PACOpaQ™
HVAC Packaged Systems

Installation and Operating Instructions
## English (US) Installation and operating instructions

Original installation and operating instructions.

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1. Symbols used in this document
The following symbols may be used in this document.

Warning
If these safety instructions are not observed, it may result in personal injury.

Warning
If these instructions are not observed, it may lead to electric shock with consequent risk of serious personal injury or death.

Warning
When pumping hazardous liquids, special attention must be paid to the risk of personal injury.

Warning
The surface of the product may be so hot that it may cause burns or personal injury.

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

Note
Notes or instructions that make the job easier and ensure safe operation.
2. Terms and Conditions

2.1 The contract

The Contract shall be comprised of the following terms, together with such terms and conditions as are set forth in Seller's written proposal or quotation (the "Quotation"), including any documents, drawings or specifications incorporated therein by reference, and any additional or different terms proposed in Buyer's purchase order (the "Purchase Order") that are accepted by Seller in writing, which together shall constitute the entire agreement between the parties, provided, however, that preprinted terms on Buyer's purchase order or invoice shall not apply and Seller gives notice of objection to such terms. An offer by Seller in its Quotation that does not stipulate an acceptance date is not binding. This Contract shall be deemed to have been entered into upon written acknowledgment of the Purchase Order by an officer or authorized representative of Seller, which may not be modified, supplemented, or waived except in a writing executed by an authorized representative of the party to be bound.

2.2 Price

The price quoted in the Quotation shall be the Purchase Price unless otherwise agreed in the Purchase Order. The Purchase Price for equipment shall include packing for shipment. Field Services shall be provided at Seller's standard rates. All other costs, including packing for storage, freight, insurance, taxes, customs duties and import/export fees, or any other item not specified in the Contract, shall be paid by Buyer unless separately stated in the Quotation and included in the price quoted. Any sales, use, or other taxes and duties imposed on the transaction or the equipment supplied shall be paid or reimbursed by Buyer.

2.3 Payment terms

Payment shall be due within 30 days of the date of Seller's invoice in U.S. funds unless otherwise agreed. If Buyer does not observe the agreed dates of payment, Buyer shall pay interest to Seller on overdue amounts at a rate that is the higher of: 9 % per annum or a rate 5 % in excess of the rate borne from time to time by new issues of six-month United States Treasury bills. Seller shall be entitled to issue its invoice for the Purchase Price for equipment upon the earlier of shipment, or notice to Buyer that Seller is ready to ship, and for services, upon completion. If the Purchase Price exceeds $250,000 USD, Buyer shall pay the Purchase Price in Progress payments as follows: Fifteen percent (15 %) upon submittal of general arrangement drawings, thirty five percent (35 %) after receipt of first Bowl Casting, twenty percent (20 %) after first case/bowl hydro test or bowl machining and thirty percent (30 %) after notification of ready to ship.

2.4 Acceptance and inspection

All equipment shall be finally inspected and accepted by Buyer within 14 days after delivery or such other period of time as is agreed in the Purchase Order. Buyer shall make all claims (including claims for shortages), excepting only those provided for under the warranty clause contained herein, in writing within such 14 day period or they are waived. Services shall be accepted upon completion. Buyer shall not revoke its acceptance. Buyer may reject the equipment only for defects that substantially impair its value, and Buyer's remedy for lesser defects shall be in accordance with Section 10, Warranty. If tests are made by Buyer to demonstrate the ability of the equipment to operate under the contract conditions and to fulfill the warranties in Section 10, Buyer is to make all preparations and incur all expenses incidental to such tests. Seller will have the right of representation at such tests at its expense, and the right to technically direct the operation of the equipment during such tests, including requiring a preliminary run for adjustments.

2.5 Title and risk of loss

Full risk of loss (including transportation delays and losses) shall pass to Buyer upon delivery, regardless of whether title has passed to Buyer, transport is arranged or supervised by Seller, or start-up is carried out under the direction or supervision of Seller. Delivery shall be ex works, INCOTERMS 2000. Loss or destruction of the equipment or injury or damage to the equipment that occurs while the risk of such loss or damage is borne by Buyer does not relieve Buyer of its obligation to pay Seller for the equipment.

2.6 Patent or trademark information

If the equipment sold hereunder is to be prepared or manufactured according to Buyer's specifications, Buyer shall indemnify Seller and hold it harmless from any claims or liability for patent or trademark infringement on account of the sale of such goods.

2.7 Changes

Buyer may request, in writing, changes in the design, drawings, specifications, shipping instructions, and shipment schedules of the equipment. As promptly as practicable after receipt of such request, Seller will advise Buyer what amendments to the Contract, if any, may be necessitated by such requested changes, including but not limited to amendment of the Purchase Price, specifications, shipment schedule, or date of delivery. Any changes agreed upon by the parties shall be evidenced by a Change Order signed by both parties.

2.8 Cancellation or termination

Buyer shall have the right to cancel the Contract upon 15 days' prior written notice to Seller, and Seller shall stop its performance upon the receipt of such notice except as otherwise agreed with Buyer. If Buyer cancels the Contract, it shall pay: (a) the agreed unit price for equipment or components completed and delivered, (b) additional material and labor costs incurred, and for engineering services supplied by Seller with respect to the canceled items, which shall be charged to Buyer at Seller's rates in effect at the time of cancellation, but which shall not exceed the contract price for such items, and (c) such other costs and expenses, including cancellation charges under subcontracts, as Seller may incur in connection with such cancellation or termination.

2.9 Delivery and delays

Seller shall use its best efforts to meet quoted delivery dates, which are estimated based on conditions known at the time 16 A1d.1 606 supercedes 9/05 PACO PUMPS of quotation. Seller shall not be liable for any nonperformance, loss, damage, or delay due to war, riots, fire, flood, strikes or other labor difficulty, governmental actions, acts of God, acts of the Buyer or its customer, delays in transportation, inability to obtain necessary labor or materials from usual sources, or other causes beyond the reasonable control of Seller. In the event of delay in performance due to any such cause, the date of delivery or time for completion will be extended to reflect the length of time lost by reason of such delay. Seller shall not be liable for any loss or damage to Buyer resulting from any delay in delivery.
2.10 Warranty
Seller warrants that the equipment or services supplied will be free from defects in material, and workmanship for a period of 24 months from the date of initial operation of the equipment, or 30 months from the date of shipment, whichever shall first occur. In the case of spare or replacement parts manufactured by Seller, the warranty period shall be for a period of six months from shipment. Repairs shall be warranted for 24 months or, if the repair is performed under this warranty, for the remainder of the original warranty period, whichever is less. Buyer shall report any claimed defect in writing to Seller immediately upon discovery and in any event, within the warranty period. Seller shall, at its sole option, repair the equipment or furnish replacement equipment or parts thereof, at the original delivery point. Seller shall not be liable for costs of removal, reinstallation, or gaining access. If Buyer or others repair, replace, or adjust equipment or parts without Seller’s prior written approval, Seller is relieved of any further obligation to Buyer under this section with respect to such equipment or parts. The repair or replacement of the equipment or spare or replacement parts by Seller under this section shall constitute Seller’s sole obligation and Buyer’s sole and exclusive remedy for all claims of defects. SELLER MAKES NO OTHER WARRANTY OR REPRESENTATION OF ANY KIND WITH RESPECT TO THE EQUIPMENT OR SERVICES OTHER THAN AS SPECIFIED IN THIS SECTION 10. ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY DISCLAIMED. For purposes of this Section, the equipment warranted shall not include equipment, parts, and work not manufactured or performed by Seller. With respect to such equipment, parts, or work, Seller’s only obligation shall be to assign to Buyer any warranty provided to Seller by the manufacturer or supplier providing such equipment, parts or work. No equipment furnished by Seller shall be deemed to be defective by reason of normal wear and tear, failure to resist erosive or corrosive action of any fluid or gas, Buyer’s failure to properly store, install, operate or maintain the equipment in accordance with good industry practices or specific recommendations of Seller, or Buyer’s failure to provide complete and accurate information to Seller concerning the operational application of the equipment.

2.11 Technical documents
Technical documents furnished by Seller to Buyer, such as drawings, descriptions, designs and the like, shall be deemed provided to Buyer on a confidential basis, shall remain Seller’s exclusive property, shall not be provided in any way to third parties, and shall only be used by Buyer for purposes of installation, operation and maintenance. Technical documents submitted in connection with a Quotation that does not result in a Purchase Order shall be returned to Seller upon request.

2.12 Limitation of liability
Seller shall in no event be liable for any consequential, incidental, indirect, special or punitive damages arising out of the Contract, or out of any breach of any of its obligations, including but not out of any defect in, or failure of, or malfunction of the equipment, including but not limited to, claims based upon loss of use, lost profits or revenue, interest, lost goodwill, work stoppage, impairment of other equipment, environmental damage, nuclear incident, loss by reason of shutdown or nonoperation, increased expenses of operation, cost of purchase of replacement power or claims of Buyer or customers of Buyer for service interruption whether or not such loss or damage is based on contract, tort (including negligence and strict liability) or otherwise. Seller’s maximum liability under this Contract shall not exceed the Purchase Order amount of the equipment or portion thereof upon which such liability is based. All such liability shall terminate upon the expiration of the warranty period, if not sooner terminated.

2.13 This company is an equal opportunity employer
This agreement incorporates by reference applicable provisions and requirements of Executive Order 11246 and FAR Section 52.222-26 (covering race, color, religion, sex and national origin); the Vietnam Era Veterans Readjustment Assistance Act of 1974 and FAR Section 52.222-35 (covering Vietnam era veterans); and the Rehabilitation Act of 1973 and FAR Section 52.222-36 (covering handicapped individuals). By acceptance of this agreement Buyer certifies that it does not and will not maintain any facilities in a segregated manner, or permit its employees to perform their services at any location under its control where segregated facilities are maintained, and further that appropriate physical facilities are maintained for both sexes. Buyer agrees that it will obtain a similar certificate prior to award of any nonexempt lower-tier subcontracts.

2.14 law and arbitration
The Contract shall be governed by the law of the State of Texas. Any disputes arising out of this Contract shall be resolved by informal mediation in any manner that the parties may agree within 45 days of written request for mediation by one party to the other. Any dispute that cannot be resolved through mediation shall be resolved by binding arbitration conducted in English in Portland, Oregon under the Commercial Rules of the American Arbitration Association except as otherwise provided in this Section. The arbitration shall be conducted by three arbitrators chosen in accordance with said Rules. The arbitrators are not entitled to award damages in excess of compensatory damages. Judgment upon the award may be entered in any court having jurisdiction.
3. PACOpaQ Installation

3.1 General instructions

Important notice:
Carefully inspect this equipment for damage, and missing pieces. If the shipment has been damaged or there are missing pieces, have the carrier note the condition on the receipt. Also, check as soon as possible for any concealed damage. It is the customer’s responsibility to file a claim for damage or missing pieces with the carrier. Failure to follow this procedure may result in refusal by the carrier to honor any claims with a consequent loss to the customer.

3.2 Lifting and rigging instructions:
Avoid twisting or uneven lifting of unit. Lifting lugs are provided on the sides, or as part of the internal structure of the system base. Lifting with a single hook will require cables. Cables are to be connected to the lugs by use of shackles. Required cable lengths may vary due to lifting lugs not being symmetrical to the center of gravity of system, or to avoid system internals.

3.3 Storage:
Unit should be stored in a dry and dust free and temperature controlled environment. It is not recommended the unit be stored outside. If the unit must be stored outside it is required that the entire unit must be covered with a watertight seal. Electronic equipment is delicate and will not withstand variations in humidity and temperature.

3.4 Bolt check instructions:
System bolts may become loose during shipment due to vibration. Bolts must be checked for tightness and for required torque. This must be done before system is pressurized.

3.5 Field connections:
Piping isolation is recommended on all package system field connections. It is the installer’s responsibility to support and anchor field piping.

Request for assistance:
If there are questions concerning the installation of this package system contact:

Service Department
Grundfos Commercial Building Services
902 Koomey Road
Brookshire, TX. 77423

1-800-955-5847
3.6 Assembly of packaged sections
(if applicable):

1. Refer to specific installation documents or drawings for the package system.

2. Familiarity with the parts requirements and any referenced documents or drawings will aid in the piping assembly. All hardware and gaskets required for re-assembly are supplied. Final package system connections hardware by others.

3. Check pipe/pump/fittings/valves end connections. Any loose scale, paint or dirt must be removed.

4. Ensure alignment of end connections between pump/pipe/fittings/valves. Connections must be square.

5. Package piping must be supported independent of the pump. If package pipe support is not part of the original package others should supply it. Package steel base is designed to provide a structural support beginning.

6. Use proper gasket (if required) and install the individual pump suction & discharge pipe/fittings/valves with the nuts & bolts provided (flat & lock washers also provided). Install the required bolts for the fitting connections (elbow, wye strainer, and butterfly valve)-to-pipe connection and tighten bolts to a snug fit. Gasket may be required.

7. Tighten and torque all pipe connection bolts as required.

8. Install and/or tighten loose pipe support brackets as required. Remove any temporary supports.

9. Refer to specific installation documents or drawings for the package system.

10. Familiarity with the parts requirements and any referenced documents or drawings will aid in the piping assembly. All hardware and gaskets required for re-assembly are supplied. Final package system connections hardware by others.

11. Ensure alignment of pipe end connections between sections. Connections must be square. Install the required bolts for each of the fitting connections (elbow, separator, valve, etc.) -to-pipe connections and tighten bolts to a snug fit. Gasket may be required.

12. Working from the middle of base sections to the outside. Snug all base connection bolts making sure the base channel flanges are flush top, bottom and side. Torque base connection bolts to approx. 75 ft/lb.

13. Ensure pipe connections are aligned. Tighten and torque all the pipe connection bolts as required.

14. Install and/or tighten loose pipe support brackets and bolts as required.

3.7 Other packaged system requirements:

1. Required electrical wiring can now be connected. A qualified electrician should do the electrical wiring. Power/control/sensing runs may be disconnected for package splits or remote/future use, and tagged with color-coded tape or with a numbering system.

2. Mount the gauge & switch wing panel. Required sensing lines can now be connected. Sensing lines may be disconnected for package splits or for remote/future use, and tagged with color-coded tape or with a numbering system.

3. Complete the package system installation per individual parts provider or manufacturer, customer, or maintenance instructions requirements.
Paco Pumps
Installation and Operating Procedures

3.1 Installation - Mechanical
Read these instructions thoroughly before installing and operating your PACO Type L Centrifugal Pump. Successful operation depends on careful attention to the procedures described in Sections 1, 2, 3 and 4 of this manual. Keep this instruction manual handy for future use.

4.1 Pump identification
All PACO Pumps are identified by Catalog and Serial Numbers. These numbers are stamped on the pump nameplate (Fig. 1) affixed to each pump volute casing, and should be referred to in all correspondence with the Company.

Fig. 1 Nameplate

4.2 Receiving
- Check pumping unit for shortage and damage immediately upon arrival. Pump accessories when required are packaged in a separate container and shipped with the unit.
- If equipment is damaged in transit, promptly report this to the carrier’s agent. Make complete notations on the freight bill to speed satisfactory adjustment by the carrier.
- Unload and handle the unit with a sling. Do not lift unit by eye bolts on the motor!

4.3 Temporary storage
- If pump is not to be installed and operated soon after arrival, store it in a clean, dry area of moderate ambient temperature.
- Rotate the shaft by hand periodically to coat bearing with lubricant to retard oxidation and corrosion.
- Follow motor manufacturer’s storage recommendations where applicable.

4.4 Location
- Locate the pump as close to the suction supply as possible. Use the shortest and most direct suction piping practical. Refer to 3.9 Suction (inlet) piping.
- Locate the pump below system level wherever possible. This will facilitate priming, assure a steady liquid flow, and provide a positive suction head.
- Make sure sufficient NPSH (Net Positive Suction Head) is provided at the suction end by considering the pump’s location in relation to the entire system. Available NPSH must always equal or exceed required NPSH specified on the pump performance curve.
- Always allow sufficient accessibility for maintenance and inspection. Provide a clear space with ample head room for use of a hoist strong enough to lift the unit.
- Make sure a suitable power source is available for the pump motor. Electrical characteristics should match those specified on the motor data plate, within the limits covered in 4. Installation-electrical and 5. Operation.
- Avoid pump exposure to sub-zero temperatures to prevent pump liquid from freezing. If freezing conditions exist during shutdown periods, see Sections 5.6 Pump shutdown and 5.7 Short duration shutdown for specific recommendations.

4.5 Horizontal pump foundation
Horizontal pumps should be permanently installed on a firm, concrete foundation mounting pad of sufficient size to dampen any vibration and prevent any deflection or misalignment. The pad may float on springs or be a raised part of the equipment room floor. The foundation should be poured without interruption to 3/4 to 1 - 1/2 inches below the final pump elevation. The top surface should be well scored or grooved before the concrete sets to provide a suitable bonding surface for the grout. Anchor bolts should be set in pipe sleeves for positioning allowance, as shown in Fig. 2. Allow enough bolt length for grout, lower base plate flange, nuts and washers. Allow the foundation to cure several days before proceeding with pump installation.
4.6 Securing base plate

- After the concrete pad has been poured and set, lower the pump base plate over the anchor bolts and rest it on loose adjustment wedges or shims placed near each anchor bolt and at intervals not to exceed 24” along each side. Shims or wedges must be placed to raise the bottom of the base 3/4” to 1 - 1/4” above the pad, allowing clearance for grout. Level the pump shaft, flanges, and base plate using a spirit level, adjusting the wedges or shims, as required.
- Check to make sure that the piping can be aligned to the pump flanges without placing any strain on either flange.
- After pump alignment has been established (LF), put nuts on foundation bolts and tighten them just enough to keep the unit base plate from moving. Construct a form or dam around the concrete pad and pour grout in and around the pump base, as shown in Fig. 2. Grout compensates for uneven foundation, distributes the weight of the unit, and prevents shifting. Use an approved, non shrinking grout (such as Embeco 636 by Master Builders, Cleveland, Ohio or equivalent). Allow at least 24 hours for this grout to set before proceeding with piping connections.
- After the grout has thoroughly hardened, check the foundation bolts and tighten if necessary. Recheck the pump alignment after the foundation bolts are secured.
- No alignment or grouting required for LCS pump.

4.7 Vertical mounting instructions

The PACO LCV Vertical Close Coupled pump need not be grouted to its foundation, but should be anchored with 4 anchor bolts set in concrete similar to the horizontal anchoring arrangement Fig. 2.

4.8 Piping-general

- Do not use pump as a support for piping! Use pipe hangers or other supports at proper intervals to provide complete piping support near the pump.
- Both suction and discharge piping should be independently supported and properly aligned so that no strain is transmitted to the pump when flange bolts are tightened.
- Make sure piping is as straight as possible, avoiding unnecessary bends and fittings. Where necessary, use 45 ° or long-sweep 90 ° pipe fittings to decrease friction loss.
- Where flanged joints are used, make sure that inside diameters properly match and mounting holes are aligned.
- Do not spring or force piping when making any connections!

4.9 Suction (inlet) piping

The sizing and installation of suction piping is particularly important. It must be selected and installed in a manner that minimizes pressure loss and permits sufficient liquid flow into the pump during starting and operation. Many NPSH problems can be traced directly to improper design of suction piping systems. Observe the following precautions when installing suction piping:

- Suction piping should be as direct as possible, and ideally the length should be at least ten times the pipe diameter. Short suction piping can be the same diameter as the suction opening. Longer piping should be one or two sizes larger (depending on length), reducing to the diameter of the pump suction opening.
- Use an eccentric reducer, with the eccentric side down Fig. 3 when reducing the pipe diameter to the diameter of suction opening.
- At no point should suction piping be smaller in diameter than the pump suction opening.
- Horizontal suction lines should follow an even gradient, if possible. A gradual upward slope to the pump is recommended for suction lift conditions, and a gradual downward slope for positive suction head.
- Avoid any high points, such as pipe loops Fig. 4, that may create air pockets and throttle the system or produce erratic pumping.
- Install a valve in the suction line to isolate the pump during shutdown and maintenance, and facilitate pump removal. Where two or more pumps are connected to the same suction line, install duplicate gate valves to isolate each pump from the line.
- Gate valves should always be installed in positions that avoid air pockets. Globe valves should not be used, particularly when NPSH is critical.
- During pumping operation, valves on suction line must always be at FULL OPEN.
- Properly sized pressure gauges can be installed in gauge taps on pump suction and discharge nozzles. Gauges enable the operator to monitor pump performance and determine that the pump conforms to the parameters of the performance curve. If cavitation, vapor binding, or other unstable operation occurs, pressure gauges will indicate wide fluctuation in suction and discharge pressures.
4.10 Discharge (outlet) piping
- Short discharge piping can be the same diameter as the pump discharge opening. Longer piping should be one or two sizes larger depending on length.
- An even gradient is best for long horizontal runs of discharge piping.
- Install a valve near the discharge opening to prime and start the pump. The discharge gate valve is also used to isolate the pump during shutdown, maintenance, and facilitate pump removal.
- Any high points in discharge piping may entrap air or gas and thus retard pump operation.
- If the possibility of liquid hammer exists, (i.e. check valves are used) close the discharge gate valve before pump shutdown.

4.11 Shaft sealing-general comments
- PACO offers both mechanical seals and packed stuffing boxes as a means to seal the shaft. Pumps with stuffing boxes are normally packed before shipment. If the pump is installed within 60 days after shipment, the packing material will be in good condition for operation with a sufficient supply of lubrication. If the pump is stored for a longer period, it may be necessary to repack the stuffing boxes.
- The stuffing box must be supplied at all times with a source of clean, clear liquid to flush and lubricate the packing. When pumps are equipped with mechanical seals, no maintenance or adjustment is required. Mechanical seals are preferred to packing on most applications because they require less maintenance.

4.12 Packing gland adjustment
With the pump running, the packing gland should be adjusted to permit 40 to 60 drops per minute leakage. This is required for shaft lubrication. After initial start up, additional packing and adjustment may be required. Pumps with mechanical seals require no adjustment.

4.13 Mechanical seals
All PACO Type L pumps that are equipped with mechanical seals are matched to conditions for which the pump was sold. Observe the following precautions to avoid seal damage and obtain maximum seal life:
- Do not exceed temperature or pressure limitations for the mechanical seal used.
- DO NOT RUN THE PUMP DRY OR AGAINST A CLOSED VALVE! Dry operation will cause seal failure within minutes.
- Clean and purge suction piping in new installations before installing and operating pump. Pipe scale, welding slag and other abrasives can cause rapid seal failure.
4.14 Coupling alignment (LF)

- The following anchoring and alignment procedure is typical and, if performed with care, should result in a smooth running, trouble-free installation.
- If the pump and motor were shipped mounted on the pump base as an assembly, remove the coupling guard.
- The pump and motor were accurately aligned at the factory, but handling during shipment usually alters this pre-alignment. Using a small straight edge and feeler gauges or a dial indicator, check for horizontal, vertical, and angular misalignment of the coupling hubs Fig. 5 and Fig. 6.
- Coupling alignment is correct when the dial indicator reads no more than .005" run out in any direction (or when the straight edge contacts both hubs evenly in both horizontal and vertical positions). If misalignment is detected, loosen the motor and shift or shim as necessary to re-align, then re-tighten bolts. Always align the motor to the pump as piping strain will occur if the pump is shifted. Never reposition pump on base!
- After final piping connections to the pump have been made, motor wiring compared, correct rotation has been established, and piping filled with liquid, check shaft alignment once again.
- Leave the coupling guards off until the pump priming procedure is completed for a final shaft alignment check.
- To protect personnel from rotating machinery, Always install coupling guards after installation is complete; before starting pump!

4.15 Coupling alignment (LCS)

- No alignment of the pump and motor is required.

5. Installation-electrical

5.1 Motors general

the motor control circuit must have the following components in order to comply with the National Electrical Code.
- **Motor Disconnecting Device**: A motor disconnecting device must be installed that is capable of disconnecting both the controller (motor starter) and the motor from their source of power.
- The disconnecting device must be located so that the controller (motor starter) can be seen from the disconnecting means. In all cases, the distance from the disconnecting device to the controller must be less than 50'.
- In most installations the disconnecting device will be a circuit breaker or fusible disconnect switch.

Motor short circuit and ground fault protection:
- Short circuit and ground fault protection are usually provided by means of a circuit breaker or fusible disconnect switch.
- The selection of the size of the circuit breaker or fuse must be in accordance with Section 430-52 and Table 430-152 of the National Electrical Code.

Motor controller with running over current protection (magnetic starter):
- These components must be installed in accordance with applicable local and state electrical codes in addition to the National Electrical Code.

Motor short circuit and ground fault protection:
- Short circuit and ground fault protection are usually provided by means of a circuit breaker or fusible disconnect switch.
- The selection of the size of the circuit breaker or fuse must be in accordance with Section 430-52 and Table 430-152 of the National Electrical Code.

Motor controller with running over current protection (magnetic starter):
- These components must be installed in accordance with applicable local and state electrical codes in addition to the National Electrical Code.

5.2 Installation wiring

- Mount the control panel or motor starter(s) in close proximity to the pump to provide convenient control and ease of installation.
- **Wire panel or starter(s) to motor(s) and pilot device(s)**: Wires to each motor must be sized for at least 125% of the motor nameplate full load amps. AWG #16 Type THW stranded wire is recommended for wiring of pilot devices (float switches).
- Check incoming power source to ensure that it is the same as the voltage and phase of the motors.
- Verify that the starters are suitable to operate the pump motors on voltage and phase that is available.
6. Operation

5.1 Priming

• The PACO Type L pump is not self-priming, and must be completely primed (filled with liquid) before starting.
• If the pump will operate with a positive suction head, prime by opening the suction valve and allowing liquid to enter pump casing. Open air vents at this time, and make sure all air is forced from pump by liquid before closing.
• Rotate the shaft by hand to free entrapped air from impeller passageways.
• If pump has a suction lift, priming must be accomplished by other methods. The use of foot valves or ejectors, or manual filling of the pump casing and suction line with liquid are possible methods suggested for this purpose.
• CAUTION: Never run the pump dry in the hope that it will prime itself! Serious damage to the mechanical seal will result.

5.2 Pre-start checklist

Make the following inspections before starting your PACO Type L pump:
1. Make sure the suction and discharge piping has been cleaned and flushed to remove dirt and debris before operating pump.
2. Double check rotation must be clockwise operating in reverse will destroy the impeller and shaft.
3. Make sure all wiring connections to the motor (and starting device) match the wiring diagram and produce clockwise rotation as viewed from the back of the motor.
4. If the motor has been in storage for an extended length of time, either before or after installation, refer to motor instructions before starting.
5. Check the voltage, phase, and line circuit frequency with the motor nameplate. Turn rotating element by hand to make sure it rotates freely.
6. Tighten plugs in gauge and drain taps. If the pump is fitted with pressure gauges, keep gauge cocks closed when not in use.
7. Check suction and discharge piping for leaks, and make sure all flange bolts are securely tightened.

6.3 Motor rotation

Never check driver rotation unless pump and driver couplings are disconnected and physically separated. Failure to follow this instruction can result in serious damage to pump and driver if rotation is wrong.

After the unit has been wired and checked to insure that all components in the system (disconnect device, magnetic starters, pilot devices and motors) are properly connected, check motor rotation as follows:
• For 3 phase units only—momentarily energize the motors to ensure that the rotation is correct as indicated by the arrow cast into the pump volute. If rotation is incorrect, interchange two wires at the motor starter terminals T1 and T2.
• IMPORTANT: The pumps must not be operated while dry. Use extreme caution that motors are energized only momentarily to determine proper rotation.

6.4 Starting the pump

The pump must not be operated without an approved coupling guard in place. Failure to observe this warning could result in injury to operating personnel.

1. Install coupling guard on coupled units.
2. Fully open gate valve (if any) in suction line, and close gate valve in discharge line.
3. Fill suction line with liquid and completely prime pump.
4. Start the motor (pump).
5. Immediately make a visual check of pump and suction piping for pressure leaks.
6. Immediately after pump reaches full operating speed, slowly open the discharge gate valve until complete system flow is achieved.
7. Check discharge piping for pressure leaks.
8. If pump is fitted with pressure gauges, open gauge cocks and record pressure reading for future reference. Verify that the pump is performing in accordance with parameters specified on performance curve.
9. Check and record voltage, amperage per phase, and kilowatts, if a wattmeter is available.
6.5 Voltage regulation
The motor will operate satisfactorily under the following conditions for voltage and frequency variation, but not necessarily in accordance with the standards established for operation under rated conditions:
• The voltage variation may not exceed 10% above or below rating specified on the motor data plate.
• The frequency variation may not exceed 5% above or below motor rating.
• The sum of the voltage and frequency variations may not exceed 10% above or below motor rating, provided the frequency variation does not exceed 5%.

6.6 Pump shutdown
The following shutdown procedures will apply in most normal shutdowns for the PACO Type L pumps. If the pump will be inoperative for an extended length of time, follow storage procedures in Extended Period Shutdown.
• Always close the discharge valve before stopping the pump. Close the valve slowly to prevent hydraulic shock.
• Cut and lock off power to the motor.

6.7 Short duration shutdown
• For overnight or temporary shutdown periods under non-freezing conditions, the pump may remain filled with liquid. Make sure the pump is fully primed before restarting.
• For short or frequent shutdown periods under freezing conditions, keep fluid moving within the pump casing and insulate or heat the pump exterior to prevent freezing.

6.8 Extended period shutdown
• For long shutdown periods, or to isolate the pump for maintenance, close suction gate valve. If no suction valve is used and the pump has positive suction head, drain all liquid from suction line to terminate liquid flow into pump suction nozzle. Remove plugs in pump drain and vent taps, as required, and drain all liquid from the pump volute casing.
• If freezing conditions will exist during long shutdown periods, completely drain the pump and blow out all liquid passages and pockets with compressed air. Freezing of pump liquid can also be prevented by filling the pump with antifreeze solution.

7. Maintenance

Warning
Do not attempt any maintenance, inspection, repair or cleaning in the vicinity of rotating equipment. Such action could result in personal injury to operating personnel.

Before attempting any inspection or repair on the pump, the driver controls must be in the "OFF" position, locked and tagged to prevent injury to personnel performing service on the pump.

7.1 Motor lubrication
Always follow motor manufacturer's lubrication instructions if available, and periodically check grease fittings and drain plugs for leaks. If lubricating instructions do not accompany motor, refer to for recommended lubrication periods.
• To lubricate the motor while running or at rest, remove grease drain plug (if any) and filler plug on grease fitting. Grease with clean lubricant until grease appears at drain hole or along motor shaft.

<table>
<thead>
<tr>
<th>Motor RPM</th>
<th>Motor HP</th>
<th>Operating conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1750 and below</td>
<td>0.33 - 7.50 HP</td>
<td>Standard 3 yrs 1 yr 6 mo</td>
</tr>
<tr>
<td></td>
<td>10-40</td>
<td>Severe 1-3 yrs 6 mo 1 yr 3 mo</td>
</tr>
<tr>
<td></td>
<td>50-150</td>
<td>Extreme 1 yr 6 mo 3 mo</td>
</tr>
<tr>
<td>above 1750</td>
<td>all HP</td>
<td>1 yr 6 mo 3 mo</td>
</tr>
</tbody>
</table>

Recommended Lubrication Periods

Standard conditions:
8 Hours per day operation, normal or light loading, clean air, 100 °F, maximum ambient temperature.

Severe conditions:
Continuous 24-hour operation, shock loading or vibration, poor ventilation, 100-150 °F, ambient temperature.

Extreme conditions:
Continuous operation, heavy shock or vibration, dirt or dust in air, extreme ambient temperature.

• One-half to one cubic inch of grease is sufficient for motors 5 HP and under, with proportionately more grease for greater HP motors.
• Most fractional and some integral frame motors have "sealed-for-life" bearings, and do not require further lubrication throughout motor life.
• Always follow motor manufacturer's lubrication instructions, and periodically check grease fittings and drain plugs for leaks.
• If lubricating instructions do not accompany motor, refer to Table, "Recommended Lubrication Periods," on page 10 for recommended lubrication periods.
• Table, "Approved lubricants," on page 11 lists recommended types of grease for both pump and motor lubrication. These types have all been thoroughly tested and should be used whenever possible.
7.2 Pump lubrication

- PACO Type LF pumps on horizontal bearing frames have bearing that may be sealed for life (requiring no lubrication), regreasable or oil lubricated.

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>LUBRICANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHELL</td>
<td>DOLIUM® R</td>
</tr>
<tr>
<td>EXXON</td>
<td>POLYREX®</td>
</tr>
<tr>
<td>CHEVRON</td>
<td>SRI GREASE NLGI 2</td>
</tr>
<tr>
<td></td>
<td>BLACK PEARL - NLGI 2</td>
</tr>
<tr>
<td>PHILIPS</td>
<td>POLYTAC™</td>
</tr>
<tr>
<td>TEXACO</td>
<td>POLYSTAR RB</td>
</tr>
</tbody>
</table>

- To lubricate regreasable bearings, remove grease drain plug (if any) and filler plug. Add clean ball bearing lubricant until grease appears at drain hole or along shaft. On units with drain hole, all old grease can be purged out ahead of new. In such cases, the drain should be left unplugged for several minutes during pump operation to allow excess grease to be forced out.

- Lubricate bearing frame bearings at intervals of one to three months, depending on severity of environment. Pumps in a clean, dry, moderate temperature (100 °F maximum) environment should be regreased at three month intervals. Too much grease can cause premature bearing failure-do not overgrease.

- On those PACO Type LF Centrifugal End Suction pumps ordered with oil lubricated bearings, Fig. 7. A regular oil maintenance program must be enforced.

- After the first 200 hours of operation the oil should be changed. To change the oil, remove the drain plug at the bottom of the bearing cover and the filler plug (that also acts as a vent plug) at the top of the housing. After draining oil, replace the fittings and refill with an acceptable oil selected from Table, “List of acceptable Lube oils,” on page 11. After the first oil change, the oil should be changed again at 2000 hours and then at intervals of 8000 hours or once yearly, thereafter.

- Approved lubricants

- Lubricant Manufacturer | Bearing oil brand name
  - Aral Refining Co.     | Aral Oil CMU
  - British Petroleum Co. | BP Energol
  - Calypsol Oil Co.      | Calypsol Bison Oil
  - Standard Oil Co.      | Chevron
  - Esso Corp             | Hydraulic Oil 11
  - Fina Oil Co.          | Circulating oil 45
  - Gulf Refining Co.     | Esso-Mar 25
  - Socony Mobil Oil Co.  | Teresso 47
  - Shell Oil Co.         | Fina hydran 34
  - Sundco Oil Co.        | Fina Cirkan 32
  - The Texas Co.         | Gulf Harmony 47
  - Texaco Ursa oil P 20  | Gulf Paramount 45
  - Dea Viscobil Sera 4   |
  - Wisura Refining Co.   | Texaco ursa oil P 20 (36)
  - Wisura Norma 25 (36)  |
### 7.3 Disassembly of pumps

**Warning**

Depending on the product being pumped, the pump should be washed down before any work is done on it.

**Warning**

Observe extreme caution when venting and/or draining hazardous liquids. Wear protective clothing in the presence of caustic, corrosive, volatile, flammable, or hot liquids. DO NOT breathe toxic vapors. DO NOT allow sparking, flames, or hot liquids in vicinity of equipment.

1. Complete disassembly instructions are outlined below. Proceed only as far as required to perform the maintenance work needed.
2. Turn off power.
3. Drain System. Flush, if necessary.

#### 7.3.1 Disassembly of liquid end

1. Remove casing bolts (8B).
2. Remove back pull-out bearing frame assembly (20Y) from casing (1A).
3. Unscrew impeller nut (8A).

**Caution**

Do not screwdriver between impeller vanes to prevent rotation. It may be necessary to use a strap wrench around the impeller shaft to prevent rotation.

4. Use appropriate size gear puller aligned behind impeller vanes to remove impeller (3A) from shaft (6A).
5. Remove impeller key (12A).
6. Remove back plate bolts (8D). Remove back plate (2K) and seal housing (26P).
7. Place seal housing on flat surface and press out seal seat (14A).
8. If shaft sleeve (5A) requires replacement, it must be evenly heated to approximately 350 °F to loosen locktite. Twist sleeve off shaft (6A).

#### 7.3.2 Disassembly of bearing frame (LF)

1. Remove slinger (13G).
2. Remove grease seal(s), (14S) if any.
3. Remove bearing house retaining ring (61K).
4. Press or tap on the pump end of the bearing-shaft assembly until one bearing is out.
5. When one bearing is out, remove second retaining ring (61F), then remove complete assembly from bearing housing.
6. Remove shaft retaining ring (61C) and press off bearings.
7. Press on new bearings, remember to press only on inner race of bearing while pressing them on.
8. Assemble frame in the reverse procedure used for disassembly.
9. Observe the following when reassembling the bearing frame.
10. Replace lip seals (14S) if worn or damaged.
11. Replace bearings (18A), (18B) if loose, rough or noisy when rotated.
12. Check shaft (6A) for runout at the sleeve (5A) area. Maximum permissible is .002" T.I.R.

### 7.4 Seal replacement (LCS)

1. Complete preparations noted.
2. Remove coupling guard (34F).
3. Remove coupling bolts (8E). Pry apart the coupling halves (23D), remove keys (12B) and set aside.

**Note**

Mark or measure the original position of the pump coupling on the motor side.

4. Unscrew tubing connector from pipe tee of air vent assembly. Pipe dope is applied to threads during factory assembly, and resulting bond may retard but will not prevent manual disassembly.
5. Remove seal cap bolts and slide seal cap (2N) up shaft to remove.
6. Remove seal head assembly manually from shaft (6A). Water-soluble lubricant may be applied to shaft to ease removal of shaft seal (14A). Pull seal head assembly manually from shaft, using slight twisting motion (as necessary) to loosen bellows from shaft.
7. Remove and discard seal spring and retainer.
8. Remove and discard seal seat from seal cap (2N) and thoroughly clean the inside cavity of seal cap.
9. Interior surface of bellows on new seal head is coated with bonding agent that adheres to motor shaft. When old seal head is removed, bonding agent no longer exists and bellows may crack or split during removal. Installation of new mechanical seal is always recommended if it becomes necessary to remove existing seal from shaft.
10. Clean and lubricate shaft (6A) with water-soluble lubricant and make sure no sharp edges exist to cut or scratch bellows of new seal.
11. Press new seal seat firmly into seal cap. Avoid direct contact of new seal.
12. Slide new seal head assembly onto shaft by applying even pressure to base of assembly.
13. Install seal cap (2N) down shaft.
14. See reassembly instructions.

### 7.5 Wear ring replacement

1. Complete preparations.
3. It may be necessary to remove volute (1A) from piping, to facilitate easy access to interior of volute. If necessary, remove flange bolts at piping.
4. To remove worn Case Wear Ring (4A), drill two holes slightly smaller than width of ring into exposed edge of ring. Once holes are drilled, a chisel may be used to completely sever ring at holes and break ring into two halves for easy removal.
5. Clean the ring cavity in the volute prior to installing wear ring to ensure a properly aligned fit.
6. To reassemble, press fit new wear ring squarely into volute casing cavity. Ring may be tapped into place to make sure it is completely impressed into cavity.

**Caution**

Do not use metal tooling against wear ring surfaces. Use only rubber, rawhide, wood or other soft material to prevent damage to ring.
7.6 Reassembly of pumps

1. All parts should be cleaned before reassembly.
2. Refer to parts list to identify required replacement items
   Specify pump serial or catalog number when ordering parts.
3. Reassembly is the reverse of disassembly.
4. Observe the following when reassembling the liquid end:
   • All mechanical seal components must be in good condition or
     leakage may result. Replacement of complete seal assembly
     is recommended.
   • New shaft sleeves are installed by bonding to shaft with
     hydraulic setting locktite.
5. Re-install coupling guards on coupled pumps.

7.7 Ordering parts

Grundfos Pumps has over 90 years of experience in the design,
manufacture, and application of centrifugal pumps and pumping
systems. Grundfos's commitment to state-of-the-art pump design
and quality manufacturing assures maximum user benefits with
optimum equipment life at lower cost.

Grundfos's commitment to their customers continues through an
extensive service organization. Highly trained technicians can
assist customers with initial startup, troubleshooting, repair, and
system analysis.

PACO maintains an extensive stock of replacement parts and
parts kits for our most popular model pumps. Shipment of these
parts is normally made within three days after receipt of an order.
On larger pumps, where it is impractical for our factory to
inventory low usage parts, replacement parts are normally
manufactured and shipped within 15 working days of receipt of an
order. In order to reduce pump repair time and shorten
inconvenient pump service interruptions, it is suggested that the
pump user stock spare parts. For suggested spare parts see
Replacement Parts Guide A1b.2, attached, and contact your local
PACO Sales Representative (see back cover for the number of
your nearest PACO Sales office). Since spare parts requirements
and quantities vary for specific pump constructions, allow your
PACO Representative to help in defining your spare part
requirements. To ensure that the proper replacement parts are
ordered for your particular pump model, when you call:
   • Identify all pertinent data from the pump name plate (see
     Pump Identification ). This should always include the pump
     Catalog or Model Number, and the pump Serial Number.
   • For replacement impellers, also include from the nameplate
     the operating conditions (GPM and TDH) and the impeller
diameter.
   • Identify all parts by item number and description as indicated
     by the appropriate assembly drawing in this manual, for your
     particular pump model.
# Type LF, Cross Section and Parts List

- **Packed Pumps Only**
- **If Applicable**

<table>
<thead>
<tr>
<th>ITEM NO</th>
<th>PART NAME</th>
<th>ITEM NO</th>
<th>PART NAME</th>
<th>ITEM NO</th>
<th>PART NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>Casing</td>
<td>*10A</td>
<td>Washer, Packing</td>
<td>16L</td>
<td>Plug, Seal Chamber</td>
</tr>
<tr>
<td>2K</td>
<td>Backplate</td>
<td>10A</td>
<td>Washer, Impeller</td>
<td>18A</td>
<td>Bearing, Inboard</td>
</tr>
<tr>
<td>3A</td>
<td>Enclosed Impeller</td>
<td>11A</td>
<td>Gasket, Casing</td>
<td>18B</td>
<td>Bearing, Outboard</td>
</tr>
<tr>
<td>4A</td>
<td>Case Wear Ring</td>
<td>11F</td>
<td>Gasket, Backplate</td>
<td>20Y</td>
<td>Bearing Frame</td>
</tr>
<tr>
<td><strong>4F</strong></td>
<td>Balance Ring</td>
<td>12A</td>
<td>Key, Impeller</td>
<td>*22A</td>
<td>Stud, Packing Gland</td>
</tr>
<tr>
<td>5A</td>
<td>Shaft Sleeve</td>
<td>12B</td>
<td>Key, Coupling</td>
<td>26P</td>
<td>Seal Housing</td>
</tr>
<tr>
<td>*5L</td>
<td>Lantern Ring</td>
<td>*13A</td>
<td>Packing</td>
<td>*26U</td>
<td>Packing Box</td>
</tr>
<tr>
<td>6A</td>
<td>Shaft</td>
<td>13G</td>
<td>Slinger</td>
<td>*35F</td>
<td>Nut, Packing Gland</td>
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<tr>
<td>*7A</td>
<td>Packing Gland</td>
<td>14A</td>
<td>Shaft Seal</td>
<td>61C</td>
<td>Snap Ring</td>
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<tr>
<td>8A</td>
<td>Cap Screw, Impeller</td>
<td>14S</td>
<td>Lip Seal</td>
<td>*61J</td>
<td>Snap Ring</td>
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<tr>
<td>8B</td>
<td>Cap Screw, Casing</td>
<td>16A</td>
<td>Plug, Drain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8D</td>
<td>Cap Screw, Brg. Frame</td>
<td>16D</td>
<td>Plug, Grease/Oil Filter</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Packed Pumps Only

** If Applicable
### 7.9 Type LC, cross section and parts list

#### Sealed Unit

![Sealed Unit Diagram]

#### Packed Unit

![Packed Unit Diagram]

<table>
<thead>
<tr>
<th>ITEM NO</th>
<th>PART NAME</th>
<th>ITEM NO</th>
<th>PART NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>*1A</td>
<td>Casing</td>
<td>11F</td>
<td>Gasket, backplate</td>
</tr>
<tr>
<td>2K</td>
<td>Backplate</td>
<td>12A</td>
<td>Key</td>
</tr>
<tr>
<td>3A</td>
<td>Impeller</td>
<td>*13A</td>
<td>Packing</td>
</tr>
<tr>
<td>4A</td>
<td>Front case wear ring</td>
<td>13G</td>
<td>Slinger</td>
</tr>
<tr>
<td>4F</td>
<td>Rear case wear ring</td>
<td>14A</td>
<td>Mechanical seal</td>
</tr>
<tr>
<td>5A</td>
<td>Shaft sleeve</td>
<td>16A</td>
<td>Plug, drain</td>
</tr>
<tr>
<td>*5L</td>
<td>Lantern ring</td>
<td>16J</td>
<td>Plug, stuffing box</td>
</tr>
<tr>
<td>*7A</td>
<td>Packing gland</td>
<td>21A</td>
<td>Bracket</td>
</tr>
<tr>
<td>8A</td>
<td>Impeller capscrew</td>
<td>*22A</td>
<td>Stud, packing gland</td>
</tr>
<tr>
<td>8B</td>
<td>Capscrew, casing</td>
<td>34B</td>
<td>Nameplate</td>
</tr>
<tr>
<td>8D</td>
<td>Capscrew, bracket</td>
<td>*35F</td>
<td>Nut, packing gland</td>
</tr>
<tr>
<td>8N</td>
<td>Capscrew, motor</td>
<td>61B</td>
<td>Snap ring</td>
</tr>
<tr>
<td>10A</td>
<td>Washer, impeller</td>
<td>*61L</td>
<td>Retaining ring</td>
</tr>
<tr>
<td>*10K</td>
<td>Washer, packing</td>
<td>65A</td>
<td>Motor</td>
</tr>
<tr>
<td>11A</td>
<td>Gasket, casing</td>
<td>84R</td>
<td>Set screws</td>
</tr>
</tbody>
</table>

* Packed pumps only
### 7.10 Type LCV, cross section and parts list

<table>
<thead>
<tr>
<th>ITEM NO</th>
<th>PART NAME</th>
<th>ITEM NO</th>
<th>PART NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>Volute</td>
<td>10A</td>
<td>Impeller washer</td>
</tr>
<tr>
<td>2H</td>
<td>Hand hole cover (not shown)</td>
<td>12A</td>
<td>Key</td>
</tr>
<tr>
<td>2K</td>
<td>Backplate</td>
<td>13G</td>
<td>Slinger</td>
</tr>
<tr>
<td>3A</td>
<td>Impeller</td>
<td>14A</td>
<td>Single mechanical seal assembly</td>
</tr>
<tr>
<td>4Q</td>
<td>Suction cover wear ring</td>
<td>20H</td>
<td>Stand</td>
</tr>
<tr>
<td>4S</td>
<td>Impeller wear ring</td>
<td>21F</td>
<td>Pedestal bracket</td>
</tr>
<tr>
<td>5A</td>
<td>Sleeve</td>
<td>32C</td>
<td>Elbow with clean out port</td>
</tr>
<tr>
<td>8A</td>
<td>Impeller screw</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## 7.11 Type LCS, cross section and parts

<table>
<thead>
<tr>
<th>ITEM NO</th>
<th>PART NAME</th>
<th>ITEM NO</th>
<th>PART NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>VOLUTE</td>
<td>17E</td>
<td>SEAL CAP O-RING</td>
</tr>
<tr>
<td>2N</td>
<td>SEAL CAP</td>
<td>20B</td>
<td>BASE RAIL</td>
</tr>
<tr>
<td>3A</td>
<td>IMPELLER</td>
<td>20C</td>
<td>MOTOR DECK</td>
</tr>
<tr>
<td>4A</td>
<td>CASE WEAR RING</td>
<td>20J</td>
<td>CAST IRON STAND</td>
</tr>
<tr>
<td>4F</td>
<td>BALANCE RING</td>
<td>20D</td>
<td>PUMP SUPPORT</td>
</tr>
<tr>
<td>6A</td>
<td>PUMP SHAFT</td>
<td>21A</td>
<td>MOTOR BRACKET</td>
</tr>
<tr>
<td>8B</td>
<td>VOLUTE SCREW</td>
<td>22A</td>
<td>SEAL CAP STUDS</td>
</tr>
<tr>
<td>8C</td>
<td>PUMP SHAFT SCREW</td>
<td>23D</td>
<td>COUPLING HALVES</td>
</tr>
<tr>
<td>8E</td>
<td>COUPLING SCREW</td>
<td>24H</td>
<td>BUSHING</td>
</tr>
<tr>
<td>8F</td>
<td>COUPLING GUARD SCREW</td>
<td>34B</td>
<td>IMPELLER WASHER</td>
</tr>
<tr>
<td>8G</td>
<td>LOCATING RING SCREW</td>
<td>34C</td>
<td>PUMP SHAFT WASHER</td>
</tr>
<tr>
<td>8N</td>
<td>MOTOR SCREW</td>
<td>34D</td>
<td>COUPLING WASHER</td>
</tr>
<tr>
<td>11A</td>
<td>VOLUTE GASKET</td>
<td>35E</td>
<td>COUPLING NUT</td>
</tr>
<tr>
<td>12B</td>
<td>COUPLING KEY</td>
<td>34F</td>
<td>COUPLING GUARD</td>
</tr>
<tr>
<td>14A</td>
<td>SEAL ASSEMBLY</td>
<td>35F</td>
<td>SEAL CAP NUT</td>
</tr>
<tr>
<td>15A</td>
<td>LOCATING RING</td>
<td>65A</td>
<td>MOTOR</td>
</tr>
<tr>
<td>16A</td>
<td>PIPE PLUG</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
8. Trouble Shooting

8.1 Symptom

<table>
<thead>
<tr>
<th>Symptoms</th>
<th>Cause Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump does not deliver any liquid at start-up.</td>
<td>1<em>2</em>3<em>4</em>5<em>6</em>7<em>8</em>9<em>10</em>11<em>14</em>16<em>17</em>22<em>23</em>24*34</td>
</tr>
<tr>
<td>Pump stops delivering liquid after start-up.</td>
<td>2<em>3</em>4<em>5</em>6<em>7</em>8<em>9</em>10<em>11</em>12<em>13</em>22<em>23</em>24*34</td>
</tr>
<tr>
<td>Pump overheats and/or ceases to deliver liquid.</td>
<td>1<em>3</em>9<em>10</em>11<em>21</em>22<em>27</em>29<em>30</em>31<em>33</em>34<em>40</em>41</td>
</tr>
<tr>
<td>Insufficient flow rate.</td>
<td>2<em>3</em>4<em>5</em>6<em>7</em>8<em>9</em>10<em>11</em>14<em>16</em>17<em>20</em>21<em>22</em>23<em>24</em>25<em>26</em>34</td>
</tr>
<tr>
<td>Excessive flow rate.</td>
<td>15<em>18</em>20*34</td>
</tr>
<tr>
<td>Discharge pressure is too high.</td>
<td>4<em>14</em>16<em>18</em>20<em>22</em>23<em>24</em>25<em>26</em>34</td>
</tr>
<tr>
<td>Shaft seal leaks appreciably, or the packing leaks excessively.</td>
<td>27<em>28</em>29<em>30</em>33<em>34</em>35<em>36</em>37<em>38</em>39*41</td>
</tr>
<tr>
<td>Shaft seal or packing fails prematurely.</td>
<td>12<em>13</em>27<em>28</em>29<em>30</em>33<em>34</em>35<em>36</em>37<em>38</em>39*41</td>
</tr>
<tr>
<td>Pump uses too much power.</td>
<td>15<em>16</em>18<em>19</em>20<em>23</em>25<em>27</em>28<em>31</em>33<em>34</em>35<em>37</em>38*44</td>
</tr>
<tr>
<td>Pump runs rough and noisily.</td>
<td>2<em>3</em>4<em>5</em>6<em>7</em>8<em>9</em>10<em>11</em>15<em>17</em>18<em>21</em>23<em>24</em>27<em>28</em>29<em>30</em></td>
</tr>
<tr>
<td>Bearings overheat and/or fail prematurely.</td>
<td>31<em>32</em>33<em>34</em>40<em>41</em>42<em>45</em>46*</td>
</tr>
</tbody>
</table>

8.2 Possible Causes

1. The pump has not been properly bled of air.
2. The pump suction line have not been completely primed.
3. The suction head (NPSHR) required by the pump is too high, or the net positive suction head available (NPSHA) at your facility is too low.
4. The fluid pumped contains too much entrained air or gas.
5. There are air pockets in the suction line.
6. An entry of air has suddenly occurred in the suction line.
7. An entry of air past the shaft seal into the pump has occurred.
8. The inlet of the suction line is insufficiently submerged.
9. The suction valve is closed or only partially open.
10. The suction strainer is clogged with dirt or debris.
11. The foot valve is clogged or undersized.
12. Little or no cooling fluid supplied to the shaft seals.
13. The lantern ring is not positioned opposite the flushing inlet thereby restricting fluid flow.
15. Pump drive rotational speed too high.
16. Pump rotation wrong or impeller installed backwards.
17. Total head of installation (back Pressure) higher than rated total head of the pump.
18. Total head of installation (back Pressure) lower than rated total head of the pump.
19. Density of fluid pumped differs from that specified when the pump was purchased.
20. Viscosity of fluid pumped differs from that specified when the pump was purchased.
21. The pump is operating at too low a rate of flow (The discharge valve may be throttled too much).
22. If pumps are operating in parallel, the pump characteristics may not be suitable for parallel operation.
23. The impeller may be clogged with debris.
24. The impeller may be damaged.
25. The casing and impeller wear rings may be excessively worn.
26. There may be internal leakage from the discharge to the suction compartments as the result of internal gasket failure.
27. There may be a misalignment of the pump shaft.
28. The shaft may chatter because it is bent.
29. The pump may run rough due to improper balancing of the impeller.
30. The shaft may not be running due to worn bearings.
31. The impeller may be rubbing against the inside of the case.
32. The concrete pad might not be of sufficient size to provide pump stability.
33. The pump may have become misaligned during Installation.
34. The operating conditions of the installation do not agree with the data specified when the pump was purchased.
35. The shaft seal may be incorrectly installed, or the stuffing box has not been packed correctly.
36. The shaft sleeve may be scored or pitted in the region of the packing due to dirt or abrasive matter in the flushing fluid.
37. Excessive tightening of the packing gland may block the flushing port thereby diminishing the sealing fluid flow.
38. Packing material may have become wedged or extruded between the shaft and the bottom of the stuffing housing due to excessive clearance on the packing backup washer.
39. The mechanical seal may have been damaged by running dry.
40. There may be excessive axial thrust (side loading) due to improper impeller central alignment.
41. The bearings may be worn.
42. The bearings may have been damaged during installation and/or or dirt or other foreign matter may have entered the bearings during greasing or oiling.
43. Excessive greasing may cause the bearings to overheat.
44. Inadequate lubrication may be causing bearing failure.
45. Dirt may have entered the bearings past the O-Rings.
46. Moisture may have entered the bearing housing causing the bearings to rust.
9. Grundfos CUE
Variable Frequency Drive

Installation and Operating Instructions

Warning
Prior to installation, read these installation and operating instructions. Installation and operation must comply with local regulations and accepted codes of good practice.

Symbols used in this document

Warning
If these safety instructions are not observed, it may result in personal injury!

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

Note
Notes or instructions that make the job easier and ensure safe operation.

9.1 Introduction
This manual introduces all aspects of your Grundfos CUE variable frequency drive in the output current range of 1.8 to 177 A.
Always keep this manual close to the CUE.

9.2 General description
The CUE is a series of external variable frequency drives especially designed for pumps.
Thanks to the start-up guide in the CUE, the installer can quickly set central parameters and put the CUE into operation.
Connected to a sensor or an external control signal, the CUE will quickly adapt the pump speed to the actual demand.

9.3 Applications
The CUE series and Grundfos standard pumps are a supplement to the Grundfos E-pumps range with integrated variable frequency drive.
A CUE solution offers the same E-pump functionality
• in the supply voltage or power ranges not covered by the E-pump range.
• in applications where an integrated variable frequency drive is not desirable or permissible.
9.4 References
Technical documentation for Grundfos CUE:
- The manual contains all information required for putting the CUE into operation.
- The data booklet contains all technical information about the construction and applications of the CUE.
- Service instructions contain all required instructions for dismantling and repairing the variable frequency drive.
Technical documentation is available on www.grundfos.com > International website > WebCAPS.
If you have any questions, please contact the nearest Grundfos company or service workshop.

10. Safety and warnings
10.1 Warning

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

Warning
Touching the electrical parts may be fatal, even after the CUE has been switched off.
Before making any work on the CUE, the mains supply and other input voltages must be switched off at least for as long as stated below.

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Min. waiting time</th>
</tr>
</thead>
<tbody>
<tr>
<td>200-240 V</td>
<td>4 minutes</td>
</tr>
<tr>
<td>380-500 V</td>
<td>1 - 5 hp</td>
</tr>
<tr>
<td>525-600 V</td>
<td>0.75 - 10 hp</td>
</tr>
<tr>
<td>525-690 V</td>
<td>1 - 10 hp</td>
</tr>
</tbody>
</table>

Wait only for shorter time if stated so on the nameplate of the CUE in question.

10.2 Safety regulations
- The On/Off button of the control panel does not disconnect the CUE from the power supply and must therefore not be used as a safety switch.
- The CUE must be grounded correctly and protected against indirect contact according to national regulations.
- The leakage current to ground exceeds 3.5 mA.
- Enclosure class NEMA 1 must not be installed freely accessible, but only in a panel.
- Enclosure class NEMA 12 must not be installed outdoors without additional protection against water and the sun.
- Always observe national and local regulations as to cable gauge size, short-circuit protection and overcurrent protection.

10.3 Installation requirements
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, grounding)
- safety on connecting inputs and outputs (PELV).

10.3.1 IT mains

Warning
Do not connect 380-500 V CUE variable frequency drives to mains supplies with a voltage between phase and ground of more than 440 V.

In connection with IT mains and grounded delta mains, the supply voltage may exceed 440 V between phase and ground.

10.3.2 Aggressive environment

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

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

10.4 Reduced performance under certain conditions
The CUE will reduce its performance under these conditions:
- low air pressure (at high altitude)
- long motor cables.

The required measures are described in the next two sections.

10.4.1 Reduction at low air pressure

Warning
At altitudes above 6600 ft, PELV cannot be met.

PELV = Protective Extra Low Voltage.

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

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

10.4.2 Reduction in connection with long motor cables

The maximum cable length for the CUE is 1000 ft for unscreened and 500 ft for screened cables. In case of longer cables, contact Grundfos.

The CUE is designed for a motor cable with a maximum gauge size as stated in section 16.6 Fuses and cable gauge size.
11. Identification

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

![Nameplate Example](image1)

Fig. 1 Example of nameplate

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

12. Mechanical installation
The individual CUE cabinet sizes are characterised by their enclosures. The table in section 16.1 shows the relationship of enclosure class and enclosure type.

12.1 Reception and storage
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 the CUE is delivered in a packaging which is not suitable for outdoor storage.

12.2 Transportation and unpacking
The CUE must only be unpacked at the installation site to prevent damage during the transport to the site.

The packaging contains accessory bag(s), documentation and the unit itself. See fig. 2.

![CUE Packaging](image2)

Fig. 2 CUE packaging

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

- Sufficient free space above and below the CUE. See table below.
- Ambient temperature up to 122 °F.
- Hang the CUE directly on the wall, or fit it with a back plate. See fig. 3.

![CUE Hung Directly on the Wall](image3)

Fig. 3 CUE hung directly on the wall or fitted with a back plate

1.5 kW Typical shaft power on the motor

<table>
<thead>
<tr>
<th>Text</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>T/C:</td>
<td>CUE (product name)</td>
</tr>
<tr>
<td>Prod. no:</td>
<td>Product number: 12345678</td>
</tr>
<tr>
<td>S/N:</td>
<td>Serial number: 123456GZ34</td>
</tr>
<tr>
<td>IN:</td>
<td>Supply voltage, frequency and maximum input</td>
</tr>
<tr>
<td>OUT:</td>
<td>Motor voltage, frequency and maximum output</td>
</tr>
<tr>
<td>CHASSIS/IP20</td>
<td>Enclosure class</td>
</tr>
<tr>
<td>Tamb.</td>
<td>Maximum ambient temperature</td>
</tr>
</tbody>
</table>

**Fig. 3** CUE Hung Directly on the Wall

**Table 1:** Required free space above and below the CUE

<table>
<thead>
<tr>
<th>Enclosure</th>
<th>Space [in]</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2, A3, A5</td>
<td>3.9</td>
</tr>
<tr>
<td>B1, B2, B3, B4, C1, C3</td>
<td>7.9</td>
</tr>
<tr>
<td>C2, C4</td>
<td>8.9</td>
</tr>
</tbody>
</table>
12.4 Mounting

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

1. Mark and drill holes. See the dimensions in section 16.2.
2. Fit the screws, but leave loose. Mount the CUE, and tighten the four screws.

![Drilling of holes](Fig. 4)

13. Electrical connection

**Warning**
The owner or installer is responsible for ensuring correct grounding and protection according to national and local standards.

**Warning**
Before making any work on the CUE, the mains supply and other voltage inputs must be switched off for at least as long as stated in section 3. Safety and warnings.

![Example of three-phase mains connection](Fig. 5)

13.1 Electrical protection

13.1.1 Protection against electric shock, indirect contact

**Warning**
The CUE must be grounded correctly and protected against indirect contact according to national regulations.

**Caution**
The leakage current to ground exceeds 3.5 mA, and a reinforced ground connection is required.

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

Instructions according to EN IEC 61800-5-1:
- The CUE must be stationary, installed permanently and connected permanently to the mains supply.
- The ground connection must be carried out with duplicate protective conductors or with a single reinforced protective conductor with a gauge size of minimum 8 AWG.

13.1.2 Protection against short-circuit, fuses

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

Grundfos demands that the back-up fuses mentioned in section 16.6 are used for protection against short-circuit.

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

13.1.3 Additional protection

**Caution**
The leakage current to ground exceeds 3.5 mA.

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

![ELCB](symbol)

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 the CUE in normal operation can be seen in section 16.7.1 Mains supply (L1, L2, L3).

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

13.1.4 Motor protection

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

13.1.5 Protection against overcurrent

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

13.1.6 Protection against supply voltage transients

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

13.2 Mains and motor connection

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

![ELCB](symbol)

The maximum output voltage of the CUE is equal to the input voltage.

**Note**
Example: If the supply voltage is 208 V, choose a 208 V rated motor.

13.2.1 Mains switch

A mains switch can be installed before the CUE according to local regulations. See fig. 5.
### 13.2.2 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.

![Wiring diagram, three-phase mains connection](image)

**Fig. 6** Wiring diagram, three-phase mains connection

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>91</td>
<td>(L1) Three-phase supply</td>
</tr>
<tr>
<td>92</td>
<td>(L2)</td>
</tr>
<tr>
<td>93</td>
<td>(L3)</td>
</tr>
<tr>
<td>95/99</td>
<td>(PE) Ground connection</td>
</tr>
<tr>
<td>96</td>
<td>(U)</td>
</tr>
<tr>
<td>97</td>
<td>(V) Three-phase motor connection, 0-100 % of supply voltage</td>
</tr>
<tr>
<td>98</td>
<td>(W)</td>
</tr>
</tbody>
</table>

*For single-phase connection, use L1 and L2.*

**Cable sizing:**
To determine the conductor gauge size for single-phase mains input cable, multiply the CUE's max. current output by 2, and choose the gauge size based on that amperage.

*For three-phase input, use the same conductor gauge size as selected for the motor.*

*For CUE to motor, use standard published three-phase wiring charts based on motor size.*

### 13.2.3 Mains connection, enclosures A2 and A3

For information about enclosure, see table in section 16.1.

**Note**

*For single-phase connection, use L1 and L2.*

**Caution**

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

1. Fit the mounting plate with two screws.

2. Connect the ground conductor to terminal 95 (PE) and the mains conductors to the terminals 91 (L1), 92 (L2), 93 (L3) of the mains plug. Put the mains plug into the socket marked MAINS.

![Connecting the ground conductor and mains conductors](image)

**Fig. 8** Connecting the ground conductor and mains conductors

3. Fix the mains cable to the mounting plate.

![Fixing the mains cable](image)

**Fig. 9** Fixing the mains cable

**Note**

*For single-phase connection, use L1 and L2.*

**Caution**

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

1. Fit the mounting plate with two screws.
13.2.4 Motor connection, enclosures A2 and A3
For information about enclosure, see table in section 16.1.

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

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

Fig. 10 Connecting the ground conductor and motor conductors

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

Fig. 11 Connecting the motor plug and fixing the screened cable

**Note**
Cable screens must be grounded at both ends.

**Note**
The cable screen must be exposed and in physical contact with the mounting plate and clamp.

13.2.5 Enclosure A5
For information about enclosure, see table in section 16.1.

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

1. Connect the ground conductor to terminal 95 (PE). See fig. 12.
2. Connect the mains conductors to the 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.

Fig. 12 Mains connection, A5

**Note**
For single-phase connection, use L1 and L2.

**Motor connection**

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

1. Connect the ground conductor to terminal 99 (PE). See fig. 13.
2. Connect the motor conductors to the 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.

Fig. 13 Motor connection, A5

**Note**
The cable screen must be exposed and in physical contact with the mounting plate and clamp.
13.2.6 Enclosures B1 and B2
For information about enclosure, see table in section 16.1.

Mains connection

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

1. Connect the ground conductor to terminal 95 (PE). See fig. 14.
2. Connect the mains conductors to the terminals 91 (L1), 92 (L2), 93 (L3).
3. Fix the mains cable with a cable clamp.

![Fig. 14 Mains connection, B1 and B2](image)

**Note** For single-phase connection, use L1 and L2.

Motor connection

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

1. Connect the ground conductor to terminal 99 (PE). See figs 16 and 17.
2. Connect the motor conductors to the terminals 96 (U), 97 (V), 98 (W).
3. Fix the screened cable with a cable clamp.

![Fig. 15 Motor connection, B1 and B2](image)

**Note** The cable screen must be exposed and in physical contact with the mounting plate and clamp.

13.2.7 Enclosures B3 and B4
For information about enclosure, see table in section 16.1.

Mains connection

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

1. Connect the ground conductor to terminal 95 (PE). See figs 16 and 17.
2. Connect the mains conductors to the terminals 91 (L1), 92 (L2), 93 (L3).
3. Fix the mains cable with a cable clamp.

![Fig. 16 Mains and motor connection, B3](image)

Motor connection

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

1. Connect the ground conductor to terminal 99 (PE). See figs 16 and 17.
2. Connect the motor conductors to the terminals 96 (U), 97 (V), 98 (W).
3. Fix the screened cable with a cable clamp.

![Fig. 17 Mains and motor connection, B4](image)
13.2.8 Enclosures C1 and C2
For information about enclosure, see table in section 16.1.

Mains connection

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

1. Connect the ground conductor to terminal 95 (PE). See fig. 18.
2. Connect the mains conductors to the terminals 91 (L1), 92 (L2), 93 (L3).

Motor connection

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

1. Connect the ground conductor to terminal 99 (PE). See fig. 18.
2. Connect the motor conductors to the terminals 96 (U), 97 (V), 98 (W).
3. Fix the screened cable with a cable clamp.

**Note**
The cable screen must be exposed and in physical contact with the mounting plate and clamp.

Fig. 18 Mains and motor connection, C1 and C2

Fig. 19 Mains and motor connection, C3

**Note**
The cable screen must be exposed and in physical contact with the mounting plate and clamp.

Fig. 20 Mains and motor connection, C4

**Note**
The cable screen must be exposed and in physical contact with the mounting plate and clamp.

13.2.9 Enclosures C3 and C4
For information about enclosure, see table in section 16.1.

Mains connection

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

1. Connect the ground conductor to terminal 95 (PE). See figs 19 and 20.
2. Connect the mains conductors to the terminals 91 (L1), 92 (L2), 93 (L3).

Motor connection

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

1. Connect the ground conductor to terminal 99 (PE). See figs 19 and 20.
2. Connect the motor conductors to the terminals 96 (U), 97 (V), 98 (W).
3. Fix the screened cable with a cable clamp.
13.3 Connecting the signal terminals

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

**Caution**
If no external on/off switch is connected, short-circuit terminals 18 and 20 using a short wire.

Connect the signal cables according to the guidelines for good practice to ensure EMC-correct installation.

- Use screened signal cables with a conductor gauge size of min. 22 AWG and max. 16 AWG.
- Use a 3-conductor screened bus cable in new systems.

**13.3.1 Wiring diagram, signal terminals 0/4-20 mA**

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Type</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>+24 V out</td>
<td>Supply to sensor</td>
</tr>
<tr>
<td>13</td>
<td>+24 V out</td>
<td>Additional supply</td>
</tr>
<tr>
<td>18</td>
<td>DI 1</td>
<td>Digital input, start/stop</td>
</tr>
<tr>
<td>19</td>
<td>DI 2</td>
<td>Digital input, programmable</td>
</tr>
<tr>
<td>20</td>
<td>GND</td>
<td>Ground for digital inputs</td>
</tr>
<tr>
<td>32</td>
<td>DI 3</td>
<td>Digital input, programmable</td>
</tr>
<tr>
<td>33</td>
<td>DI 4</td>
<td>Digital input, programmable</td>
</tr>
<tr>
<td>39</td>
<td>GND</td>
<td>Ground for analog output</td>
</tr>
<tr>
<td>42</td>
<td>AO 1</td>
<td>Analog output, 0-20 mA</td>
</tr>
<tr>
<td>50</td>
<td>+10 V out</td>
<td>Supply to potentiometer</td>
</tr>
<tr>
<td>51</td>
<td>AI 1</td>
<td>External setpoint, 0-10 V/0/4-20 mA</td>
</tr>
<tr>
<td>54</td>
<td>AI 2</td>
<td>Sensor input, sensor 1, 0/4-20 mA</td>
</tr>
<tr>
<td>55</td>
<td>GND</td>
<td>Ground for analog inputs</td>
</tr>
<tr>
<td>61</td>
<td>RS-485 GND Y</td>
<td>GENIbus, GND</td>
</tr>
<tr>
<td>68</td>
<td>RS-485 A</td>
<td>GENIbus, signal A (+)</td>
</tr>
<tr>
<td>69</td>
<td>RS-485 B</td>
<td>GENIbus, signal B (-)</td>
</tr>
</tbody>
</table>

Terminals 27, 29 and 37 are not used.

**Note**
The RS-485 screen must be connected to ground.

**13.3.2 Minimum connection, signal terminals**

Operation is only possible when the terminals 18 and 20 are connected, for instance by means of an external on/off switch or a short wire.

**Fig. 21** Wiring diagram, signal terminals

**Fig. 22** Required minimum connection, signal terminals
13.3.3 Access to signal terminals
All signal terminals are behind the terminal cover of the CUE front. Remove the terminal cover as shown in figs 23 and 24.

Fig. 23  Access to signal terminals, A2 and A3

Fig. 24  Access to signal terminals, A5, B1, B2, B3, B4, C1, C2, C3 and C4

Fig. 25  Signal terminals (all enclosures)

13.3.4 Fitting the conductor
1. Remove the insulation at a length of 0.34 - 0.39 in (9-10 mm).
2. Insert a screwdriver with a tip of maximum 0.015 x 0.1 in (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.

Fig. 26  Fitting the conductor into the signal terminal

13.3.5 Setting the analog inputs, terminals 53 and 54
The contacts A53 and A54 are positioned behind the control 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 the A54.

Remove the control panel to set the contact. See fig. 27.

Fig. 27  Setting contact A54 to current signal "I"

6.3.6 RS-485 GENIbus network connection
One or more CUE units can be connected to a control unit via GENIbus. See the example in fig. 28.

Fig. 28  Example of an RS-485 GENIbus network
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 control panel to set the contact. See fig. 29.

**Fig. 29** Setting the termination contact to "ON"

### 13.4 Connecting the signal relays

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

![Fig. 30](image) Terminals for signal relays in normal state (not activated)

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 1</td>
<td>Common</td>
</tr>
<tr>
<td>NO 1</td>
<td>NO 2</td>
</tr>
<tr>
<td>NC 1</td>
<td>NC 2</td>
</tr>
</tbody>
</table>

**Access to signal relays**

The relay outputs are positioned as shown in figs 31 to 36.

**Fig. 31** Terminals for relay connection, A2 and A3

**Fig. 32** Terminals for relay connection, A5, B1 and B2

**Fig. 33** Terminals for relay connection, C1 and C2
13.5 Connecting the MCB 114 sensor input module

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

13.5.1 Configuration of the MCB 114

The MCB 114 is equipped with three analog inputs for these sensors:

- One additional sensor 0/4-20 mA. See section 10.7.13 Sensor 2 (3.16).
- Two Pt100/Pt1000 temperature sensors for measurement of motor bearing temperature or an alternative temperature, such as liquid temperature. See sections 10.7.18 Temperature sensor 1 (3.21) and 10.7.19 Temperature sensor 2 (3.22).

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

13.5.2 Wiring diagram, MCB 114

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Type</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (VDO)</td>
<td>+24 V</td>
<td>Supply to sensor</td>
</tr>
<tr>
<td>2 (I IN)</td>
<td>AI 3</td>
<td>Sensor 2, 0/4-20 mA</td>
</tr>
<tr>
<td>3 (GND)</td>
<td>GND</td>
<td>Ground for analog input</td>
</tr>
<tr>
<td>4 (TEMP)</td>
<td>AI 4</td>
<td>Temperature sensor 1, Pt100/Pt1000</td>
</tr>
<tr>
<td>5 (WIRE)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 (GND)</td>
<td>GND</td>
<td>Ground for temperature sensor 1</td>
</tr>
<tr>
<td>7 (TEMP)</td>
<td>AI 5</td>
<td>Temperature sensor 2, Pt100/Pt1000</td>
</tr>
<tr>
<td>8 (WIRE)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 (GND)</td>
<td>GND</td>
<td>Ground for temperature sensor 2</td>
</tr>
</tbody>
</table>

Terminals 10, 11 and 12 are not used.
13.6 EMC-correct installation
This section gives guidelines for good practice when installing the 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. 38.
- Avoid terminating the screen by twisting the ends. See fig. 39. Use cable clamps or EMC screwed cable entries instead.
- Connect the screen to ground at both ends for both motor and signal cables. See fig. 40. If the controller has no cable clamps, connect only the screen to the CUE. See fig. 41.
- Avoid unscreened motor and signal cables in electrical cabinets with variable frequency drives.
- Make the motor cable as short as possible in applications without output filter to limit the noise level and minimise leakage currents.
- Screws for ground connections must always be tightened whether a cable is connected or not.
- Keep main 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.

![Fig. 38](image) Example of stripped cable with screen

![Fig. 39](image) Do not twist the screen ends

![Fig. 40](image) Example of connection of a 3-conductor bus cable with screen connected at both ends

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

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Typical shaft power P2</th>
<th>RFI filter type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x 200-240 V*</td>
<td>1.5 - 10 hp</td>
<td>C1</td>
</tr>
<tr>
<td>3 x 200-240 V</td>
<td>1 - 60 hp</td>
<td>C1</td>
</tr>
<tr>
<td>3 x 380-500 V</td>
<td>0.75 - 125 hp</td>
<td>C1</td>
</tr>
<tr>
<td>3 x 525-600 V</td>
<td>1 - 10 hp</td>
<td>C3</td>
</tr>
<tr>
<td>3 x 525-690 V</td>
<td>15 - 125 hp</td>
<td>C3</td>
</tr>
</tbody>
</table>

* 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.

13.7.1 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.

13.8 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 variable-frequency-driven motor.

Two types of output filter are available as accessories for the CUE:
- dU/dt filters
- Sine-wave filters.

Use of output filters

<table>
<thead>
<tr>
<th>Pump type</th>
<th>Typical shaft power P2</th>
<th>dU/dt filter [ft]</th>
<th>Sine-wave filter [ft]</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP, BM, BMB with 380 V motor and up</td>
<td>Up to 10 hp</td>
<td>–</td>
<td>0-1000</td>
</tr>
<tr>
<td>Other pumps, noise reduction</td>
<td>Up to 10 hp</td>
<td>–</td>
<td>0-1000</td>
</tr>
<tr>
<td></td>
<td>15 hp and up</td>
<td>0-500</td>
<td>500-1000</td>
</tr>
<tr>
<td>Other pumps, higher noise reduction</td>
<td>Up to 10 hp</td>
<td>–</td>
<td>0-1000</td>
</tr>
<tr>
<td></td>
<td>15 hp and up</td>
<td>–</td>
<td>0-1000</td>
</tr>
<tr>
<td>Pumps with 690 V motor</td>
<td>All</td>
<td>–</td>
<td>0-1000</td>
</tr>
</tbody>
</table>

The lengths stated apply to the motor cable.
Figures 42 and 43 show installations with and without filter and where to use screened and unscreened cable.

Fig. 42 Example of installation without filter

Fig. 43 Example of installation with filter. The cable between the CUE and filter must be short.

Fig. 44 Submersible pump without connection box. Variable frequency drive and filter installed close to the well.

Fig. 45 Submersible pump with connection box and screened cable. Variable frequency drive and filter installed close to the well.

* Both ends of the screened cable between filter and connection box must be connected to ground.

14. Operating modes

The following operating modes are set on the control panel in menu OPERATION, display 1.2. See section 10.5.2.

<table>
<thead>
<tr>
<th>Operating mode</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>The pump is running in the control mode selected.</td>
</tr>
<tr>
<td>Stop</td>
<td>The pump has been stopped (green indicator light is flashing).</td>
</tr>
<tr>
<td>Min.</td>
<td>The pump is running at minimum speed.</td>
</tr>
<tr>
<td>Max.</td>
<td>The pump is running at maximum speed.</td>
</tr>
</tbody>
</table>

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

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

15. Control modes

The control mode is set on the control panel in menu INSTALLATION, display 3.1. See section 17.7.1.

There are two basic control modes:
- Uncontrolled operation (open loop)
- Controlled operation (closed loop) with a sensor connected.

See sections 15.1 and 15.2.

15.1 Uncontrolled operation (open)

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 the MPC or another external controller.
### 5.2 Controlled operation (closed loop)

<table>
<thead>
<tr>
<th>Condition</th>
<th>Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportional differential pressure. The differential pressure is reduced at falling flow rate and increased at rising flow rate.</td>
<td><img src="image1" alt="Diagram" /></td>
</tr>
<tr>
<td>Constant differential pressure, pump. The differential pressure is kept constant, independently of the flow rate.</td>
<td><img src="image2" alt="Diagram" /></td>
</tr>
<tr>
<td>Constant differential pressure, system. The differential pressure is kept constant, independently of the flow rate.</td>
<td><img src="image3" alt="Diagram" /></td>
</tr>
<tr>
<td>Constant pressure. The pressure is kept constant, independently of the flow rate.</td>
<td><img src="image4" alt="Diagram" /></td>
</tr>
<tr>
<td>Constant pressure with stop function. The outlet pressure is kept constant at high flow rate. On/off operation at low flow rate.</td>
<td><img src="image5" alt="Diagram" /></td>
</tr>
<tr>
<td>Constant level. The liquid level is kept constant, independently of the flow rate.</td>
<td><img src="image6" alt="Diagram" /></td>
</tr>
<tr>
<td>Constant level with stop function. The liquid level is kept constant at high flow rate. On/off operation at low flow rate.</td>
<td><img src="image7" alt="Diagram" /></td>
</tr>
<tr>
<td>Constant flow rate. The flow rate is kept constant, independently of the head.</td>
<td><img src="image8" alt="Diagram" /></td>
</tr>
</tbody>
</table>

**Constant temperature.** The liquid temperature is kept constant, independently of the flow rate.
16. Menu overview

Menu structure
The CUE has a start-up guide, which is started at the first start-up. After the start-up guide, the CUE has a menu structure divided into four main menus:

1. **GENERAL** gives access to the start-up guide for the general setting of the CUE.

2. **OPERATION** enables the setting of setpoint, selection of operating mode and resetting of alarms. It is also possible to see the latest five warnings and alarms.

3. **STATUS** shows the status of the CUE and the pump. It is not possible to change or set values.

4. **INSTALLATION** gives access to all parameters. Here a detailed setting of the CUE can be made.
17. Setting by means of the control panel

17.1 Control panel

**Warning**

The On/Off button on the control panel does not disconnect the CUE from the power supply and must therefore not be used as a safety switch.

The On/Off button has the highest priority. In "off" condition, pump operation is not possible.

The control panel is used for local setting of the CUE. The functions available depend on the pump family connected to the CUE.

The editing buttons of the control panel can be set to these values:
- **Active**
- **Not active**.

When set to **Not active** (locked), the editing buttons do not function. It is only possible to navigate in the menus and read values.

Activate or deactivate the buttons by pressing the arrow up and arrow down buttons simultaneously for 3 seconds.

**Adjusting the display contrast**

Press OK and + for darker display.

Press OK and – for brighter display.

**Indicator lights**

The operating condition of the pump is indicated by the indicator lights on the front of the control panel. See fig. 47. The table show the function of the indicator lights.

<table>
<thead>
<tr>
<th>Indicator light</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>On</strong> (green)</td>
<td>The pump is running or has been stopped by a stop function.</td>
</tr>
<tr>
<td></td>
<td>If flashing, the pump has been stopped by the user (CUE menu), external start/stop or bus.</td>
</tr>
<tr>
<td><strong>Off</strong> (orange)</td>
<td>The pump has been stopped with the On/Off button.</td>
</tr>
<tr>
<td><strong>Alarm</strong> (red)</td>
<td>Indicates an alarm or a warning.</td>
</tr>
</tbody>
</table>

**Displays, general terms**

Figures 48 and 49 shows the general terms of the display.

**17.2 Back to factory setting**

Follow this procedure to get back to the factory setting:
1. Switch off the power supply to the CUE.
2. Press On/Off, OK and + while switching on the power supply.
   The CUE will reset all parameters to factory settings. The display will turn on when the reset is completed.

---

**Fig. 47** Control panel of the CUE

**Editing buttons**

<table>
<thead>
<tr>
<th>Button</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>On/Off</td>
<td>Makes the pump ready for operation STARTS and stops the pump.</td>
</tr>
<tr>
<td>OK</td>
<td>Saves changed values, resets alarms and expands the value field.</td>
</tr>
<tr>
<td></td>
<td>Changes values in the value field.</td>
</tr>
</tbody>
</table>

**Navigating buttons**

<table>
<thead>
<tr>
<th>Button</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Navigates from one menu to another. When the menu is changed, the display shown will always be the top display of the new menu.</td>
</tr>
<tr>
<td></td>
<td>Navigates up and down in the individual menu.</td>
</tr>
</tbody>
</table>

---

**Fig. 48** Example of display in the start-up guide

**Fig. 49** Example of display in the user menu
17.3 Start-up guide

Check that equipment connected is ready for start-up, and that the CUE has been connected to power supply.
Have nameplate data for motor, pump and CUE at hand.

Use the start-up guide for the general setting of the CUE including the setting of the correct direction of rotation.
The start-up guide is started the first time when the CUE is connected to supply voltage. It can be restarted in menu GENERAL. Please note that in this case all previous settings will be erased.

Bulleted lists show possible settings. Factory settings are shown in bold.

17.3.1 Welcoming display

- Press OK. You will now be guided through the start-up guide.

17.3.2 Language (1/16)

Select the language to be used in the display:
- English UK
- English US
- German
- French
- Italian
- Spanish
- Portuguese
- Greek
- Dutch
- Swedish
- Finnish
- Danish
- Polish
- Russian
- Hungarian
- Czech
- Chinese
- Japanese
- Korean.

17.3.3 Units (2/16)

Select the units to be used in the display:
- SI: m, kW, bar...
- US: ft, HP, psi...

17.3.4 Pump family (3/16)

Select pump family according to the pump nameplate:
- CR, CRI, CRN, CRT
- SP, SP-G, SP-NE
- ...
Select "Other" if the pump family is not on the list.

17.3.5 Rated motor power (4/16)

Set the rated motor power, P2, according to the motor nameplate:
- 0.75 - 125 HP (0.55 - 90 kW).
The setting range is size-related, and the factory setting corresponds to the rated power of the CUE.

17.3.6 Supply voltage (5/16)

Select supply voltage according to the rated supply voltage of the installation site.

* Single-phase input - three-phase output.
The setting range depends on the CUE type, and the factory setting corresponds to the rated supply voltage of the CUE.
17.3.7 Max. motor current (6/16)

Set the maximum motor current according to the motor nameplate:
- 0-999 A.

The setting range depends on the CUE type, and the factory setting corresponds to a typical motor current at the motor power selected.

17.3.8 Speed (7/16)

Set the rated speed according to the pump nameplate:
- 0-9999 rpm.

The factory setting depends on previous selections. Based on the set rated speed, the CUE will automatically set the motor frequency to 50 or 60 Hz.

17.3.9 Frequency (7A/16)

This display appears only if manual entering of the frequency is required.

Set the frequency according to the motor nameplate:
- 40-200 Hz.

The factory setting depends on previous selections.

17.3.10 Control mode (8/16)

Select the desired control mode. See section 17.7.1.
- Open loop
- Const. pressure
- Const. diff. pressure
- Prop. diff. pressure
- Const. flow rate
- Const. temperature
- Constant level
- Const. other value.

The possible settings and the factory setting depend on the pump family.

The CUE will give an alarm if the control mode selected requires a sensor and no sensor has been installed. To continue the setting without a sensor, select "Open loop", and proceed. When a sensor has been connected, set the sensor and control mode in menu INSTALLATION.

17.3.11 Rated flow rate (8A/16)

This display appears only if the control mode selected is proportional differential pressure.

Set the rated flow rate according to the pump nameplate:
- 1-28840 gpm (1-6550 m³/h).

17.3.12 Rated head (8B/16)

This display only appears if the control mode selected is proportional differential pressure.

Set the rated head according to the pump nameplate:
- 1-3277 ft (1-999 m).

17.3.13 Sensor connected to terminal 54 (9/16)

Set the measuring range of the connected sensor with a signal range of 4-20 mA. The measuring range depends on the control mode selected:

<table>
<thead>
<tr>
<th>Proportional differential pressure:</th>
<th>Constant differential pressure:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 0-20 ft</td>
<td>• 0-20 ft</td>
</tr>
<tr>
<td>• 0-33 ft</td>
<td>• 0-33 ft</td>
</tr>
<tr>
<td>• 0-54 ft</td>
<td>• 0-54 ft</td>
</tr>
<tr>
<td>• 0-84 ft</td>
<td>• 0-84 ft</td>
</tr>
<tr>
<td>• 0-200 ft</td>
<td>• 0-200 ft</td>
</tr>
<tr>
<td>• 0-334 ft</td>
<td>• 0-334 ft</td>
</tr>
<tr>
<td>• Other.</td>
<td>• Other.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Constant pressure:</th>
<th>Constant flow rate:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 0-58 psi</td>
<td>• Other.</td>
</tr>
<tr>
<td>• 0-87 psi</td>
<td></td>
</tr>
<tr>
<td>• 0-120 psi</td>
<td></td>
</tr>
<tr>
<td>• 0-145 psi</td>
<td></td>
</tr>
<tr>
<td>• 0-232 psi</td>
<td></td>
</tr>
<tr>
<td>• 0-362 psi</td>
<td></td>
</tr>
<tr>
<td>• 0-580 psi</td>
<td></td>
</tr>
<tr>
<td>• 0-870 psi</td>
<td></td>
</tr>
<tr>
<td>• Other.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Constant temperature:</th>
<th>Constant level:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Other.</td>
<td>• Other.</td>
</tr>
</tbody>
</table>

Grundfos CUE
If the control mode selected is "Const. other value", or if the measuring range selected is "Other", the sensor must be set according to the next section, display 9A/16.

17.3.14 Another sensor connected to terminal 54 (9A/16)

Sensor 1

<table>
<thead>
<tr>
<th>4-20 mA</th>
<th>bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>10.0</td>
</tr>
</tbody>
</table>

This display only appears when the control mode "Const. other value" or the measuring range "Other" has been selected in display 9/16.

- Sensor output signal:
  - 0-20 mA
  - 4-20 mA

- Unit of measurement of sensor:
  - bar, mbar, m, kPa, psi, ft, m³/h, m³/min, m²/s, l/h, l/min, l/s, gal/h, gal/m, gal/s, ft³/h, ft³/min, ft³/s, °C, °F, %.

- Sensor measuring range.

The measuring range depends on the sensor connected and the measuring unit selected.

17.3.15 Priming and venting (10/16)

Make sure that there is water in the pump. Next, if necessary. Press OK to continue.

See the installation and operating instructions of the pump.

The general setting of the CUE is now completed, and the startup guide is ready for setting the direction of rotation:

- Press OK to go on to automatic or manual setting of the direction of rotation.

17.3.16 Automatic setting of the direction of rotation (11/16)

**Warning**

During the test, the pump will run for a short time. Ensure no personnel or equipment is in danger!

Before setting the direction of rotation, the CUE will make an automatic motor adaptation of certain pump types. This will take a few minutes. The adaptation is carried out during standstill.

The CUE automatically tests and sets the correct direction of rotation without changing the cable connections.

This test is not suitable for certain pump types and will in certain cases not be able to determine the correct direction of rotation. In these cases, the CUE changes over to manual setting where the direction of rotation is determined on the basis of the installer's observations.

The CUE will now make a motor parameter test and check if the pump is turning in the right...

| Previous 11/16 | Next |

...that the system is open for flow. The pump will be running during the test. Press OK to continue.

| Previous 11/16 | Next |

Information displays.

- Press OK to continue.

The pump will start in 10 secs. To cancel, press any button.

| 0 % | 100 % |

12/16

The pump starts after 10 seconds.

It is possible to interrupt the test and return to the previous display.

Testing the direction of rotation. To interrupt, press any button.

| 0 % | 100 % |

13/16

The pump runs with both directions of rotation and stops automatically.

It is possible to interrupt the test, stop the pump and go to manual setting of the direction of rotation.

Test completed and correct direction of rotation is now set. Press OK to continue.

| Previous 14/16 | Next |

The correct direction of rotation has now been set.

- Press OK to set the setpoint.
  - See Setpoint (15/16) on page 26.

17.3.17 Setpoint (15/16)

Setpoint

| 0.00 bar |

The automatic setting of the direction of rotation has failed.

- Press OK to go to manual setting of the direction of rotation.

Set the setpoint according to the control mode and sensor selected.
17.3.18 General settings are completed (16/16)

- Press OK to make the pump ready for operation or start the pump in the operating mode Normal. Then display 1.1 of menu OPERATION will appear.

17.3.19 Manual setting when the direction of rotation is visible (13/16)

It must be possible to observe the motor fan or shaft.

- Press OK to continue.

The pump starts after 10 seconds.

It is possible to interrupt the test and return to the previous display.

The pressure will be shown during the test if a pressure sensor is connected. The motor current is always shown during the test.

State if the direction of rotation is correct.

- Yes

- No

The correct direction of rotation has now been set.

The direction of rotation is not correct.

- Press OK to set the setpoint. See Setpoint (15/16) on page 26.

17.3.20 Manual setting when the direction of rotation is not visible (13/16)

It must be possible to observe the head or flow rate.

- Press OK to continue.

The pump starts after 10 seconds.

It is possible to interrupt the test and return to the previous display.

The pressure will be shown during the test if a pressure sensor is connected. The motor current is always shown during the test.

The first test is completed.

- Write down the pressure and/or flow rate, and press OK to continue the manual test with the opposite direction of rotation.

The pump starts after 10 seconds.
It is possible to interrupt the test and return to the previous display.

<table>
<thead>
<tr>
<th>Feedback</th>
<th>Motor current</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00 bar</td>
<td>0.00 A</td>
</tr>
</tbody>
</table>

12/15

The pressure will be shown during the test if a pressure sensor is connected. The motor current is always shown during the test.

Second test completed.
Write down head/flow rate. Press OK to continue.

Which test gave the highest pump performance?

Press OK to continue.

The second test is completed.
Write down the pressure and/or flow rate, and state which test gave the highest pump performance:

- First test
- Second test
- Make new test.

Test completed and correct direction of rotation is now set. Press OK to continue.

14/16

The correct direction of rotation has now been set.
- Press OK to set the setpoint. See Setpoint (15/16) on page 26.

17.4 Menu GENERAL

- **Note** If the start-up guide is started, all previous settings will be erased!
  - The start-up guide must be carried out on a cold motor!

- **Note** Repeating the start-up guide may lead to a heating of the motor.

The menu makes it possible to return to the start-up guide, which is usually only used during the first start-up of the CUE.

17.4.1 Return to start-up guide (0.1)

State your choice:

- Yes
- No.

If Yes is selected, all settings will be erased, and the entire start-up guide must be completed.

17.4.2 Type code change (0.2)

This display is for service use only.

17.4.3 Copy of settings

It is possible to copy the settings of a CUE and reuse them in another one.

Options:

- **No copy.**
- **to CUE** (copies the settings of the CUE).
- **to control panel** (copies the settings to another CUE).

The CUE units must have the same firmware version. See section 10.6.16 Firmware version (2.16).

17.5 Menu OPERATION

17.5.1 Setpoint (1.1)

Setpoint set
Actual setpoint
Actual value

Set the setpoint in units of the feedback sensor.

In control mode **Open loop**, the setpoint is set in % of the maximum performance. The setting range will lie between the min. and max. curves. See fig. 56.

In all other control modes except proportional differential pressure, the setting range is equal to the sensor measuring range. See fig. 57.

In control mode **Proportional differential pressure**, the setting range is equal to 25 % to 90 % of max. head. See fig. 58.

If the pump is connected to an external setpoint signal, the value in this display will be the maximum value of the external setpoint signal. See section 20.1.2 External setpoint.
17.5.2 Operating mode (1.2)

Set one of the following operating modes:

- **Normal** (duty)
- **Stop**
- **Min.**
- **Max.**

The operating modes can be set without changing the setpoint setting.

17.5.3 Fault indications

Faults may result in two types of indication: Alarm or warning.

An **“alarm”** will activate an alarm indication in CUE and cause the pump to change operating mode, typically to stop. However, for some faults resulting in alarm, the pump is set to continue operating even if there is an alarm.

A **“warning”** will activate a warning indication in CUE, but the pump will not change operating or control mode.

**Alarm (1.3)**

In case of an alarm, the cause will appear in the display.

See section 15.1 Warning and alarm list.

**Warning (1.4)**

In case of warning, the cause will appear in the display.

See section 15.1 Warning and alarm list.

17.5.4 Fault log

For both fault types, alarm and warning, the CUE has a log function.

**Alarm log (1.5-1.9)**

In case of an “alarm”, the last five alarm indications will appear in the alarm log. "Alarm log 1” shows the latest alarm, "Alarm log 2” shows the latest alarm but one, etc.

The display shows three pieces of information:

- the alarm indication
- the alarm code
- the number of minutes the pump has been connected to the power supply after the alarm occurred.

**Warning log (1.10-1.14)**

In case of a “warning”, the last five warning indications will appear in the warning log. “Warning log 1” shows the latest fault, “Warning log 2” shows the latest fault but one, etc.

The display shows three pieces of information:

- the warning indication
- the warning code
- the number of minutes the pump has been connected to the power supply after the warning occurred.

17.6 Menu STATUS

The displays appearing in this menu are status displays only. It is not possible to change or set values.

The tolerance of the displayed value is stated under each display. The tolerances are stated as a guide in % of the maximum values of the parameters.

**10.6.1 Actual setpoint (2.1)**

This display shows the actual setpoint and the external setpoint.

The **actual setpoint** is shown in units of feedback sensor.

The **external setpoint** is shown in a range of 0-100 %. If the external setpoint influence is disactivated, the value 100 % is shown. See section 13.2 External setpoint.

**10.6.2 Operating mode (2.2)**

This display shows the actual operating mode (Normal, Stop, Min. or Max.). Furthermore, it shows where this operating mode was selected (CUE menu, Bus, External or On/off button).

**10.6.3 Actual value (2.3)**

This display shows the actual value controlled.

If no sensor is connected to the CUE, “—” will appear in the display.
17.6.4 Measured value, sensor 1 (2.4)

This display shows the actual value measured by sensor 1 connected to terminal 54.
If no sensor is connected to the CUE, “–” will appear in the display.

17.6.5 Measured value, sensor 2 (2.5)

This display is only shown if an MCB 114 sensor input module has been installed. 
This display shows the actual value measured by sensor 2 connected to an MCB 114.
If no sensor is connected to the CUE, “–” will appear in the display.

17.6.6 Speed (2.6)

Tolerance: ± 5 %
This display shows the actual pump speed.

17.6.7 Input power and motor current (2.7)

Tolerance: ± 10 %
This display shows the actual pump input power in W or kW and the actual motor current in Ampere [A].

17.6.8 Operating hours and power consumption (2.8)

Tolerance: ± 2 %
This display shows the number of operating hours and the power consumption. The value of operating hours is an accumulated value and cannot be reset. The value of power consumption is an accumulated value calculated from the unit’s birth, and it cannot be reset.

17.6.9 Lubrication status of motor bearings (2.9)

This display shows how many times the user has given the lubricated information and when to replace the motor bearings. When the motor bearings have been relubricated, confirm this action in the INSTALLATION menu. See section 17.7.17 Confirming relubrication/replacement of motor bearings (3.20). When relubrication is confirmed, the figure in the above display will be increased by one.

17.6.10 Time until relubrication of motor bearings (2.10)

This display is only shown if display 2.11 is not shown. 
This display shows when to relubricate the motor bearings. The controller monitors the operating pattern of the pump and calculates the period between bearing relubrications. If the operating pattern changes, the calculated time till relubrication may change as well. 
The estimated time until relubrication takes into account if the pump has been running with reduced speed. See section 17.7.17 Confirming relubrication/replacement of motor bearings (3.20).

17.6.11 Time until replacement of motor bearings (2.11)

This display is only shown if display 2.10 is not shown. 
This display shows when to replace the motor bearings. The controller monitors the operating pattern of the pump and calculates the period between bearing replacements. 
The estimated time until replacement of motor bearings takes into account if the pump has been running with reduced speed. See section 17.7.17 Confirming relubrication/replacement of motor bearings (3.20).

17.6.12 Temperature sensor 1 (2.12)

This display is only shown if an MCB 114 sensor input module has been installed. 
This display shows the measuring point and the actual value measured by Pt100/Pt1000 temperature sensor 1 connected to the MCB 114. The measuring point is selected in display 3.21. If no sensor is connected to the CUE, “–” will appear in the display.
10.6.13 Temperature sensor 2 (2.13)

This display is only shown if an MCB 114 sensor input module has been installed.
This display shows the measuring point and the actual value measured by Pt100/Pt1000 temperature sensor 2 connected to the MCB 114. The measuring point is selected in display 3.22. If no sensor is connected to the CUE, “–” will appear in the display.

17.6.14 Flow rate (2.14)

This display is only shown if a flowmeter has been configured. This display shows the actual value measured by a flowmeter connected to the digital pulse input (terminal 33) or the analog input (terminal 54).

17.6.15 Accumulated flow (2.15)

This display is only shown if a flowmeter has been configured. This display shows the value of the accumulated flow and the specific energy for the transfer of the pumped liquid. The flow measurement can be connected to the digital pulse input (terminal 33) or the analog input (terminal 54).

17.6.16 Firmware version (2.16)

This display shows the version of the software.

17.6.17 Configuration file (2.17)

This display shows the configuration file.

17.7 Menu INSTALLATION

17.7.1 Control mode (3.1)

Select one of the following control modes:
- Open loop
- Const. pressure
- Const. diff. pressure
- Prop. diff. pressure
- Const. flow rate
- Const. temperature
- Constant level
- Const. other value.

Note
If the pump is connected to a bus, the control mode cannot be selected via the CUE. See section 20.3 GENibus signal.

17.7.2 Controller (3.2)

The CUE has a factory setting of gain (K_p) and integral time (T_i). However, if the factory setting is not the optimum setting, the gain and the integral time can be changed in the display.
- The gain (K_p) can be set within the range from 0.1 to 20.
- The integral time (T_i) can be set within the range from 0.1 to 3600 s. If 3600 s is selected, the controller will function as a P controller.
- Furthermore, it is possible to set the controller to inverse control, meaning that if the setpoint is increased, the speed will be reduced. In the case of inverse control, the gain (K_p) must be set within the range from –0.1 to –20.
The table below shows the suggested controller settings:

<table>
<thead>
<tr>
<th>System/application</th>
<th>$K_p$</th>
<th>$T_i$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating system 1)</td>
<td>0.2</td>
<td>0.5</td>
</tr>
<tr>
<td>Heating system 2)</td>
<td>0.2</td>
<td>0.5</td>
</tr>
<tr>
<td>Cooling system 1)</td>
<td>0.2</td>
<td>0.5</td>
</tr>
<tr>
<td>Cooling system 2)</td>
<td>0.2</td>
<td>0.5</td>
</tr>
<tr>
<td>CUE L</td>
<td>-2.5</td>
<td>100</td>
</tr>
<tr>
<td>CUE Q</td>
<td>0.5</td>
<td>-0.5</td>
</tr>
<tr>
<td>CUE Δp</td>
<td>0.5</td>
<td>-0.5</td>
</tr>
<tr>
<td>CUE Δp</td>
<td>0.5</td>
<td>0.5*</td>
</tr>
</tbody>
</table>

1. Heating systems are systems in which an increase in pump performance will result in a rise in temperature at the sensor.
2. Cooling systems are systems in which an increase in pump performance will result in a drop in temperature at the sensor.

$L_1 = \text{Distance in [m] between pump and sensor.}$
$L_2 = \text{Distance in [m] between heat exchanger and sensor.}$

**How to set the PI controller**

For most applications, the factory setting of the controller constants $K_p$ and $T_i$ will ensure optimum pump operation. However, in some applications an adjustment of the controller may be needed.

Proceed as follows:

1. Increase the gain ($K_p$) until the motor becomes unstable. Instability can be seen by observing if the measured value starts to fluctuate. Furthermore, instability is audible as the motor starts hunting up and down.

   As some systems, such as temperature controls, are slow-reacting, it may be difficult to observe that the motor is unstable.

2. Set the gain ($K_p$) to half the value of the value which made the motor unstable. This is the correct setting of the gain.

3. Reduce the integral time ($T_i$) until the motor becomes unstable.

4. Set the integral time ($T_i$) to twice the value which made the motor unstable. This is the correct setting of the integral time.

**General rules of thumb:**
- If the controller is too slow-reacting, increase $K_p$.
- If the controller is hunting or unstable, dampen the system by reducing $K_p$ or increasing $T_i$.

17.7.3 External setpoint (3.3)

The input for external setpoint signal (terminal 53) can be set to the following types:
- **Active**
- **Not active.**

If **Active** is selected, the actual setpoint is influenced by the signal connected to the external setpoint input. See section 20.2 External setpoint.
17.7.4 Signal relays 1 and 2 (3.4 and 3.5)
The CUE has two signal relays. In the display below, select in which operating situations the signal relay should be activated.

![Signal relay 1](image1)
![Signal relay 2](image2)

- Ready
- Alarm
- Operation
- Pump running
- Not active
- Warning
- Relubricate.

**Note** For distinction between alarm and warning, see section 17.5.3 Fault indications.

17.7.5 Buttons on the CUE (3.6)

The editing buttons (+, –, On/Off, OK) on the control panel can be set to these values:
- **Active**
- **Not active**.

When set to **Not active** (locked), the editing buttons do not function. Set the buttons to **Not active** if the pump should be controlled via an external control system.

Activate the buttons by pressing the arrow up and arrow down buttons simultaneously for 3 seconds.

17.7.6 Protocol (3.7)

This display shows the protocol selection for the RS-485 port of the CUE. The protocol can be set to these values:
- **GENIbus**
- **FC**
- **FC MC**.

If GENIbus is selected, the communication is set according to the Grundfos GENIbus standard. FC and FC MC is for service purpose only.

17.7.7 Pump number (3.8)

This display shows the GENIbus number. A number between 1 and 199 can be allocated to the pump. In the case of bus communication, a number must be allocated to each pump.

The factory setting is “–”.

17.7.8 Digital inputs 2, 3 and 4 (3.9 to 3.11)

The digital inputs of the CUE (terminal 19, 32 and 33) can individually be set to different functions. Select one of the following functions:
- **Min.** (min. curve)
- **Max.** (max. curve)
- **Ext. fault** (external fault)
- **Flow switch**
- **Alarm reset**
- **Dry running** (from external sensor)
- **Accumulated flow** (pulse flow, only terminal 33)
- **Not active**.

The selected function is active when the digital input is activated (closed contact). See also section 20.1 Digital inputs.

- **Min.**
  When the input is activated, the pump will operate according to the min. curve.

- **Max.**
  When the input is activated, the pump will operate according to the max. curve.

- **Ext. fault**
  When the input is activated, a timer will be started. If the input is activated for more than 5 seconds, an external fault will be indicated. If the input is deactivated, the fault condition will cease and the pump can only be restarted manually by resetting the fault indication.

- **Flow switch**
  When this function is selected, the pump will be stopped when a connected flow switch detects low flow. It is only possible to use this function if the pump is connected to a pressure sensor or a level sensor, and the stop function is activated. See sections 17.7.10 and 17.7.11.

- **Alarm reset**
  When the input has been activated, the alarm is reset if the cause of the alarm no longer exists.
Dry running
When this function is selected, lack of inlet pressure or water shortage can be detected. This requires the use of an accessory, such as:

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

When lack of inlet pressure or water shortage (Dry running) is detected, the pump will be stopped. The pump cannot restart as long as the input is activated.

Restarts may be delayed by up to 30 minutes, depending on the pump family.

Accumulated flow
When this function is set for digital input 4 and a pulse sensor is connected to terminal 33, the accumulated flow can be measured.

17.7.9 Digital flow input (3.12)

This display appears only if a flowmeter has been configured in display 3.11.

The display is used for setting the volume for every pulse for the function Accumulated flow with a pulse sensor connected to terminal 33.

Setting range:
- 0-265 gal/pulse (0-1000 litre/pulse).

The volume can be set in the unit selected in the start-up guide.

17.7.10 Constant pressure with stop function (3.13)

Settings
The stop function can be set to these values:
- Active
- Not active.

The on/off band can be set to these values:
- ΔH is factory-set to 10 % of actual setpoint.
- ΔH can be set within the range from 5 % to 30 % of the actual setpoint.

Operating conditions for the stop function
It is only possible to use the stop function if the system incorporates a pressure sensor, a check valve and a diaphragm tank.

Descriptions
The stop function is used for changing between on/off operation at low flow and continuous operation at high flow.

Low flow can be detected in two different ways:
1. A built-in "low-flow detection function" which functions if the digital input is not set up for flow switch.
2. A flow switch connected to the digital input.

1. Low-flow detection function
The pump will check the flow regularly by reducing the speed for a short time. If there is no or only a small change in pressure, this means that there is low flow.

The speed will be increased until the stop pressure (actual setpoint + 0.5 x ΔH) is reached and the pump will stop after a few seconds. The pump will restart at the latest when the pressure has fallen to the start pressure (actual setpoint – 0.5 x ΔH).

If the flow in the off period is higher than the low-flow limit, the pump will restart before the pressure has fallen to the start pressure.

When restarting, the pump will react in the following way:
1. If the flow is higher than the low-flow limit, the pump will return to continuous operation at constant pressure.
2. If the flow is lower than the low-flow limit, the pump will continue in start/stop operation. It will continue in start/stop operation until the flow is higher than the low-flow limit. When the flow is higher than the low-flow limit, the pump will return to continuous operation.

2. Low-flow detection with flow switch
When the digital input is activated because there is low-flow, the speed will be increased until the stop pressure (actual setpoint + 0.5 x ΔH) is reached, and the pump will stop. When the pressure has fallen to start pressure, the pump will start again.

If there is still no flow, the pump will reach the stop pressure and stop. If there is flow, the pump will continue operating according to the setpoint.

The check valve must always be installed before the pressure sensor. See figs 51 and 52.

Caution
If a flow switch is used to detect low flow, the switch must be installed on the system side after the diaphragm tank.
Diaphragm tank
The stop function requires a diaphragm tank of a certain minimum size. The tank must be installed as close as possible after the pump and the precharge pressure must be 0.7 x actual setpoint. Recommended diaphragm tank size:

<table>
<thead>
<tr>
<th>Rated flow rate of pump [gpm]</th>
<th>Typical diaphragm tank size [gallons]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-26</td>
<td>2</td>
</tr>
<tr>
<td>27-105</td>
<td>4.4</td>
</tr>
<tr>
<td>106-176</td>
<td>14</td>
</tr>
<tr>
<td>177-308</td>
<td>34</td>
</tr>
<tr>
<td>309-440</td>
<td>62</td>
</tr>
</tbody>
</table>

If a diaphragm tank of the above size is installed in the system, the factory setting of \( \Delta H \) is the correct setting. If the tank installed is too small, the pump will start and stop too often. This can be remedied by increasing \( \Delta H \).

17.7.11 Constant level with stop function (3.13)

Settings
The stop function can be set to these values:
- **Active**
- **Not active**.

The on/off band can be set to these values:
- \( \Delta H \) is factory-set to **10 % of actual setpoint**.
- \( \Delta H \) can be set within the range from 5 % to 30 % of actual setpoint.

A built-in low-flow detection function will automatically measure and store the power consumption at approx. 50 % and 85 % of the rated speed. If **Active** is selected, proceed as follows:
1. Close the isolating valve to create a no-flow condition.
2. Press OK to start the auto-tuning.

**Operating conditions for the stop function**
It is only possible to use the constant level stop function if the system incorporates a level sensor, and all valves can be closed.

**Description**
The stop function is used for changing between on/off operation at low flow and continuous operation at high flow.

Low flow can be detected in two different ways:
1. With the built-in low-flow detection function.
2. With a flow switch connected to a digital input.

1. **Low-flow detection function**
The built-in low-flow detection is based on the measurement of speed and power.
When low flow is detected, the pump will stop. When the level has reached the start level, the pump will start again. If there is still no flow, the pump will reach the stop level and stop. If there is flow, the pump will continue operating according to the setpoint.

2. **Low-flow detection with flow switch**
When the digital input is activated because of low flow, the speed will be increased until the stop level (actual setpoint – 0.5 x \( \Delta H \)) is reached, and the pump will stop. When the level has reached the start level, the pump will start again. If there is still no flow, the pump will reach the stop level and stop. If there is flow, the pump will continue operating according to the setpoint.

17.7.12 Sensor 1 (3.15)

Setting of sensor 1 connected to terminal 54. This is the feedback sensor.

Select among the following values:
- Sensor output signal:
  - 0-20 mA
  - 4-20 mA.
- Unit of measurement of sensor:
  - bar, mbar, kPa, psi, ft, m³/h, m³/s, l/s, gpm, °C, °F, %.
- Sensor measuring range.
17.7.13 Sensor 2 (3.16)

Setting of sensor 2 connected to an MCB 114 sensor input module.

Select among the following values:

- Sensor output signal:
  0-20 mA
  4-20 mA.

- Unit of measurement of sensor:
  bar, mbar, m, kPa, psi, ft, m³/h, m³/s, l/s, gpm, °C, °F, %.

- Sensor measuring range:
  0-100 %.

17.7.14 Duty/standby (3.17)

Settings

The duty/standby function can be set to these values:

- Active
- Not active.

Activate the duty/standby function as follows:

1. Connect one of the pumps to the mains supply.
   Set the duty/standby function to Not active.
   Make the necessary settings in menu OPERATION and INSTALLATION.
2. Set the operating mode to Stop in menu OPERATION.
3. Connect the other pump to the mains supply.
   Make the necessary settings in menu OPERATION and INSTALLATION.
   Set the duty/standby function to Active.

The running pump will search for the other pump and automatically set the duty/standby function of this pump to Active. If it cannot find the other pump, a fault will be indicated.

The two pumps must be connected electrically via the GENibus, and nothing else must be connected on the GENibus.

The duty/standby function applies to two pumps connected in parallel and controlled via GENibus. Each pump must be connected to its own CUE and sensor.

The primary targets of the function are the following:

- To start the standby pump if the duty pump is stopped due to an alarm.
- To alternate the pumps at least every 24 hours.
17.7.15 Operating range (3.18)

How to set the operating range:

• Set the min. speed within the range from a pump-dependent min. speed to the adjusted max. speed. The factory setting depends on the pump family.

• Set the max. speed within the range from adjusted min. speed to the pump-dependent maximum speed. The factory setting will be equal to 100 %, i.e. the speed stated on the pump nameplate.

The area between the min. and max. speed is the actual operating range of the pump.

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

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

Fig. 54 Setting of the min. and max. curves in % of maximum performance

10.7.16 Motor bearing monitoring (3.19)

The motor bearing monitoring function can be set to these values:

• Active
• Not active.

When the function is set to Active, the CUE will give a warning when the motor bearings are due to be relubricated or replaced.

Description

The motor bearing monitoring function is used to give an indication when it is time to relubricate or replace the motor bearings. See display 2.10 and 2.11.

The warning indication and the estimated time take into account if the pump has been running with reduced speed. Furthermore, the bearing temperature is included in the calculation if temperature sensors are installed and connected to an MCB 114 sensor input module.

The counter will continue counting even if the function is switched to Not active, but a warning will not be given when it is time for relubrication.

10.7.17 Confirming relubrication/replacement of motor bearings (3.20)

This function can be set to these values:

• Relubricated
• Replaced
• Nothing done.

When the motor bearings have been relubricated or replaced, confirm this action in the above display by pressing "OK".

Note Relubricated cannot be selected for a period of time after confirming relubrication.

Relubricated

When the warning Relubricate motor bearings has been confirmed,

• the counter is set to 0.
• the number of relubrications is increased by 1.

When the number of relubrications has reached the permissible number, the warning Replace motor bearings appears in the display.
When the warning Replace motor bearings has been confirmed,
- the counter is set to 0.
- the number of relubrications is set to 0.
- the number of bearing changes is increased by 1.

### 17.7.18 Temperature sensor 1 (3.21)

This display is only shown if an MCB 114 sensor input module has been installed.
Select the function of a Pt100/Pt1000 temperature sensor 1 connected to an MCB 114:
- D-end bearing
- ND-end bearing
- Other liq. temp. 1
- Other liq. temp. 2
- Motor winding
- Pumped liq. temp.
- Ambient temp.
- Not active.

### 17.7.19 Temperature sensor 2 (3.22)

This display is only shown if an MCB 114 sensor input module has been installed.
Select the function of a Pt100/Pt1000 temperature sensor 2 connected to an MCB 114:
- D-end bearing
- ND-end bearing
- Other liq. temp. 1
- Other liq. temp. 2
- Motor winding
- Pumped liq. temp.
- Ambient temp.
- Not active.

### 17.7.20 Standstill heating (3.23)

The standstill heating function can be set to these values:
- Active
- Not active.

When the function is set to Active and the pump is stopped by a stop command, a current will be applied to the motor windings.

### 17.7.21 Ramps (3.24)

Set the time for each of the two ramps, ramp-up and ramp-down:
- Factory setting: Depending on power size.
- The range of the ramp parameter: 1-3600 s.

The ramp-up time is the acceleration time from 0 rpm to the rated motor speed. Choose a ramp-up time such that the output current does not exceed the maximum current limit for the CUE.

The ramp-down time is the deceleration time from rated motor speed to 0 rpm. Choose a ramp-down time such that no overvoltage arises and such that the generated current does not exceed the maximum current limit for the CUE.

### 18. Setting by means of PC Tool E-products

Special setup requirements differing from the settings available via the CUE require the use of Grundfos PC Tool E-products. This again requires the assistance of a Grundfos service technician or engineer. Contact your local Grundfos company for more information.
19. Priority of settings

The On/Off button has the highest priority. In "off" condition, pump operation is not possible.

The CUE can be controlled in various ways at the same time. If two or more operating modes are active at the same time, the operating mode with the highest priority will be in force.

19.1 Control without bus signal, local operating mode

<table>
<thead>
<tr>
<th>Priority</th>
<th>CUE menu</th>
<th>External signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stop</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Max.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Stop</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Min.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Normal</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Normal</td>
<td></td>
</tr>
</tbody>
</table>

Example: If an external signal has activated the operating mode Max., it will only be possible to stop the pump.

19.2 Control with bus signal, remote-controlled operating mode

<table>
<thead>
<tr>
<th>Priority</th>
<th>CUE menu</th>
<th>External signal</th>
<th>Bus signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stop</td>
<td></td>
<td>Stop</td>
</tr>
<tr>
<td>2</td>
<td>Max.</td>
<td></td>
<td>Max.</td>
</tr>
<tr>
<td>3</td>
<td>Stop</td>
<td></td>
<td>Stop</td>
</tr>
<tr>
<td>4</td>
<td>Min.</td>
<td></td>
<td>Min.</td>
</tr>
<tr>
<td>5</td>
<td>Normal</td>
<td></td>
<td>Normal</td>
</tr>
</tbody>
</table>

Example: If the bus signal has activated the operating mode Max., it will only be possible to stop the pump.

20. External control signals

20.1 Digital inputs

The overview shows functions in connection with closed contact.

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Type</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>DI 1</td>
<td>Start/stop of pump</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Min. (min. curve)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Max. (max. curve)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ext. fault (external fault)</td>
</tr>
<tr>
<td>19</td>
<td>DI 2</td>
<td>Flow switch</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Alarm reset</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dry running (from external sensor)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not active.</td>
</tr>
<tr>
<td>32</td>
<td>DI 3</td>
<td>Flow switch</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Alarm reset</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dry running (from external sensor)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Not active.</td>
</tr>
</tbody>
</table>

The same function must not be selected for more than one input. See fig. 21.

20.2 External setpoint

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Type</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>53</td>
<td>AI 1</td>
<td>External setpoint (0-10 V)</td>
</tr>
</tbody>
</table>

The setpoint can be remote-set by connecting an analog signal transmitter to the setpoint input (terminal 53).

Open loop

In control mode Open loop (constant curve), the actual setpoint can be set externally within the range from the min. curve to the setpoint set via the CUE menu. See fig. 56.

Fig. 56 Relation between the actual setpoint and the external setpoint signal in control mode Open loop
Closed loop
In all other control modes, except proportional differential pressure, the actual setpoint can be set externally within the range from the lower value of the sensor measuring range (sensor min.) to the setpoint set via the CUE menu. See fig. 57.

Example: At a sensor min. value of 0 bar, a setpoint set via the CUE menu of 3 bar and an external setpoint of 80 %, the actual setpoint will be as follows:

\[
\text{Actual setpoint} = (3 - 0) \times 80 \% + 0 = 2.4 \text{ bar.}
\]

Proportional differential pressure
In control mode Proportional differential pressure, the actual setpoint can be set externally within the range from 25 % of maximum head to the setpoint set via the CUE menu. See fig. 58.

Example: At a maximum head of 12 metres, a setpoint of 6 metres set via the CUE menu and an external setpoint of 40 %, the actual setpoint will be as follows:

\[
\text{Actual setpoint} = (6 - 12 \times 25 \%) \times 40 \% + 12/4 = 4.2 \text{ m.}
\]

20.3 GENIbus signal
The CUE supports serial communication via an RS-485 input. The communication is carried out according to the Grundfos GENIbus protocol and enables connection to a building management system or another external control system. Operating parameters, such as setpoint and operating mode can be remote-set via the bus signal. At the same time, the pump can provide status information about important parameters, such as actual value of control parameter, input power and fault indications.

Contact Grundfos for further details.

Note: If a bus signal is used, the number of settings available via the CUE will be reduced.

20.4 Other bus standards
Grundfos offers various bus solutions with communication according to other standards. Contact Grundfos for further details.

21. Maintenance and service
21.1 Cleaning the CUE
Keep the cooling fins and fan blades clean to ensure sufficient cooling of the CUE.

21.2 Service parts and service kits
For further information on service parts and service kits, visit www.grundfos.com > International website > WebCAPS.
22. Troubleshooting

22.1 Warning and alarm list

In case of an alarm, the CUE will change the operating mode depending on the pump type. AMA, Automatic Motor Adaptation. Not active in the present software.

Resetting an alarm manually
- Press OK in the alarm display.
- Press On/Off twice.
- Activate a digital input DI 2-DI 4 set to Alarm reset or the digital input DI 1 (Start/stop).

If it is not possible to reset an alarm, the reason may be that the fault has not been remedied, or that the alarm has been locked.

Resetting a locked alarm
- Switch off the power supply to the CUE for approx. 30 seconds. Switch on the power supply, and press OK in the alarm display to reset the alarm.

15.2.3 Locked alarm
In case of a locked alarm, the CUE will stop the pump and become locked. Pump operation cannot be resumed until the cause of the locked alarm has been remedied and the alarm has been reset.

22.2 Resetting of alarms

In case of fault or malfunction of the CUE, check the alarm list in menu OPERATION. The latest five alarms and latest five warnings can be found in the log menus. Contact a Grundfos technician if an alarm occurs repeatedly.

22.2.1 Warning
The CUE will continue the operation as long as the warning is active. The warning remains active until the cause no longer exists. Some warnings may switch to alarm condition.

22.2.2 Alarm
In case of an alarm, the CUE will stop the pump or change the operating mode depending on the alarm type and pump type. See section 15.1 Warning and alarm list.

Pump operation will be resumed when the cause of the alarm has been remedied and the alarm has been reset.

22.3 Indicator lights

The table shows the function of the indicator lights.

22.4 Signal relays

The table shows the function of the signal relays.

1) In case of an alarm, the CUE will change the operating mode depending on the pump type.

2) AMA, Automatic Motor Adaptation. Not active in the present software.

3) Warning is reset in display 3.20.
23. Technical data

23.1 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.
- Enclosure class = IP20.

The table shows that the CUE enclosure is A2.

<table>
<thead>
<tr>
<th>Typical shaft power P2</th>
<th>Enclosure class and type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 x 200-240 V</td>
</tr>
<tr>
<td>[kW]</td>
<td>[HP]</td>
</tr>
<tr>
<td>0.55</td>
<td>0.75</td>
</tr>
<tr>
<td>0.75</td>
<td>1</td>
</tr>
<tr>
<td>1.1</td>
<td>1.5</td>
</tr>
<tr>
<td>1.5</td>
<td>2</td>
</tr>
<tr>
<td>2.2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3.7</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5.5</td>
<td>7.5</td>
</tr>
<tr>
<td>7.5</td>
<td>10</td>
</tr>
<tr>
<td>18.5</td>
<td>25</td>
</tr>
<tr>
<td>22</td>
<td>30</td>
</tr>
<tr>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>37</td>
<td>50</td>
</tr>
<tr>
<td>45</td>
<td>60</td>
</tr>
<tr>
<td>55</td>
<td>75</td>
</tr>
<tr>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>90</td>
<td>125</td>
</tr>
</tbody>
</table>
23.2 Main dimensions and weight

Fig. 59 Enclosures A2 and A3

Fig. 60 Enclosures A5, B1, B2, B3, B4, C1, C2, C3 and C4

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>a</td>
<td>B</td>
<td>b</td>
<td>C</td>
</tr>
<tr>
<td>A2</td>
<td>10.6</td>
<td>10.1</td>
<td>3.5</td>
<td>2.8</td>
<td>8.1</td>
</tr>
<tr>
<td>with IP21/NEMA1 option</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A3</td>
<td>10.6</td>
<td>10.1</td>
<td>5.1</td>
<td>4.3</td>
<td>8.1</td>
</tr>
<tr>
<td>with IP21/NEMA1 option</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A5</td>
<td>16.5</td>
<td>15.8</td>
<td>9.5</td>
<td>8.5</td>
<td>7.9</td>
</tr>
<tr>
<td>B1</td>
<td>18.9</td>
<td>17.9</td>
<td>9.5</td>
<td>8.3</td>
<td>10.2</td>
</tr>
<tr>
<td>B2</td>
<td>25.6</td>
<td>24.6</td>
<td>9.5</td>
<td>8.3</td>
<td>10.2</td>
</tr>
<tr>
<td>B3</td>
<td>15.7</td>
<td>15.0</td>
<td>6.5</td>
<td>5.5</td>
<td>9.8</td>
</tr>
<tr>
<td>with IP21/NEMA1 option</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B4</td>
<td>20.5</td>
<td>19.5</td>
<td>9.1</td>
<td>7.9</td>
<td>9.5</td>
</tr>
<tr>
<td>with IP21/NEMA1 option</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td>26.8</td>
<td>25.5</td>
<td>12.1</td>
<td>10.7</td>
<td>12.2</td>
</tr>
<tr>
<td>C2</td>
<td>30.3</td>
<td>29.1</td>
<td>14.6</td>
<td>13.1</td>
<td>13.2</td>
</tr>
<tr>
<td>C3</td>
<td>21.7</td>
<td>20.5</td>
<td>12.1</td>
<td>10.6</td>
<td>13.1</td>
</tr>
<tr>
<td>with IP21/NEMA1 option</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td>26.0</td>
<td>24.8</td>
<td>14.6</td>
<td>13.0</td>
<td>13.1</td>
</tr>
<tr>
<td>with IP21/NEMA1 option</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1) The dimensions are maximum height, width and depth. Dimensions are without options.

23.3 Surroundings

<table>
<thead>
<tr>
<th>Relative humidity</th>
<th>5-95 % RH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature</td>
<td>Max. 122 °F</td>
</tr>
<tr>
<td>Average ambient temperature over 24 hours</td>
<td>Max. 113 °F</td>
</tr>
<tr>
<td>Minimum ambient temperature at full operation</td>
<td>32 °F</td>
</tr>
<tr>
<td>Minimum ambient temperature at reduced operation</td>
<td>14 °F</td>
</tr>
<tr>
<td>Temperature during storage and transportation</td>
<td>−13 to 149 °F</td>
</tr>
<tr>
<td>Storage duration</td>
<td>Max. 6 months</td>
</tr>
<tr>
<td>Maximum altitude above sea level without performance reduction</td>
<td>3280 ft</td>
</tr>
<tr>
<td>Maximum altitude above sea level with performance reduction</td>
<td>9840 ft</td>
</tr>
</tbody>
</table>

23.4 Terminal tightening torques

<table>
<thead>
<tr>
<th>Enclosure type</th>
<th>Mains</th>
<th>Motor</th>
<th>Ground</th>
<th>Relay</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2</td>
<td>1.3</td>
<td>1.3</td>
<td>2.2</td>
<td>0.4</td>
</tr>
<tr>
<td>A3</td>
<td>1.3</td>
<td>1.3</td>
<td>2.2</td>
<td>0.4</td>
</tr>
<tr>
<td>A5</td>
<td>1.3</td>
<td>1.3</td>
<td>2.2</td>
<td>0.4</td>
</tr>
<tr>
<td>B1</td>
<td>1.3</td>
<td>1.3</td>
<td>2.2</td>
<td>0.4</td>
</tr>
<tr>
<td>B2</td>
<td>3.3</td>
<td>3.3</td>
<td>2.2</td>
<td>0.4</td>
</tr>
<tr>
<td>B3</td>
<td>3.3</td>
<td>3.3</td>
<td>2.2</td>
<td>0.4</td>
</tr>
<tr>
<td>B4</td>
<td>3.3</td>
<td>3.3</td>
<td>2.2</td>
<td>0.4</td>
</tr>
<tr>
<td>C1</td>
<td>7.4</td>
<td>7.4</td>
<td>2.2</td>
<td>0.4</td>
</tr>
<tr>
<td>C2</td>
<td>10.3 / 17.7</td>
<td>10.3 / 17.7</td>
<td>2.2</td>
<td>0.4</td>
</tr>
<tr>
<td>C3</td>
<td>7.4</td>
<td>7.4</td>
<td>2.2</td>
<td>0.4</td>
</tr>
<tr>
<td>C4</td>
<td>10.3 / 17.7</td>
<td>10.3 / 17.7</td>
<td>2.2</td>
<td>0.4</td>
</tr>
</tbody>
</table>

1) Conductor gauge size ≤ 4/0 AWG.
2) Conductor gauge size ≥ 4/0 AWG.

Note: The CUE comes in a packaging which is not suitable for outdoor storage.
23.5 Cable length

<table>
<thead>
<tr>
<th>Description</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum length, screened motor cable</td>
<td>500 ft</td>
</tr>
<tr>
<td>Maximum length, unscreened motor cable</td>
<td>1000 ft</td>
</tr>
<tr>
<td>Maximum length, signal cable</td>
<td>1000 ft</td>
</tr>
</tbody>
</table>

23.6 Fuses and cable gauge size

**Warning**
Always comply with national and local regulations as to cable gauge sizes.

23.6.1 Cable gauge size to signal terminals

<table>
<thead>
<tr>
<th>Terminals</th>
<th>Cable Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum cable gauge size to signal terminals, rigid conductor</td>
<td>14 AWG</td>
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<td>Minimum cable gauge size to signal terminals</td>
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23.6.2 Non-UL fuses and conductor cross-section (gauge size) to mains and motor

| Typical shaft power P2 | Maximum fuse size | Fuse type | Maximum conductor cross-section
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1) Screened motor cable, unscreened supply cable. AWG, see section 16.6.3.
23.6.3 UL fuses and conductor cross-section (gauge size) to mains and motor

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<th>Bussmann T</th>
<th>SIBA RK1</th>
<th>Littel Fuse RK1</th>
<th>Ferraz-Shawmut CC</th>
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</table>

1) Screened motor cable, unscreened supply cable.  
2) American Wire Gauge.
23.7 Inputs and outputs

23.7.1 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 ground | > 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.

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

23.7.2 Motor output (U, V, W)

- Output voltage in % of supply voltage.
- Depending on the pump family selected.

23.7.3 RS-485 GENIbus connection

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

23.7.4 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 k\( \Omega \)

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

23.7.5 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 V DC 10 mA
| Minimum terminal load | 24 V AC 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).

23.7.6 Analog inputs

| Analog input 1, terminal number | 53
| Voltage signal | A53 = "U" \(^1\)
| Voltage range | 0-10 V
| Input resistance, \( R_i \) | Approx. 10 k\( \Omega \)
| Maximum voltage | ± 20 V
| Current signal | A53 = "I" \(^1\)
| Current range | 0-20, 4-20 mA
| Input resistance, \( R_i \) | Approx. 200 \( \Omega \)
| 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 \( \Omega \)
| 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.

23.7.7 Analog output

| Analog output 1, terminal number | 42
| Current range | 0-20 mA
| Maximum load to ground | 500 \( \Omega \)
| Maximum fault | 0.8 % of full scale

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

23.7.8 MCB 114 sensor input module

| Analog input 3, terminal number | 2
| Current range | 0/4-20 mA
| Input resistance | < 200 \( \Omega \)

| Analog inputs 4 and 5, terminal number | 4, 5 and 7, 8
| Signal type, 2- or 3-wire | Pt100/Pt1000

Note: When using Pt100 with 3-wire cable, the resistance must not exceed 30 \( \Omega \).

23.8 Sound pressure level

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

The sound pressure level of a motor controlled by a variable frequency drive may be higher than that of a corresponding motor which is not controlled by a variable frequency drive. See section 6.7 RFI filters.

24. 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.

Subject to alterations.
25. CU 352 (3X2)
Installation and Operating Instructions

25.1 Indicator lights
The CU 3X2 has one green and one red indicator light.
The green indicator light is on when the power supply has been switched on.
The red indicator light is on when the system is in alarm mode.

2.2 Terminals

For further information, see section 9.12 Terminal groups.

25.3 Potentially explosive environments
The CU 3X2 must not be installed in explosive environments, but may be used together with Grundfos pumps approved for installation in potentially explosive environments.

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LCD display</td>
</tr>
<tr>
<td>2</td>
<td>Changes to next column in menu structure.</td>
</tr>
<tr>
<td>3</td>
<td>Changes to help text.*</td>
</tr>
<tr>
<td>4</td>
<td>Goes up in lists.</td>
</tr>
<tr>
<td>5</td>
<td>Goes down in lists.</td>
</tr>
<tr>
<td>6</td>
<td>Increases the value of a selected parameter.</td>
</tr>
<tr>
<td>7</td>
<td>Reduces the value of a selected parameter.</td>
</tr>
<tr>
<td>8</td>
<td>Goes one display back.</td>
</tr>
<tr>
<td>9</td>
<td>Goes back to menu &quot;Status&quot;.</td>
</tr>
<tr>
<td>10</td>
<td>Saves a value.</td>
</tr>
<tr>
<td>11</td>
<td>Green indicator light (operation)</td>
</tr>
<tr>
<td>12</td>
<td>Red indicator light (alarm)</td>
</tr>
<tr>
<td>13</td>
<td>Changes the brightness of the display.</td>
</tr>
</tbody>
</table>

* Some help texts apply to the entire display, other texts to the individual lines of the display.
26. Identification

The CU 3X2 can be identified by means of the nameplate on the back. See fig. 3.

![Example of name plate](image)

**Fig. 3** Example of name plate

<table>
<thead>
<tr>
<th>Pos.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Type designation</td>
</tr>
<tr>
<td>2</td>
<td>Product number and version number</td>
</tr>
<tr>
<td>3</td>
<td>Serial number</td>
</tr>
<tr>
<td>4</td>
<td>Production code (year and week)</td>
</tr>
<tr>
<td>5</td>
<td>Rated voltage, frequency and power</td>
</tr>
</tbody>
</table>

The CU 3X2 has a label for the backup battery. See fig. 4.

![Label for backup battery](image)

**Fig. 4** Label for backup battery

![Protective earth terminal](image)

**Fig. 5** Protective earth terminal

26.1 Type key

<table>
<thead>
<tr>
<th>Code</th>
<th>Example</th>
<th>CU 3 X 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>CU</td>
<td>Control unit</td>
<td></td>
</tr>
<tr>
<td>3X</td>
<td>Controller series</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Model number</td>
<td></td>
</tr>
</tbody>
</table>

27. Installation

The CU 3X2 is only intended for use in control panels.

Before installation, check the following:

- Does the CU 3X2 correspond to the one ordered?
- Is it suitable for the power supply available at the installation site?
- Has it been damaged during transportation?

**Warning**

*Switch off the power supply before making connections. Make sure that it cannot be accidentally switched on.*

**Warning**

*The electrical installation should be carried out by an authorised person in accordance with local regulations.*

**Warning**

*Observe local regulations for safety, health and environment.*

**Warning**

*The terminals L and N as well as 70 to 75 may be connected to dangerous contact voltage. External control voltage from other groups may occur.*

**Warning**

*All wires to units outside the control panel must be of the type H05VV-F according to CENELEC HD21 (to avoid injury from touching wires).*

**USA and Canada:**

*Field wiring installation shall comply with National Electrical Code (NEC) and/or Canadian Electrical Code.*

**Warning**

*The installation must incorporate a circuit breaker in order to switch off the mains supply. It must be close to the CU 3X2 and easily accessible for the operator. It must be marked as circuit breaker for the CU 3X2. The circuit breaker must be according to IEC 60947-1 and IEC 60947-3.*
27.1 Location
The CU 3X2 is designed for installation in the front of a control panel or a separate cabinet.
For outdoor installation the CU 3X2 must be mounted in a control cabinet with an enclosure class of minimum IPX4.

27.2 Enclosure class
The CU 3X2 is IP54 when mounted in the front of an IPX4 enclosure. The cabinet must be of a flame-retardant material.

USA and Canada
The CU 3X2 is type 3R when mounted in the front of a cabinet with type rating 1, 2, 3, 3R, 5, 12, 12K or 13.

27.3 Terminals
All terminals are suitable for conductors of 0.5 to 2.5 mm² or AWG 20-13.

27.4 Cables
Cables must be rated min. 70 °C.

28. Mechanical installation
Fasten the CU 3X2 with the four screws, M5 x 10, supplied with the unit (pos. 1).
Maximum torque: 1.4 Nm.
Dimensions of the CU 3X2, see section 14. Dimensions.

---

**Warning**

**Short-circuit protection**
The installation must incorporate external fuses.

**EU/IEC:**
Use fuses that comply with IEC 60127. Rated maximum 10 A, minimum 250 VAC in both line and in neutral when connecting the controller to the power source.

**USA and Canada (branch circuit protection):**
Use a UL/CSA-listed non-time delay, class-rated Branch Circuit Fuse (such as class RK5) rated maximum 10 A, minimum 250 VAC in both line and in neutral when connecting the controller to the power source.

---

**Note**
In order to achieve enclosure class IP54, the CU 3X2 must be mounted in a panel or cabinet.

Connect the earth terminal (between the cable clamps) on the CU 3X2 to the mounting frame (pos. 2, fig. 6). See fig. 7.

---

In fig. 6 and 7, the dimensions are:
Min. 1.5 mm
Max. 3 mm
29. **EMC-correct installation**

The CU 3X2 is normally mounted in a panel which also contains an IO 351 module, contactors and other power equipment. The panel can also contain other Grundfos modules and frequency converters.

In order to ensure faultless operation, it is very important to install the electronic modules in an EMC-correct way:

- Ensure a sufficient earth connection between the CU 3X2 and the frame. See fig. 7.
- Use screened cables for GEN1bus. Connect the screen to the cable clamp of the CU 3X2 in front of the terminals A1, Y1 and B1. See fig. 8. Also use screened cable for the CIM module.

![Fig. 8 Screen fixed with cable clamp](image)

*Any isolating plastic tape between screen and sheath must be removed before mounting the cable in the cable clamp.*

- Signal conductors for digital and analog inputs and outputs should be screened, i.e. run the screen all the way to the CU 3X2 and connect it to frame with for instance a cable clamp. Do not twist screen ends to avoid pig tails, as this will destroy the screen effect at high frequencies. Use cable clamps instead.
29.1 Internal GENIbus connection
Internal communication is established via GENIbus.

29.2 Fieldbus communication interface modules
The CU 3X2 can be connected to an external communication network via an add-on CIM module. CIM: Communication Interface Module.
The CIM modules must be ordered separately.
Connect the CIM module as described in the installation and operating instructions supplied with the module.

29.3 Fitting the CIM module

**Warning**
*Switch off the power supply to the CU 3X2 before fitting the CIM module.*

The CIM module must be fitted by an authorised person.

**Warning**
*Electrostatic discharge (ESD) must be avoided when fitting the CIM module, for instance by wearing an antistatic wrist strap as shown in fig. 12.*

1. Remove the screw in the back cover of the CU 3X2. See fig. 10.
2. Open the back cover and break off the tap. See fig. 11.

3. Fit the CIM module. See fig. 12.

4. Place the labels supplied with the CIM module on the back cover. See fig. 13.

5. Refit the back cover to the CU 3X2, and secure it with the mounting screw. See fig. 14.
30. Startup
Startup must be carried out by an authorised person.

Warning
Prior to startup, read the installation and operating instructions for the product in question.

31. Technical data
Transient voltages typically present on the mains supply are category 2.
Altitude above sea level
Maximum 2000 m.
Ambient temperature
- During operation: -20 °C* to +60 °C (must not be exposed to direct sunlight).
- In stock: -20 °C to +60 °C.
- During transportation: -20 °C to +60 °C.
* At temperatures below 0 °C, the display may react slowly.
Relative air humidity
5 to 95 %.
Enclosure class
IP1X.
For indoor use only.
Pollution degree
External pollution degree 3.

32. Electrical data
32.1 Supply voltage
1 x 100-240 VAC ± 10 %, 50/60 Hz, PE (Class 1 equipment).
32.2 Power consumption
Maximum 22 W.
32.3 Circuit breaker
Installation of circuit breakers must be done in accordance with local regulations.
32.4 Backup fuse
Maximum 10 A. Both standard fuses as well as quick- and slow-blow fuses are suitable.
32.5 Short-circuit protection
Use fuses that comply with IEC 60127.
USA and Canada (branch circuit protection):
Use a UL/CSA-listed non-time delay (high capacity) fuse that complies with the UL248 series or an inverse time circuit breaker that complies with UL489.
Fuse types RK1, RKS, J and CC are acceptable.

32.6 Digital inputs
<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open-circuit voltage</td>
<td>24 VDC</td>
</tr>
<tr>
<td>Closed-circuit current</td>
<td>5 mA, DC</td>
</tr>
<tr>
<td>Frequency range</td>
<td>0-4 Hz</td>
</tr>
</tbody>
</table>

32.7 Analog inputs
<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input current and voltage</td>
<td>0-20 mA</td>
</tr>
<tr>
<td>Tolerance</td>
<td>± 3.3 % of full scale</td>
</tr>
<tr>
<td>Repetitive accuracy</td>
<td>± 1 % of full scale</td>
</tr>
<tr>
<td>Input resistance, current</td>
<td>&lt; 250 Ω</td>
</tr>
<tr>
<td>Input resistance, voltage</td>
<td>&gt; 50 kΩ ± 10 %</td>
</tr>
<tr>
<td>Supply to sensor</td>
<td>24 V, 30 mA, short-circuit protected</td>
</tr>
</tbody>
</table>

32.8 Digital outputs (relay outputs)
<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normally open contacts</td>
<td>C, NO</td>
</tr>
<tr>
<td>Maximum contact load</td>
<td>240 VAC, 2 A</td>
</tr>
<tr>
<td>Minimum contact load</td>
<td>5 VDC, 10 mA</td>
</tr>
</tbody>
</table>

32.9 Conductors
<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rigid conductors</td>
<td>0.5 - 2.5 mm²</td>
</tr>
<tr>
<td>Flexible conductors without ferrule</td>
<td>20-13 AWG (US)</td>
</tr>
<tr>
<td>Flexible conductors with ferrule</td>
<td>0.5 - 1.5 mm²</td>
</tr>
<tr>
<td>With/without plastic collar</td>
<td>20-13 AWG (US)</td>
</tr>
</tbody>
</table>

32.10 USB port
<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB port</td>
<td>USB 2.0, type B</td>
</tr>
</tbody>
</table>
32.11 Battery backup (UPS)
A battery can be connected to the CU 3X2 as backup for the normal power supply. The battery can be connected directly to the CU 3X2 without a fuse.
With the backup battery the CU 3X2 can continue to operate despite interruptions in the normal power supply.

Fig. 15  Label for backup battery

32.11.1 Battery data
The backup battery should meet the below requirements:

<table>
<thead>
<tr>
<th>Battery make</th>
<th>Power Sonic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery type</td>
<td>Lead acid battery AGM type</td>
</tr>
<tr>
<td>Battery series</td>
<td>PS 12xxx series UL R/C under file number MH20845</td>
</tr>
<tr>
<td>Rated voltage</td>
<td>12 V</td>
</tr>
<tr>
<td>Battery capacity</td>
<td>40 Ah, recommended (24 hours operating time)</td>
</tr>
<tr>
<td>Nominal charging time</td>
<td>8 hours (40 Ah battery)</td>
</tr>
</tbody>
</table>

32.11.2 Battery monitoring
The CU 3X2 can monitor the following:
- short circuit
- wrong polarity
- defective battery
- battery missing
- low battery voltage.

32.12 Terminal groups
The terminals of the groups 2, 3, 5 and 6 are insulated from all other terminal groups by reinforced insulation, 2224 VAC.

<table>
<thead>
<tr>
<th>Group 1</th>
<th>Connection of power supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 2</td>
<td>Internal GENIbus connection</td>
</tr>
<tr>
<td>Group 3</td>
<td>Fieldbus connection (CIM module) (not standard)</td>
</tr>
<tr>
<td>Group 4</td>
<td>Connection of backup battery</td>
</tr>
<tr>
<td>Group 5</td>
<td>Digital inputs</td>
</tr>
<tr>
<td>Group 6</td>
<td>Ethernet connection</td>
</tr>
<tr>
<td>Group 7</td>
<td>Service connection (GENIbus)</td>
</tr>
<tr>
<td>Group 8</td>
<td>Analog inputs</td>
</tr>
<tr>
<td>Group 9</td>
<td>USB port</td>
</tr>
<tr>
<td>Group 10</td>
<td>Digital outputs</td>
</tr>
</tbody>
</table>

All control terminals in groups 2, 3, 5 and 6 are supplied with SELV voltage (Safety Extra-Low Voltage).
### 33. Overview of inputs and outputs

- **DI:** Digital input
- **DO:** Digital output
- **AI:** Analog input
- **NC:** Normally closed contact
- **NO:** Normally open contact
- **C:** Common.

Position numbers, see fig. 16.

<table>
<thead>
<tr>
<th>Group</th>
<th>Terminal</th>
<th>Designation</th>
<th>Data</th>
<th>Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>L</td>
<td>Connection to phase conductor</td>
<td>1 x 100-240 VAC ± 10 %, 50/60 Hz</td>
<td><img src="CU3X2" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>Connection to neutral conductor</td>
<td></td>
<td><img src="CU3X2" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>PE</td>
<td>Connection to protective earth</td>
<td></td>
<td><img src="CU3X2" alt="Diagram" /></td>
</tr>
<tr>
<td>2</td>
<td>A1</td>
<td>RS-485 A</td>
<td>GENIbus (Fix the screen with a cable clamp.)</td>
<td><img src="IO351" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>Y1</td>
<td>RS-485 GND</td>
<td></td>
<td><img src="IO351" alt="Diagram" /></td>
</tr>
<tr>
<td></td>
<td>B1</td>
<td>RS-485 B</td>
<td></td>
<td><img src="IO351" alt="Diagram" /></td>
</tr>
<tr>
<td>3</td>
<td>0 V</td>
<td>Connection to battery</td>
<td>Backup battery</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>+12 VDC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>DI1</td>
<td>Digital input</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>GND</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>DI2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>GND</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>DI3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All terminals (except mains terminals) must only be connected to voltages not exceeding 16 V<sub>rms</sub> and 22.6 V<sub>peak</sub> or 35 VDC.

- **Ethernet RJ45**
- External computing devices connected to the Ethernet connection must comply with the standards IEC 60950 and UL 60950.

- **GENIbus**
- Service connection

| 7     | 47       | +24 V | Supply to sensor. Short-circuit-protected 30 mA | ![Diagram](CU352) |
|       | 50       | +24 V | Supply to sensor. Short-circuit-protected 30 mA | |
|       | 51       | AI1   | Input for analog signal, 0-20/4-20 mA or 0-10 V | |
| 8     | 53       | +24 V | Supply to sensor. Short-circuit-protected 30 mA | |
|       | 54       | AI2   | Input for analog signal, 0-20/4-20 mA or 0-10 V | |
|       | 57       | AI3   | | |
|       | 58       | GND*  | | |

All terminals (except mains terminals) must only be connected to voltages not exceeding 16 V<sub>rms</sub> and 22.6 V<sub>peak</sub> or 35 VDC.
34. Maintenance

The CU 3X2 is maintenance-free during normal use and operation. It should be cleaned with a wet cloth.

35. Service

The CU 3X2 cannot be serviced. It must be replaced if faulty. See section 13. Replacing the CU 3X2.

36. Replacing the CU 3X2

1. Switch off the power supply to the CU 3X2.
2. Switch off the power supply to components with external supply.
3. Mark the individual conductors with the numbers of the corresponding terminals.
4. Disconnect all conductors.
5. Remove the CU 3X2 from the panel/cabinet.
6. Fit the new unit as described in section 5. Mechanical installation.
7. Connect all conductors according to markings.
8. Configure the new CU 3X2 by means of a PC Tool. See service instructions for the product in question.

36.1 Replacing the CIM module

See also section 29.3 Fitting the CIM module.

1. Switch off the power supply to the CU 3X2.
2. Switch off the power supply to components with external supply.
3. Mark the individual conductors with the numbers of the corresponding terminals.
4. Remove the screws that holds the CIM module.
5. Remove the CIM module from the CU 3X2.
6. Fit the new CIM module.
7. Connect the CIM module as described in the installation and operating instructions supplied with the CIM module.

37. Dimensions

![Fig. 17 Dimensional sketch](image)

38. 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.

* GND is isolated from other earth connections.
39. Suction diffuser- IOM

39.1 Installation
1. Install suction diffuser in piping with proper flow direction as indicated on diffuser.
2. Provide appropriate clearance in back of diffuser for removal of strainer (Fig. 2, Po no. 3).
3. Use support foot to adjust the height (Fig. 2, Po no. 7).
4. Flush system piping and operate pumps for initial circulation of system.
5. After initial system circulation is complete, remove and discard the temporary mesh screen (See Fig. 2, Po no. 6). Do not discard the permanent screen.

Installation

When using inertia base, the suction diffuser must also be footed on the base along with the pump.

39.2 Operation and Maintenance
Periodically (dependent on system conditions) open the suction diffuser and clean debris from strainer basket. Inspect strainer for holes. Replace if damaged.
be think innovate