

High-efficiency Circulator / Drinking Water Pump

Calio S / Calio-Therm S

Installation/Operating Manual



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Installation/Operating Manual Calio S / Calio-Therm S

Original operating manual

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Glossary

Discharge line

The pipeline which is connected to the discharge nozzle

Pump

Machine without drive, additional components or accessories

Pump set

Complete pump set consisting of pump, drive, additional components and accessories

Suction lift line/suction head line

The pipeline which is connected to the suction nozzle

1 General

1.1 Principles

This operating manual is valid for the type series and variants indicated on the front cover.

The manual describes the proper and safe use of this equipment in all phases of operation.

The name plate indicates the type series and size as well as the main operating data. They uniquely identify the pump (set) and serve as identification for all further business processes.

In the event of damage, immediately contact your nearest KSB Service centre to maintain the right to claim under warranty.

1.2 Target group

This operating manual is aimed at the target group of trained and qualified specialist technical personnel. (⇒ Section 2.4, Page 8) (⇒ Section 2.4, Page 8)

1.3 Symbols

Table 1: Symbols used in this manual

Symbol	Description
✓	Conditions which need to be fulfilled before proceeding with the step-by-step instructions
▷	Safety instructions
⇒	Result of an action
⇔	Cross-references
1. 2.	Step-by-step instructions
	Note Recommendations and important information on how to handle the product



2 Safety

All the information contained in this section refers to hazardous situations. In addition to the present general safety information the action-related safety information given in the other sections must be observed.

2.1 Key to safety symbols/markings

Table 2: Definition of safety symbols/markings

Symbol	Description
 DANGER	DANGER This signal word indicates a high-risk hazard which, if not avoided, will result in death or serious injury.
 WARNING	WARNING This signal word indicates a medium-risk hazard which, if not avoided, could result in death or serious injury.
 CAUTION	CAUTION This signal word indicates a hazard which, if not avoided, could result in damage to the machine and its functions.
	General hazard In conjunction with one of the signal words this symbol indicates a hazard which will or could result in death or serious injury.
	Electrical hazard In conjunction with one of the signal words this symbol indicates a hazard involving electrical voltage and identifies information about protection against electrical voltage.
	Machine damage In conjunction with the signal word CAUTION this symbol indicates a hazard for the machine and its functions.
	Warning: Strong magnetic field In conjunction with one of the signal words this symbol indicates a hazard involving magnetic fields and identifies information about protection against magnetic fields.

2.2 General

This operating manual contains general installation, operating and maintenance instructions that must be observed to ensure safe operation of the system and prevent personal injury and damage to property.

The safety information in all sections of this manual must be complied with.

The operating manual must be read and understood by the responsible specialist personnel/operators prior to installation and commissioning.

The contents of this operating manual must be available to the specialist personnel at the site at all times.

Information attached directly to the product must always be complied with and kept in a perfectly legible condition at all times. This applies to, for example:

- Flow direction arrow
- Markings for connections
- Name plate

The operator is responsible for ensuring compliance with all local regulations not taken into account in this operating manual.

2.3 Intended use

- The pump (set) must only be operated in the fields of application and within the use limits specified in the other applicable documents.
- Only operate pumps/pump sets which are in perfect technical condition.
- Do not operate the pump (set) in partially assembled condition.
- Only use the pump to handle the fluids described in the data sheet or product literature of the pump model or variant.
- Never operate the pump without the fluid to be handled.
- Observe the minimum flow rate and maximum flow rate indicated in the data sheet or product literature (e.g. to prevent overheating, cavitation damage, bearing damage).
- Do not throttle the flow rate on the suction side of the pump (to prevent cavitation damage).
- Consult the manufacturer about any use or mode of operation not described in the data sheet or product literature.

2.4 Personnel qualification and training

All personnel involved must be fully qualified to transport, install, operate, maintain and inspect the equipment this manual refers to.

The responsibilities, competence and supervision of all personnel involved in transport, installation, operation, maintenance and inspection must be clearly defined by the operator.

Deficits in knowledge must be rectified by means of training and instruction provided by sufficiently trained specialist personnel. If required, the operator can commission the manufacturer/supplier to train the personnel.

Training on the pump (set) must always be supervised by technical specialist personnel.

This device may be operated by **children** from the age of 8 as well as by persons of limited physical, sensory or mental abilities or lacking experience and knowledge, provided that they are supervised, they have been instructed on how to use this device safely and they understand the hazards it presents. It is impermissible for **children** to play with this device. **Children** must not clean the device or perform any **service work to be carried out by the operator** at the device without supervision.

2.5 Consequences and risks caused by non-compliance with this manual

- Non-compliance with these operating instructions will lead to forfeiture of warranty cover and of any and all rights to claims for damages.
- Non-compliance can, for example, have the following consequences:
 - Hazards to persons due to electrical, thermal, mechanical and chemical effects and explosions
 - Failure of important product functions
 - Failure of prescribed maintenance and servicing practices
 - Hazard to the environment due to leakage of hazardous substances

2.6 Safety awareness

In addition to the safety information contained in this manual and the intended use, the following safety regulations shall be complied with:

- Accident prevention, health regulations and safety regulations
- Explosion protection regulations
- Safety regulations for handling hazardous substances
- Applicable standards, directives and laws

2.7 Safety information for the user/operator

- Fit protective equipment (e.g. contact guards) supplied by the operator for hot, cold or moving parts, and check that the equipment functions properly.
- Do not remove any protective equipment (e.g. contact guards) during operation.
- Provide the personnel with protective equipment and make sure it is used.
- Contain leakages (e.g. at the shaft seal) of hazardous fluids handled (e.g. explosive, toxic, hot) so as to avoid any danger to persons and the environment. Adhere to all relevant laws.
- Eliminate all electrical hazards. (In this respect refer to the applicable national safety regulations and/or regulations issued by the local energy supply companies.)
- If shutting down the pump does not increase potential risk, fit an emergency-stop control device in the immediate vicinity of the pump (set) during pump set installation.

2.8 Safety information for maintenance, inspection and installation

- Modifications or alterations of the pump (set) are only permitted with the manufacturer's prior consent.
- Use only original spare parts or parts/components authorised by the manufacturer. The use of other parts/components can invalidate any liability of the manufacturer for resulting damage.
- The operator ensures that maintenance, inspection and installation is performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.
- Only carry out work on the pump (set) during standstill of the pump.
- Only perform work on the pump set when it has been disconnected from the power supply (de-energised).
- The pump (set) must have cooled down to ambient temperature.
- Pump pressure must have been released and the pump must have been drained.
- When taking the pump set out of service always adhere to the procedure described in the manual. (⇒ Section 6.4, Page 33)
- Decontaminate pumps which handle fluids posing a health hazard.
- As soon as the work has been completed, re-install and re-activate any safety-relevant devices and protective devices. Before returning the product to service, observe all instructions on commissioning. (⇒ Section 6.1, Page 24)

2.9 Unauthorised modes of operation

Never operate the pump (set) outside the limits stated in the data sheet and in this manual.

The warranty relating to the operating reliability and safety of the supplied pump (set) is only valid if the equipment is used in accordance with its intended use.

3 Transport/Temporary Storage/Disposal

3.1 Checking the condition upon delivery

1. On transfer of goods, check each packaging unit for damage.
2. In the event of in-transit damage, assess the exact damage, document it and notify KSB or the supplying dealer and the insurer about the damage in writing immediately.

3.2 Transport

	CAUTION
	<p>Improper pump transport Damage to the pump!</p> <ul style="list-style-type: none"> ▷ Never suspend the pump/pump set from the power cable. ▷ Prevent the pump (set) from getting knocked or dropped.

3.3 Storage/preservation

If commissioning is to take place some time after delivery, we recommend that the following measures be taken for pump (set) storage.

	CAUTION
	<p>Damage during storage due to humidity, dirt, or vermin Corrosion/contamination of the pump (set)!</p> <ul style="list-style-type: none"> ▷ For outdoor storage cover the packed or unpacked pump (set) and accessories with waterproof material.

	CAUTION
	<p>Wet, contaminated or damaged openings and connections Leakage or damage to the pump!</p> <ul style="list-style-type: none"> ▷ Clean and cover pump openings and connections as required prior to putting the pump into storage.

Store the pump (set) in a dry, protected room where the atmospheric humidity is as constant as possible.

If properly stored indoors, the equipment is protected for a maximum of 12 months.

For storing a pump (set) which has already been operated, observe the instructions in (⇒ Section 6.4.1, Page 33) .

3.4 Return to supplier

1. Drain the pump as per operating instructions. (⇒ Section 7.2, Page 35)
2. Flush and clean the pump, particularly if it has been used for handling noxious, explosive, hot or other hazardous fluids.
3. If the pump has handled fluids whose residues could lead to corrosion damage in the presence of atmospheric humidity or could ignite upon contact with oxygen also neutralise the pump and blow through with anhydrous inert gas to ensure drying.
4. Always complete and enclose a certificate of decontamination when returning the pump.
Indicate any safety measures and decontamination measures taken.

3.5 Disposal

	 WARNING
	<p>Fluids handled, consumables and supplies which are hot and/or pose a health hazard</p> <p>Hazard to persons and the environment!</p> <ul style="list-style-type: none">▷ Collect and properly dispose of flushing fluid and any fluid residues.▷ Wear safety clothing and a protective mask if required.▷ Observe all legal regulations on the disposal of fluids posing a health hazard.

1. Dismantle the pump (set).
Collect greases and other lubricants during dismantling.
2. Separate and sort the pump materials, e.g. by:
 - Metals
 - Plastics
 - Electronic waste
 - Greases and other lubricants
3. Dispose of materials in accordance with local regulations or in another controlled manner.

4 Description of the Pump (Set)

4.1 General description

Glandless, non-self-priming in-line pumps for handling clean fluids or fluids not chemically and mechanically aggressive to the pump materials.

The combination of a high-efficiency hydraulic system with high-efficiency motor technology, integrated differential pressure control and operating software enables an optimum adjustment of the pumps to changing operating conditions and minimises operating costs.



Fig. 1: Description of Calio S

1	Pump casing	2	Thermal insulation shell
3	Motor with control module	4	Plastic housing
5	Display	6	Control element "-", "+", "●" (pushbuttons)
7	Vent plug, deblocking	8	Plug-type connector for power cable

The motor with control module (3) is fastened to the pump casing (1) with four screws. The control module adjusts the differential pressure of the pump to a setpoint which can be set within the control range. The criteria for differential pressure control depend on the set operating mode. In all operating modes, the pump adapts to fluctuating demand (e.g. from control valves being activated).

Advantages of a pump-integrated control system are savings in energy and operating costs and a reduction in flow noises as unnecessarily high heads are reduced. In addition, the combination of an efficient hydraulic system with a high-efficiency electric motor makes sure that the input power is converted into hydraulic energy as efficiently as possible at all times.

4.2 Designation

Example: Calio S 25-40-130 BMS

Table 3: Designation key

Code	Description	
Calio S	Type series	
	Calio S	High-efficiency pump
	Calio-Therm S	High-efficiency pump for handling drinking water, casing made of stainless steel
25	Nominal diameter of pipe connection	
	15	R 1/2

Code	Description	
25	25	R 1
	30	R 1 1/4
40	Head in m x 10 (example: 40 = 4 m)	
130	Overall length	
	130	130 mm
	_1)	See dimensions
BMS	Building Management System	
	BMS	With BMS function
	_1)	Without BMS function

4.3 Name plate

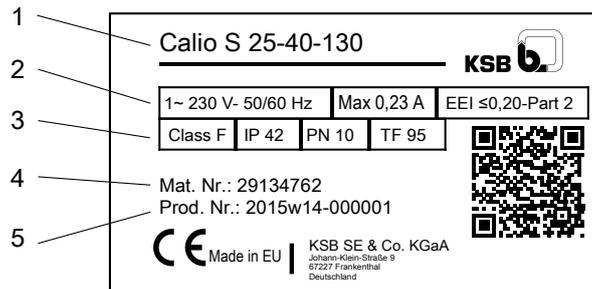


Fig. 2: Name plate (example)

1	Type series	2	Voltage, frequency, max. current input, energy efficiency index (EEI)
3	Thermal class, enclosure, pressure class, temperature class	4	Material number
5	Serial number		

Key to the serial number Example: 2015w14-000001

Table 4: Key to the serial number

Code	Description
2015	Year of production 2015
14	Week of production (calendar week) 14
000001	Consecutive number

4.4 Design details

Design

- Maintenance-free high-efficiency wet rotor pump (glandless)
- Screw-ended

Drive

- High-efficiency electric motor with continuously variable differential pressure control
- Electronically commutated synchronous motor with permanent magnet rotor
- 230 V, 50 Hz/60 Hz
- IP42 enclosure
- Thermal class F

1) Blank

- Temperature class TF 95
- Interference emissions EN 55014-1
- Interference immunity EN 55014-2

Bearings

- Product-lubricated special plain bearing

Operating modes

- Automatic mode with constant-pressure control or proportional-pressure control
- Open-loop control via setpoint setting

Automatic functions

- Continuous output adjustment depending on the mode of operation
- Soft start (limitation of starting current)
- Full motor protection with integrated trip electronics
- Setback operation

Manual functions

- Setting the operating mode
- Vent function
- Deblocking the rotor
- Setting the differential pressure setpoint
- Setting the speed level

Signalling and display functions

- Alternating display of flow rate and electrical input power
- Error codes indicated on the display

4.5 Configuration and function

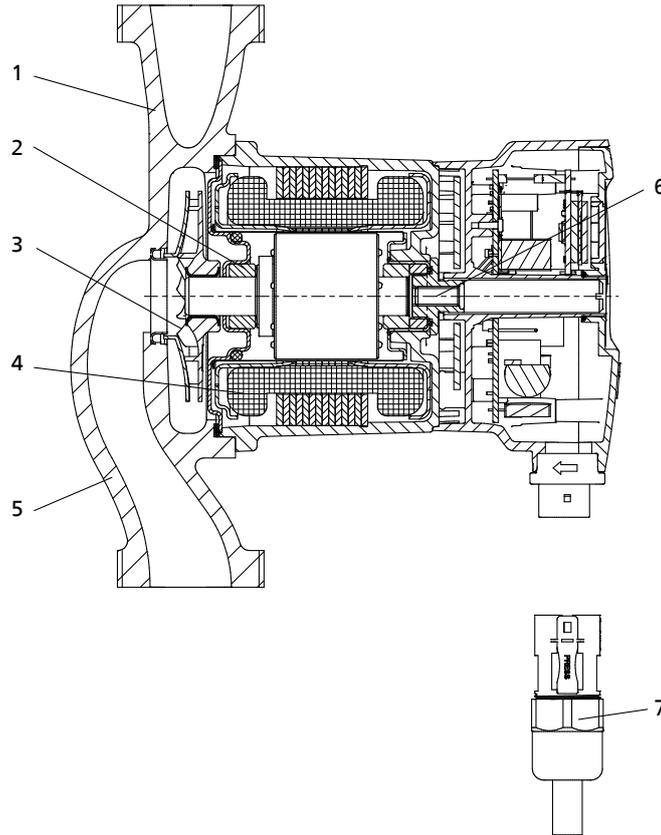


Fig. 3: Sectional drawing of the pump

1	Discharge nozzle	2	Radial plain bearing
3	Impeller	4	Motor
5	Suction nozzle	6	Motor shaft
7	Plug-type connector		

Design The pump is designed with a radial fluid inlet and a radial outlet arranged on the same axis. The impeller is rigidly connected to the motor shaft. The motor housing is equipped with a plug-type connector. Mechanical sealing is not required as the rotating assembly is completely isolated from the stator winding. The rotating assembly is lubricated and cooled by the fluid handled. The motor housing is made of aluminium. Most of the internal parts are made of stainless steel. The advanced lubricating system and high-quality ceramic bearings ensure smooth running and a long service life.

Function The fluid enters the pump via the suction nozzle (5) and is accelerated outward in a cylindrical flow by the rotating impeller (3), which is driven by the motor shaft (6). In the flow passage of the pump casing the kinetic energy of the fluid is converted into pressure energy. The fluid is pumped to the discharge nozzle (1), where it leaves the pump. The shaft runs in radial plain bearings (2), which are supported by the motor (4).

4.6 Noise characteristics

Table 5: Noise characteristics

Size	Sound pressure level
All	45 dB (A) max.

4.7 Scope of supply

Depending on the model, the following items are included in the scope of supply:

- Pump set
- Two-piece thermal insulation shell (for Calio S only)
- Sealing elements
- Installation/operating manual

4.8 Dimensions and weight

For dimensions and weights please refer to the type series booklet of the pump (set).

4.9 Accessories

No accessories available.

4.10 Technical data

Table 6: Technical data of Calio S / Calio-Therm S pumps

Characteristic	Value
Maximum flow rate	Depends on the pump type, see type series booklet
Maximum head	Depends on the pump type, see type series booklet
Speed	Depends on the pump type, see type series booklet
Mains voltage	1~ 230 VAC +/- 10 %
Frequency	50 Hz / 60 Hz
Nominal current	See name plate
Thermal class	F
Enclosure	IP42
Input power P1	See name plate
Nominal diameter	See name plate / type code in the type series booklet
Mating flanges	See name plate / type code in the type series booklet
Pump weight	Depends on the pump type, see type series booklet
Dimensions	Depends on the pump type, see type series booklet
Permissible ambient temperature	0 °C to +40 °C
Maximum relative humidity	≤ 95 %
Permissible fluid temperature	+2 °C to 95 °C
Maximum permissible operating pressure	PN 10 ²⁾
Sound pressure level	< 45 dB (A)
Minimum inlet pressure	< 75 °C: 0.05 bar; > 90 °C: 0.28 bar
Permissible fluids	<p>Calio S Heating water to VDI 2035 Water/glycol mixture, max. mixing ratio 1:1 ³⁾. If the glycol content equals or exceeds 20 %, check and verify the operating data (only use brand name products with corrosion inhibitors, observe the information provided by the producer as well as the safety data sheets). Fluids other than those above must only be used upon prior approval by the pump manufacturer. For ethylene/propylene glycols with corrosion inhibitors, commercial oxygen binders, anti-corrosives, fluids with several additives, and cooling brines see the following danger note.</p> <p>Calio-Therm S As above, plus drinking water.</p>

2) Standard design

3) If any glycol is contained in the fluid, the operating data of the pump must be adjusted to a higher viscosity, depending on the mixing ratio.

Characteristic	Value
EEl	See type series booklet. ⁴⁾
EMC (electromagnetic compatibility)	General EMC: EN 61000-3-2, 61000-3-3
Interference emissions	EN 55014-1
Interference immunity	EN 55014-2

Table 7: Technical data of the thermal insulation shells

Characteristic	Value
Material	EPP 40 g/l
Thermal conductivity value	0.038 W/mK
Water vapour diffusion resistance factor μ	< 37200
Permissible temperature range	110 °C max.

	 DANGER
	<p>Non-compliance with manufacturer's instructions Personal injury and damage to property!</p> <ul style="list-style-type: none"> ▷ Use permissible fluids only. ▷ Always observe the safety data sheets and manufacturer's instructions! ▷ Observe the manufacturer's instructions on mixing ratios. ▷ If any additives are to be mixed into the fluid, do so on the discharge side of the pump.

4) Reference value for the most efficient of circulators: $EEl \leq 0.20$

5 Installation at Site

5.1 Safety regulations

	<p style="background-color: #e67e22; color: white; padding: 5px;">⚠ DANGER</p> <p>Installation in potentially explosive atmospheres Explosion hazard!</p> <ul style="list-style-type: none"> ▷ Never install the pump in potentially explosive atmospheres. ▷ Observe the information given in the data sheet and on the name plates of the pump system.
	<p style="background-color: #e67e22; color: white; padding: 5px;">⚠ DANGER</p> <p>Calio S pumps used for drinking water or foodstuff applications Danger of poisoning!</p> <ul style="list-style-type: none"> ▷ The pump materials are not suitable for drinking water and foodstuff applications. Never use the pump for drinking water or foodstuff applications.

5.2 Checks to be carried out prior to installation

Before beginning with the installation check the following:

- The pump set can be operated on the power supply network according to the data on the name plate.
- The fluid to be handled matches the description of suitable fluids.

5.3 Installing the pump set

	<p style="background-color: #f1c40f; padding: 5px;">CAUTION</p> <p>Ingress of fluid into the motor Damage to the pump set!</p> <ul style="list-style-type: none"> ▷ Install the pump set with the pump shaft in a horizontal position. Connect the piping without transmitting any stresses and strains. ▷ Never install the pump set with the motor terminal box pointing downwards. ▷ Undo the hexagon socket head cap screws. Then turn the motor housing.
	<p style="background-color: #2980b9; color: white; padding: 5px;">NOTE</p> <p>We recommend installing shut-off valves upstream and downstream of the pump. Make sure that no leaking water can drip into the pump motor or terminal box.</p>
	<p style="background-color: #e67e22; color: white; padding: 5px;">⚠ DANGER</p> <p>Leakage at the pump Leakage of hot fluids!</p> <ul style="list-style-type: none"> ▷ Insert the O-ring in the correct position.
	<p style="background-color: #2980b9; color: white; padding: 5px;">NOTE</p> <p>The direction of flow of a vertically installed pump should be upwards.</p>

	<p style="background-color: #FFD700; margin: 0;">CAUTION</p> <p>Air entering the pump Damage to vertically installed pump sets whose direction of flow is downwards! ▷ Fit a vent valve at the highest point of the suction line.</p>
	<p style="background-color: #0070C0; color: white; margin: 0;">NOTE</p> <p>Do not install the pump at the lowest point of the system to prevent any impurities from collecting in the pump.</p>

The control unit can be turned through 360°. The position must be effected with the pump set removed from the system.

1. Undo and store the 4 hexagon socket head cap screws.
2. Rotate the drive unit until it has reached the required position. Compare it against the permissible installation positions. Adjust the position if required.
3. Fit and tighten the 4 hexagon socket head cap screws again.

Permissible installation positions

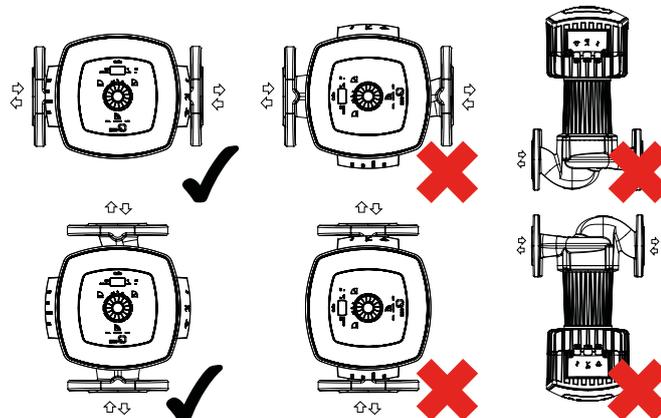


Fig. 4: Permissible installation positions

Screw-ended pumps

1. Position the pump set as indicated in an easily accessible place.
 ⇨ An arrow on the pump casing and thermal insulation shell indicates the direction of flow.
2. Accurately insert the sealing element.
3. Connect the pump and piping with a pipe union.
4. Tighten the pipe union hand-tight with an assembly tool (e.g. pipe wrench).
5. Accurately insert the sealing element in the opposite pipe union.
6. Tighten the pipe union hand-tight with an assembly tool (e.g. pipe wrench).

5.4 Connecting the piping

	<p style="background-color: #FFA500; margin: 0;">! WARNING</p> <p>Hot surface Risk of burns ▷ Never touch a pump set when it is in operation.</p>
---	---

	<p>⚠ WARNING</p>
	<p>Impermissible loads acting on the pump nozzles Risk of burns by hot fluids escaping!</p> <ul style="list-style-type: none"> ▷ Do not use the pump as an anchorage point for the piping. ▷ Anchor the pipes in close proximity to the pump and connect them without transmitting any stresses or strains. ▷ Take appropriate measures to compensate for thermal expansion of the piping.

	<p>CAUTION</p>
	<p>Contamination/dirt in the piping Damage to the pump!</p> <ul style="list-style-type: none"> ▷ Flush the piping prior to commissioning or replacing the pump. Remove any foreign matter.

	<p>NOTE</p>
	<p>Installing check and shut-off elements in the system is recommended, depending on the type of plant and pump. However, such elements must not obstruct proper drainage or hinder disassembly of the pump.</p>

- ✓ Suction lift lines have been laid with a rising slope, suction head lines with a downward slope towards the pump.
 - ✓ The nominal diameters of the pipelines are equal to or greater than the nominal diameters of the pump nozzles.
 - ✓ The pipelines have been anchored in close proximity to the pump and connected without transmitting any stresses or strains.
1. Thoroughly clean, flush and blow through all vessels, pipelines and connections (especially of new installations).

	<p>CAUTION</p>
	<p>Welding beads, scale and other impurities in the piping Damage to the pump!</p> <ul style="list-style-type: none"> ▷ Free the piping from any impurities.

5.5 Enclosure/insulation

	<p>⚠ WARNING</p>
	<p>The pump takes on same temperature as the fluid handled Risk of burns!</p> <ul style="list-style-type: none"> ▷ Insulate the volute casing. ▷ Fit protective equipment.

	<p>NOTE</p>
	<p>The pump set is supplied with a thermal insulation shell. (Calio S only)</p>

5.6 Electrical connection

	<p>⚠ DANGER</p>
	<p>Electrical connection work by unqualified personnel Danger of death from electric shock!</p> <ul style="list-style-type: none"> ▷ Always have the electrical connections installed by a trained and qualified electrician. ▷ Observe regulations IEC 60364.
	<p>⚠ DANGER</p>
	<p>Work performed on an energised terminal box Danger of death from electric shock!</p> <ul style="list-style-type: none"> ▷ Switch off the power supply at least 5 minutes prior to commencing work and ensure that it cannot be switched on again unintentionally.
	<p>⚠ DANGER</p>
	<p>Pump acting as a generator when running in reverse Danger to life from hazardous induction voltage at the motor terminals!</p> <ul style="list-style-type: none"> ▷ Prevent the fluid from flowing back by closing the shut-off elements.
	<p>⚠ DANGER</p>
	<p>Plastic housing opened Risk of fatal injury due to electric shock!</p> <ul style="list-style-type: none"> ▷ The plastic housing must not be opened.
	<p>⚠ WARNING</p>
	<p>Incorrect connection to the mains Damage to the mains network, short circuit!</p> <ul style="list-style-type: none"> ▷ Observe the technical specifications of the local energy supply companies.

The power cable needs to be wired to the supplied plug.



After the cable/plug assembly has been completed, connect the plug to the corresponding jack at the pump (IP42).

Table 8: Power cable

Cable	Cable type
Outside diameter of the cable	5.5 - 10.0 mm
Outside diameter of the core (including insulation)	2.95 mm max.
Cable cross-sections	0.75 mm ² - 1.5 mm ² massive or fine core cable

Connecting the cable at the pump

1. Verify the supply voltage at the site against the data on the name plate of the pump.
2. Switch off the pump's power supply. Secure it against unintentional start-up. Verify that the pump is de-energised.
3. Strip the power cable as shown in the diagram.
At the cable to be inserted into the plug, strip about 24 mm of the sheath. Then strip at least 12 mm of the insulation at each strand (see illustration).

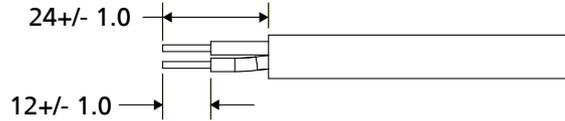


Fig. 5: Stripping the cable

4. Remove the supplied plug-type connector from its packaging. Undo and remove the screwed-on cable gland. Feed the stripped cable through the cable gland.

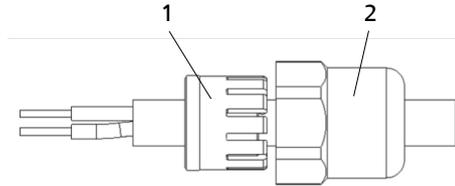


Fig. 6: Plug-type connection

1	Strain relief device
2	Cable gland

NOTE

When fitting the power cable to the plug-type connection make sure to insert the strain relief device into the cable gland in the correct position. Only in its correct installation position can the strain relief device function correctly in combination with the cable gland.
Otherwise the strain relief device will be pressed onto the blue locking/unlocking mechanism of the plug, which causes it to open and release the cores.

5. Insert the stripped cores/strands of the cable into the corresponding terminals L, N and Earth (PE) of the plug. The markings are also shown on the blue removal mechanism (ring). The automatic locking mechanism locks the strand in place, establishes contact and prevents the strand from sliding out of the plug.
A marking underneath the PE terminal helps identify the correct connection.
After the cable has been wired to the plug, screw the cable entry onto the plug and tighten it.



Fig. 7: Plug-type connection with marking

1	PE marking
---	------------

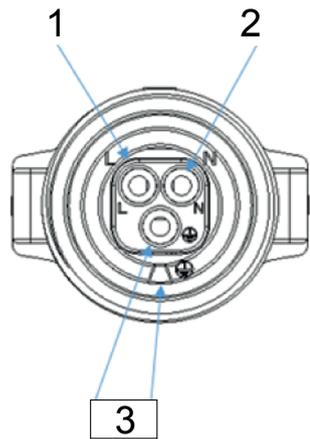


Fig. 8: Connections at the plug

1	Phase (230 VAC)	2	Neutral (N)
3	Earth (embossed marking on the ring) (PE)		

6. After the cable/plug assembly has been completed, connect the plug to the jack at the pump.
7. The cores/strands can be removed from the plug by pressing down the blue ring.

6 Commissioning/Start-up/Shutdown

6.1 Commissioning/Start-up

6.1.1 Prerequisites for commissioning/start-up

Before commissioning/starting up the pump set, make sure that the following conditions are met:

- The pump set has been properly connected to the power supply and is equipped with all protection devices.
- The pump has been primed with the fluid to be handled. The pump has been vented.

6.1.2 Priming and venting the pump

	CAUTION
	<p>Increased wear due to dry running Damage to the pump set!</p> <ul style="list-style-type: none"> ▷ Never operate the pump set without liquid fill. ▷ Never close the shut-off element in the suction line and/or supply line during pump operation.

1. Vent the pump and suction line and prime both with the fluid to be handled.
2. Fully open the shut-off element in the suction line.
3. During operation (at top speed) loosen the screw plug until some air escapes.

	! DANGER
	<p>Hot fluid handled spurting out in the vent plug area Risk of burns!</p> <ul style="list-style-type: none"> ▷ Wear protective clothing.

4. Close the screw plug again.
5. Repeat this procedure several times until all air has escaped.

6.1.3 Start-up

	! DANGER
	<p>Non-compliance with the permissible pressure and temperature limits if the pump is operated with the suction and discharge lines closed. Hot fluids escaping!</p> <ul style="list-style-type: none"> ▷ Never operate the pump with the shut-off elements in the suction line and/or discharge line closed. ▷ Only start up the pump set against a slightly or completely open discharge-side shut-off element.

	! DANGER
	<p>Excessive temperatures due to dry-running Risk of injury! Damage to the pump set!</p> <ul style="list-style-type: none"> ▷ Never operate the pump set without a liquid fill. ▷ Prime the pump as per operating instructions. ▷ Always operate the pump within the permissible operating range.

	CAUTION
	<p>Abnormal noises, vibrations, temperatures or leakage Damage to the pump!</p> <ul style="list-style-type: none"> ▷ Switch off the pump (set) immediately. ▷ Eliminate the causes before returning the pump set to service.

- ✓ The system piping has been cleaned.
- ✓ Pump, suction line and inlet tank, if any, have been vented and primed with the fluid to be pumped.
- ✓ The lines for priming and venting have been closed.
 1. Fully open the shut-off element in the suction head/suction lift line.
 2. Close or slightly open the shut-off element in the discharge line.
 3. Start up the motor.

	CAUTION
	<p>Excessive starting frequency Damage to the pump!</p> <ul style="list-style-type: none"> ▷ The pump can be started up 33 times per day (24 hours) as a maximum.

6.1.4 Operation

Control elements (pushbuttons)

All settings can be made by using the three control elements.

Table 9: Control elements (pushbuttons)

Control element	Function
	Reduce the setpoint/setting (-)
	Increase the setpoint/setting (+)
	Change the operating mode, turn on display backlighting, save the setpoint

Display

Numerical display (1 digit before and 1 after the decimal point) of the (measured) electrical input power in [W] and the flow rate in [m³/h] on the integrated display panel. For the input of the discharge head setpoint, the setpoint is displayed in the unit [m].



Fig. 9: Display panel of the pump

Example:

Display of the (measured) electrical input power in **Proportional-pressure control** operating mode.

The input power will be displayed for 5 seconds.



Fig. 10: Display in Proportional-pressure Control operating mode

Symbols

The operating modes, functions and settings are indicated by symbols on the front panel. Lit symbols indicate that the corresponding operating mode or function is active.

Table 10: Key to the pump symbols

Symbol	Description	Unit
W	Electrical input power (measured) This symbol is lit when the input power value is shown on the display.	W
m	Selected setpoint in [m] in Constant-pressure or Proportional-pressure control operating mode	m
m ³ /h	Flow rate. This symbol is lit when the flow rate value is shown on the display.	m ³ /h
0.0	Two-digit display with one decimal point showing the value of the setpoint or the measured input power in the range from 0.0 to 9.9	-
E	Constant-pressure Control operating mode This symbol is lit when this operating mode is active.	-
↙	Proportional-pressure Control operating mode This symbol is lit when this operating mode is active.	-
▴	Open-loop Control operating mode This symbol is lit when this operating mode is active.	-
☾	Setback Operation operating mode	-
E8	The pump signals a fault (here: error code E8) An error code is shown on the display. The display indicates error codes E1 - E9.	-

6.1.5 Mode of operation

6.1.5.1 Information on settings

For common applications such as two-pipe systems and underfloor heating systems Proportional-pressure Control ($\Delta p-v$) is the recommended operating mode. This operating mode offers an extended control range with additional potential savings compared with Constant-pressure Control ($\Delta p-c$). Depending on the balancing of branch circuits, undersupply may occur at a consumer installation. The Constant-pressure Control ($\Delta p-c$) operating mode can be selected as an option. If noises are audible at low flow rates the Proportional-pressure Control ($\Delta p-v$) operating mode can be selected. The setting of the discharge head setpoint depends on the piping curve of the system and on the heat requirements. As standard the pumps are set to Proportional-pressure Control ($\Delta p-v$) and maximum performance.

6.1.5.2 Constant-pressure control

Function

In Constant-pressure Control the set head ② is maintained irrespective of the flow rate. The set differential pressure setpoint H_s is constant, situated between the maximum curve ① and the permissible flow rate range.

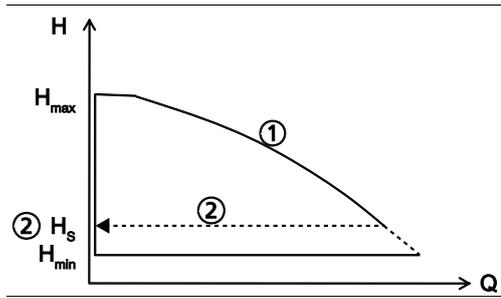


Fig. 11: Constant-pressure Control function

Setting
Table 11: Selecting Constant-pressure Control and the setpoint

Display	Step/option
	Step 1: Activating the setting mode <ul style="list-style-type: none"> Press and hold the control element (●) for 3 seconds. <ul style="list-style-type: none"> This will activate the display backlighting. The flashing operating mode symbol indicates the active operating mode.
	Step 2: Selecting the Constant-pressure Control operating mode <ul style="list-style-type: none"> Press the control element (●) repeatedly until the symbol for Constant-pressure Control flashes. <ul style="list-style-type: none"> Press and hold the control element (●) for a minimum of 0.5 seconds.
	Step 3: The Constant-pressure Control operating mode has been selected. <ul style="list-style-type: none"> Press (+) or (-) to increase or decrease the corresponding setpoint.
	Step 4: Confirming the current setpoint <ul style="list-style-type: none"> Press and hold the control element (●) for a minimum of 3 seconds. <ul style="list-style-type: none"> The value to be saved flashes several times and will then be stored in permanent memory.


NOTE

If 10 seconds pass without any settings being made or saved, the control unit will revert to the previous settings.

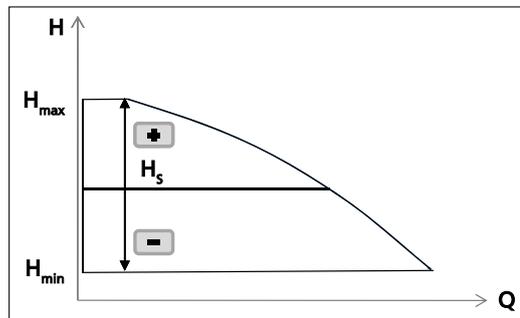


Fig. 12: Constant-pressure Control settings

6.1.5.3 Proportional-pressure control

Function

Within the permissible flow rate range the Proportional-pressure Control decreases or increases the differential pressure setpoint between $\frac{1}{2} H_s$ and H_s (factory-set) in a linear fashion with the flow rate.

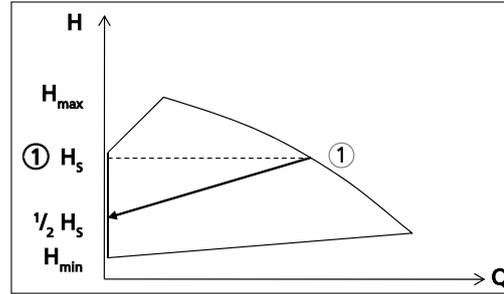


Fig. 13: Proportional-pressure Control function

Setting

Table 12: Selecting Proportional-pressure Control and the setpoint

Display	Step/option
	Step 1: Activating the setting mode <ul style="list-style-type: none"> Press and hold the control element (●) for 3 seconds. <ul style="list-style-type: none"> This will activate the display backlighting. The flashing operating mode symbol indicates the active operating mode.
	Step 2: Selecting the Proportional-pressure Control operating mode <ul style="list-style-type: none"> Press the control element (●) repeatedly until the symbol for Proportional-pressure Control flashes. <ul style="list-style-type: none"> Press and hold the control element (●) for a minimum of 0.5 seconds.
	Step 3: The Proportional-pressure Control operating mode has been selected. <ul style="list-style-type: none"> Press (+) or (-) to increase or decrease the corresponding setpoint.
	Step 4: Confirming the current setpoint <ul style="list-style-type: none"> Press and hold the control element (●) for a minimum of 3 seconds. <ul style="list-style-type: none"> The value to be saved flashes several times and will then be stored in permanent memory.



NOTE

If 10 seconds pass without any settings being made or saved, the control unit will revert to the previous settings.

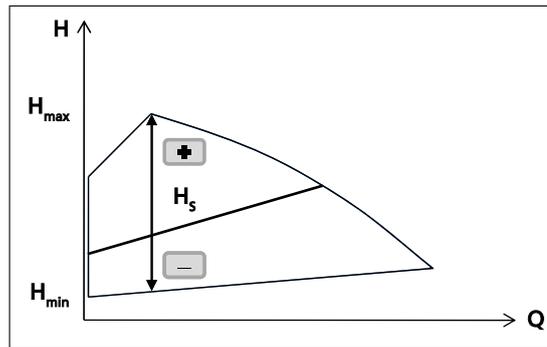


Fig. 14: Proportional-pressure Control settings

6.1.5.4 Open-loop control

Function

In Open-loop Control operating mode the pump runs at a set speed level. Up to three speed different levels are available for selection.

Setting

Table 13: Selecting Open-loop Control and the setpoint

Display	Step/option
	Step 1: Activating the setting mode <ul style="list-style-type: none"> Press and hold the control element (●) for 3 seconds. <ul style="list-style-type: none"> This will activate the display backlighting. The flashing operating mode symbol indicates the active operating mode.
	Step 2: Selecting the Open-loop Control operating mode <ul style="list-style-type: none"> Press the control element (●) repeatedly until the symbol for Open-loop Control flashes. <ul style="list-style-type: none"> Press and hold the control element (●) for a minimum of 0.5 seconds.
	Step 3: The Open-loop Control operating mode has been selected. <ul style="list-style-type: none"> Press (+) or (-) to increase or decrease the corresponding speed level to level 1, 2 or 3.
	Step 4: Confirming the current speed level <ul style="list-style-type: none"> Press and hold the control element (●) for a minimum of 3 seconds. <ul style="list-style-type: none"> The value to be saved flashes several times and will then be stored in permanent memory.



NOTE

If 10 seconds pass without any settings being made or saved, the control unit will revert to the previous settings.

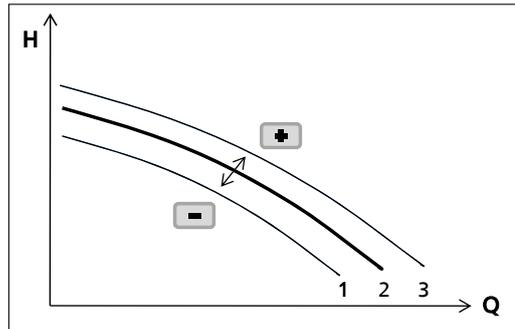


Fig. 15: Open-loop Control settings

6.1.5.5 Setback operation

Function

When the fluid temperature has been sinking continuously for a short period of time the pump recognises minimum heating requirements and automatically switches to operation at minimum speed. When heating requirements increase again, the pump automatically switches back to control mode. If the pump detects a continuous decrease in the supply temperature over a period of 12 minutes and the Setback Operation function is enabled, the pump will switch to the Setback Operation operating mode. No specific temperature limit has been defined.



NOTE

For applications with small differences between supply and return temperature disabling the Setback Operation is recommended (e.g. for underfloor heating systems combined with condensing boilers or heat pumps).

Prerequisites:

1. The pump is installed in the supply line.
2. The Setback Operation function must be enabled in the higher-level control system (this will reduce the supply temperature).

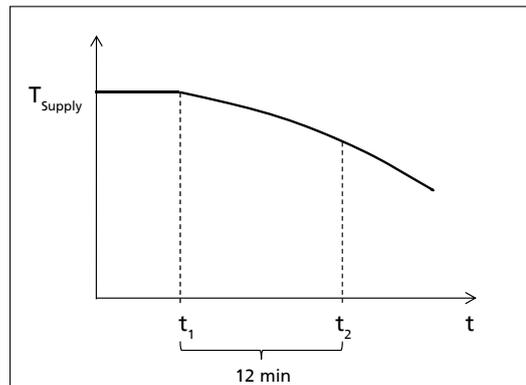


Fig. 16: Setback operation

Setting

Table 14: Setting the operating mode to Setback Operation

Display	Step/option
	Press and hold the control element (●) for 3 seconds. This will activate the display backlighting.
	The flashing operating mode symbol indicates the active operating mode (Constant-pressure Control, Proportional-pressure Control, Open-loop Control).

Display	Step/option
	Press the control element (●) repeatedly for at least 0.5 seconds at a time until the operating mode symbol for Setback Operation (crescent) flashes. 0 = Setback Operation disabled 1 = Setback Operation enabled
	To enable (display "1") or disable (display "0") the Setback Operation function press the control elements (+) or (-).
	To save the setting press the control element (●) for 3 seconds as a minimum. The value to be saved flashes several times and will then be stored in permanent memory. Note: If 10 seconds pass without any control element being pressed, the "editing" mode will end. The pump will change to display mode, showing the input power / flow rate.

6.1.5.6 Functions

6.1.5.6.1 Saving data

The operating data of the pump are saved. Data storage will be maintained also when the pump is stopped or de-energised. Once the pump is switched on again it will be operated with the data and duty point that were active before the pump was last stopped.

6.1.5.6.2 Protective functions

Function

The electronic motor protection automatically reduces the pump power in the event of overloading.

Available protective functions:

- Protection against overheating
- Voltage monitoring
- Locked rotor

Settings

None

6.1.5.6.3 Fault messages

Function

The pump indicates errors by showing an error code on the display. The error codes is composed of an "E" followed by the numbers 0-9. In the following example error E8 has occurred at the pump. The display flashes in 0.5-second intervals.



Fig. 17: Display of error code E8 (motor fault)

If an error has occurred, the pump settings cannot be modified. Once the error has been cleared, the display will revert to the set operating mode.

Table 15: Error codes

Error code	Cause	Description	Remedy
E1	Overvoltage	The voltage supplied by the mains is too high.	Check the mains voltage.
E2	Undervoltage	The voltage supplied by the mains is too low.	Check the mains voltage.
E3	Blockage	The rotor is blocked.	Remove the vent plug and manually deblock the shaft. If the pump stops and error E3 is displayed, the pump can be started up again by manually rotating the rotor (with the vent plug removed). (Rotor blockage - see action B in the table Trouble-shooting). Caution: The pump must be de-energised first. If this is unsuccessful, the cause may be a different one and the pump should be replaced.
E6	Winding fault	Winding defective	Replace the pump.
E7	Short circuit	Short circuit in the motor	Replace the pump.
E8	Motor out of step	Motor fault	Disconnect the pump from the 230 VAC power supply. Then re-connect it immediately. Check if the rotor is blocked. Exclude forced flow through the pump.
E9	Excessive temperature of the printed circuit board	Printed circuit board not cooled sufficiently	Check the operating conditions.

6.2 Shutdown

- ✓ The shut-off element in the suction line is and remains open.
 1. Close the shut-off element in the discharge line.
 2. Switch off the motor and make sure the pump set runs down smoothly to a standstill.

	NOTE
	If the discharge line is equipped with a non-return or check valve, the shut-off element may remain open provided that the system conditions and system regulations are considered and observed.

For prolonged shutdown periods:

1. Close the shut-off element in the suction line.

	CAUTION
	<p>Risk of freezing during prolonged pump shutdown periods Damage to the pump!</p> <ul style="list-style-type: none"> ▷ Drain the pump and the cooling/heating chambers (if any) or otherwise protect them against freezing.

6.3 Operating limits

	DANGER
	<p>Non-compliance with operating limits for pressure, temperature, fluid handled and speed Hot fluids escaping!</p> <ul style="list-style-type: none"> ▷ Comply with the operating data indicated in the data sheet. ▷ Avoid prolonged operation against a closed shut-off element. ▷ Never operate the pump at product temperatures exceeding those specified in the data sheet or on the name plate.

6.3.1 Ambient temperature

	CAUTION
	<p>Operation outside the permissible ambient temperature Damage to the pump (set)!</p> <ul style="list-style-type: none"> ▷ Observe the specified limits for permissible ambient temperatures.

Observe the following parameters and values during operation:

Table 16: Fluid temperature specified for the ambient temperature [°C]

	Fluid temperature	Ambient temperature
Calio S	95	40
Calio S BMS	110	40
Calio-Therm S	95	40

6.3.2 Density of the fluid handled

The power input of the pump changes depending on the viscosity of the fluid handled.

	CAUTION
	<p>Impermissibly high density of the fluid handled Motor overload!</p> <ul style="list-style-type: none"> ▷ Observe the information on fluid density in the data sheet.

6.4 Shutdown/storage/preservation

6.4.1 Measures to be taken for shutdown

The pump (set) remains installed

- ✓ Sufficient fluid is supplied for the operation check run of the pump.
- 1. For prolonged shutdown periods, start up the pump (set) regularly between once a month and once every three months for approximately five minutes.
 - ⇒ This will prevent the formation of deposits within the pump and the pump intake area.

The pump (set) is removed from the pipe and stored

- ✓ The pump has been drained properly (⇒ Section 7.2, Page 35) and the safety instructions for dismantling the pump have been observed. (⇒ Section 7.3, Page 35)
- 1. Observe any additional instructions and information provided. (⇒ Section 3, Page 10)

6.5 Returning to service

	 WARNING
	<p>Failure to re-install or re-activate protective devices Risk of injuries by escaping fluid!</p> <ul style="list-style-type: none">▷ As soon as the work is completed, re-install and/or re-activate any safety-relevant and protective devices.

- ✓ The safety-relevant devices and protective devices have been properly re-installed and re-activated.
1. For returning the equipment to service, observe the sections on commissioning/start-up (⇒ Section 6.1, Page 24) and the operating limits .
 2. In addition, carry out all servicing/maintenance operations before returning the pump (set) to service (⇒ Section 7, Page 35) .

7 Servicing/Maintenance

7.1 Maintenance/inspection

The circulators are almost maintenance-free.

If the pump has not been in operation for a prolonged period of time or if the system is severely contaminated, the rotor can become blocked.

To unlock the rotor undo the screw plug, insert a screwdriver (4 mm) into the shaft end, and use the screwdriver to rotate the rotor.

	NOTE
	<p>Any repairs on the pump must only be performed by one of our authorised service partners. In the event of a failure, please contact your heating system engineer.</p>

7.2 Drainage/cleaning

	⚠ WARNING
	<p>Fluids handled, consumables and supplies which are hot and/or pose a health hazard Hazard to persons and the environment!</p> <ul style="list-style-type: none"> ▷ Collect and properly dispose of flushing fluid and any fluid residues. ▷ Wear safety clothing and a protective mask if required. ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.

1. Always flush and clean the pump before transporting it to the workshop.
Provide a certificate of decontamination for the pump.

7.3 Removing the pump set from the piping

	⚠ DANGER
	<p>Work performed on an energised terminal box Danger of death from electric shock!</p> <ul style="list-style-type: none"> ▷ Switch off the power supply at least 5 minutes prior to commencing work and ensure that it cannot be switched on again unintentionally.

 	⚠ DANGER
	<p>Strong magnetic field in the rotor area Danger of death for persons with pacemaker! Interference with magnetic data carriers, electronic devices, components and instruments! Uncontrolled magnetic attraction forces between magnet-equipped components, tools or similar!</p> <ul style="list-style-type: none"> ▷ Keep a safety distance of at least 0.3 m.

	⚠ DANGER
	<p>Pump acting as a generator when running in reverse Danger to life from hazardous induction voltage at the motor terminals!</p> <ul style="list-style-type: none"> ▷ Prevent the fluid from flowing back by closing the shut-off elements.

	<p>⚠ WARNING</p> <p>Strong magnetic field Danger of crushing injuries when pulling out the rotor! Strong magnetic field can suddenly pull the rotor back into its original position! Danger of magnetic parts near the rotor being attracted!</p> <ul style="list-style-type: none"> ▷ The rotor must only be removed from the motor housing by authorised specialist personnel. ▷ Remove any magnetic parts from the vicinity of the rotor. ▷ Keep the assembly area clean. ▷ Keep a safety distance of at least 0.3 m from electronic components.
	<p>⚠ WARNING</p> <p>Hot surface Risk of injury!</p> <ul style="list-style-type: none"> ▷ Allow the pump set to cool down to ambient temperature.
	<p>CAUTION</p> <p>Strong magnetic field in the rotor area Interference with magnetic data carriers, electronic devices, components and instruments! Uncontrolled magnetic attraction forces between magnetic components, tools or similar!</p> <ul style="list-style-type: none"> ▷ Remove any magnetic parts from the vicinity of the rotor. ▷ Keep the assembly area clean.
	<p>CAUTION</p> <p>Danger by strong magnetic field Negative impact on or damage to electrical devices!</p> <ul style="list-style-type: none"> ▷ The rotor must generally only be removed from the motor housing by authorised specialist personnel.

- ✓ The pump set has been de-energised and secured against unintentional start-up.
 - ✓ The pump has cooled down to ambient temperature.
 - ✓ A container for collecting the fluid has been positioned underneath the pump set.
1. Close the shut-off elements.
 2. Disconnect the discharge nozzle and suction nozzle from the piping.
 3. Depending on the pump size / motor size, remove the supports from the pump set.
 4. Remove the complete pump set from the piping.

8 Trouble-shooting

	 WARNING
	<p>Improper work to remedy faults Risk of injury!</p> <p>▷ For any work performed to remedy faults, observe the relevant information given in this operating manual and/or in the product literature provided by the accessories manufacturer.</p>

If problems occur that are not described in the following table, consultation with the KSB customer service is required.

- A Pump is running, but does not deliver
- B Pump does not start up or pump running irregularly
- C Pump running but not delivering water
- D Noises during pump operation

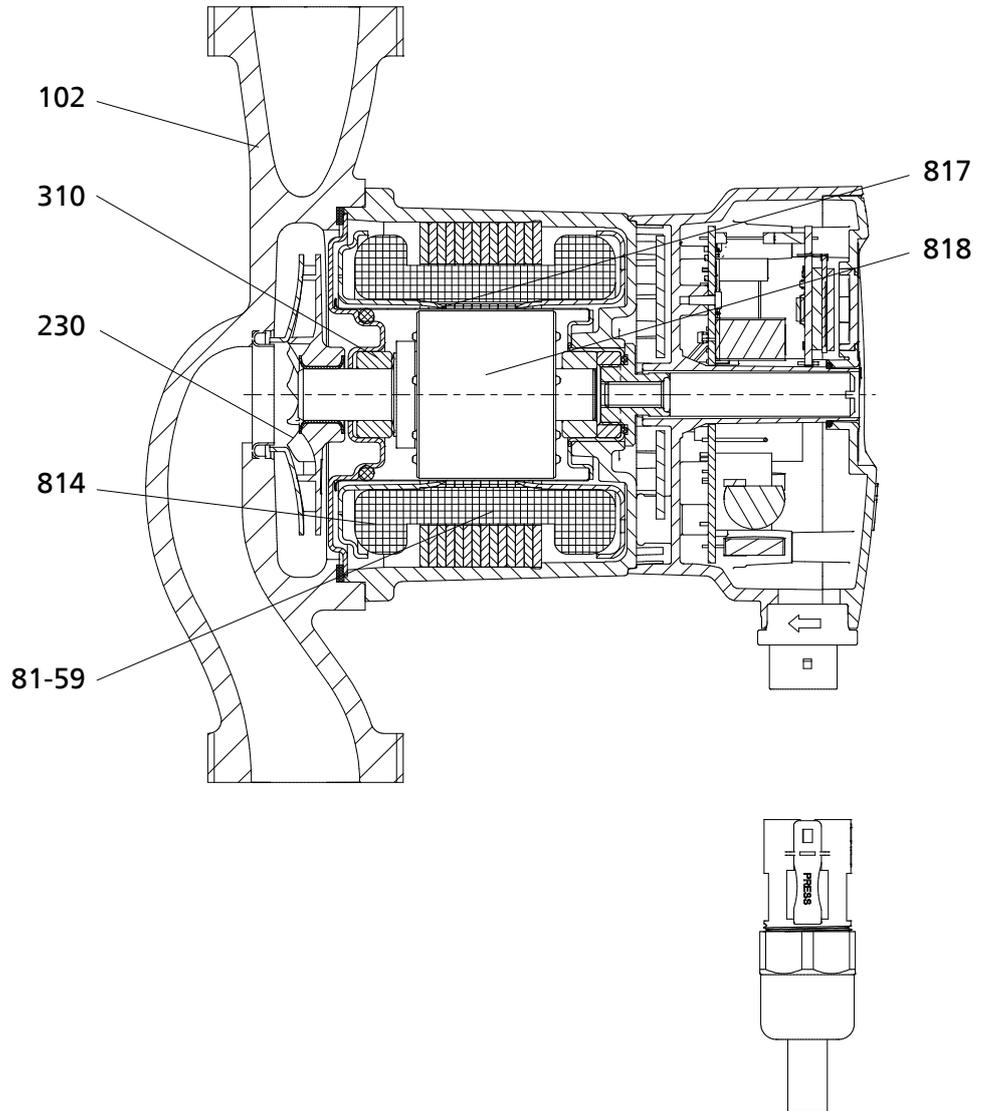
Table 17: Trouble-shooting

Error value	Possible cause	Remedy ⁵⁾
A	<ul style="list-style-type: none"> ▪ See error codes (⇒ Section 6.1.5.6.3, Page 31) 	<ul style="list-style-type: none"> ▪ Reset the control system. Check the power supply and fuses.
B	<ul style="list-style-type: none"> ▪ Impurities in the pump 	<ul style="list-style-type: none"> ▪ (⇒ Section 7.1, Page 35)
B	<ul style="list-style-type: none"> ▪ Blockage in the pump 	<ul style="list-style-type: none"> ▪ Unblock. Gently rotate the rotor with a screwdriver (4 mm)
C	<ul style="list-style-type: none"> ▪ Air in the system ▪ Shut-off valves closed 	<ul style="list-style-type: none"> ▪ Vent the system and the pump. ▪ Open the shut-off elements.
D	<ul style="list-style-type: none"> ▪ Power too high ▪ System pressure too low ▪ Air in the system 	<ul style="list-style-type: none"> ▪ Reduce the differential pressure setpoint. ▪ Increase the system pressure by filling more water into the boiler. ▪ Vent the system and the pump.

5) Pump pressure must be released before attempting to remedy faults on parts which are subjected to pressure.

9 Related Documents

9.1 Sectional drawing with list of components



Part No.	Description	Part No.	Description
102	Volute casing	230	Impeller
310	Plain bearing	81-59	Stator
814	Copper winding	817	Can
818	Rotor		

10 EU Declaration of Conformity

Manufacturer: **KSB SE & Co. KGaA**
Johann-Klein-Straße 9
67227 Frankenthal (Germany)

The manufacturer herewith declares that the product:

Calio S, Calio-Therm S

Serial number range: 2018w01 to 2019w52

- is in conformity with the provisions of the following Directives as amended from time to time:
 - Pump set: Low-voltage Directive 2014/35/EU
 - Electromagnetic Compatibility Directive 2014/30/EU
 - Pump set: Ecodesign Directive 2009/125/EC, Regulations No. 641/2009 and 622/2012

The manufacturer also declares that

- the following harmonised international standards have been applied:
 - EN 60335-1, EN 60335-2-51,
 - EN 55014-1, EN 55014-2,
 - EN 61000-3-2, EN 61000-3-3,
 - EN 16297-1, EN 16297-2

The EU Declaration of Conformity was issued in/on:

Frankenthal, 1 February 2018



Joachim Schullerer
Head of Product Development Pump Systems and Drives
KSB SE & Co. KGaA
Johann-Klein-Straße 9
67227 Frankenthal

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