CUE

Installation and operating instructions

Installation and operating instructions

Other languages

net.grundfos.com/qr/i/96780034

be
think
innovate

GRUNDFOS

Original installation and operating instructions

These installation and operating instructions describe the Grundfos CU

E frequency converter.

Sections 1-7 provide the information necessary to be able to install and start up the products in a safe way.

Sections 8-13 provide important information about operating the setup, as well as information about fault finding and disposal of the product.

CONTENTS

		Page
1.	**General information**	**2**
1.1	Hazard statements	2
1.2	Notes	3
1.3	References	3
2.	**Product introduction**	**3**
2.1	Product description	3
2.2	Intended use	3
2.3	Applications	3
2.4	Identification	3
3.	**Receiving the product**	**4**
3.1	Transporting the product	4
3.2	Inspecting the product	4
3.3	Scope of delivery	4
4.	**Installation requirements**	**4**
4.1	IT mains	5
4.2	Aggressive environment	5
4.3	Reduced performance under certain conditions	5
5.	**Mechanical installation**	**5**
5.1	Enclosure types	5
5.2	Space requirements and air circulation	5
5.3	Mounting	5
5.4	Mounting on the floor	6
6.	**Electrical connection**	**6**
6.1	Electrical protection	6
6.2	EMC-correct installation	7
6.3	RFI filters	8
6.4	Motor cable	9
6.5	Mains and motor connection	9
6.6	STO installation, optional	14
6.7	Connecting the signal terminals	14
6.8	Connecting the signal relays	17
7.	**Starting up the product**	**19**
7.1	Switching on the product	19
7.2	Activating the optional STO function	19
8.	**Control functions**	**20**
8.1	Operating panel	20
8.2	Menu overview	20
8.3	Operating modes	21
8.4	Control modes	21
9.	**Setting the product**	**22**
9.1	First-time setup via the startup guide	22
9.2	Uploading or downloading of data	22
9.3	Asynchronous motor setup	22
9.4	Checking the motor rotation	22
9.5	Permanent-magnet motor setup	22
9.6	Synchronous reluctance motor setup	22
9.7	Automatic Energy Optimisation (AEO)	22
9.8	Local-control test	23
9.9	System startup	23
9.10	Resetting to default settings	23
10.	**Servicing the product**	**23**
11.	**Fault finding the product**	**24**
11.1	Overview of warnings and alarms	24
12.	**Technical data**	**27**
12.1	Enclosure	27
12.2	Operating conditions	27
12.3	Mechanical data	27
12.4	Electrical data	31
12.5	Dimensions and weights	32
12.6	Miscellaneous data	34
13.	**Disposal**	**34**

Read this document before installing the product. Installation and operation must comply with local regulations and accepted codes of good practice.

1. General information

1.1 Hazard statements

The symbols and hazard statements below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious personal injury.

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious personal injury.

CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

The hazard statements are structured in the following way:

SIGNAL WORD

Description of hazard

Consequence of ignoring the warning.

- Action to avoid the hazard.

1.2 Notes

The symbols and notes below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

Observe these instructions for explosion-proof products.

A blue or grey circle with a white graphical symbol indicates that an action must be taken.

A red or grey circle with a diagonal bar, possibly with a black graphical symbol, indicates that an action must not be taken or must be stopped.

If these instructions are not observed, it may result in malfunction or damage to the equipment.

Tips and advice that make the work easier.

1.3 References

Technical documentation for Grundfos CUE:

- The manual contains all information required for putting CUE into operation.
- The data booklet contains all technical information about the construction and applications of CUE.
- The service instructions contain all required instructions for dismantling and repairing the frequency converter.

Technical documentation is available on Grundfos Product Center at www.grundfos.com.

If you have any questions, please contact the nearest Grundfos company or service workshop.

2. Product introduction

2.1 Product description

CUE is a series of external frequency converters especially designed for pumps.

With the startup guide in CUE, the installer can quickly set central parameters and put CUE into operation.

Connected to a sensor or an external control signal, CUE will quickly adapt the pump speed to the actual demand.

The operating panel displays any alarms or warnings.

If the pump speed exceeds the rated speed, the pump will be overloaded.

2.2 Intended use

CUE frequency converters can be used in both new and existing installations. Local operation is performed via the operating panel which has a graphic display showing the menu structure. The menu structure uses the same system as Grundfos E-pumps.

Remote operation is performed via external signals, for instance via digital inputs or GENIbus.

2.3 Applications

The CUE series and Grundfos standard pumps are a supplement to the Grundfos E-pumps range with integrated frequency converter.

A CUE solution offers the same E-pump functionality in these cases:

- in mains voltage or power ranges not covered by the E-pump range
- in applications where an integrated frequency converter is not desirable or permissible.

2.4 Identification

2.4.1 Nameplate

CUE can be identified by means of the nameplate. An example is shown below.

TM04 3272 3808

Fig. 1 Example of nameplate

Text	Description
T/C:	CUE (product name) 202P1M2... (internal code)
Prod. no:	Product number: 12345678
S/N:	Serial number: 123456G234 The last three digits indicate the production date: 23 is the week, and 4 is the year 2004.
1.5 kW (2 hp)	Typical shaft power on the motor
IN:	Supply voltage, frequency and maximum input current
OUT:	Motor voltage, frequency and maximum output current. The maximum output frequency usually depends on the pump type.
CHASSIS/IP20	Enclosure class
Tamb.	Maximum ambient temperature

2.4.2 Packaging label

CUE can also be identified by means of the label on the packaging.

3. Receiving the product

WARNING

Crushing of feet

Death or serious personal injury

- Use safety shoes during transport and avoid stacking the boxes.

CAUTION

Heavy lifting

Minor or moderate personal injury

- Use proper lifting equipment when handling the product.
- Follow local regulations.

3.1 Transporting the product

To prevent damage during the transport, CUE must only be unpacked at the installation site.

3.2 Inspecting the product

Check on receipt that the packaging is intact and the unit is complete. In case of damage during transport, contact the transport company to complain.

Note that CUE is delivered in packaging which is not suitable for outdoor storage.

3.3 Scope of delivery

The packaging contains one or more accessory bags, documentation and the unit itself. See fig. 2.

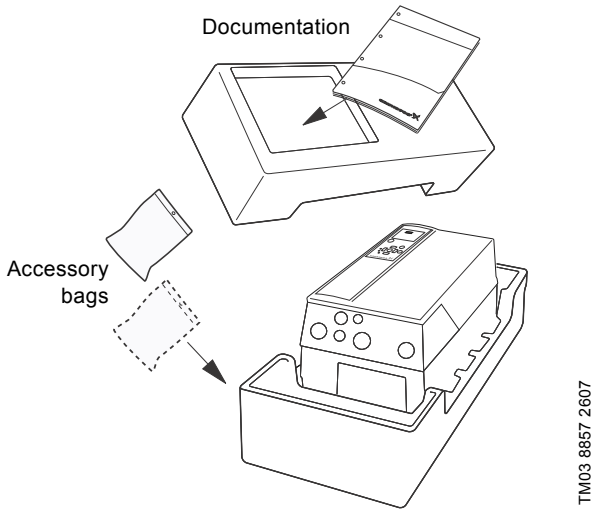


Fig. 2 CUE packaging

3.3.1 Lifting CUE

Always lift the product using the lifting holes. Use a bar to avoid bending the lifting holes. See fig. 3.

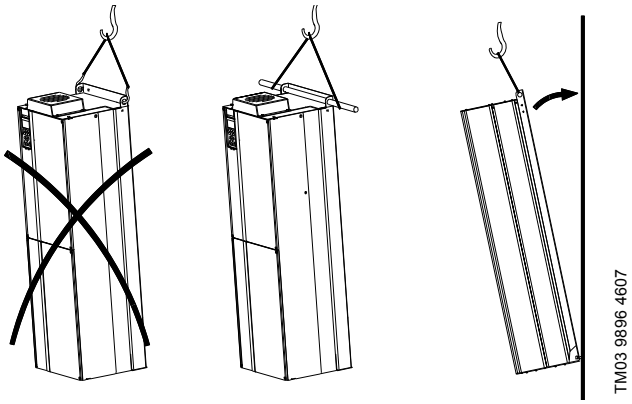


Fig. 3 Recommended lifting method

4. Installation requirements

Any installation, maintenance and inspection must be carried out by trained persons.

WARNING

Sharp element

Death or serious personal injury

- Use safety knives and protective gloves when unpacking the product.

WARNING

Heavy lifting

Death or serious personal injury

- Use proper lifting equipment when handling the product.
- Follow local regulations.

WARNING

Electric shock

Death or serious personal injury

- Before starting any work on the product, make sure that the power supply has been switched off at least for as long as stated below and that it cannot be accidentally switched on.
- Touching the electrical parts may be fatal, even after CUE has been switched off.

Voltage	Min. waiting time		
	4 minutes	15 minutes	20 minutes
200-240 V	0.75 - 3.7 kW (1-5 hp)	5.5 - 45 kW (7.5 - 60 hp)	
380-500 V	0.55 - 7.5 kW (0.75 - 10 hp)	11-90 kW (15-125 hp)	110-250 kW (150-350 hp)
525-600 V	0.75 - 7.5 kW (1-10 hp)		
525-690 V			11-250 kW (15-350 hp)

Only wait for a shorter period of time if stated on the nameplate of the product in question.

Safety regulations

- The OFF button of the operating panel does not disconnect CUE from the power supply and must therefore not be used as a safety switch.
- CUE must be earthed correctly and protected against indirect contact according to local regulations.
- The leakage current to protective earth exceeds 3.5 mA.
- Enclosure class IP20/21 must not be installed freely accessible, but only in a panel.
- Enclosure class IP54/55 must not be installed outdoors without additional protection against weather conditions and the sun.
- The STO function does not disconnect CUE from the power supply and must therefore not be used as a safety switch.
- The STO function does not prevent unwanted movement from external forces on the motor, for example, back pressure, and the motor shaft must be covered.

Always observe local regulations concerning cable cross-section, short-circuit protection and overcurrent protection.

The general safety necessitates special considerations as to these aspects:

- fuses and switches for overcurrent and short-circuit protection
- selection of cables (mains current, motor, load distribution and relay)
- net configuration (IT, TN, earthing)
- safety on connecting inputs and outputs (PELV).

4.1 IT mains

Do not connect 380-500 V CUE frequency converters to mains supplies with a voltage between phase and protective earth of more than 440 V.

In connection with IT mains and earthed delta mains, the mains voltage may exceed 440 V between phase and protective earth.

4.2 Aggressive environment

CUE must not be installed in an environment where the air contains liquids, particles or gases which may affect and damage the electronic components.

CUE contains a large number of mechanical and electronic components. They are all vulnerable to environmental impact.

4.3 Reduced performance under certain conditions

CUE reduces its performance under these conditions:

- low air pressure (at high altitude)
- long motor cables.

The required measures are described in the next two sections.

4.3.1 Reduction at low air pressure

At altitudes above 2000 m (6600 ft), the PELV requirements cannot be met.

PELV = Protective Extra Low Voltage.

At low air pressure, the cooling capacity of air is reduced, and CUE automatically reduces the performance to prevent overload.

It may be necessary to select a CUE unit with a higher performance.

4.3.2 Reduction in connection with long motor cables

The maximum cable length is 300 m (1000 ft) for unscreened and 150 m (500 ft) for screened cables. In case of longer cables, contact Grundfos.

CUE is designed for a motor cable with a maximum cross-section as stated in section *12.3.4 Non-UL fuses and conductor cross-section to mains and motor, for installations outside North America* and *12.3.5 UL fuses and conductor cross-section to mains and motor, for installations in North America*.

5. Mechanical installation

The individual CUE cabinet sizes are characterised by their enclosures. The table in section *12.1 Enclosure* shows the relationship between enclosure class and enclosure type.

5.1 Enclosure types

Products with integrated STO function must be installed in an IP54 cabinet according to IEC 60529 or in an equivalent environment. In special applications, a higher IP degree may be necessary.

5.2 Space requirements and air circulation

CUE units can be mounted side by side, but as sufficient air circulation is required for cooling, these requirements must be met:

- Sufficient free space above and below the CUE cabinet. See the table below.
- Ambient temperature up to 50 °C (122 °F)
- Hang the CUE cabinet directly on the wall, or fit it with a back plate. See fig. 4.

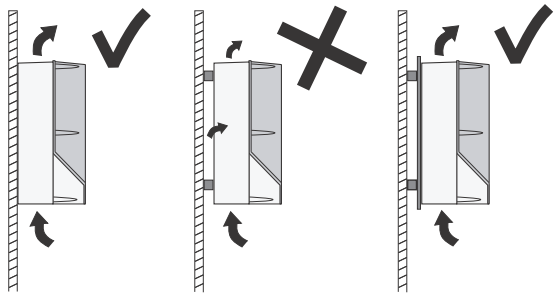


Fig. 4 CUE hung directly on the wall or fitted with a back plate

Required free space above and below the CUE cabinet

Enclosure	Space [mm (in)]
A2, A3, A4, A5	100 (3.9)
B1, B2, B3, B4, C1, C3	200 (7.9)
C2, C4, D1h, D2h	225 (8.9)

5.3 Mounting

The user is responsible for mounting CUE securely on a firm surface.

1. Mark and drill holes. See section *12.5.1 Enclosures A2-A5, B1-B4 and C1-C4.*.
2. Fit the screws at the bottom, but leave loose. Mount CUE, and tighten the four screws.

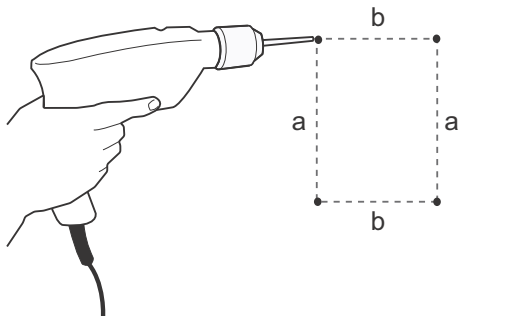


Fig. 5 Drilling of holes in the wall

5.4 Mounting on the floor

WARNING

Crushing of feet

Death or serious personal injury

- CUE is very heavy and may fall if the pedestal is not anchored to the floor.

The user is responsible for mounting CUE securely on a firm surface.

See the pedestal-kit instructions for further information.

By means of a pedestal (optional), CUE can also be mounted on the floor.

1. Mark the mounting holes on the floor. See fig. 6.
2. Drill the holes.
3. Mount the pedestal on the floor.
4. Mount CUE on the pedestal using the enclosed screws.

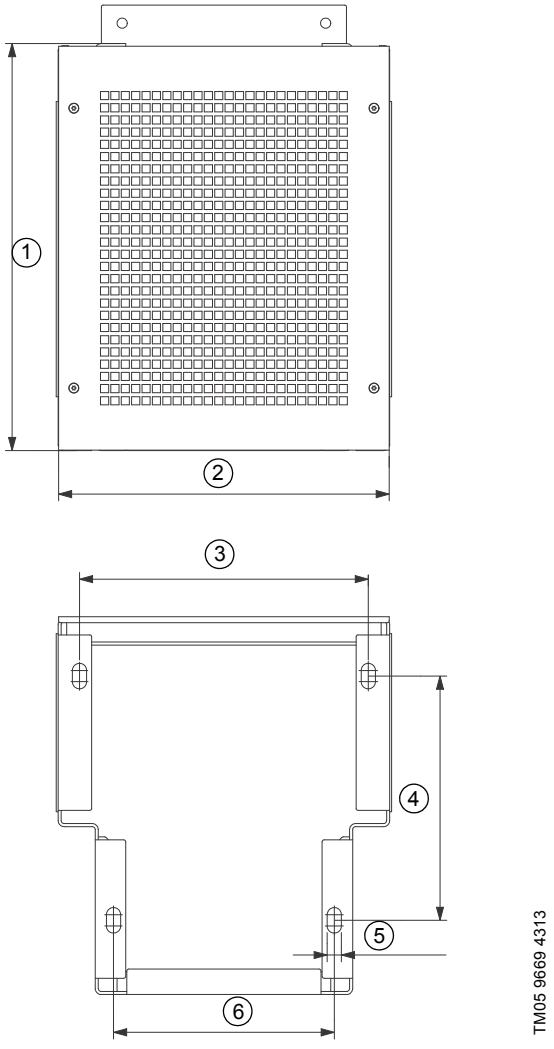


Fig. 6 Drilling template for pedestal

Pos.	D1h [mm]	D2h [mm]
1	400	400
2	325	420
3	283.8	378.8
4	240	240
5	4 x 14	4 x 14
6	217	317

6. Electrical connection

WARNING

Electric shock

Death or serious personal injury

- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on. See *4. Installation requirements*.
- Touching the electrical parts may be fatal, even after CUE has been switched off.

The owner or installer is responsible for ensuring correct earthing and protection according to local standards.

For products with STO, ensure short-circuit protection of the cable between terminal 37 and the external safety device.

Security measures are the responsibility of the user.

The frequency converter parameters can be password protected.

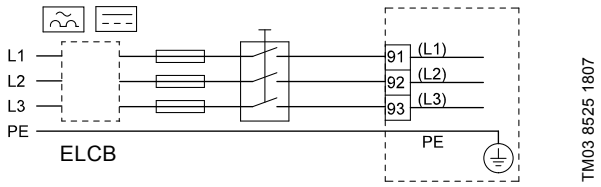


Fig. 7 Example of three-phase mains connection of CUE with main switch, backup fuses and additional protection

6.1 Electrical protection

6.1.1 Protection against electric shock, indirect contact

CAUTION

Electric shock

Minor or moderate personal injury

- CUE must be earthed correctly and protected against indirect contact according to local regulations.

The leakage current to protective earth exceeds 3.5 mA, and a reinforced earth connection is required.

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

Instructions according to EN IEC 61800-5-1:

- CUE must be stationary, installed permanently and connected permanently to the mains supply.
- The protective 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.

6.1.2 Protection against short circuit, fuses

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

Grundfos requires that the backup fuses mentioned in section *12.3.3 Cable cross-section to signal terminals* are used for protection against short circuit.

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

6.1.3 Additional protection

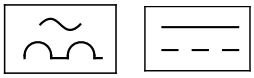
WARNING

Electric shock

Death or serious personal injury

- The leakage current to protective earth exceeds 3.5 mA.

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



ELCB/RCD

The circuit breaker is type B.

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

The leakage current of CUE in normal operation can be seen in section *12.4 Electrical data*.

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

6.1.4 Motor protection

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

6.1.5 Protection against overcurrent

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

6.1.6 Protection against mains voltage transients

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

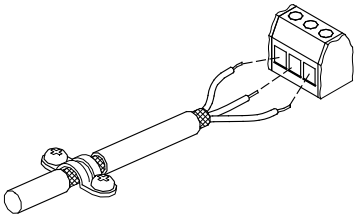
6.2 EMC-correct installation

The motor cable must be screened for CUE to meet EMC requirements.

This section provides guidelines for good practice when installing CUE. Follow these guidelines to meet EN 61800-3, first environment.

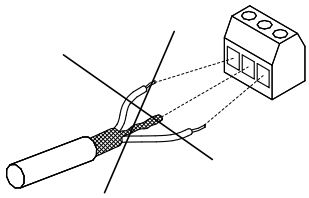
- Use only motor and signal cables with a braided metal screen in applications without output filter.
- There are no special requirements to supply cables, apart from local requirements.
- Leave the screen as close to the connecting terminals as possible. See fig. 7.
- Avoid terminating the screen by twisting the ends. See fig. 9. Use cable clamps or EMC screwed cable entries instead.
- Connect the screen to frame at both ends for both motor and signal cables. See fig. 10. If the controller has no cable clamps, connect only the screen to the CUE cabinet. See fig. 11.
- Avoid unscreened motor and signal cables in electrical cabinets with frequency converters.
- Make the motor cable as short as possible in applications without output filter to limit the noise level and minimise leakage currents.
- Screws for frame connections must always be tightened whether a cable is connected or not.
- Keep mains cables, motor cables and signal cables separated in the installation if possible.

Other installation methods may give similar EMC results if the above guidelines for good practice are followed.



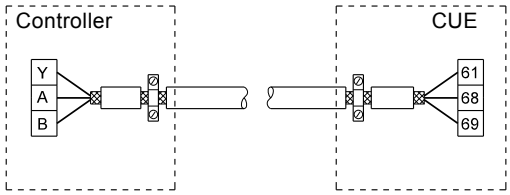
TM02 1325 0901

Fig. 8 Example of stripped cable with screen



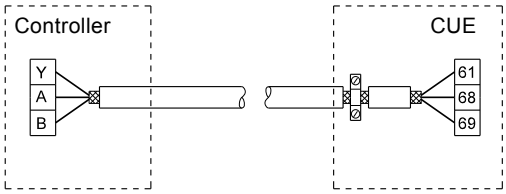
TM03 8812 2507

Fig. 9 Do not twist the screen ends



TM03 8732 2407

Fig. 10 Example of connection of a 3-conductor bus cable with screen connected at both ends



TM03 8731 2407

Fig. 11 Example of connection of a 3-conductor bus cable with screen connected to CUE (controller with no cable clamps)

6.3 RFI filters

To meet the EMC requirements, CUE comes with the following types of built-in radio-frequency interference filter (RFI).

Voltage [V]	Typical shaft power P2 [kW (hp)]	RFI filter type
1 x 200-240*	1.1 - 7.5 (1.5 - 10 hp)	C1
3 x 200-240	0.75 - 45 (1-60 hp)	C1
3 x 380-500	0.55 - 90 (0.75 - 125 hp)	C1
3 x 380-500	110-250 (150-350 hp)	C3
3 x 525-600	0.75 - 7.5 (1-10 hp)	C3
3 x 525-690	11-250 (15-350 hp)	C3

* Single-phase input - three-phase output.

Description of RFI filter types

C1:	For use in domestic areas.
C3:	For use in industrial areas with own low-voltage transformer.

RFI filter types are according to EN 61800-3.

Equipment of category C3

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

6.3.1 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.

Two types of output filters are available as accessories for CUE:

- dU/dt filters
- sine-wave filters.

Use of output filters

The table below shows when we recommend an output filter and the type to use. The selection depends on the following:

- pump type
- motor cable length
- the required reduction of the acoustic noise from the motor.

Pump type	dU/dt filter	Sine-wave filter
SP, BM, BMB with motor voltage from 380 V and up	-	0-300 m*
Pumps with Grundfos motor MG71 and MG80 up to and including 1.5 kW (2 hp)	-	0-300 m*
Applications with desired reduction of dU/dt and noise emission, low reduction	0-150 m*	-
Applications with desired reduction of dU/dt, voltage peaks and noise emission, high reduction	-	0-300 m*
Applications with motors of 500 V and up	-	0-300 m*

* The lengths stated apply to the motor cable.

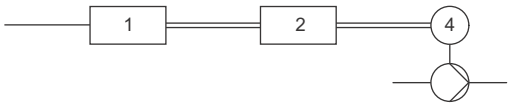
6.4 Motor cable

To meet EN 61800-3, the motor cable must always be a screened cable, whether an output filter is installed or not.

The mains cable need not be a screened cable. See figs 12, 13, 14 and 15.

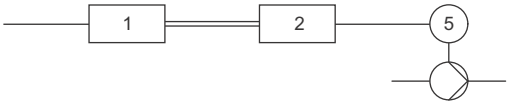
TM04 4289 1109

Fig. 12 Example of installation without filter



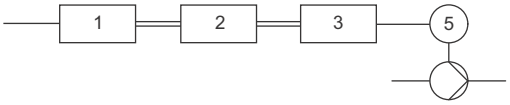
TM04 4290 1109

Fig. 13 Example of installation with filter. The cable between CUE and filter must be short



TM04 4291 1109

Fig. 14 Submersible pump without connection box. Frequency converter and filter installed close to the well



TM04 4292 1109

Fig. 15 Submersible pump with connection box and screened cable. Frequency converter and filter installed far away from the well and connection box installed close to 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

6.5 Mains and motor connection

Check that the mains voltage and frequency correspond to the values on the nameplate of CUE and the motor.

The motor cable must be screened for CUE to meet EMC requirements.

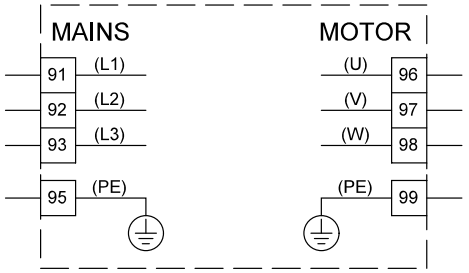
The supply voltage and frequency are marked on the CUE nameplate. Make sure that CUE is suitable for the power supply of the installation site.

6.5.1 Main switch

A main switch can be installed before the CUE cabinet according to local regulations. See fig. 7.

6.5.2 Wiring diagram

The wires in the terminal box must be as short as possible. Excepted from this is the protective conductor which must be so long that it is the last one to be disconnected in case the cable is inadvertently pulled out of the cable entry.



TM03 8799 2507

Fig. 16 Wiring diagram, three-phase mains connection

Terminal		Function
91	(L1)	Three-phase mains supply
92	(L2)	
93	(L3)	
95/99	(PE)	Protective earth connection
96	(U)	Three-phase motor connection, 0-100 % of mains voltage
97	(V)	
98	(W)	

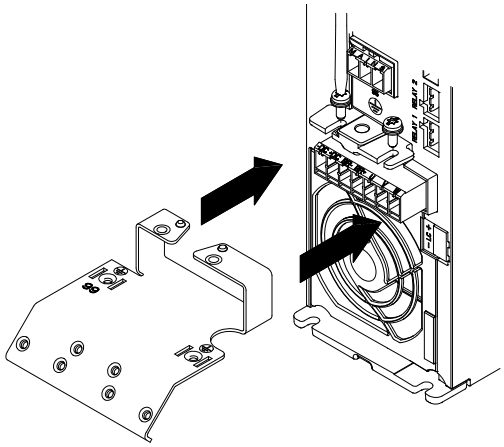
For single-phase connection, use L1 and L2.

6.5.3 Mains connection, enclosures A2 and A3

Check that the mains voltage and frequency correspond to the values on the nameplate of CUE and the motor.

Enclosure	Torque Nm [ft (lb)]			
	Mains	Motor	Protective earth	Relay
A2	1.8 (1.3)	1.8 (1.3)	3 (2.2)	0.6 (0.4)
A3	1.8 (1.3)	1.8 (1.3)	3 (2.2)	0.6 (0.4)

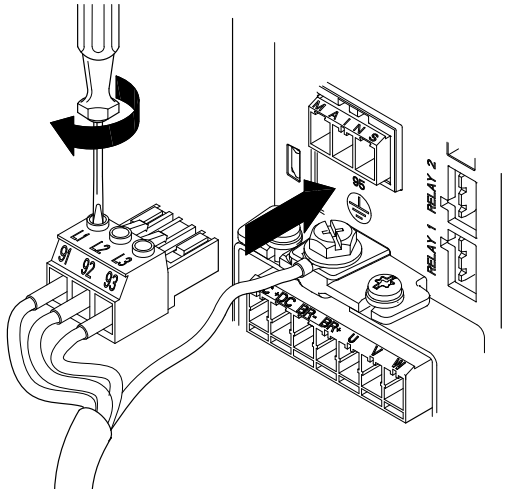
1. Fit the mounting plate with two screws.



TM03 9010 2807

Fig. 17 Fitting the mounting plate

2. Connect the earth conductor to terminal 95 (PE) and the mains conductors to terminals 91 (L1), 92 (L2), 93 (L3) of the mains plug.

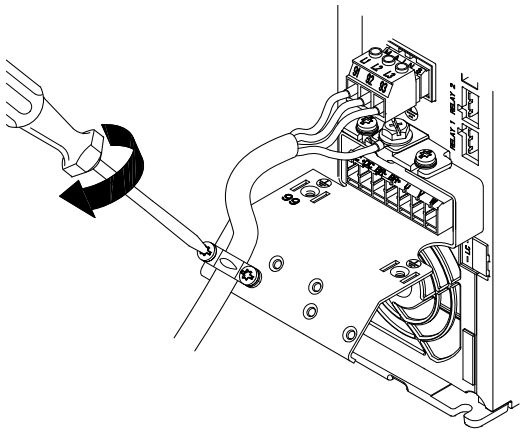


TM03 9011 2807

Fig. 18 Connecting the earth conductor and mains conductors

For single-phase connection, use L1 and L2.

3. Fix the mains cable to the mounting plate.

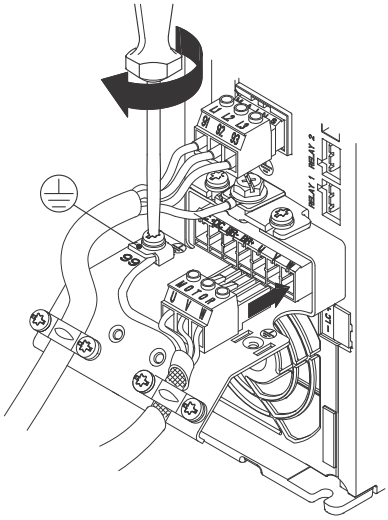


TM03 9014 2807

Fig. 19 Fixing the mains cable

6.5.4 Motor connection, enclosures A2 and A3

1. Connect the earth conductor to terminal 99 (PE) on the mounting plate.
2. Connect the motor conductors to terminals 96 (U), 97 (V), 98 (W) of the motor plug.



TM07 4879 2619

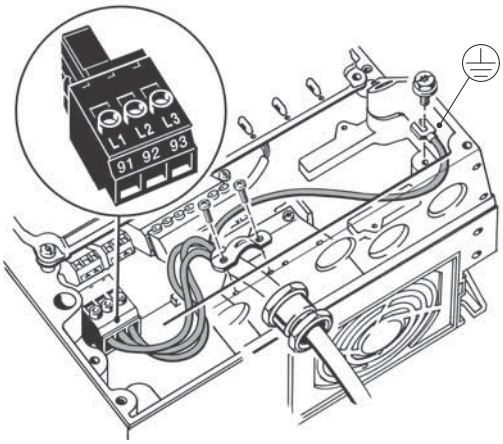
Fig. 20 Connecting the earth conductor and motor conductors

3. Put the motor plug into the socket marked "MOTOR".
4. Fix the screened cable to the mounting plate with a cable clamp.

6.5.5 Mains connection, enclosures A4 and A5

Enclosure	Torque Nm [ft (lb)]			
	Mains	Motor	Protective earth	Relay
A4	1.8 (1.3)	1.8 (1.3)	3 (2.2)	0.6 (0.4)
A5	1.8 (1.3)	1.8 (1.3)	3 (2.2)	0.6 (0.4)

1. Connect the earth conductor to terminal 95 (PE). See fig. 21.
2. Connect the mains conductors to terminals 91 (L1), 92 (L2), 93 (L3) of the mains plug.
3. Put the mains plug into the socket marked "MAINS".
4. Fix the mains cable with a cable clamp.



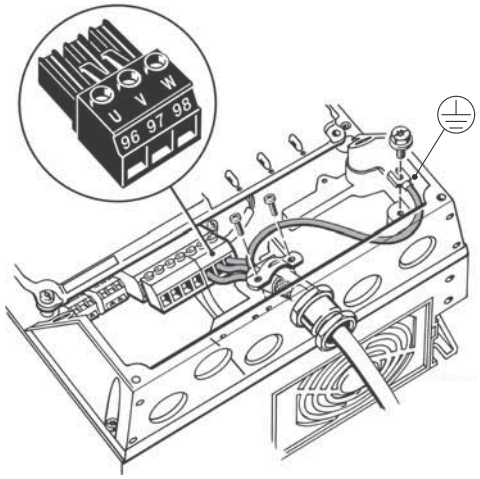
TM03 9017 2619

Fig. 21 Mains connection, A4 and A5

For single-phase connection, use L1 and L2.

6.5.6 Motor connection, enclosures A4 and A5

1. Connect the earth conductor to terminal 99 (PE). See fig. 22.
2. Connect the motor conductors to terminals 96 (U), 97 (V), 98 (W) of the motor plug.
3. Put the motor plug into the socket marked "MOTOR".
4. Fix the screened cable with a cable clamp.



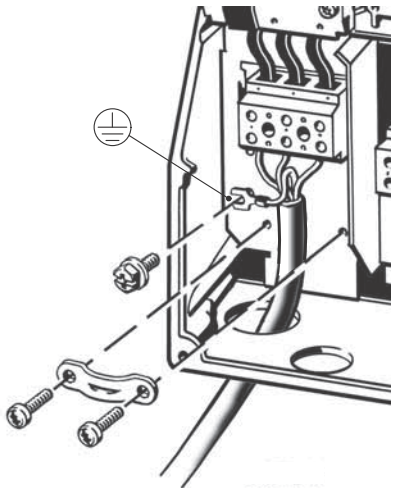
TM03 9018 2619

Fig. 22 Motor connection, A4 and A5

6.5.7 Mains connection, enclosures B1 and B2

Enclosure	Torque Nm [ft (lb)]			
	Mains	Motor	Protective earth	Relay
B1	1.8 (1.3)	1.8 (1.3)	3 (2.2)	0.6 (0.4)
B2	4.5 (3.3)	4.5 (3.3)	3 (2.2)	0.6 (0.4)

1. Connect the earth conductor to terminal 95 (PE). See fig. 23.
2. Connect the mains conductors to terminals 91 (L1), 92 (L2), 93 (L3).
3. Fix the mains cable with a cable clamp.



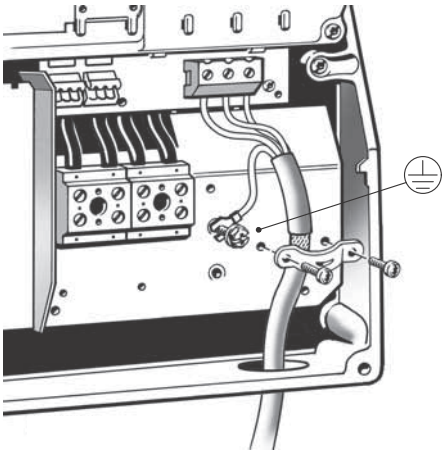
TM03 9019 2619

Fig. 23 Mains connection, B1 and B2

For single-phase connection, use L1 and L2.

6.5.8 Motor connection, enclosures B1 and B2

1. Connect the earth conductor to terminal 99 (PE). See fig. 24.
2. Connect the motor conductors to terminals 96 (U), 97 (V), 98 (W).
3. Fix the screened cable with a cable clamp.



TM03 9020 2619

Fig. 24 Motor connection, B1 and B2

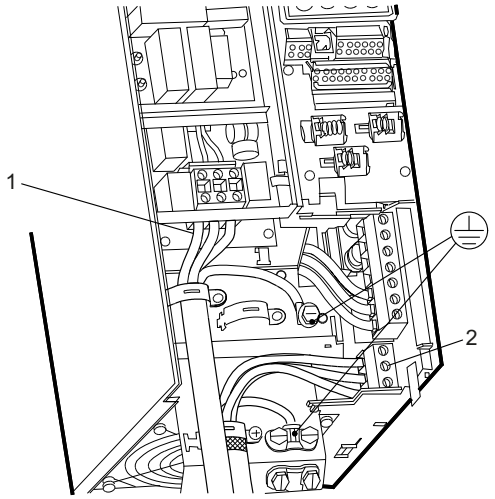
6.5.9 Mains connection, enclosures B3 and B4

Enclosure	Torque Nm [ft (lb)]			
	Mains	Motor	Protective earth	Relay
B3	1.8 (1.3)	1.8 (1.3)	3 (2.2)	0.6 (0.4)
B4	4.5 (3.3)	4.5 (3.3)	3 (2.2)	0.6 (0.4)

1. Connect the earth conductor to terminal 95 (PE). See figs 25 and 26.
2. Connect the mains conductors to terminals 91 (L1), 92 (L2), 93 (L3).
3. Fix the mains cable with a cable clamp.

6.5.10 Motor connection, enclosures B3 and B4

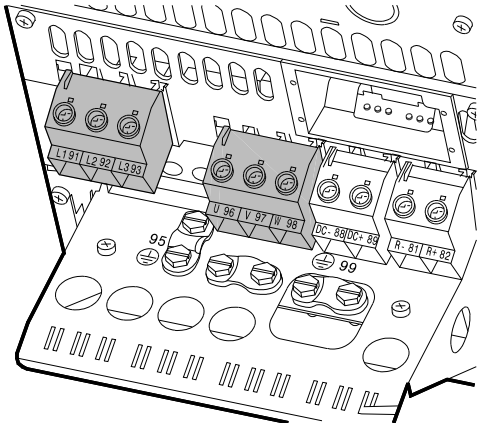
1. Connect the earth conductor to terminal 99 (PE). See figs 25 and 26.
2. Connect the motor conductors to terminals 96 (U), 97 (V), 98 (W).
3. Fix the screened cable with a cable clamp.



TM03 9446 4007

Fig. 25 Mains and motor connection, B3

Pos.	Description
1	Mains
2	Motor



TM03 9449 4007

Fig. 26 Mains and motor connection, B4

6.5.11 Mains connection, enclosures C1 and C2

Enclosure	Torque Nm [ft (lb)]			
	Mains	Motor	Protective earth	Relay
C1	10 (7.4)	10 (7.4)	3 (2.2)	0.6 (0.4)
C2	14[1)]/24[2)] (10.3[1)]/17.7[2)])	14[1)]/24[2)] (10.3[1)]/17.7[2)])	3 (2.2)	0.6 (0.4)

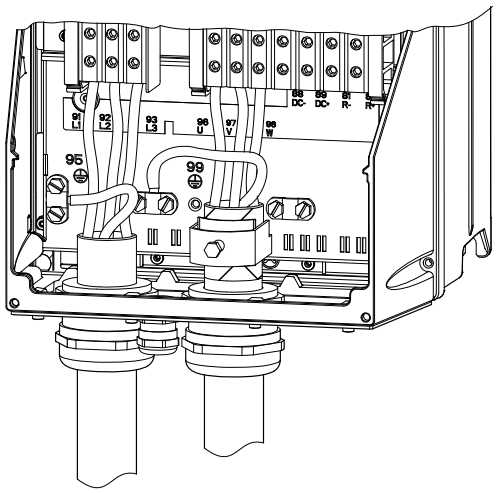
[1)] Conductor cross-section ≤ 95 mm² (≤ 4/0 AWG)

[2)] Conductor cross-section ≥ 95 mm² (≥ 4/0 AWG).

1. Connect the earth conductor to terminal 95 (PE). See fig. 27.
2. Connect the mains conductors to terminals 91 (L1), 92 (L2), 93 (L3).

6.5.12 Motor connection, enclosures C1 and C2

1. Connect the earth conductor to terminal 99 (PE). See fig. 27.
2. Connect the motor conductors to terminals 96 (U), 97 (V), 98 (W).
3. Fix the screened cable with a cable clamp.



TM03 9016 2807

Fig. 27 Mains and motor connection, C1 and C2

6.5.13 Mains connection, enclosures C3 and C4

Enclosure	Torque Nm [ft (lb)]			
	Mains	Motor	Protective earth	Relay
C3	10	10	3 (2.2)	0.6 (0.4)
C4	14[1)]/24[2)] (10.3[1)]/17.7[2)])	14[1)]/24[2)] (10.3[1)]/17.7[2)])	3 (2.2)	0.6 (0.4)

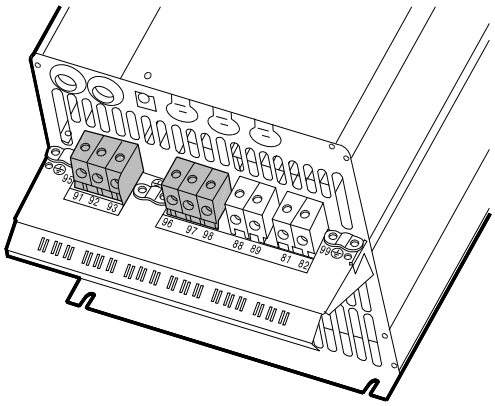
[1)] Conductor cross-section ≤ 95 mm² (≤ 4/0 AWG)

[2)] Conductor cross-section ≥ 95 mm² (≥ 4/0 AWG).

1. Connect the earth conductor to terminal 95 (PE). See figs 28 and 29.
2. Connect the mains conductors to terminals 91 (L1), 92 (L2), 93 (L3).
3. Fix the mains cable with a cable clamp.

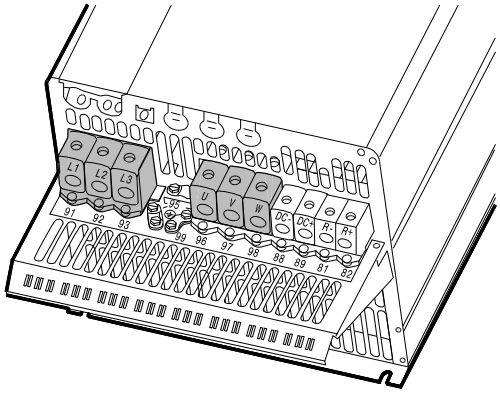
6.5.14 Motor connection, enclosures C3 and C4

1. Connect the earth conductor to terminal 99 (PE). See figs 28 and 29.
2. Connect the motor conductors to terminals 96 (U), 97 (V), 98 (W).
3. Fix the screened cable with a cable clamp.



TM03 9448 4007

Fig. 28 Mains and motor connection, C3



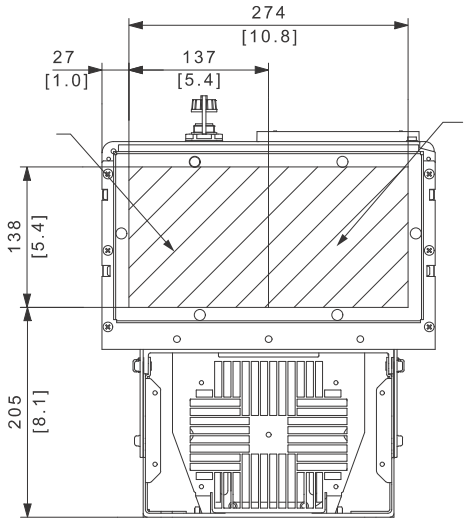
TM03 9447 4007

Fig. 29 Mains and motor connection, C4

6.5.15 Gland plate, enclosures D1h and D2h

Cables are connected through the gland plate from the bottom. The gland plate must be fitted to CUE to ensure the specified protection degree as well as to ensure sufficient cooling.

Drill holes in the marked areas. See fig. 30.



TM05 9326 3713

Fig. 30 CUE viewed from the bottom [mm]

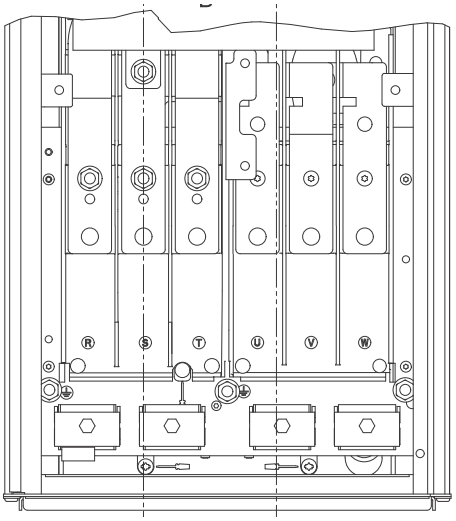
6.5.16 Mains connection, enclosures D1h and D2h

Enclosure	Torque [ft-lb (Nm)]			
	Mains	Motor	Protective earth	Relay
D1h	19-40	19-40	3 (2.2)	0.6 (0.4)
D2h	19-40	19-40	3 (2.2)	0.6 (0.4)

1. Connect the earth conductor to terminal 95 (PE). See fig. 31.
2. Connect the mains conductors to terminals 91 (L1), 92 (L2), 93 (L3).
3. Fix the mains cable with a cable clamp.

6.5.17 Terminal location

Take the following terminal positions into consideration when you design the cable connection. See fig. 31.



TM05 9329 3713

Fig. 31 Earth, mains and motor connection for D1h and D2h

6.5.18 Motor connection, enclosures D1h and D2h

1. Connect the earth conductor to terminal 99 (PE). See fig. 31.
2. Connect the motor conductors to terminals 96 (U), 97 (V), 98 (W).
3. Fix the screened cable with a cable clamp.

6.6 STO installation, optional

DANGER

Exposure to high pressure or toxic liquids

Death or serious personal injury

- Failure to remove the jumper will disable the STO function and the motor might not stop as intended and can cause severe injury or death.
- Failure to use safety-monitoring relay compliant with Category 3 /PL "d", ISO 13849-1 or SIL 2, EN 62061 and IEC 61508. Perform a functional test every 12 months to ensure that the system works properly.

To enable the integrated STO, follow these steps:

1. Remove the jumper wire between control terminals 37 and 12 or 13. Cutting or breaking the jumper is not sufficient to avoid short-circuiting.

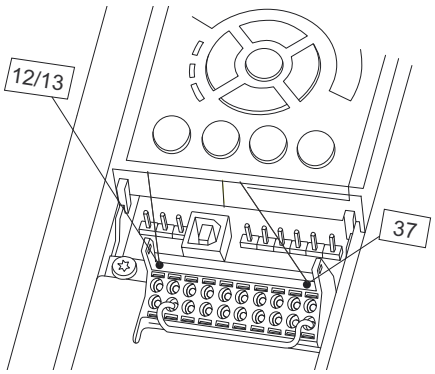


Fig. 32

2. Connect an external safety-monitoring relay via a NO safety function to terminal 37 (STO) and either terminal 12 or 13, 24 V DC.

Select and apply the components in the safety control system appropriately to achieve the desired level of operational safety. Before integrating and using STO in an installation, carry out a thorough risk analysis on the installation to determine whether the STO functionality and safety levels are appropriate and sufficient.

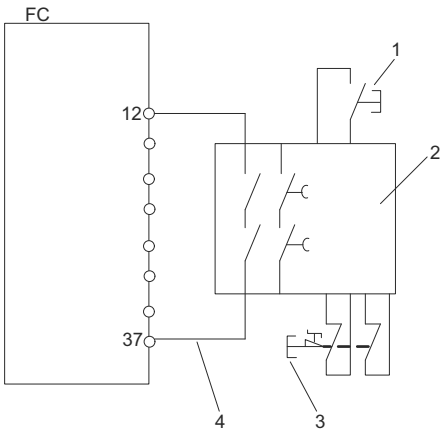


Fig. 33 STO wiring

Pos.	Description
1	Reset button
2	Safety relay (category 3, PL d or SIL2)
3	Emergency stop button
4	Short-circuit protected cable if the product is not installed inside an IP54 cabinet.

6.6.1 Restart behaviour after STO activation

By default the STO function is set to unintended-restart prevention behaviour. To terminate STO and resume normal operation with manual reset, do the following:

- Reapply 24 V DC supply to terminal 37.
- Send a reset signal via bus, Digital I/O or the reset button.
- Set the STO function to automatic restart by changing the value of 5-19 terminal 37 "Safe Stop" from default value 1. "Safe Stop Alarm" to value 3, "Safe Stop Warning".

Automatic restart means that STO is terminated, and normal operation is resumed, as soon as the 24 V DC is applied to terminal 37. No reset signal is required.

6.6.2 Restart settings

- Remove the 24 V DC voltage supply to terminal 37 using the interrupt device while the frequency converter drives the motor, that is the mains supply is not interrupted.
- Check that the motor coasts and that the alarm Safe Stop displays in the local operating panel if mounted.
- Reapply 24 V DC to terminal 37.
- Ensure that the motor remains in the coasted state.
- Send reset signal via bus, Digital I/O or the reset button.
- Ensure that the motor becomes operational again.

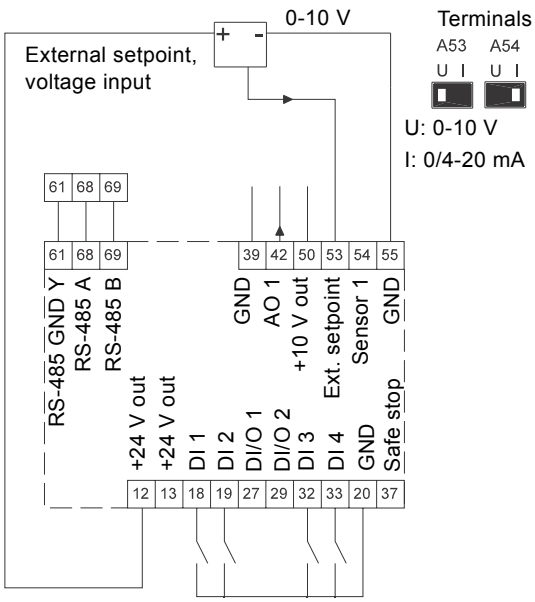
6.7 Connecting the signal terminals

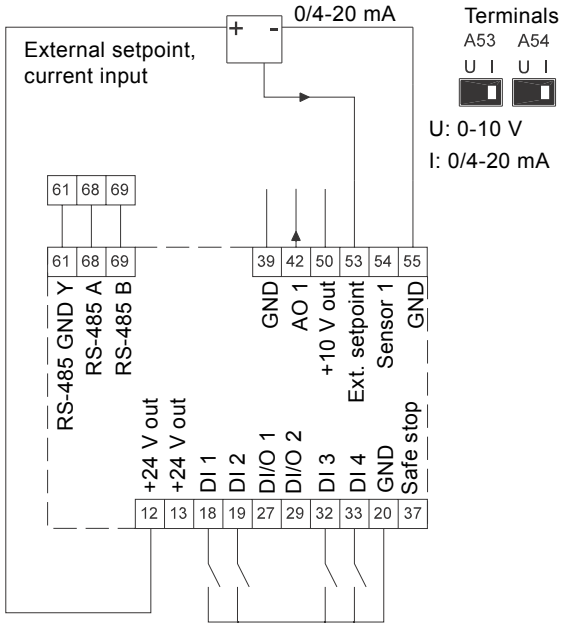
As a precaution, signal cables must be separated from other groups by reinforced insulation in their entire lengths.

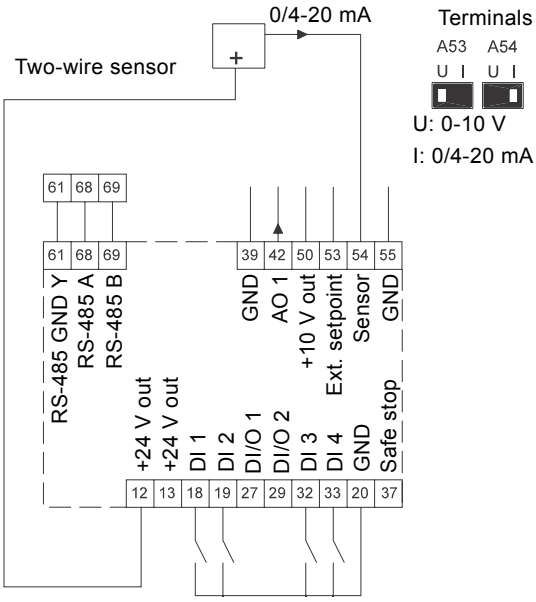
Connect the signal cables according to the guidelines for good practice to ensure EMC-correct installation. See section *6.6.1 Restart behaviour after STO activation*.

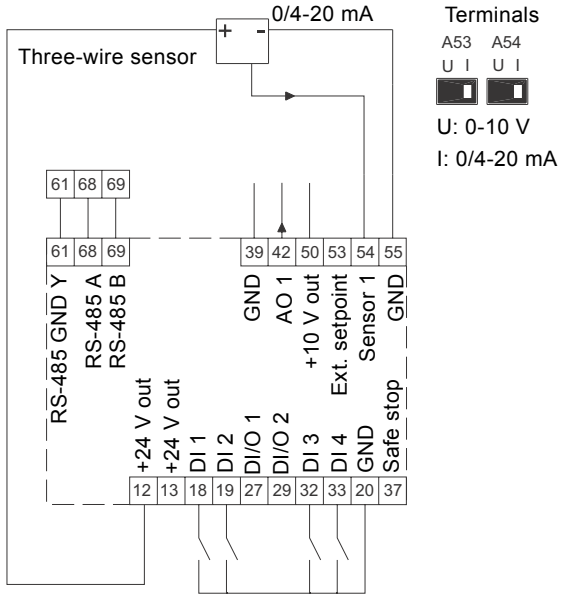
- Use screened signal cables with a conductor cross-section of minimum 0.5 mm^2 and maximum 1.5 mm^2.
- Use a 3-conductor screened bus cable in new systems.

6.7.1 Wiring diagram, signal terminals









Terminal	Type	Function	Terminal	Type	Function
12	+24 V out	Supply to sensor	39	GND	Frame for analog output
13	+24 V out	Additional supply	42	AO 1	Analog output, 0-20 mA
18	DI 1	Digital input, programmable	50	+10 V out	Supply to potentiometer
19	DI 2	Digital input, programmable	53	AI 1	External setpoint, 0-10 V, 0/4-20 mA
20	GND	Common frame for digital inputs	54	AI 2	Sensor input, sensor 1, 0/4-20 mA
27	DI/O 1	Digital input/output, programmable	55	GND	Common frame for analog inputs
29	DI/O 2	Digital input/output, programmable	61	RS-485 GND Y	GENIbus, frame
32	DI 3	Digital input, programmable	68	RS-485 A	GENIbus, signal A (+)
33	DI 4	Digital input, programmable	69	RS-485 B	GENIbus, signal B (-)
37	Safe stop	Safe stop			

The RS-485 screen must be connected to frame.

6.7.2 Connection of a thermistor (PTC) to CUE

The connection of a thermistor (PTC) in a motor to CUE requires an external PTC relay.

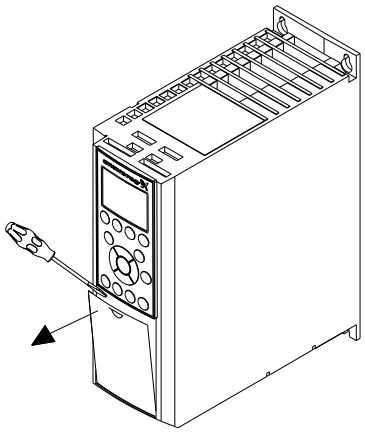
The requirement is based on the fact that the thermistor in the motor only has one layer of insulation to the windings. The terminals in CUE require two layers of insulation since they are part of a PELV circuit.

A PELV circuit provides protection against electric shock. Special connection requirements apply to this type of circuit. The requirements are described in EN 61800-5-1.

In order to maintain PELV, all connections made to the control terminals must be PELV. For example, the thermistor must have reinforced or double insulation.

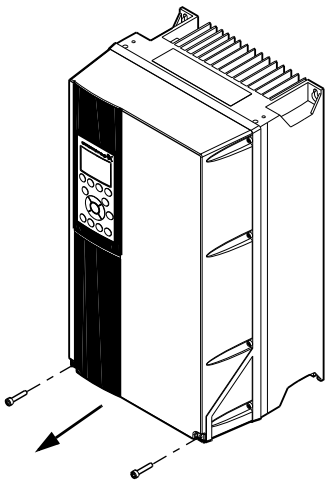
Access to signal terminals

All signal terminals are behind the terminal cover of the CUE front. Remove the terminal cover as shown in figs 34 and 35.



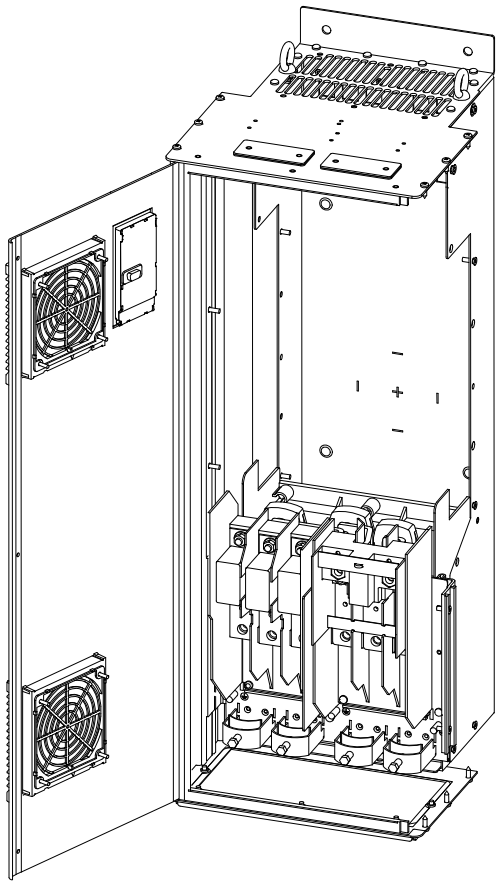
TM03 9003 1219

Fig. 34 Access to signal terminals, A2 and A3



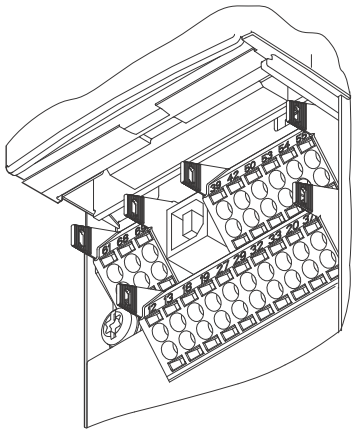
TM03 9004 1219

Fig. 35 Access to signal terminals, A4, A5, B1, B2, B3, B4, C1, C2, C3 and C4



TM05 9654 4213

Fig. 36 Access to signal terminals, D1h and D2h

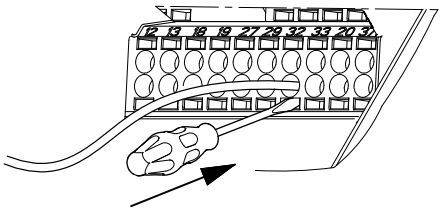


TM03 9025 2807

Fig. 37 Signal terminals, all enclosures

Fitting the conductor

1. Remove the insulation at a length of 9 to 10 mm.
2. Insert a screwdriver with a tip of maximum 0.4 x 2.5 mm into the square hole.
3. Insert the conductor into the corresponding round hole. Remove the screwdriver. The conductor is now fixed in the terminal.



TM03 9026 2807

Fig. 38 Fitting the conductor into the signal terminal

Setting the analog inputs, terminals 53 and 54

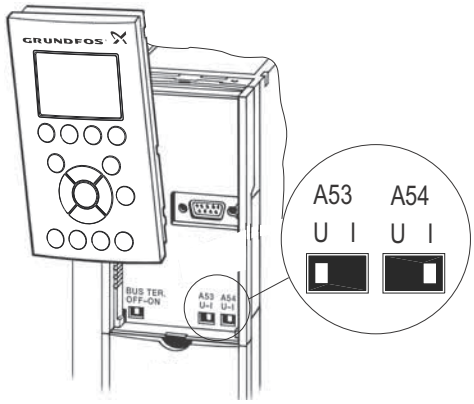
Contacts A53 and A54 are positioned behind the operating panel and used for setting the signal type of the two analog inputs.

The factory setting of the inputs is voltage signal "U".

If a 0/4-20 mA sensor is connected to terminal 54, the input must be set to current signal "I".

Switch off the power supply before setting contact A54.

Remove the operating panel to set the contact. See fig. 39.



TM03 9104 1219

Fig. 39 Setting contact A54 to current signal "I"

RS-485 GENIbus network connection

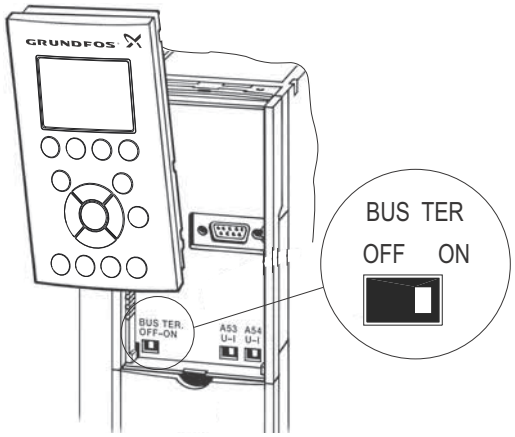
One or more CUE units can be connected to a control unit via GENIbus.

The reference potential, GND, for RS-485 (Y) communication must be connected to terminal 61.

If more than one CUE unit is connected to a GENIbus network, the termination contact of the last CUE must be set to "ON" (termination of the RS-485 port).

The factory setting of the termination contact is "OFF" (not terminated).

Remove the operating panel to set the contact. See fig. 40.

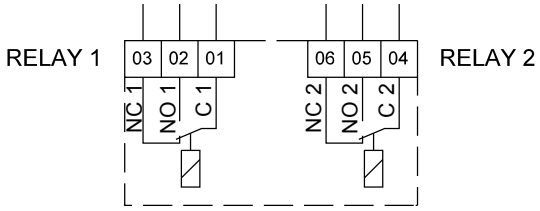


TM03 9006 1219

Fig. 40 Setting the termination contact to "ON"

6.8 Connecting the signal relays

As a precaution, signal cables must be separated from other groups by reinforced insulation in their entire lengths.



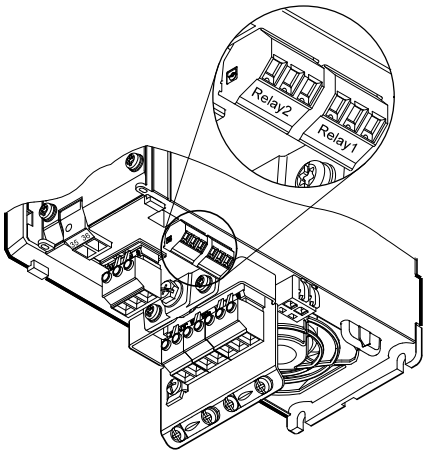
TM03 8801 2507

Fig. 41 Terminals for signal relays in normal state (not activated)

Terminal		Function
C 1	C 2	Common
NO 1	NO 2	Normally open contact
NC 1	NC 2	Normally closed contact

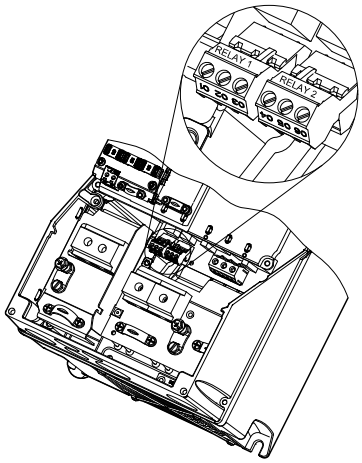
6.8.1 Access to signal relays

The relay outputs are positioned as shown in figs 42 to 47.



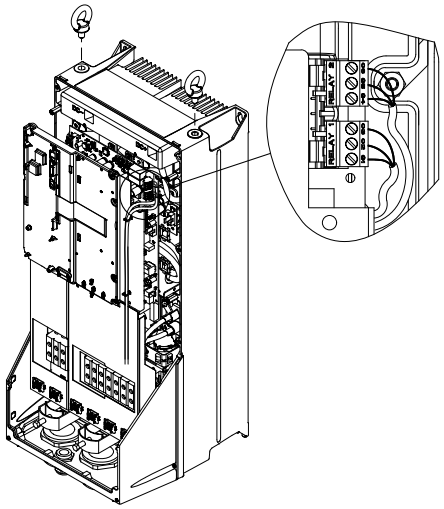
TM03 9007 2807

Fig. 42 Terminals for relay connection, A2 and A3



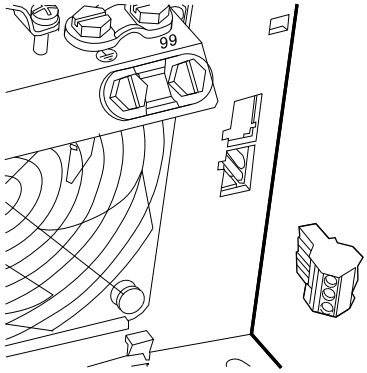
TM03 9008 2807

Fig. 43 Terminals for relay connection, A4, A5, B1 and B2



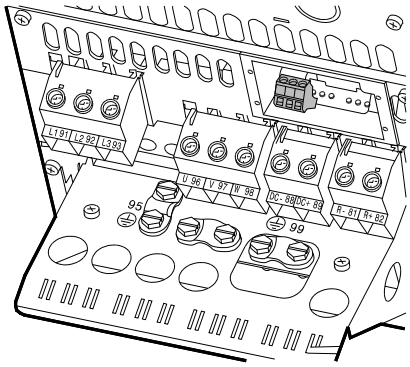
TM03 9009 2807

Fig. 44 Terminals for relay connection, C1 and C2



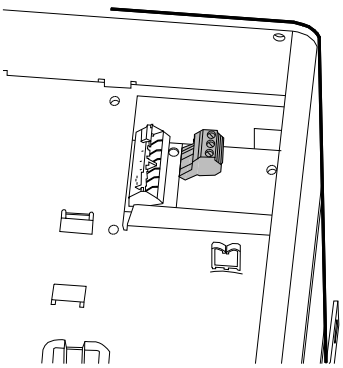
TM03 9442 4007

Fig. 45 Terminals for relay connection, B3



TM03 9441 4007

Fig. 46 Terminals for relay connection, B4



TM03 9440 4007

Fig. 47 Terminals for relay connection, C3, C4, D1h and D2h, in the upper right corner of CUE

6.8.2 Connecting the MCB 114 sensor input module

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

Configuration of MCB 114

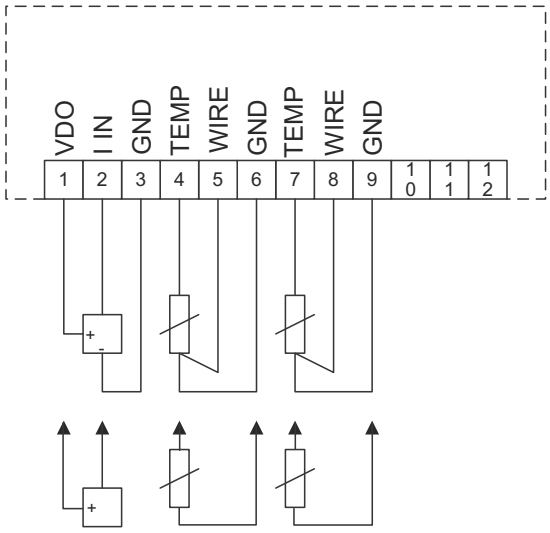
MCB 114 is equipped with three analog inputs for the following sensors:

- One additional sensor 0/4-20 mA.
- Two Pt100/Pt1000 temperature sensors for measurement of motor bearing temperature or an alternative temperature, such as liquid temperature.

When MCB 114 has been installed, CUE automatically detects if the sensor is Pt100 or Pt1000 when it is switched on.

Wiring diagram, MCB 114

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



TM04 3273 3908

Fig. 48 Wiring diagram, MCB 114

Terminal	Type	Function
1 (VDO)	+24 V out	Supply to sensor
2 (I IN)	AI 3	Sensor 2, 0/4-20 mA
3 (GND)	GND	Common frame for analog input
4 (TEMP) 5 (WIRE)	AI 4	Temperature sensor 1, Pt100/Pt1000
6 (GND)	GND	Common frame for temperature sensor 1
7 (TEMP) 8 (WIRE)	AI 5	Temperature sensor 2, Pt100/Pt1000
9 (GND)	GND	Common frame for temperature sensor 2

Terminals 10, 11 and 12 are not used.

6.8.3 Fitting MCB 114 in CUE

Enclosures A2, A3 and B3

1. Switch off the power to CUE. See section *6.5 Mains and motor connection*.
2. Remove the operating panel, the terminal cover and the frame from CUE. See fig. 49.
3. Fit MCB 114 into port B.
4. Connect the signal cables, and fasten the cables with the enclosed cable strips.
5. Remove the knock-out plate in the extended frame so that MCB 114 fits under the extended frame.
6. Fit the extended frame and the terminal cover.
7. Fit the operating panel in the extended frame.
8. Connect power to CUE.

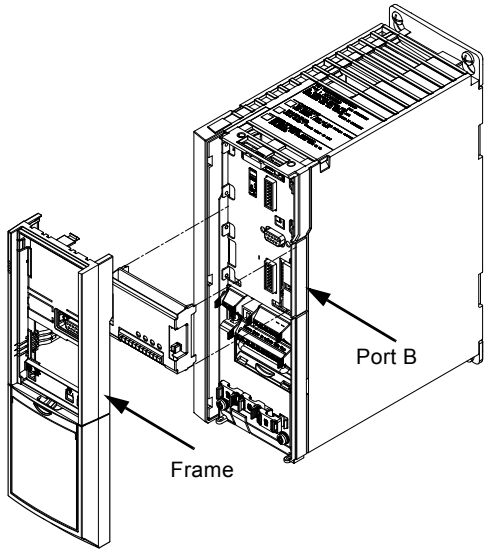


Fig. 49 Enclosures A2, A3 and B3

Enclosures A5, B1, B2, B4, C1, C2, C3, C4, D1 and D2

1. Switch off the power to CUE. See section *6.5 Mains and motor connection*.
2. Remove the operating panel and the cradle from CUE. See fig. 50.
3. Fit MCB 114 into port B.
4. Connect the signal cables, and fasten the cables with the enclosed cable strips. See fig. 50.
5. Fit the cradle and the operating panel.
6. Connect power to CUE.

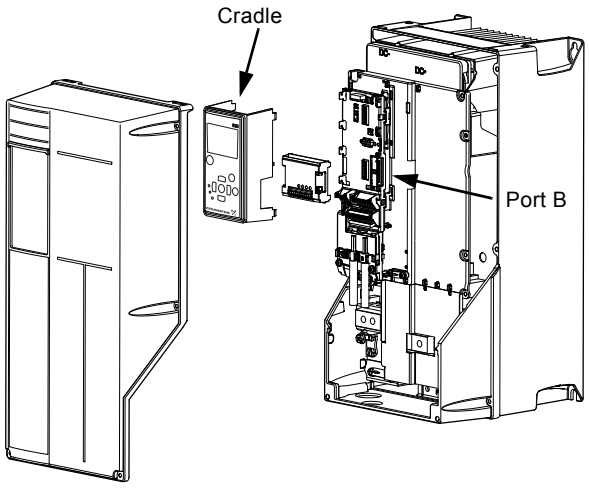


Fig. 50 Enclosures A5, B1, B2, B4, C1, C2, C3, C4, D1 and D2

7. Starting up the product

Any installation, maintenance and inspection must be carried out by trained persons.

Before you switch on the power supply, you must do the following:

- Close the cover.
- Ensure that all cable glands are tightened properly.
- Ensure that there is no voltage on output terminals, phase-to-phase and phase-to-ground.
- Confirm continuity of the motor by measuring Ω values on U-V, V-W and W-U.
- Check for proper grounding of the frequency converter and the motor.
- Check that there are no loose connections on the terminals.
- Confirm that the supply voltage matches the voltage of the frequency converter and the motor.

7.1 Switching on the product

- Confirm that the input voltage is balanced within 3 %. If not, correct the input-voltage imbalance before proceeding. Repeat this procedure after the voltage correction.
- Ensure that any optional equipment wiring matches the installation application.
- Ensure that all operator devices are in the OFF position. The panel doors must be closed, and covers must be securely fastened.
- Apply power to the unit, but do not start the frequency converter yet. For units with a disconnect switch, turn it to the ON position to apply power to the frequency converter.

7.2 Activating the optional STO function

The STO function is activated by removing the voltage at terminal 37 of the frequency converter. By connecting the frequency converter to external safety devices providing a safe delay, an installation for a Safe Stop 1 is obtained. External safety devices need to fulfil Cat./PL or SIL when connected to terminal 37.

The STO function can be used for the following motor types:

- asynchronous
- synchronous
- permanent magnet motors.

When terminal 37 is activated, the frequency converter issues an alarm, trips the unit and coasts the motor to a stop. A manual restart is required. Use the STO function to stop the frequency converter in emergency stop situations. In normal operating mode, the STO terminal 37 must be deactivated to start the motor.

A successful commissioning test of the STO function is required after the initial installation and after each subsequent change to the installation.

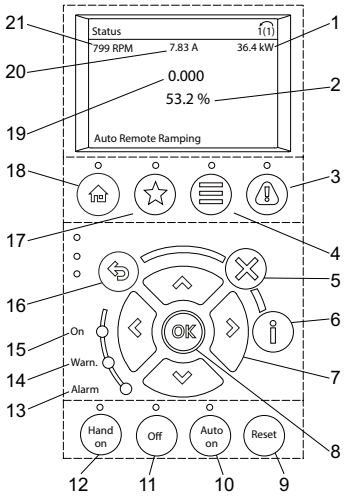
8. Control functions

The display contrast can be adjusted by pressing [Status] and then pressing [Up] or [Down].

8.1 Operating panel

The operating panel consists of a display and several buttons. It enables manual setting and monitoring of the system, such as follows:

- Start, stop and control of speed.
- Reading of operating data and warnings and alarms.
- Setting functions for the frequency converter.
- Manual reset of the frequency converter.



TM07 4597 2119

Fig. 51 Operating panel

Pos.	Buttons	Description
1		Power [kW]
2		Reference [%]
3		[Alarm log]: shows a list of current warnings, the last 10 alarms and the maintenance log.
4		[Main menu]: allows access to all programming settings.
5		[Cancel]: cancels the last change or command as long as the display mode has not changed.
6		[Info]: press for a definition of the function being displayed.
7		[Up]/[Down]/[Left]/[Right]: use the four arrow buttons to navigate between items in the menu.
8	OK	[OK]: used to access parameter groups or to accept a selection.
9	RESET	[RESET]: resets the frequency converter manually after a fault has been cleared.
10	AUTO ON	[AUTO ON]: puts the system in remote operational mode. • Responds to an external start command by control terminals or serial communication.
11	OFF	[OFF]: stops the motor but does not remove power to the frequency converter.
12	HAND ON	[HAND ON]: starts 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]: reverts to the previous step or list in the menu structure.
17		[Favourites]: allows access to programming parameters for initial set-up instructions and many detailed application instructions.
18		[Status]: shows operational information.
19		Frequency
20		Motor current
21		Speed, RPM

8.2 Menu overview

Overview of the main menus. The ** represents a number to a submenu.

- "0-** Operation / Display"
- "1-** Load and Motor"
- "2-** Brakes"
- "3-** Reference / Ramps"
- "4-** Limits / Warnings"
- "5-** Digital In/Out"
- "6-** Analog In/Out"
- "8-** Comm. and Options"
- "14-** Special Functions"
- "15-** Drive Information"
- "16-** Data Readouts"
- "18-** Info & Readouts"
- "20-** Drive Closed Loop"
- "21-** Ext. Closed Loop"
- "22-** Appl. Functions"
- "23-** Timer-based Functions"
- "27-** Cascade CTL Option"
- "29-** Water Application Functions"
- "30-** Special Features"
- "35-** Sensor Input Option"
- "200 - Operation Settings"
- "201- Key Functions"
- "202 - Sensors"
- "203 - Status Monitor"

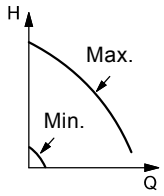
Example: To get to the menu "1-28 Motor Rotation Check", you must do the following:

1. navigate to "1-** Load and Motor", and press [OK].
2. Use the [Up] and [Down] buttons to navigate to "1-2* Motor Data", and press [OK].
3. Use the [Up] and [Down] buttons to navigate to "1-28 Motor Rotation Check", and press [OK] to select the menu.

8.3 Operating modes

The following operating modes are set on the operating panel using the [Favourites] menu.

Operating mode	Description
Normal	The pump is running in the operating mode selected
Stop	The pump has been stopped, and the green indicator light is flashing
Min.	The pump is running at minimum speed
Max.	The pump is running at maximum speed
User curve	The pump is running at user-defined speed



Minimum and maximum curves.
The pump speed is kept at a given set value for minimum and maximum speed.

Example: Maximum curve operation can for instance be used in connection with venting the pump during installation.

Example: Minimum curve operation can for instance be used in periods with a very small flow rate requirement.

8.4 Control modes

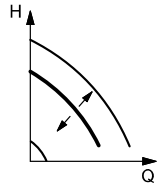
The control mode is set in the [Favourites] menu.

There are two basic control modes:

- Uncontrolled operation (open loop).
- Controlled operation (closed loop) with a sensor connected.

See sections *8.4.1 Uncontrolled operation (open loop)* and *8.4.2 Controlled operation (closed loop)*.

8.4.1 Uncontrolled operation (open loop)

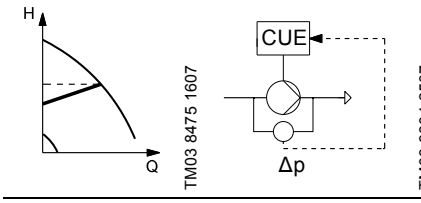


Constant curve.
The speed is kept at a set value in the range between the minimum and maximum curves.
The setpoint is set in % corresponding to the required speed.

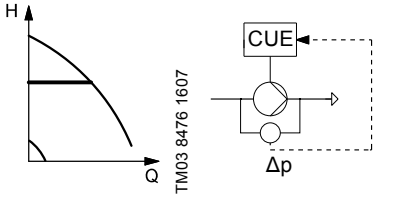
Example: Operation on constant curve can for instance be used for pumps with no sensor connected.

Example: Typically used in connection with an overall control system such as MPC or another external controller.

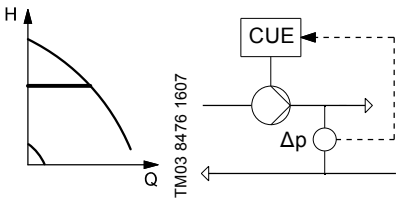
8.4.2 Controlled operation (closed loop)



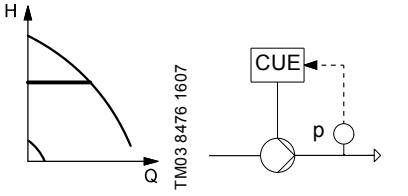
Proportional differential pressure.
The differential pressure is reduced at falling flow rate and increased at rising flow rate.



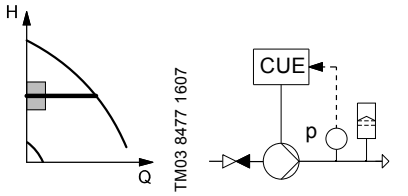
Constant differential pressure, pump.
The differential pressure is kept constant, independently of the flow rate.



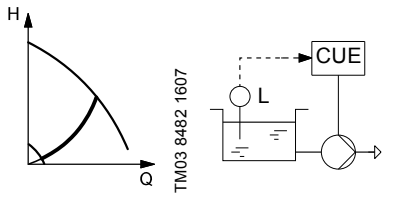
Constant differential pressure, system.
The differential pressure is kept constant, independently of the flow rate.



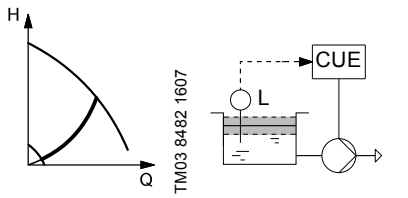
Constant pressure.
The pressure is kept constant, independently of the flow rate.



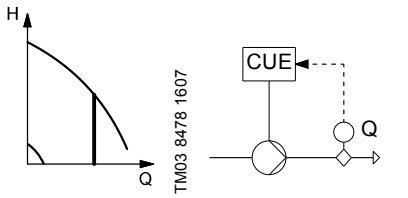
Constant pressure with stop function.
The outlet pressure is kept constant at high flow rate. On/off operation at low flow rate.



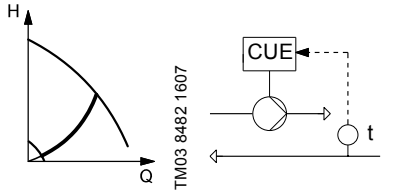
Constant level.
The liquid level is kept constant, independently of the flow rate.



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

9. Setting the product

To make a correct programming, it is often necessary to make settings in several submenus. The programmed data is saved internally in the frequency converter.

It is possible to make a backup of the data by uploading the data to the operating panel"s memory.

The menus are accessed or changed from [Main Menu] or [Favourites] on the operating panel. However, not all menus are available in [Favourites].

All settings that have been made are visible in [Favourites] > "Q5 - Changes Made".

See *8.1 Operating panel* and *8.2 Menu overview*.

9.1 First-time setup via the startup guide

The startup guide starts automatically the first time the product is switched on or after startup of the frequency converter. The guide enables quick configuration of basic pump- and application parameters.

1. Follow the on-screen instructions to complete the commissioning of the frequency converter. Some data from the motor nameplate is needed.

Reactivate the start-up guide by pressing [Favourites] > "Q4" - "Run start-up guide".

9.2 Uploading or downloading of data

It is possible to download stored data to another frequency converter.

2. Navigate to "0-5* Copy/Save", and press [OK].
3. Press [OK] to activate "0-50 LCP Copy".
4. Press [Up] to select "[1] All to LCP" to upload data to the operating panel, or
5. select "[2] All from LCP" to download data from the operating panel.
6. Press [OK]. A progress bar shows the uploading or downloading progress.

9.3 Asynchronous motor setup

To set an asynchronous motor manually in [Main menu], enter the following motor data available on the motor nameplate.

- "1-20 Motor Power [kW]" or "1-21 Motor Power [HP]"
- "1-22 Motor Voltage"
- "1-23 Motor Frequency"
- "1-24 Motor Current"
- "1-25 Motor Nominal Speed"
- "1-29 Automatic Motor Adaptation (AMA)".

9.4 Checking the motor rotation

There is a risk of damage to the pumps or the compressors if the motor is running in the wrong direction. Before starting the frequency converter, check the motor rotation.

1. Navigate to "1-28 Motor Rotation Check", and press [OK].
2. Scroll to "[1] Enable".

The following text appears: "Note! Motor may run in wrong direction".

3. Press [OK].
4. Follow the on-screen instructions.

To change the direction of rotation, remove power to the frequency converter and wait before touching the product. See waiting time in section *4. Installation requirements*.

- Reverse the connection of any 2 of the 3 motor wires on the motor or frequency-converter side of the connection.

9.5 Permanent-magnet motor setup

To set a permanent-magnet motor manually in [Main menu], enter the motor data available on the motor nameplate.

1. Activate PM motor operation "1-10 Motor Construction", select "[1] PM, non salient SPM."
2. Set "0-02 Motor Speed Unit" to "[0] RPM".

Programme the following parameters in the listed order:

1. "1-24 Motor Current"
2. "1-26 Motor Cont. Rated Torque"
3. "1-25 Motor Nominal Speed"
4. "1-39 Motor Poles"
5. "1-30 Stator Resistance (Rs)". Enter line to common stator winding resistance (Rs). If only line-line data is available, divide the line-line value by 2 to achieve the line-common (starpoint) value.
6. "1-37 d-axis Inductance (Ld)". Enter line to common direct axis inductance of the PM motor. If only line-line data is available, divide the line-line value by 2 to achieve the line-common (starpoint) value.
7. "1-40 Back EMF at 1000 RPM". Enter line-to-line back EMF of the PM motor at 1000 RPM mechanical speed (RMS value). Back EMF is the voltage generated by a PM motor when no frequency converter is connected and the shaft is turned externally. Back EMF is normally specified for nominal motor speed or for 1000 RPM measured between 2 lines. If the value is not available for a motor speed of 1000 RPM, calculate the correct value as follows: If back EMF is for example 320 V at 1800 RPM, it can be calculated at 1000 RPM as follows: Back EMF = (Voltage / RPM)*1000 = (320/1800)*1000 = 178. This is the value that must be programmed for "1-40 Back EMF at 1000 RPM".

9.5.1 Test motor operation

1. Start the motor at low speed (100-200 RPM). If the motor does not turn, check the installation, general programming, and motor data to ensure that it is correct.
2. Check if the start function in "1-70 PM Start Mode" fits the application requirements.

9.6 Synchronous reluctance motor setup

To set a synchronous reluctance motor manually in [Main menu], enter the following motor data available on the motor nameplate:

- "1-10 Motor Construction"
- "1-23 Motor Frequency"
- "1-24 Motor Current"
- "1-25 Motor Nominal Speed"
- "1-26 Motor Cont. Rated Torque"
- "1-29 Automatic Motor Adaptation (AMA)".

9.7 Automatic Energy Optimisation (AEO)

AEO is not relevant for permanent-magnet motors.

AEO is a procedure which minimises voltage to the motor, thereby reducing energy consumption, heat, and noise.

To activate AEO, set "1-03 Torque Characteristics" to "[2] Auto Energy Optim. CT" or "[3] Auto Energy Optim. VT".

9.8 Local-control test

1. Press [Hand On] to provide a local start command to the frequency converter.
2. Accelerate the frequency converter to full speed by pressing [Up]. Moving the cursor left of the decimal point provides quicker input changes.
3. Note any acceleration problems.
4. Press [Off]. Note any deceleration problems.

9.9 System startup

The below steps require wiring and application programming to be completed. We recommend that you follow this procedure after application setup is completed.

1. Press [Auto On].
2. Apply an external run command.
3. Adjust the speed reference throughout the speed range.
4. Remove the external run command.
5. Check the sound and vibration levels of the motor to ensure that the system is working as intended. If warnings or alarms occur, see *11.1 Overview of warnings and alarms* or refer to the service instructions for the frequency converter.

9.10 Resetting to default settings

You can make a backup of the changed settings first by uploading them to the operating panel.

9.10.1 Recommended reset

We recommend that you use "14-22 Operation Mode" to perform a reset to default settings. In this way some settings are kept, such as operating hours, serial communication selections, personal menu settings, fault log, alarm log, and other monitoring functions.

1. Navigate to "14-** Special Functions", and press [OK].
2. Select "14-22 Operation Mode", and press [OK].
3. Use [Up] and [Down] to navigate to "[2] Initialisation", and press [OK].
4. Switch off the power to the unit, and wait for the display to switch off.
5. Reconnect the power.
6. Alarm 80, "Drive initialised to default value", is displayed.
7. Press [Reset] to return to operating mode.

9.10.2 Manual reset

You can also manually reset to default settings, but this deletes all motor-, programming-, localisation-, and monitoring data. It will not reset settings for "15-00 Operating hours", "15-03 Power Up"s", "15-04 Over Temp"s" and "15-05 Over Volt"s".

1. Switch off the power to the unit, and wait for the display to switch off.
2. Press and hold [Status], [Main Menu] and [OK] at the same time while switching on the power to the unit. It takes approximately 5 seconds or until you hear an audible click and the fan starts.

10. Servicing the product

CAUTION

Electric shock

Minor or moderate personal injury

- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on. See *4. Installation requirements*
- Touching the electrical parts may be fatal, even after CUE has been switched off.

Conduct a functional test every 12 months to detect any failure or malfunction of the STO functionality.

To conduct the functional test, perform the following steps:

- Remove the 24 V DC voltage supply at terminal 37.
- Check if the operating panel displays the alarm "Safe Stop A68"
- Verify that the frequency converter trips the unit.
- Verify that the motor is coasting and comes to a complete stop.
- Verify that the motor cannot be started.
- Reconnect the 24 V DC voltage supply to terminal 37.
- Verify that the motor is not started automatically and restarts only by giving a reset signal (via bus, Digital I/O, or the [Reset] button).

11. Fault finding the product

11.1 Overview of warnings and alarms

Type	LED indicator
Warning	Yellow
Alarm	Flashing red
Trip lock	Yellow and red

Number	Description	Warning	Alarm	Alarm, trip lock
1	10 V low	●	-	-
2	Live zero error	(●)	(●)	-
3	No motor	(●)	-	-
4	Mains phase loss	(●)	(●)	(●)
5	DC voltage high	●	-	-
6	DC voltage low	●	-	-
7	DC overvoltage	●	●	-
8	DC undervoltage	●	●	-
9	Inverter overloaded	●	●	-
10	Motor overtemperature	(●)	(●)	-
11	Motor thermistor overtemperature	(●)	(●)	-
12	Torque limit	●	●	-
13	Overcurrent	●	●	●
14	Protective earth fault	-	●	●
15	Hardware mismatch	-	●	●
16	Short circuit	-	●	●
17	Control word timeout	(●)	(●)	-
18	Start failed	-	●	-
21	Parameter error	●	●	-
23	Internal fan fault	●	-	-
24	External fan fault	●	-	-
25	Brake resistor short circuit	●	-	-
26	Brake resistor power limit	(●)	(●)	-
27	Brake chopper fault	●	●	-
28	Brake check failed	(●)	(●)	-
29	Heat sink temperature	●	●	●
30	Motor phase U missing	(●)	(●)	(●)
31	Motor phase V missing	(●)	(●)	(●)
32	Motor phase W missing	(●)	(●)	(●)
33	Inrush fault	-	●	●
34	Fieldbus communication fault	●	●	-
35	Option fault	(●)	-	-
36	Mains failure	●	●	-
38	Internal fault	-	●	●
39	Heat sink sensor	-	●	●
40	Overload of digital output terminal 27	(●)	-	-
41	Overload of digital output terminal 29	(●)	-	-
42	Overload X30/6 or X30/7	(●)	-	-
45	Protective earth fault 2	●	●	●
46	Power card supply	-	●	●
47	24 V supply low	●	●	●
48	1.8 V supply low	-	●	●
49	Speed limit	●	-	-
50	AMA calibration failed	-	●	-
51	AMA check U_{nom} and I_{nom}	-	●	-
52	AMA low I_{nom}	-	●	-
53	AMA motor too large	-	●	-
54	AMA motor too small	-	●	-
55	AMA parameter out of range	-	●	-

Number	Description	Warning	Alarm	Alarm, trip lock
56	AMA interrupted by user	-	●	-
57	AMA timeout	-	●	-
58	AMA internal fault	●	●	-
59	Current limit	●	-	-
60	External interlock	●	●	-
61	Feedback error	(●)	(●)	-
62	Output frequency at maximum limit	●	-	-
64	Voltage limit	●	-	-
65	Control card overtemperature	●	●	●
66	Heat sink temperature low	●	-	-
67	Option configuration has changed	-	●	-
68	Safe stop activated	(●)	(●)[1]	-
69	Power card temperature	-	●	●
70	Illegal FC configuration	-	-	●
71	PTC 1 safe stop	●	●	-
72	Dangerous failure	●	●	●
76	Power unit setup	●	-	-
77	Reduced power mode	●	-	-
79	Illegal power section configuration	-	●	-
80	Drive initialised to default value	-	●	-
81	CSIV corrupt	-	●	-
82	CSIV parameter error	-	●	-
90	Feedback monitor	(●)	(●)	-
91	Analog input 54 wrong settings	-	-	●
92	No flow	(●)	(●)	-
93	Dry pump	(●)	(●)	-
94	End of curve	(●)	(●)	-
95	Broken belt	(●)	(●)	-
96	Start delayed	(●)	-	-
97	Stop delayed	(●)	-	-
98	Clock fault	●	-	-
99	Locked rotor	-	●	-
100	Derag limit fault	-	●	(●)
104	Mixing fan fault	(●)	(●)	-
148	System temperature	●	●	-
200	Fire mode	(●)	-	-
201	Fire mode was active	(●)	-	-
243	Brake IGBT	●	●	-
244	Heat sink temperature	●	●	●
245	Heat sink sensor	-	●	●
246	Power card supply	-	●	●
247	Power card temperature	-	●	●
248	Illegal power section configuration	-	●	●
249	Temperature of the rectifier heat sink	●	-	-
250	New spare part	-	-	●
251	New type code	-	●	●
274	The flow is not confirmed	-	●	-
275	Flow switch failure	-	●	-
2004	External fault	-	●	-
2007	Too high bearing temperature	●	●	
2008	Too high bearing temperature	●	●	-
2010	Setpoint signal outside range	-	●	-
2011	Sensor 1 is outside range	-	●	-
2012	Sensor 2 is outside range	-	●	-
2013	Temperature sensor 1 is outside range	-	●	-
2014	Temperature sensor 2 is outside range	-	●	-
2016	Limit 1 is exceeded	●	●	-

Number	Description	Warning	Alarm	Alarm, trip lock
2017	Limit 2 is exceeded	•	•	-

(•)This warning or alarm is programmable. Warnings and alarms depend on the parameter settings.

[1] This warning or alarm cannot be auto reset via parameter selection.

12. Technical data

12.1 Enclosure

The individual CUE cabinet sizes are characterised by their enclosures. The table shows the relationship of enclosure class and enclosure type.

Example:

Read from the nameplate:

- Supply voltage = 3 x 380-500 V.
- Typical shaft power = 1.5 kW (2 hp).
- Enclosure class = IP20.

The table shows that the CUE enclosure is A2.

<table>
<tr><th colspan="2" rowspan="2">Typical shaft power P2</th><th colspan="12">Enclosure</th></tr>
<tr><th colspan="3">1 x 200-240 V</th><th colspan="2">3 x 200-240 V</th><th colspan="2">3 x 380-500 V</th><th colspan="2">3 x 525-600 V</th><th colspan="2">3 x 525-690 V</th></tr>
<tr><th>[kW]</th><th>[hp]</th><th>IP20</th><th>IP21</th><th>IP55</th><th>IP20</th><th>IP55</th><th>IP20</th><th>IP55</th><th>IP20</th><th>IP55</th><th>IP21</th><th>IP55</th></tr>
<tr><td>0.55</td><td>0.75</td><td></td><td></td><td></td><td></td><td></td><td rowspan="6">A2</td><td rowspan="6">A4</td><td></td><td></td><td></td><td></td></tr>
<tr><td>0.75</td><td>1</td><td></td><td></td><td></td><td rowspan="4">A2</td><td rowspan="4">A4</td><td rowspan="5">A3</td><td rowspan="5">A5</td><td></td><td></td></tr>
<tr><td>1.1</td><td>1.5</td><td>A3</td><td></td><td>A5</td><td></td><td></td></tr>
<tr><td>1.5</td><td>2</td><td></td><td rowspan="4">B1</td><td rowspan="4">B1</td><td></td><td></td></tr>
<tr><td>2.2</td><td>3</td><td></td><td></td><td></td><td></td></tr>
<tr><td>3</td><td>4</td><td></td><td rowspan="2">A3</td><td rowspan="2">A5</td><td></td><td></td></tr>
<tr><td>3.7</td><td>5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>4</td><td>5</td><td></td><td></td><td></td><td></td><td></td><td>A2</td><td>A4</td><td rowspan="3">A3</td><td rowspan="3">A5</td><td></td><td></td></tr>
<tr><td>5.5</td><td>7.5</td><td></td><td>B1</td><td>B1</td><td rowspan="3">B3</td><td rowspan="3">B1</td><td rowspan="2">A3</td><td rowspan="2">A5</td><td></td><td></td></tr>
<tr><td>7.5</td><td>10</td><td></td><td>B2</td><td>B2</td><td></td><td></td></tr>
<tr><td>11</td><td>15</td><td></td><td></td><td></td><td></td><td></td><td rowspan="3">B3</td><td rowspan="3">B1</td><td></td><td></td><td rowspan="4">B2</td><td rowspan="4">B2</td></tr>
<tr><td>15</td><td>20</td><td></td><td></td><td></td><td rowspan="2">B4</td><td>B2</td><td></td><td></td></tr>
<tr><td>18.5</td><td>25</td><td></td><td></td><td></td><td rowspan="3">C1</td><td></td><td></td></tr>
<tr><td>22</td><td>30</td><td></td><td></td><td></td><td rowspan="2">C3</td><td rowspan="3">B4</td><td rowspan="3">B2</td><td></td><td></td></tr>
<tr><td>30</td><td>40</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>37</td><td>50</td><td></td><td></td><td></td><td rowspan="2">C4</td><td rowspan="2">C2</td><td rowspan="3">C1</td><td></td><td></td><td rowspan="5">C2</td><td rowspan="5">C2</td></tr>
<tr><td>45</td><td>60</td><td></td><td></td><td></td><td rowspan="2">C3</td><td></td><td></td></tr>
<tr><td>55</td><td>75</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>75</td><td>100</td><td></td><td></td><td></td><td></td><td></td><td rowspan="2">C4</td><td rowspan="2">C2</td><td></td><td></td></tr>
<tr><td>90</td><td>125</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

12.2 Operating conditions

Relative humidity	5-95 % RH
Ambient temperature	Max. 50 °C (122 °F)
Average ambient temperature over 24 hours	Max. 45 °C (113 °F)
Minimum ambient temperature at full operation	0 °C (32 °F)
Minimum ambient temperature at reduced operation	-10 °C (14 °F)
Temperature during storage and transport	-25 to 65 °C (-13 to 149 °F)
Storage duration	Max. 6 months
Maximum altitude above sea level without performance reduction	1000 m (3280 ft)
Maximum altitude above sea level with performance reduction	3000 m (9840 ft)

CUE comes in a packaging which is not suitable for outdoor storage.

12.3 Mechanical data

12.3.1 Cable gland

Select standard gland holes for CUE frequency converters used outside USA and Canada.

Select imperial gland holes for CUE frequency converters used inside USA and Canada.

Enclosure	Standard gland holes	Imperial gland holes
A3 IP20/21 / NEMA type 1	3 x 22.5 (1/2")	3 x 22.5 (1/2")
	3 x 28.4 (3/4")	3 x 28.4 (3/4")
A4 IP55 / NEMA type 12	1 x 22.5 (1/2")	1 x 22.5 (1/2")
	3 x 28.4 (3/4")	3 x 28.4 (3/4")
A5 IP55 / NEMA type 12	6 x 26.3	6 x 28.4 (3/4")
B1 IP21 / NEMA type 1	2 x 22.5 (1/2")	2 x 22.5 (1/2")
	3 x 37.2	3 x 34.7 (1")
B1 IP55 / NEMA type 12	2 x 21.5	2 x 22.5 (1/2")
	1 x 26.3	1 x 28.4 (3/4")
	3 x 33.1	3 x 34.7 (1")
B2 IP21 / NEMA type 1 and B2 IP55 / NEMA type 12	1 x 21.5	1 x 22.5 (1/2")
	1 x 26.3	1 x 28.4 (3/4")
	1 x 33.1	1 x 34.7 (1")
	2 x 42.9	2 x 44.2 (1 1/4")

12.3.2 Cable requirements

Maximum length, screened motor cable	150 m (500 ft)
Maximum length, unscreened motor cable	300 m (1000 ft)
Maximum length, signal cable	300 m (1000 ft)

Always comply with local regulations as to cable cross-sections.

12.3.3 Cable cross-section to signal terminals

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

12.3.4 Non-UL fuses and conductor cross-section to mains and motor, for installations outside North America

Typical shaft power P2	Maximum fuse size	Fuse type	Maximum conductor cross-section[1)]
[kW (hp)]	[A]		[mm^2]
1 x 200-240 V			
1.1 (1.5)	20	gG	4
1.5 (2)	30	gG	10
2.2 (3)	40	gG	10
3 (4)	40	gG	10
3.7 (5)	60	gG	10
5.5 (7.5)	80	gG	10
7.5 (10)	100	gG	35
3 x 200-240 V			
0.75 (1)	10	gG	4
1.1 (1.5)	20	gG	4
1.5 (2)	20	gG	4
2.2 (3)	20	gG	4
3 (4)	32	gG	4
3.7 (5)	32	gG	4
5.5 (7.5)	63	gG	10
7.5 (10)	63	gG	10
11 (15)	63	gG	10
15 (20)	80	gG	35
18.5 (25)	125	gG	50
22 (30)	125	gG	50
30 (40)	160	gG	50
37 (50)	200	aR	95
45 (60)	250	aR	120
3 x 380-500 V			
0.55 (0.75)	10	gG	4
0.75 (1)	10	gG	4
1.1 (1.5)	10	gG	4
1.5 (2)	10	gG	4
2.2 (3)	20	gG	4
3 (4)	20	gG	4
4 (5)	20	gG	4
5.5 (7.5)	32	gG	4
7.5 (10)	32	gG	4
11 (15)	63	gG	10
15 (20)	63	gG	10
18.5 (25)	63	gG	10
22 (30)	63	gG	35
30 (40)	80	gG	35
37 (50)	100	gG	50
45 (60)	125	gG	50
55 (75)	160	gG	50
75 (100)	250	aR	95
90 (125)	250	aR	120
110 (150)	300	gG	2 × 70
132 (200)	350	gG	2 × 70
160 (250)	400	gG	2 × 185
200 (300)	500	gG	2 × 185
250 (350)	600	gR	2 × 185
3 x 525-600 V			
0.75 (1)	10	gG	4
1.1 (1.5)	10	gG	4
1.5 (2)	10	gG	4
2.2 (3)	20	gG	4
3 (4)	20	gG	4
4 (5)	20	gG	4
5.5 (7.5)	32	gG	4
7.5 (10)	32	gG	4
3 x 525-690 V			
11 (15)	63	gG	35
15 (20)	63	gG	35
18.5 (25)	63	gG	35
22 (30)	63	gG	35
30 (40)	63	gG	35
37 (50)	80	gG	95
45 (60)	100	gG	95
55 (75)	125	gG	95
75 (100)	160	gG	95
90 (125)	160	gG	95
110 (150)	225	-	2 × 70
132 (200)	250	-	2 × 70
160 (250)	350	-	2 × 70
200 (300)	400	-	2 × 185
250 (350)	500	-	2 × 185

1) Screened motor cable, unscreened supply cable. AWG. See section *12.3.5 UL fuses and conductor cross-section to mains and motor, for installations in North America*.

12.3.5 UL fuses and conductor cross-section to mains and motor, for installations in North America

Typical shaft power P2	Fuse type							Maximum conductor cross-section[1]
[kW (hp)]	Bussmann RK1/E1958/ JFHR2	Bussmann J/E4273 T/ JDDZ	Bussmann T/E4274 H/ JDDZ	SIBA RK1/ Bussmann E125085 JFHR2	Littel Fuse RK1/SIBA E180276 RKI/JDDZ	Ferraz-Shawmut CC/Littel Fuse E71611 JFHR2	Ferraz-Shawmut RK1/E60314 JFHR2	[AWG][2]
1 x 200-240 V								
1.1 (1.5)	KTN-R20	-	-	-	-	-	-	10
1.5 (2)	KTN-R30	-	-	-	-	-	-	7
2.2 (3)	KTN-R40	-	-	-	-	-	-	7
3 (4)	KTN-R40	-	-	-	-	-	-	7
3.7 (5)	KTN-R60	-	-	-	-	-	-	7
5.5 (7.5)	-	-	-	-	-	-	-	7
7.5 (10)	-	-	-	-	-	-	-	2
3 x 200-240 V								
0.75 (1)	KTN-R10	JKS-10	JJN-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
1.1 (1.5)	KTN-R20	JKS-20	JJN-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
1.5 (2)	KTN-R20	JKS-20	JJN-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
2.2 (3)	KTN-R20	JKS-20	JJN-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
3 (4)	KTN-R30	JKS-30	JJN-30	5012406-032	KTN-R30	ATM-R30	A2K-30R	10
3.7 (5)	KTN-R30	JKS-30	JJN-30	5012406-032	KTN-R30	ATM-R30	A2K-30R	10
5.5 (7.5)	KTN-R50	JKS-50	JJN-50	5012406-050	KLN-R50	-	A2K-50R	7
7.5 (10)	KTN-R50	JKS-60	JJN-60	5012406-050	KLN-R60	-	A2K-50R	7
11 (15)	KTN-R60	JKS-60	JJN-60	5014006-063	KLN-R60	A2K-60R	A2K-60R	7
15 (20)	KTN-R80	JKS-80	JJN-80	5014006-080	KLN-R80	A2K-80R	A2K-80R	2
18.5 (25)	KTN-R125	JKS-150	JJN-125	2028220-125	KLN-R125	A2K-125R	A2K-125R	1/0
22 (30)	KTN-R125	JKS-150	JJN-125	2028220-125	KLN-R125	A2K-125R	A2K-125R	1/0
30 (40)	FWX-150	-	-	2028220-150	L25S-150	A25X-150	A25X-150	1/0
37 (50)	FWX-200	-	-	2028220-200	L25S-200	A25X-200	A25X-200	4/0
45 (60)	FWX-250	-	-	2028220-250	L25S-250	A25X-250	A25X-250	250 MCM
3 x 380-500 V								
0.55 (0.75)	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
0.75 (1)	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
1.1 (1.5)	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
1.5 (2)	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
2.2 (3)	KTS-R20	JKS-20	JJS-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
3 (4)	KTS-R20	JKS-20	JJS-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
4 (5)	KTS-R20	JKS-20	JJS-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
5.5 (7.5)	KTS-R30	JKS-30	JJS-30	5012406-032	KTN-R30	ATM-R30	A2K-30R	10
7.5 (10)	KTS-R30	JKS-30	JJS-30	5012406-032	KTN-R30	ATM-R30	A2K-30R	10
11 (15)	KTS-R40	JKS-40	JJS-40	5014006-040	KLS-R40	-	A6K-40R	7
15 (20)	KTS-R40	JKS-40	JJS-40	5014006-040	KLS-R40	-	A6K-40R	7
18.5 (25)	KTS-R50	JKS-50	JJS-50	5014006-050	KLS-R50	-	A6K-50R	7
22 (30)	KTS-R60	JKS-60	JJS-60	5014006-063	KLS-R60	-	A6K-60R	2
30 (40)	KTS-R80	JKS-80	JJS-80	2028220-100	KLS-R80	-	A6K-80R	2
37 (50)	KTS-R100	JKS-100	JJS-100	2028220-125	KLS-R100	-	A6K-100R	1/0
45 (60)	KTS-R125	JKS-150	JJS-150	2028220-125	KLS-R125	-	A6K-125R	1/0
55 (75)	KTS-R150	JKS-150	JJS-150	2028220-160	KLS-R150	-	A6K-150R	1/0
75 (100)	FWH-220	-	-	2028220-200	L50S-225	-	A50-P225	4/0
90 (125)	FWH-250	-	-	2028220-250	L50S-250	-	A50-P250	250 MCM
110 (150)	FWH-300	JJS-300	NOS-300	170M3017	2028220-38	L50S-300	A50-P300	2 x 2/0
132 (200)	FWH-350	JJS-350	NOS-350	170M3018	2028220-38	L50S-350	A50-P350	2 x 2/0
160 (250)	FWH-400	JJS-400	NOS-400	170M4012	206xx32-400	L50S-400	A50-P400	2 x 350 MCM
200 (300)	FWH-500	JJS-500	NOS-500	170M4014	206xx32-500	L50S-500	A50-P500	2 x 350 MCM
250 (350)	FWH-600	JJS-600	NOS-600	170M4016	206xx32-600	L50S-600	A50-P600	2 x 350 MCM
-	-	-	-	Bussmann E125085 JFHR2	SIBA E180276 JFHR2	-	Ferraz-Shawmut E76491 JFHR2	-
3 x 525-600 V								
0.75 (1)	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
1.1 (1.5)	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
1.5 (2)	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
2.2 (3)	KTS-R20	JKS-20	JJS-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
3 (4)	KTS-R20	JKS-20	JJS-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
4 (5)	KTS-R20	JKS-20	JJS-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
5.5 (7.5)	KTS-R30	JKS-30	JJS-30	5012406-032	KTN-R30	ATM-R30	A2K-30R	10
7.5 (10)	KTS-R30	JKS-30	JJS-30	5012406-032	KTN-R30	ATM-R30	A2K-30R	10

Typical shaft power P2	Fuse type							Maximum conductor cross-section[1]
[kW (hp)]	Bussmann RK1/E1958/ JFHR2	Bussmann J/E4273 T/ JDDZ	Bussmann T/E4274 H/ JDDZ	SIBA RK1/ Bussmann E125085 JFHR2	Littel Fuse RK1/SIBA E180276 RKI/JDDZ	Ferraz-Shawmut CC/Littel Fuse E71611 JFHR2	Ferraz-Shawmut RK1/E60314 JFHR2	[AWG][2]
3 x 525-690 V								
11 (15)	KTS-R-25	JKS-25	JJS-25	5017906-025	KLSR025	HST25	A6K-25R	1/0
15 (20)	KTS-R-30	JKS-30	JJS-30	5017906-030	KLSR030	HST30	A6K-30R	1/0
18.5 (25)	KTS-R-45	JKS-45	JJS-45	5014006-050	KLSR045	HST45	A6K-45R	1/0
22 (30)	KTS-R-45	JKS-45	JJS-45	5014006-050	KLSR045	HST45	A6K-45R	1/0
30 (40)	KTS-R-60	JKS-60	JJS-60	5014006-063	KLSR060	HST60	A6K-60R	1/0
37 (50)	KTS-R-80	JKS-80	JJS-80	5014006-080	KLSR075	HST80	A6K-80R	1/0
45 (60)	KTS-R-90	JKS-90	JJS-90	5014006-100	KLSR090	HST90	A6K-90R	1/0
55 (75)	KTS-R-100	JKS-100	JJS-100	5014006-100	KLSR100	HST100	A6K-100R	1/0
75 (100)	KTS-R125	JKS-125	JJS-125	2028220-125	KLS-125	HST125	A6K-125R	1/0
90 (125)	KTS-R150	JKS-150	JJS-150	2028220-150	KLS-150	HST150	A6K-150R	1/0
110 (150)	-	-	-	170M3017	2061032.38	-	6.6URD30D08A038	2 x 2/0
132 (200)	-	-	-	170M3018	2061032.350	-	6.6URD30D08A0350	2 x 2/0
160 (250)	-	-	-	170M4011	2061032.350	-	6.6URD30D08A0350	2 x 2/0
200 (300)	-	-	-	170M4012	2061032.350	-	6.6URD30D08A0400	2 x 350 MCM
250 (350)	-	-	-	170M4014	2061032.500	-	6.6URD30D08A0500	2 x 350 MCM

1 Screened motor cable, unscreened supply cable.

2 American Wire Gauge.

12.4 Electrical data

Mains supply (L1, L2, L3)

Supply voltage	200-240 V ± 10 %
Supply voltage	380-500 V ± 10 %
Supply voltage	525-600 V ± 10 %
Supply voltage	525-690 V ± 10 %
Supply frequency	50/60 Hz
Maximum temporary imbalance between phases	3 % of rated value
Leakage current to protective 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.

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

Motor output (U, V, W)

Output voltage	0-100 %[1)]
Output frequency	0-590 Hz[2)]
Switching on output	Not recommended

1) Output voltage in percentage of supply voltage.

2) Depending on the pump family selected.

RS-485 GENIbus 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, 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)[1)]	240 VAC, 2 A
Maximum terminal load (AC-15)[1)]	240 VAC, 0.2 A
Maximum terminal load (DC-1)[1)]	50 VDC, 1 A
Minimum terminal load	24 VDC 10 mA 24 VAC 20 mA

1) 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	53
Voltage signal	A53 = "U"[1)]
Voltage range	0-10 V
Input resistance, R_i	Approx. 10 kΩ
Maximum voltage	± 20 V
Current signal	A53 = "I"[1)]
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
Analog input 2, terminal number	54
Current signal	A54 = "I"[1)]
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

1) 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	42
Current range	0-20 mA
Maximum load to frame	500 Ω
Maximum fault	0.8 % of full scale

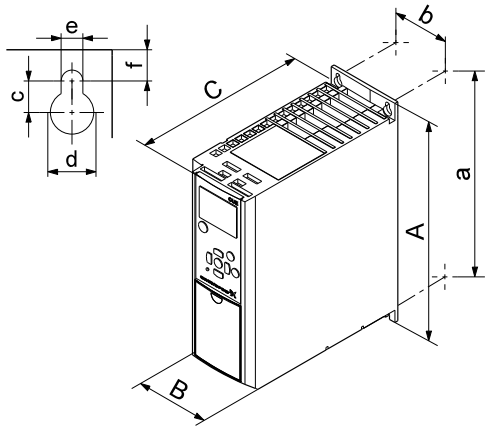
The analog output is galvanically separated from the supply voltage (PELV) and other high-voltage terminals.

MCB 114 sensor input module

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

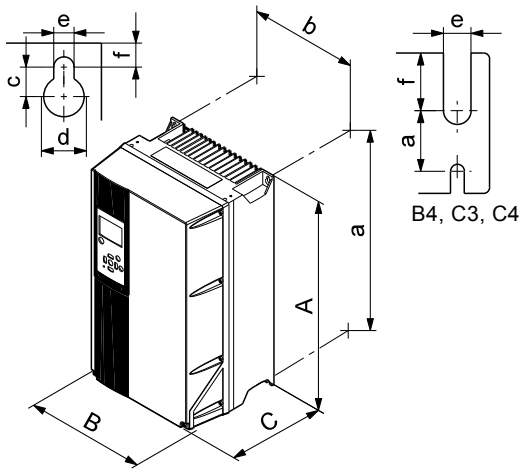
12.5 Dimensions and weights

12.5.1 Enclosures A2-A5, B1-B4 and C1-C4.



TM03 9000 2807

Fig. 52 Dimensions for enclosures A2 and A3



TM03 9002 2807

Fig. 53 Dimensions for enclosures A4, A5, B1, B2, B3, B4, C1, C2, C3 and C4

Enclosure	Height [mm][1)]		Width [mm][1)]		Depth [mm][1)]		Screw holes [mm]				Weight [kg]
	A	a	B	b	C	C	c	Ød	Øe	f	
A2	268	257	90	70	205	219	8	11	5.5	9	4.9
IP21/NEMA1	375	350	90	70	205	219	8	11	5.5	9	5.3
A3	268	257	130	110	205	219	8	11	5.5	9	6.6
IP21/NEMA1	375	350	130	110	205	219	8	11	5.5	9	7
A4	420	401	200	171	175	175	8.2	12	6.5	6	9.2
A5	420	402	242	215	200	200	8.2	12	6.5	9	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
IP21/NEMA1	475	-	165	-	249	262	8	12	6.8	7.9	-
B4	520	495	231	200	242	242	-	-	8.5	15	23.5
IP21/NEMA1	670	-	255	-	246	246	-	-	8.5	15	-
C1	680	648	308	272	310	310	12	19	9	9.8	45
C2	770	739	370	334	335	335	12	19	9	9.8	65
C3	550	521	308	270	333	333	-	-	8.5	17	35
IP21/NEMA1	755	-	329	-	337	337	-	-	8.5	17	-
C4	660	631	370	330	333	333	-	-	8.5	17	50
IP21/NEMA1	950	-	391	-	337	337	-	-	8.5	17	-

[1)] The dimensions are maximum height, width and depth.

12.5.2 Enclosures D1h and D2h

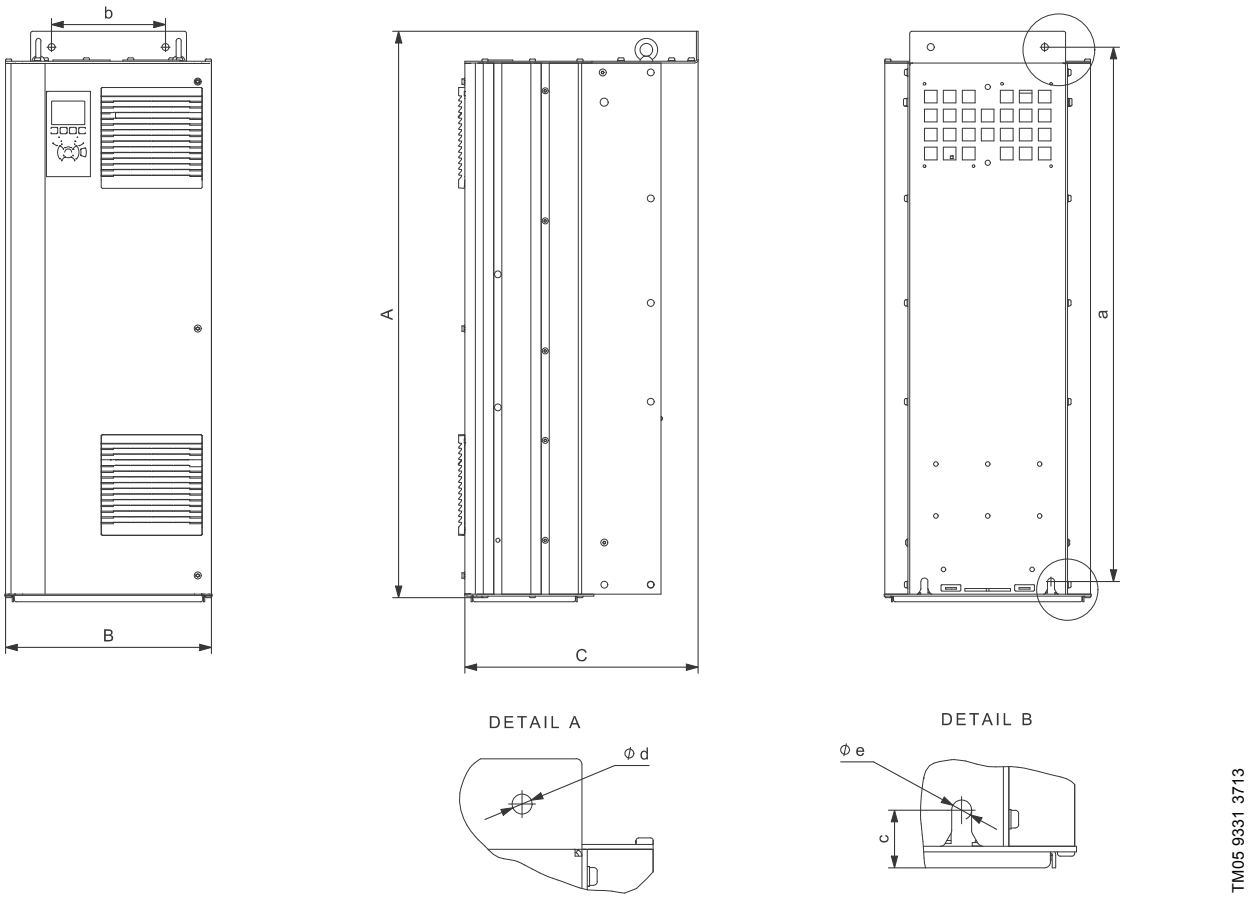


Fig. 54 Dimensions for enclosures D1h and D2h

Enclosure	Height [mm][1)]		Width [mm][1)]		Depth [mm][1)]	Screw holes [mm]				Weight [kg]
	A	a	B	b	C	c	Ød	Øe	f	
D1h	901	844	325	180	378	20	11	11	25	62
D2h	1107	1051	420	280	378	20	11	11	25	125

Shipping dimensions					
Enclosure	**Height [mm][1)]**	**Width [mm][1)]**	**Depth [mm][1)]**	**Weight [kg]**	
D1h	850	370	460	73	Only 3 x 380-500 V, 110 kW (150 hp)
D1h	850	370	460	72 - 124.5	
D2h	1190	560	640	18 - 125.5	

1) The dimensions are maximum height, width and depth.

12.6 Miscellaneous data

12.6.1 Sound pressure level

The sound pressure of CUE is maximum 70 dB(A).

The sound pressure level of a motor controlled by a frequency converter may be higher than that of a corresponding motor which is not controlled by a frequency converter. See section *6.3 RFI filters*.

12.6.2 STO application

The STO signal must be SELV or PELV supplied.

European directive	Machinery Directive (2006/42/EC)	EN ISO 13849-1
		EN IEC 62061
		EN IEC 61800-5-2
	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
Safety standards	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 61800-5-2 (Safe Torque Off, STO) IEC 60204-1 (Stop Category 0)
Safety performance	**IOS 13849-1**	
	Category	Cat 3
	Diagnostic Coverage	DC: 90 %, medium
	Mean Time to Dangerous Failure	MTTFd: 14000 years, high
	Performance Level	PL d
	IEC 61508 / IEC 62061	
	Safety Integrity Level	SIL 2, SIL CL2
	Probability of Dangerous Failure per Hour	PFH: 1E-10/h. High Demand Mode.
	Probability of Dangerous Failure on Demand	PFD: 1E-10. Low Demand Mode.
	Safe Failure Fraction	SFF: > 99 %
	Hardware Fault Tolerance	HFT: 0 (1oo1)
	Proof Test Interval T1	20 years
	Mission time TM	20 years
Reaction time	Input to output response time	Maximum 20 ms

13. Disposal

This product or parts of it must be disposed of in an environmentally sound way:

1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

The crossed-out wheelie bin symbol on a product means that it must be disposed of separately from household waste. When a product marked with this symbol reaches its end of life, take it to a collection point designated by the local waste disposal authorities. The separate collection and recycling of such products will help protect the environment and human health.

See also end-of-life information at www.grundfos.com/product-recycling.

Argentina
Bombas GRUNDFOS de Argentina S.A.
Ruta Panamericana km. 37.500 Centro Industrial Garin
1619 Garín Pcia. de B.A.
Phone: +54-3327 414 444
Telefax: +54-3327 45 3190

Australia
GRUNDFOS Pumps Pty. Ltd.
P.O. Box 2040
Regency Park
South Australia 5942
Phone: +61-8-8461-4611
Telefax: +61-8-8340 0155

Austria
GRUNDFOS Pumpen Vertrieb Ges.m.b.H.
Grundfosstraße 2
A-5082 Grödig/Salzburg
Tel.: +43-6246-883-0
Telefax: +43-6246-883-30

Belgium
N.V. GRUNDFOS Bellux S.A.
Boomsesteenweg 81-83
B-2630 Aartselaar
Tél.: +32-3-870 7300
Télécopie: +32-3-870 7301

Belarus
Представительство ГРУНДФОС в Минске
220125, Минск
ул. Шафарнянская, 11, оф. 56, БЦ «Порт»
Тел.: +7 (375 17) 286 39 72/73
Факс: +7 (375 17) 286 39 71
E-mail: minsk@grundfos.com

Bosnia and Herzegovina
GRUNDFOS Sarajevo
Zmaja od Bosne 7-7A,
BH-71000 Sarajevo
Phone: +387 33 592 480
Telefax: +387 33 590 465
www.ba.grundfos.com
e-mail: grundfos@bih.net.ba

Brazil
BOMBAS GRUNDFOS DO BRASIL
Av. Humberto de Alencar Castelo Branco, 630
CEP 09850 - 300
São Bernardo do Campo - SP
Phone: +55-11 4393 5533
Telefax: +55-11 4343 5015

Bulgaria
Grundfos Bulgaria EOOD
Slatina District
Iztochna Tangenta street no. 100
BG - 1592 Sofia
Tel. +359 2 49 22 200
Fax. +359 2 49 22 201
email: bulgaria@grundfos.bg

Canada
GRUNDFOS Canada Inc.
2941 Brighton Road
Oakville, Ontario
L6H 6C9
Phone: +1-905 829 9533
Telefax: +1-905 829 9512

China
GRUNDFOS Pumps (Shanghai) Co. Ltd.
10F The Hub, No. 33 Suhong Road
Minhang District
Shanghai 201106
PRC
Phone: +86 21 612 252 22
Telefax: +86 21 612 253 33

COLOMBIA
GRUNDFOS Colombia S.A.S.
Km 1.5 vía Siberia-Cota Conj. Potrero Chico,
Parque Empresarial Arcos de Cota Bod. 1A.
Cota, Cundinamarca
Phone: +57(1)-2913444
Telefax: +57(1)-8764586

Croatia
GRUNDFOS CROATIA d.o.o.
Buzinski prilaz 38, Buzin
HR-10010 Zagreb
Phone: +385 1 6595 400
Telefax: +385 1 6595 499
www.hr.grundfos.com

GRUNDFOS Sales Czechia and Slovakia s.r.o.
Čajkovského 21
779 00 Olomouc
Phone: +420-585-716 111

Denmark
GRUNDFOS DK A/S
Martin Bachs Vej 3
DK-8850 Bjerringbro
Tlf.: +45-87 50 50 50
Telefax: +45-87 50 51 51
E-mail: info_GDK@grundfos.com
www.grundfos.com/DK

Estonia
GRUNDFOS Pumps Eesti OÜ
Peterburi tee 92G
11415 Tallinn
Tel: + 372 606 1690
Fax: + 372 606 1691

Finland
OY GRUNDFOS Pumput AB
Trukkikuja 1
FI-01360 Vantaa
Phone: +358-(0) 207 889 500

France
Pompes GRUNDFOS Distribution S.A.
Parc d'Activités de Chesnes
57, rue de Malacombe
F-38290 St. Quentin Fallavier (Lyon)
Tél.: +33-4 74 82 15 15
Télécopie: +33-4 74 94 10 51

Germany
GRUNDFOS GMBH
Schlüterstr. 33
40699 Erkrath
Tel.: +49-(0) 211 929 69-0
Telefax: +49-(0) 211 929 69-3799
e-mail: infoservice@grundfos.de
Service in Deutschland:
e-mail: kundendienst@grundfos.de

Greece
GRUNDFOS Hellas A.E.B.E.
20th km. Athinon-Markopoulou Av.
P.O. Box 71
GR-19002 Peania
Phone: +0030-210-66 83 400
Telefax: +0030-210-66 46 273

Hong Kong
GRUNDFOS Pumps (Hong Kong) Ltd.
Unit 1, Ground floor
Siu Wai Industrial Centre
29-33 Wing Hong Street &
68 King Lam Street, Cheung Sha Wan
Kowloon
Phone: +852-27861706 / 27861741
Telefax: +852-27858664

Hungary
GRUNDFOS Hungária Kft.
Tópark u. 8
H-2045 Törökbálint,
Phone: +36-23 511 110
Telefax: +36-23 511 111

India
GRUNDFOS Pumps India Private Limited
118 Old Mahabalipuram Road
Thoraipakkam
Chennai 600 096
Phone: +91-44 2496 6800

Indonesia
PT. GRUNDFOS POMPA
Graha Intirub Lt. 2 & 3
Jln. Cililitan Besar No.454. Makasar,
Jakarta Timur
ID-Jakarta 13650
Phone: +62 21-469-51900
Telefax: +62 21-460 6910 / 460 6901

Ireland
GRUNDFOS (Ireland) Ltd.
Unit A, Merrywell Business Park
Ballymount Road Lower
Dublin 12
Phone: +353-1-4089 800
Telefax: +353-1-4089 830

Italy
GRUNDFOS Pompe Italia S.r.l.
Via Gran Sasso 4
I-20060 Truccazzano (Milano)
Tel.: +39-02-95838112
Telefax: +39-02-95309290 / 95838461

Japan
GRUNDFOS Pumps K.K.
1-2-3, Shin-Miyakoda, Kita-ku,
Hamamatsu
431-2103 Japan
Phone: +81 53 428 4760
Telefax: +81 53 428 5005

Korea
GRUNDFOS Pumps Korea Ltd.
6th Floor, Aju Building 679-5
Yeoksam-dong, Kangnam-ku, 135-916
Seoul, Korea
Phone: +82-2-5317 600
Telefax: +82-2-5633 725

Latvia
SIA GRUNDFOS Pumps Latvia
Deglava biznesa centrs
Augusta Deglava ielā 60, LV-1035, Rīga,
Tālr.: + 371 714 9640, 7 149 641
Fakss: + 371 914 9646

Lithuania
GRUNDFOS Pumps UAB
Smolensko g. 6
LT-03201 Vilnius
Tel: + 370 52 395 430
Fax: + 370 52 395 431

Malaysia
GRUNDFOS Pumps Sdn. Bhd.
7 Jalan Peguam U1/25
Glenmarie Industrial Park
40150 Shah Alam
Selangor
Phone: +60-3-5569 2922
Telefax: +60-3-5569 2866

Mexico
Bombas GRUNDFOS de México S.A. de C.V.
Boulevard TLC No. 15
Parque Industrial Stiva Aeropuerto
Apodaca, N.L. 66600
Phone: +52-81-8144 4000
Telefax: +52-81-8144 4010

Netherlands
GRUNDFOS Netherlands
Veluwezoom 35
1326 AE Almere
Postbus 22015
1302 CA ALMERE
Tel.: +31-88-478 6336
Telefax: +31-88-478 6332
E-mail: info_gnl@grundfos.com

New Zealand
GRUNDFOS Pumps NZ Ltd.
17 Beatrice Tinsley Crescent
North Harbour Industrial Estate
Albany, Auckland
Phone: +64-9-415 3240
Telefax: +64-9-415 3250

Norway
GRUNDFOS Pumper A/S
Strømsveien 344
Postboks 235, Leirdal
N-1011 Oslo
Tlf.: +47-22 90 47 00
Telefax: +47-22 32 21 50

Poland
GRUNDFOS Pompy Sp. z o.o.
ul. Klonowa 23
Baranowo k. Poznania
PL-62-081 Przeźmierowo
Tel: (+48-61) 650 13 00
Fax: (+48-61) 650 13 50

Portugal
Bombas GRUNDFOS Portugal, S.A.
Rua Calvet de Magalhães, 241
Apartado 1079
P-2770-153 Paço de Arcos
Tel.: +351-21-440 76 00
Telefax: +351-21-440 76 90

Romania
GRUNDFOS Pompe România SRL
Bd. Biruintei, nr 103
Pantelimon county Ilfov
Phone: +40 21 200 4100
Telefax: +40 21 200 4101
E-mail: romania@grundfos.ro

Russia
ООО Грундфос Россия
ул. Школьная, 39-41
Москва, RU-109544, Russia
Тел. (+7) 495 564-88-00 (495) 737-30-00
Факс (+7) 495 564 8811
E-mail grundfos.moscow@grundfos.com

Serbia
Grundfos Srbija d.o.o.
Omladinskih brigada 90b
11070 Novi Beograd
Phone: +381 11 2258 740
Telefax: +381 11 2281 769
www.rs.grundfos.com

Singapore
GRUNDFOS (Singapore) Pte. Ltd.
25 Jalan Tukang
Singapore 619264
Phone: +65-6681 9688
Telefax: +65-6681 9689

Slovakia
GRUNDFOS s.r.o.
Prievozská 4D
821 09 BRATISLAVA
Phona: +421 2 5020 1426
sk.grundfos.com

Slovenia
GRUNDFOS LJUBLJANA, d.o.o.
Leskoškova 9e, 1122 Ljubljana
Phone: +386 (0) 1 568 06 10
Telefax: +386 (0)1 568 06 19
E-mail: tehnika-si@grundfos.com

South Africa
Grundfos (PTY) Ltd.
16 Lascelles Drive, Meadowbrook Estate
1609 Germiston, Johannesburg
Tel.: (+27) 10 248 6000
Fax: (+27) 10 248 6002
E-mail: lgradidge@grundfos.com

Spain
Bombas GRUNDFOS Españ a S.A.
Camino de la Fuentecilla, s/n
E-28110 Algete (Madrid)
Tel.: +34-91-848 8800
Telefax: +34-91-628 0465

Sweden
GRUNDFOS AB
Box 333 (Lunnagårdsgatan 6)
431 24 Mölndal
Tel.: +46 31 332 23 000
Telefax: +46 31 331 94 60

Switzerland
GRUNDFOS Pumpen AG
Bruggacherstrasse 10
CH-8117 Fällanden/ZH
Tel.: +41-44-806 8111
Telefax: +41-44-806 8115

Taiwan
GRUNDFOS Pumps (Taiwan) Ltd.
7 Floor, 219 Min-Chuan Road
Taichung, Taiwan, R.O.C.
Phone: +886-4-2305 0868
Telefax: +886-4-2305 0878

Thailand
GRUNDFOS (Thailand) Ltd.
92 Chaloem Phrakiat Rama 9 Road,
Dokmai, Pravej, Bangkok 10250
Phone: +66-2-725 8999
Telefax: +66-2-725 8998

Turkey
GRUNDFOS POMPA San. ve Tic. Ltd. Sti.
Gebze Organize Sanayi Bölgesi
Ihsan dede Caddesi,
2. yol 200. Sokak No. 204
41490 Gebze/ Kocaeli
Phone: +90 - 262-679 7979
Telefax: +90 - 262-679 7905
E-mail: satis@grundfos.com

Ukraine
Бізнес Центр Європа
Столичне шосе, 103
м. Київ, 03131, Україна
Телефон: (+38 044) 237 04 00
Факс.: (+38 044) 237 04 01
E-mail: ukraine@grundfos.com

United Arab Emirates
GRUNDFOS Gulf Distribution
P.O. Box 16768
Jebel Ali Free Zone
Dubai
Phone: +971 4 8815 166
Telefax: +971 4 8815 136

United Kingdom
GRUNDFOS Pumps Ltd.
Grovebury Road
Leighton Buzzard/Beds. LU7 4TL
Phone: +44-1525-850000
Telefax: +44-1525-850011

U.S.A.
GRUNDFOS Pumps Corporation
9300 Loiret Blvd.
Lenexa, Kansas 66219
Phone: +1-913-227-3400
Telefax: +1-913-227-3500

Uzbekistan
Grundfos Tashkent, Uzbekistan The Representative Office of Grundfos Kazakhstan in Uzbekistan
38a, Oybek street, Tashkent
Телефон: (+998) 71 150 3290 / 71 150 3291
Факс: (+998) 71 150 3292

Addresses Revised 15.01.2019

96780034 0919
ECM: 1264572