98.4	98.4
200	300	289	242	37	84.9	87.8	88.5	96.5	97.2	97.3	98.0	98.3	98.3	98.2	98.5	98.5
250	350	347	290	37	85.2	88.0	88.7	96.6	97.2	97.4	98.0	98.3	98.4	98.2	98.5	98.5
315	450	411	344	37	86.0	88.3	88.6	96.8	97.3	97.3	98.1	98.4	98.4	98.3	98.5	98.5

IP55

Power P2		Nom. power	Nom. current	Standby loss	Frequency [%]											
					10	10	10	50	50	50	90	90	90	100	100	100
					Current [%]											
		[kVA]	[A]	[W]	25	50	100	25	50	100	25	50	100	25	50	100
					Operating point											
[kW]	[hp]				1	2	3	4	5	6	7	8	9	10	11	12
					Efficiency [%]											
11	15	15.5	13	22	64.4	74.2	80.7	87.6	91.7	94.0	91.2	95.1	96.5	91.7	95.6	96.8
15	20	21.5	18	22	69.9	78.0	82.9	90.0	93.1	94.7	93.0	95.9	96.9	93.4	96.3	97.1
18	25	26.3	22	22	73.0	79.8	84.0	91.2	93.7	95.1	93.8	96.3	97.0	94.2	96.7	97.3
22	30	32.3	27	22	75.6	81.4	84.9	92.3	94.3	95.4	94.6	96.6	97.2	94.9	96.9	97.5
30	40	40.6	34	22	76.9	82.7	86.1	92.6	94.7	95.7	94.8	96.9	97.4	95.1	97.1	97.6
37	50	49	41	22	79.0	83.9	86.6	93.4	95.0	95.9	95.4	97.1	97.5	95.6	97.3	97.7
45	60	62.1	52	25	87.7	90.3	91.0	96.9	97.5	97.6	98.0	98.5	98.5	98.2	98.6	98.6

Power P2		Nom. power	Nom. current	Standby loss	Frequency [%]											
					10	10	10	50	50	50	90	90	90	100	100	100
					Current [%]											
		[kVA]	[A]	[W]	25	50	100	25	50	100	25	50	100	25	50	100
					Operating point											
[kW]	[hp]				1	2	3	4	5	6	7	8	9	10	11	12
					Efficiency [%]											
55	75	74.1	62	25	88.8	90.8	91.0	97.2	97.6	97.6	98.2	98.5	98.4	98.3	98.6	98.5
75	100	99.2	83	37	87.6	90.0		96.9	97.5	97.6	98.1	98.5	98.4	98.2	98.6	98.5
90	125	119.5	100	37	86.4	88.7	88.9	96.7	97.2	97.2	98.0	98.3	98.3	98.2	98.5	98.4

IP54

Power P2		Nom. power	Nom. current	Standby loss	Frequency [%]											
					10	10	10	50	50	50	90	90	90	100	100	100
					Current [%]											
		[kVA]	[A]	[W]	25	50	100	25	50	100	25	50	100	25	50	100
					Operating point											
[kW]	[hp]				1	2	3	4	5	6	7	8	9	10	11	12
					Efficiency [%]											
110	150	157	131	37	84.6	87.6	88.5	96.4	97.1	97.2	97.9	98.3	98.3	98.1	98.4	98.4
132	200	185	155	37	83.4	86.8	88.0	96.1	97.0	97.2	97.8	98.2	98.3	98.0	98.4	98.4
160	250	229	192	37	84.1	87.3	88.4	96.3	97.1	97.3	97.9	98.3	98.3	98.1	98.4	98.4
200	300	289	242	37	84.9	87.8	88.5	96.5	97.2	98.3	98.0	98.3	98.3	98.2	98.5	98.5
250	350	347	290	37	85.2	88.0	88.7	96.6	97.2	97.4	98.0	98.3	98.4	98.2	98.5	98.5
315	450	411	344	37	86.0	88.3	88.6	96.8	97.3	97.3	98.1	98.4	98.4	98.3	98.5	98.5

12. Standards

The CUE is designed according to the following directives and standards:

EMC Directive 2004/108/EC:

- EN 50011
- EN 61000-6-3
- EN 61800-3.

Low Voltage Directive 2006/95/EC:

- EN 50178
- EN 61800-5-1:2003/IEC 61800-5-1:2003
- EN 61800-3:2005/IEC 61800-3:2004/IEC 60034-11
- EN 6034-12/IEC 60034-12/IEC 60038/IEC 62114
- EN 50102
- EN ISO 2409
- EN ISO 3743-1
- EN ISO 4871
- EN ISO 11203
- DIN 44082.

The CUE variants with the Safe Torque Off (STO) are also designed according to the following directives and standards:

Machine Directive 2006/42/EC:

- EN ISO 13849-1
- EN IEC 62061
- EN IEC 61800-5-2.

Safety of Machinery:

- EN ISO 13849-1/IEC 62061/IEC 60204-1.

Functional Safety:

- IEC 61508-1 to -7/ IEC 61800-5-2.

Safety function:

- IEC 618-5-2 (Safe Torque Off, STO)
- IEC 60204-1 (stop category 0).

13. Accessories

CUE accessories

Connectors	Type	Product number
Connectors for CUE (spare parts)	All types	97641449
Add-on module		
Sensor input module	MCB 114	96760901
Multipump module	MCO 101	99753103
Grundfos Local Control Panel	GLCP	99591437
Remote-mounting option for GLCP, with 3 m cable	GLCP remote mounting	96801229
Floor mounting option		
Enclosures D1 and D2 option, including pedestal parts and instructions	Floor mounting	96801230
Enclosure D1h option, including pedestal parts	Floor mounting	98606900
Enclosure D2h option, including pedestal parts	Floor mounting	98606903
IP21/NEMA1 option		
Enclosure A2	IP21/NEMA1 A2	96801223
Enclosure A3	IP21/NEMA1 A3	96801224
Enclosure B3	IP21/NEMA1 B3	96801225
Enclosure B4	IP21/NEMA1 B4	96801226
Enclosure C3	IP21/NEMA1 C3	96801227
Enclosure C4	IP21/NEMA1 C4	96801228
Output filters		
Sine-wave filters [18)]		
dU/dt filters [18)]		

[18)] For product numbers of sine-wave filters and dU/dt filters, see the section about selection tables.

Related information

Selection tables

Output filters

Communication modules

Communication interface	Type	Product number
LonWorks gateway	CIU 100	96753735
PROFIBUS gateway	CIU 150	96753081
Modbus gateway	CIU 200	96753082
GSM modem	CIU 250	96787106
BACnet communication interface	CIU 300	96893769
Grundfos Remote Management (GRM)	CIU 271	96898819
CIU 900	Empty CIU unit For all CIM modules	99448387
CIU 901	Empty CIU unit with built-in IO board (IO 270) For the CIM 200, CIM 260 and CIM 500	99448389
CIM 040 GENI TTL	For the CU 354 DDD	98415941
CIM 050 GENIbus		96824631
CIM 060 GlowPan	98778357 antenna kit required for the CIM 060	98778356
CIM 100 LON	LON for pumps	96824797
CIM 110	LON for boosters and twin pumps, CIM to be installed in the master head in the twin pumps and the Multi-E	96824798
CIM 150 PROFIBUS DP		96824793
CIM 200 Modbus RTU		96824796

Communication interface	Type	Product number
CIM 260-EU 3G/4G cellular	For European frequency bands 99518079 antenna kit required 3G/4G SIM card	99439302
CIM 260-US 3G/4G cellular	For North American frequency bands 99518079 antenna kit required 3G/4G SIM card	99439306
CIM 280-EU Grundfos iSolutions Cloud/GRM 3G/4G [19)]	For European frequency bands 99518079 antenna kit required	99439724
CIM 280-US Grundfos iSolutions Cloud/GRM 3G/4G [19)]	For North American frequency bands 99518079 antenna kit required	99439725
CIM 300 BACnet MS/TP		96893770
CIM 500 Ethernet [20)]	For Industrial Ethernet protocols: PROFINET, Modbus TCP, BACnet IP, EtherNet/IP and GRM IP	98301408

19) The 3G/4G SIM card must have the additional international PDU SMS roaming activated.

20) Additional GRM contract is necessary for data hosting in the Grundfos iSolutions Cloud/GRM.

Sensors, SI units

Danfoss pressure sensor, cable not included	Type	Measuring range [bar]	Product number
Pressure connection: G 1/2" A (DIN 16288 - B6kt) Electrical connection: Plug (DIN 43650)	MBS 3000	0 - 2.5	96478188
	MBS 3000	0-4	91072075
	MBS 3000	0-6	91072076
	MBS 3000	0-10	91072077
	MBS 3000	0-16	91072078
	MBS 3000	0-25	91072079
Danfoss pressure sensor option, 2 m screened cable			
Pressure connection: G 1/2" A (DIN 16288 - B6kt) 5 cable clips (black) Instruction manual PT (00 40 02 12)	MBS 3000	0-4	96428014
	MBS 3000	0-6	96428015
	MBS 3000	0-10	96428016
	MBS 3000	0-16	96428017
	MBS 3000	0-25	96428018
Pressure connection: G 1/4" A (DIN 16288 - B6kt) 5 cable clips (black) Instruction manual PT (00 40 02 12)	MBS 3000	0 - 2.5	405159
	MBS 3000	0-4	405160
	MBS 3000	0-6	405161
	MBS 3000	0-10	405162
	MBS 3000	0-16	405163
Grundfos differential pressure sensor option, 0.9 m screened cable			
Pressure connection: 7/16" Including fittings for pressure connection (1/4" - 7/16") Brackets for wall and motor mounting 3 capillary tubes (short/long) and 5 cable clips (black) Installation and operating instructions Service kit instructions	DPI	0 - 0.6	96611522
	DPI	0-1	96611523
	DPI	0 - 1.6	96611524
	DPI	0 - 2.5	96611525
	DPI	0-4	96611526
	DPI	0-6	96611527
	DPI	0-10	96611550
Carlo Gavazzi temperature sensor		[°C]	
Temperature sensors	TTA (0) 25	0-25	96432591
	TTA (-25) 25	-25 to +25	96430194
	TTA (50) 100	50-100	96432592
	TTA (0) 150	0-150	96430195
Sensor pocket for TTA, with G 1/2" connection	∅9 x 50	-	96430201
	∅9 x 100	-	96430202
Cutting ring bush for TTA, with G 1/2" connection	-	-	96430203
Siemens flowmeter		[m^3/h]	

Danfoss pressure sensor, cable not included	Type	Measuring range [bar]	Product number
Siemens flowmeter, MAGFLO	MAG 3100/5000	1-5 (DN 25)	00ID8285
	MAG 3100/5000	3-10 (DN 40)	00ID8286
	MAG 3100/5000	6-30 (DN 65)	00ID8287
	MAG 3100/5000	20-75 (DN 100)	00ID8288
Siemens analog level sensor		[bar]	
Analog level sensor with cable hanger	-	0.5	96377410
Ultrasonic transmitter for level	-	0.5	96693767
Jumo level sensor			
With 10 m cable	4390	0 - 0.1	99488569
With 20 m cable	4390	0 - 0.1	99488553
With 30 m cable	4390	0-1	99488550
With 75 m cable	4390	0-1	99488564
With 120 m cable	4390	0-1	99488566
With 30 m cable	4390	0 - 2.5	99488565
With 65 m cable	4390	0-6	99488567
With 105 m cable	4390	0-10	99488578

All sensors have a 4-20 mA output.

Sensors, US units

Danfoss pressure sensor, cable not included	Type	Measuring range [psi]	Product number
Pressure connection: 1/4"-18 NPT Electrical connection: DIN 43650 (plug not included)	MBS 3000	0-58	91136013
	MBS 3000	0-87	91136014
	MBS 3000	0-145	91136015
	MBS 3000	0-232	91136016
	MBS 3000	0-362	91136017
	MBS 3000	0-580	91136018
	MBS 3000	0-870	91136019
Danfoss pressure sensor, 2 m screened cable			
Pressure connection: 1/2"-14 NPT	MBS 3000	0-120	96437852
Grundfos differential pressure sensor, 0.9 m screened cable		[ft]	
Pressure connection: 7/16" flare	DPI	0-20	96624396
	DPI	0-33	96624397
	DPI	0-54	96624398
	DPI	0-84	96624399
	DPI	0-200	96624441
	DPI	0-334	96624442

All sensors have a 4-20 mA output.

Pt100 temperature sensors

Pt100 temperature sensor	Type	Measuring range	Product number
With 20 m (65 ft) cable	-	-	96408957
With 40 m (131 ft) cable	-	-	96408684
With 60 m (197 ft) cable	-	-	96408958
With 80 m (262 ft) cable	-	-	96408959
With 100 m (328 ft) cable	-	-	96408960
With 20 m (65 ft) cable	-	-	96437784
With 40 m (131 ft) cable	-	-	96437785
With 60 m (197 ft) cable	-	-	96437786
With 80 m (262 ft) cable	-	-	96437787
With 100 m (328 ft) cable	-	-	96437788

Pt100 temperature sensor	Type	Measuring range	Product number
Pt100 temperature sensor and cable extension			
Pt100	-	-	95043173
Cable extension [21)]	-	-	00RM5271
Cable extension, disassembled option [21)]	-	-	96571480
Cable extension, assembled option [21)]	-	-	96763223

21) State the number of meters when ordering.

Other accessories

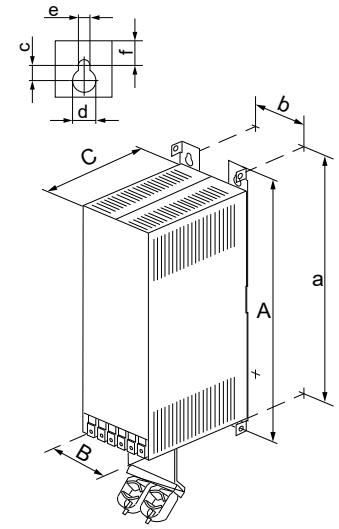
Dry-running protection [22)]	Type	Product number
Module, sensor, 5 m (16 ft) cable, 200-240 V [23)]	LiqTec	96556429
Module, sensor, 5 m (16 ft) cable, 80-130 V [23)]	LiqTec	99556430
Extension cable, 15 m (49 ft)		96443676

22) Main pump types: CR, CRI, CRN, MTR, SPK, CRK and CHI

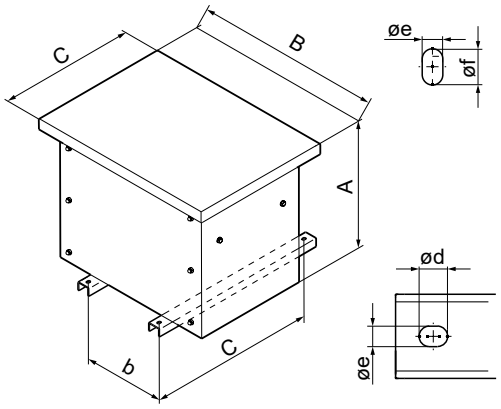
23) Sensor connection: 1/2"

Output filters

Dimensions and weights of output filters



Wall mounting



Floor mounting

Product number	Mounting	IP rating	Height [mm]		Width [mm]		Depth [mm]		Screw holes [mm]			Weight [kg]
			A	a	B	b	C	c	Ød	Øe	f	
Sine-wave filters												
96754941	Wall	IP20	200	190	75	60	205	-	8	4.5	7	4.2
96754972	Wall	IP20	268	257	90	70	206	-	11	6.5	8	5.8
96754973	Wall	IP20	268	257	90	70	205	-	11	6.5	8	7.1
96754974	Wall	IP20	268	257	130	90	205	-	11	6.5	8	9.1
96754976	Wall	IP20	330	312	150	120	260	-	19	9	12	16.9
96754977	Wall	IP20	430	412	150	120	260	-	19	9	12	19.9
96754978	Wall	IP20	530	500	170	125	260	-	19	9	12	39
96755019	Wall	IP20	610	580	170	125	260	-	19	9	12	41
96755021	Wall	IP20	200	190	75	60	205	-	8	4.5	7	41
97774436	Floor	IP23	918	-	940	779	792	660	11	22	-	205
97775142	Floor	IP23	918	-	940	779	792	660	11	22	-	237
97775146	Floor	IP23	918	-	940	779	792	660	11	22	-	307
97775148	Floor	IP23	918	-	940	779	792	660	11	22	-	370
97775149	Floor	IP23	1161	-	1260	1099	991	860	11	22	-	425
97775161	Wall	IP20	465	420	118	85	243	-	13	6.2	-	21
97775162	Wall	IP20	505	460	158	125	310	-	13	6.2	-	31
97775163	Wall	IP20	625	580	158	125	310	-	13	6.2	-	49
97775164	Floor	IP23	715	-	798	676	620	502	11	22	-	142
97775165	Floor	IP23	715	-	798	676	620	502	11	22	-	160
97775166	Floor	IP23	918	-	940	779	792	660	11	22	-	270
97775167	Floor	IP23	1161	-	1260	1099	991	860	11	22	-	475
97775168	Floor	IP23	1161	-	1260	1099	991	860	11	22	-	673
93303174	Floor	IP23	1290	570	800	760	1152	-	-	11	15	445
93303175	Floor	IP23	1290	610	800	760	1152	-	-	11	15	605
93303176	Floor	IP23	1290	610	800	760	1152	-	-	11	15	810
93303177	Floor	IP23	1290	540	800	760	1152	-	-	11	15	550
dU/dt filters												
97669869	Wall	IP20	475	379	157	125	248	11.5	13	6.2	6	16.2
97669896	Wall	IP20	475	379	158	125	248	11.5	13	6.2	6	25.5
97669902	Wall	IP20	525	429	188	155	335	11.5	13	6.2	6	30
97669905	Floor	IP23	620	-	425	325	700	660	-	13	17	64.5

Product number	Mounting	IP rating	Height [mm]		Width [mm]		Depth [mm]		Screw holes [mm]			Weight [kg]
			A	a	B	b	C	c	Ød	Øe	f	
97669906	Floor	IP23	620	-	425	325	700	660	-	13	17	67.5
97689248	Floor	IP23	620	-	425	325	700	660	-	13	17	78.5
93303173	Floor	IP23	792	660.5	940	779	918	-	-	11	22	182

Common mode filters

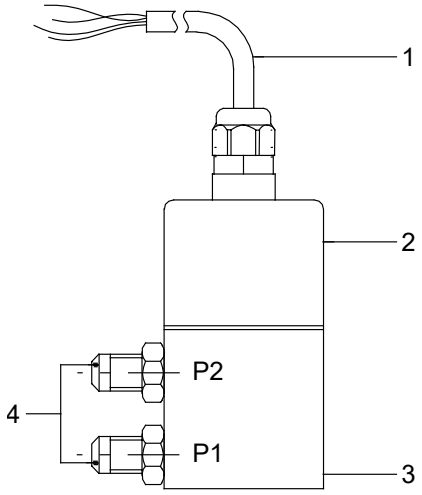
Product number	Description
99455084	Common mode filter, D frame
99455091	Common mode filter, C2, C3 and C4 frame
99455094	Common mode filter, A and B frame
99846117	Common mode filter, C1 frame

Grundfos differential pressure sensor, DPI

Product description

A cable (1) goes through an M12 x 1.5 Pg connection.

The sensor housing and parts in contact with the medium are made of Inox DIN W.-Nr. 1.4305 (3) with a composite PA top (2). The pressure connections (4) are DIN W.-Nr. 1.4305, 7/16" UNF, and the gaskets are FKM.



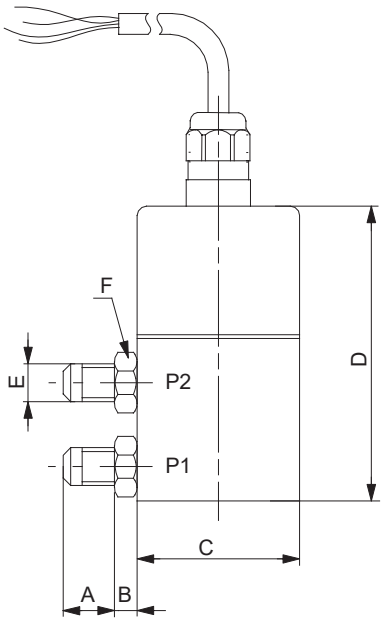
TM032057

DPI position numbers

The sensor is supplied with an angular bracket for mounting on the motor, or a bracket for wall mounting.

Options with other cable lengths and various fitting connectors are available.

Dimensions

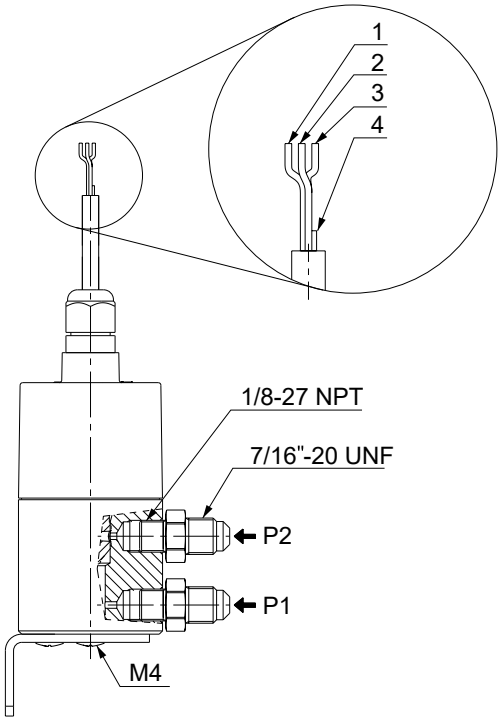


TM075436

Dimensions, DPI

Pos.	Dimensions
A	14 [mm]
B	6 [mm]
C	45 [mm]
D	77 [mm]
E	7/16"-20 UNF
F	SW 14
P1	Pump 1
P2	Pump 2

Wiring diagram



TM032225

Wiring diagram, DPI

Pos.	Color	Function
1	Brown	Supply voltage, 12-30 V
2	Yellow	GND
3	Green	Control signal
4	White	Test signal: must not be connected to the supply voltage, as it may cut off the conductor.

Technical data

Supply voltage	12-30 VDC
Output signal	4-20 mA
Load [Ω]	24 V: max. 500 Ω 16 V: max. 200 Ω 12 V: max. 100 Ω
Max. system pressure, P1 and P2 simultaneously	16 bar
Rupture pressure [bar (psi)]	1.5 (21.7) × system pressure
Measuring accuracy	2.5 % BFSL
Response time	< 0.5 sec
Liquid temperature range	-10 to +70 °C (14-158 °F)
Storage temperature range	-40 to +80 °C (-40 to +176 °F)
Electrical connection	3-wire 0.13 mm^2 (26 AWG) 0.9 m (2 ft) cable M12 × 1.5 in sensor top
Short-circuit proof	Yes
Protected against reverse polarity	Yes
Over supply voltage	Yes
Materials in contact with medium	DIN W.-Nr. 1.4305 FKM and PPS
Enclosure class	IP55
Weight	550 g (1.2 lb)
EMC (electromagnetic compatibility)	According to EN 61326-1
Emission/immunity	According to EN 61326-1
Connections	7/16"-UNF
Sealing material	FKM

Temperature sensor, TTA

Product description

The TTA is a temperature sensor with a Pt100 resistance element mounted in a 6×100 mm (4 inches) diameter measuring tube made of stainless steel, DIN W.-Nr. 1.4571, and a 4-20 mA sensor built into a type B head, DIN 43.729.

The connecting head is made of painted pressure die-cast aluminum with a Pg 16 screwed connection, stainless screws and neoprene rubber gasket.

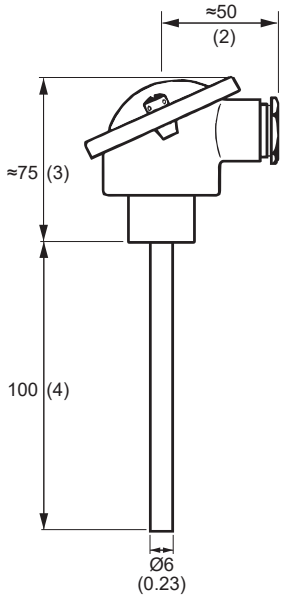
The sensor is built into the system by means of a cutting ring bush or by one of two designated sensor pockets, 9×100 mm (4 inches) or 9×50 mm (2 inches) in diameter.

The sensor pocket is made of stainless steel SINOX SSH 2 for 6 mm (0.2 inch) diameter measuring tubes and has a G 1/2" process connection.

The cutting ring bush for the 6 mm (0.2 inch) diameter measuring tube has a G 1/2" process connection.

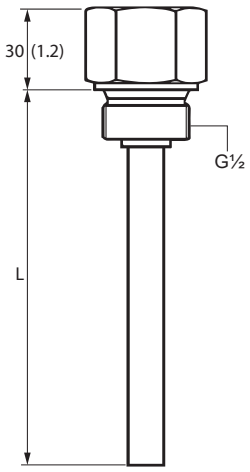
The cutting ring bush or the sensor pocket must be ordered separately.

Dimensions



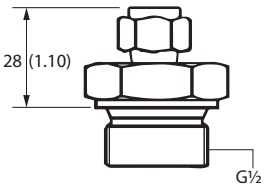
TM075439

TTA sensor



TM075438

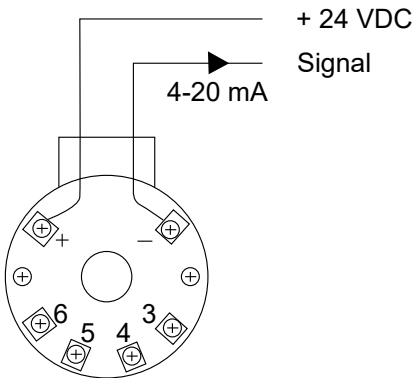
Sensor pocket



TM075440

Cutting ring bush

Wiring diagram



TM082679

Technical data

Description	TTA
Measuring accuracy	According to IEC 751, class B 0.3 °C at 0 °C (32.5 °F at 32 °F)
Response time • Without sensor pocket • With oil-filled sensor pocket	 • 28 s • 75 s
Enclosure class	IP55
Output signal	4-20 mA [24)]
Supply voltage	8.0 - 35.0 VDC
EMC (electromagnetic compatibility) • Emission • Immunity	According to EN 61326

24) All sensors have a 4-20 mA output.

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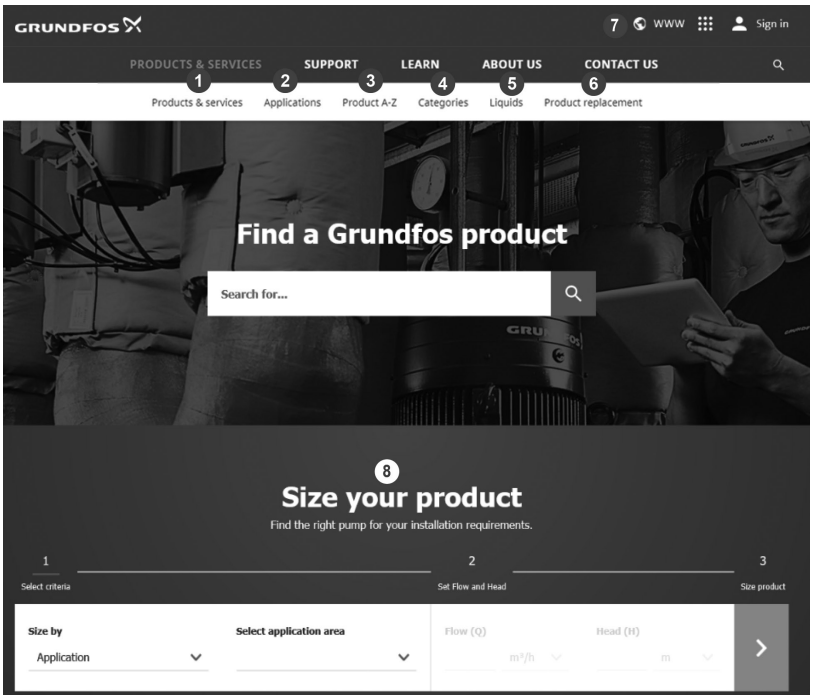

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