

High-efficiency Heating Circulator

Calio S BMS

Installation/Operating Manual



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Installation/Operating Manual Calio S BMS

Original operating manual

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Contents

	Glossary	5
1	General.....	6
1.1	Principles	6
1.2	Target group.....	6
1.3	Other applicable documents.....	6
1.4	Symbols	6
1.5	Key to safety symbols/markings.....	7
2	Safety	8
2.1	General.....	8
2.2	Intended use	8
2.2.1	Prevention of foreseeable misuse	8
2.3	Personnel qualification and training.....	9
2.4	Consequences and risks caused by non-compliance with this manual	9
2.5	Safety awareness	9
2.6	Safety information for the operator/user	9
2.7	Safety information for maintenance, inspection and installation	10
2.8	Unauthorised modes of operation	10
3	Transport/Storage/Disposal	11
3.1	Checking the condition upon delivery	11
3.2	Transport.....	11
3.3	Storage/preservation	11
3.4	Return to supplier.....	12
3.5	Disposal	12
4	Description.....	13
4.1	General description	13
4.2	Product information as per Regulation No. 1907/2006 (REACH).....	13
4.3	Designation.....	13
4.4	Name plate.....	14
4.5	Design details.....	15
4.6	Configuration and function.....	16
4.7	Noise characteristics	17
4.8	Scope of supply.....	17
4.9	Dimensions and weight.....	17
4.10	Accessories	17
5	Installation at Site	18
5.1	Safety regulations.....	18
5.2	Checks to be carried out prior to installation.....	18
5.3	Installing the pump set	19
5.4	Connecting the piping	20
5.5	Fitting the enclosure/insulation.....	21
5.6	Electrical connection	22
5.6.1	Connecting the electric cable.....	23
6	Commissioning/Start-up/Shutdown.....	27
6.1	Commissioning/Start-up	27
6.1.1	Prerequisites for commissioning/start-up	27
6.1.2	Priming and venting the pump.....	27
6.1.3	Start-up.....	28
6.2	Operating limits.....	29
6.2.1	Frequency of starts.....	29
6.2.2	Ambient temperature.....	29
6.2.3	Minimum inlet pressure.....	29

6.2.4	Maximum operating pressure	30
6.2.5	Fluid handled	30
6.3	Shutdown/storage/preservation	31
6.3.1	Shutdown	31
6.3.2	Measures to be taken for shutdown.....	31
6.4	Returning to service	32
7	Operation.....	33
7.1	Control panel	33
7.1.1	Locking the control panel	34
7.1.2	Display	34
7.2	Operating modes.....	35
7.2.1	Information on settings.....	35
7.2.2	Constant-pressure control	35
7.2.3	Proportional-pressure control	37
7.2.4	Eco Mode	39
7.2.5	Open-loop control	41
7.3	Functions.....	43
7.3.1	Remote ON/OFF (digital input).....	43
7.3.2	External analog 0 - 10 V DC signal	44
7.3.3	Setback operation	46
7.3.4	Deblocking the impeller	47
7.3.5	Saving data	47
7.3.6	General fault messages.....	47
7.4	Resetting the factory setting	47
8	Servicing/Maintenance	48
8.1	Servicing/inspection.....	48
8.2	Drainage/cleaning	48
8.3	Removing the pump set from the piping	48
9	Trouble-shooting.....	50
10	Related Documents	52
10.1	Sectional drawing with list of components	52
10.2	Wiring diagram.....	52
11	UK Declaration of Conformity.....	53
	Index	54

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

Setback operation

Setback Operation avoids running the pump set at an unchanged control curve during the night. It lowers the mass flow rate, noise level and power consumption.

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 operating 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 facility 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 2.3, Page 9)

1.3 Other applicable documents


Table 1: Overview of other applicable documents

Document	Contents
Data sheet	Description of the technical data of the pump (set)

For accessories and/or integrated machinery components, observe the relevant manufacturer's product literature.










1.4 Symbols

Table 2: 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

1.5 Key to safety symbols/markings

Table 3: Definition of safety symbols/markings

Symbol	Description
	DANGER This signal word indicates a high-risk hazard which, if not avoided, will result in death or serious injury.
	WARNING This signal word indicates a medium-risk hazard which, if not avoided, could result in death or serious injury.
	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.
	Warning for persons with pacemaker In conjunction with one of the signal words this symbol indicates a hazard involving magnetic fields and identifies special information for persons with a pacemaker.
	Warning about hot surfaces In conjunction with one of the signal words this symbol indicates a hazard involving hot surfaces.



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 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.
- Comply with all the safety instructions given in the individual sections of this operating manual.
- 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 and markings 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.

2.2 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.

2.2.1 Prevention of foreseeable misuse

- Observe all safety information and instructions in this manual.
- Never exceed the permissible application and operating limits specified in the data sheet or product literature regarding pressure, temperature, etc.

2.3 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.

2.4 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

2.5 Safety awareness

In addition to the safety information contained in this operating 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

2.6 Safety information for the operator/user

- 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.
- 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 stopping 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.

2.7 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 are 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 6.3, Page 31) (⇒ Section 6.3.2, Page 31)
- 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 27)

2.8 Unauthorised modes of operation

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


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

3 Transport/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

	<p>CAUTION</p> <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

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

If commissioning is to take place some time after delivery, we recommend that the following measures be taken for pump (set) 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. New pumps/pump sets are supplied by our factory duly prepared for storage.

For storing a pump (set) which has already been operated, observe the instructions in (⇒ Section 6.3.2, Page 31) .

Table 4: Ambient conditions for storage

Ambient condition	Value
Relative humidity	80 % maximum
Ambient temperature	0 °C to + 40 °C




- Well-ventilated
- Dry
- Dust-free
- Shock-free
- Vibration-free

3.4 Return to supplier

1. Prior to returning the product to the supplier, flush and clean it, particularly if it has been used in noxious, explosive, hot or other hazardous fluids.
2. If the product has been used in fluids whose residues could lead to corrosion damage in the presence of atmospheric humidity or could ignite upon contact with oxygen, the product must also be neutralised and treated with anhydrous inert gas to ensure drying.
3. Always complete and enclose a certificate of decontamination when returning the product.
Indicate any safety measures and decontamination measures taken.

	<p>NOTE</p> <p>If required, a blank certificate of decontamination can be downloaded from the following web site: www.ksb.com/certificate_of_decontamination</p>
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3.5 Disposal

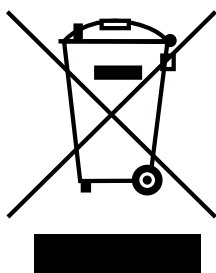
 	<p>⚠ DANGER</p> <p>Strong magnetic field in the pump rotor area Danger of death for persons with pacemaker! Interference with magnetic data carriers, electronic devices, components and instruments! Uncontrolled magnetic attraction forces between magnet-equipped components, tools or similar!</p> <p>▷ Keep a safety distance of at least 0.3 m.</p>
	<p>⚠ WARNING</p> <p>Fluids handled, consumables and supplies which are hot and/or pose a health hazard Hazard to persons and the environment!</p> <p>▷ 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.</p>

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.

Electrical or electronic equipment marked with the adjacent symbol must not be disposed of in household waste at the end of its service life.

Contact your local waste disposal partner for returns.

If the used electrical or electronic equipment contains personal data, the operator is responsible for deleting it before the equipment is returned.



4 Description

4.1 General description

- High-efficiency heating circulator with continuously variable speed control
- Non-self-priming in-line pump with integrated permanent magnet synchronous motor and electronic variable speed system
- Pump for handling clean, non-aggressive fluids which are not chemically and mechanically aggressive to the pump materials

4.2 Product information as per Regulation No. 1907/2006 (REACH)

For information as per European chemicals regulation (EC) No. 1907/2006 (REACH) see <https://www.ksb.com/en-global/company/corporate-responsibility/reach>.

4.3 Designation

Example: Calio S 25-40 BMS

Table 5: Designation key

Code	Description	
Calio S	Type series	
25	Connection	
	25	G 1 1/2
	30	G 2
40	Head H ¹⁾ [m]	
	40	Head H × 10 Example: 4 m × 10 = 40
BMS	Building Management System function	

¹ At flow rate Q = 0 m³/h

4.4 Name plate

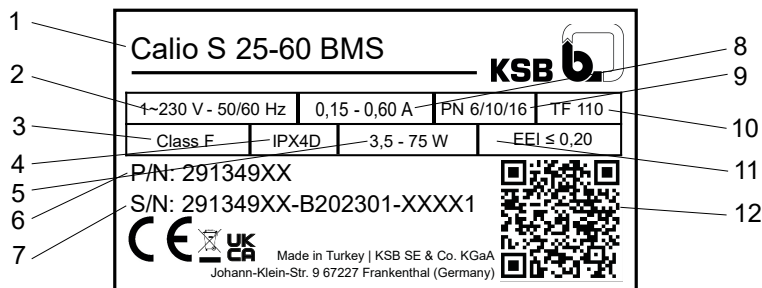


Fig. 1: Name plate (example)

1	Type series, size	7	Production number
2	Mains voltage, frequency	8	Current input
3	Thermal class	9	Pressure class
4	Enclosure	10	Temperature class
5	Power input	11	Energy efficiency index EEI
6	Material number	12	QR code

Key to the production
number

Example: 291349XX-B202301-XXXX1

Table 6: Key to the production number

Code	Description
291349XX	Material number
2023	Year of production
01	Week of production
XXXX1	Consecutive number

4.5 Design details

Design

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

Drive

- High-efficiency permanent magnet synchronous motor, brushless, self-cooling, with continuously variable differential pressure control
- 1~230 V AC +/- 10%
- Frequency 50 Hz/60 Hz
- Enclosure IPX4D
- Thermal class F
- Temperature class TF 110
- Energy efficiency index $EEI \leq 0.20$
- Interference emissions EN 55014-1, EN 61000-3-2, EN 61000-3-3
- Interference immunity EN 55014-2

Bearings

- Product-lubricated special plain bearing

Connections

- Screw-ended

Operating modes

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

Automatic functions

- Continuously variable speed adjustment depending on the mode of operation
- Soft start (limitation of starting current)
- Full motor protection with integrated trip electronics
- Setback operation
- 0 - 10 V with external differential pressure/speed setpoint
- Remote ON/OFF
- General fault message
- Self-venting function

Manual functions

- Setting the operating mode
- Setting the discharge head setpoint
- Setting the speed level

Signalling functions and display functions

- Alternating display of flow rate, head and electrical input power
- Error messages on the display

4.6 Configuration and function

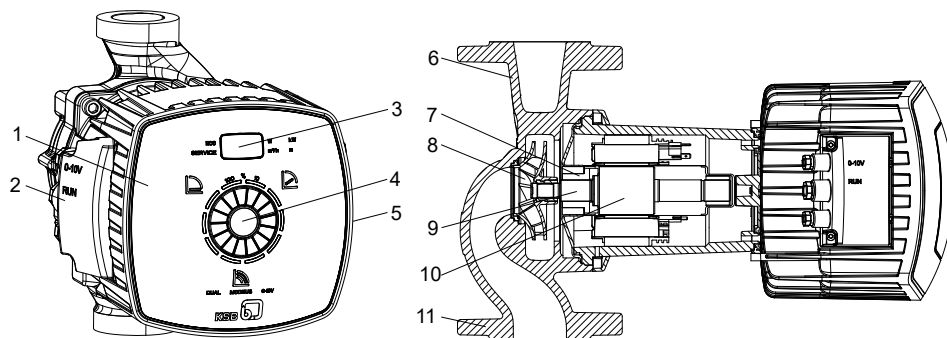


Fig. 2: Illustration of the pump set

1	Control panel	7	Radial plain bearing
2	Connections for control cables	8	Impeller
3	Display	9	Motor shaft
4	Control element (dial and control button)	10	Motor
5	Connections for power supply and general fault message	11	Suction nozzle
6	Discharge nozzle		

Design The pump is designed with a radial fluid inlet (suction nozzle) and a radial fluid outlet (discharge nozzle) arranged on the same axis. The impeller is rigidly connected to the motor shaft. 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 lubricating system, high-quality carbon bearings and precision-balanced rotor ensure smooth running and a long service life. The integrated continuously variable differential pressure control and operating software enable an optimum adjustment of the pump to changing operating conditions and minimise operating costs. 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.

Function The fluid enters the pump via the suction nozzle and is accelerated outward in a cylindrical flow by the rotating impeller (8). 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 (6), where it leaves the pump. The shaft runs in radial plain bearings (7), which are supported by the motor (10).

4.7 Noise characteristics

Average sound pressure level < 45 dB (A)

4.8 Scope of supply

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

- Pump set
- Sealing elements
- Two-piece thermal insulation shell (only for overall length ≥ 180 mm)
- Installation/operating manual

4.9 Dimensions and weight






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

4.10 Accessories

No accessories available.

5 Installation at Site

5.1 Safety regulations







	<div style="background-color: #e67e22; color: white; padding: 5px;"> DANGER</div> <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.
	<div style="background-color: #e67e22; color: white; padding: 5px;"> DANGER</div> <p>Use for drinking water or foodstuff applications Danger of poisoning!</p> <ul style="list-style-type: none"> ▷ Never use the pump for drinking water or foodstuff applications.
	<div style="background-color: #f1c40f; padding: 5px;">CAUTION</div> <p>Improper installation of the pump set Damage to the pump set!</p> <ul style="list-style-type: none"> ▷ Observe the permissible ambient conditions and the pump set's type of enclosure. ▷ Observe the permissible ambient temperatures. Ambient temperatures < 0 °C are not permitted. ▷ In the event of outdoor installation, fit a protective roof to protect the pump set from the weather (e. g. sun, rain, snow).

5.2 Checks to be carried out prior to installation

Before beginning with the installation check the following:

- All structural work required has been checked and prepared in accordance with the dimensions in the outline drawing.
- The data on the name plate of the pump set has been checked. The pump set must be suitable for operation on the available power supply network.
(⇒ Section 4.4, Page 14)
- The fluid to be handled matches the description of suitable fluids.
(⇒ Section 6.2.5.1, Page 30)

5.3 Installing the pump set

	<div data-bbox="507 235 683 280">! DANGER</div> <p>Leakage at the pump Leakage of hot fluids!</p> <ul style="list-style-type: none"> ▸ Fit the sealing elements and make sure they are positioned correctly.
	<div data-bbox="507 445 639 479">CAUTION</div> <p>Air entering the pump Damage to vertically installed pump sets whose direction of flow is downwards!</p> <ul style="list-style-type: none"> ▸ Fit a vent valve at the highest point of the suction line.
	<div data-bbox="507 651 639 685">CAUTION</div> <p>Fluid entering the electronic system housing Damage to the pump set!</p> <ul style="list-style-type: none"> ▸ Install the pump set with the pump shaft in horizontal position. Connect the piping without transmitting any stresses and strains. ▸ Never install the pump set with the electronic system housing pointing upwards or downwards. ▸ Undo the hexagon socket head cap screws. Then turn the electronic system housing.
	<div data-bbox="507 1025 587 1059">NOTE</div> <p>Installing shut-off valves upstream and downstream of the pump set is recommended. Make sure that no leakage drips onto the pump set.</p>
	<div data-bbox="507 1184 587 1218">NOTE</div> <p>The direction of flow of a vertically installed pump should be upwards.</p>
	<div data-bbox="507 1341 587 1375">NOTE</div> <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 panel can be turned. Positioning must be effected with the pump set removed from the system.

✓ The pump set is secured against tipping over.

1. Undo and store the 4 hexagon socket head cap screws.
2. Rotate the control panel 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

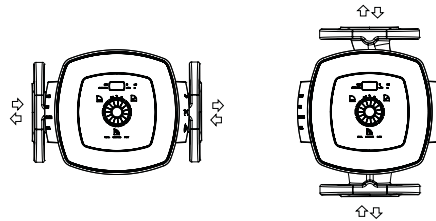



Fig. 3: Permissible installation positions

Screw-ended pump

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 a suitable tool.
5. Accurately insert the sealing element in the opposite pipe union.
6. Tighten the pipe union hand-tight with a suitable tool.


5.4 Connecting the piping


	<div style="background-color: #f4a460; padding: 5px;">! WARNING</div> <p>Hot surface Risk of burns</p> <ul style="list-style-type: none"> ▷ Never touch a pump set when it is in operation.
	<div style="background-color: #f4a460; padding: 5px;">! WARNING</div> <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.
	<div style="background-color: #f4d03f; padding: 5px;">CAUTION</div> <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 sizes of the piping are equal to or greater than the nominal sizes of the pump nozzles.
 - ✓ The piping has 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, piping and connections (especially of new installations).








5.5 Fitting the enclosure/insulation

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

	<p>CAUTION</p> <p>Heat build-up at motor housing and electronic system housing</p> <p>Pump overheating!</p> <ul style="list-style-type: none"> ▷ Do not insulate the motor housing and electronic system housing.
--	--

- ✓ Overall length ≥ 180 mm: The supplied thermal insulation shell is available.
1. Insulate the volute casing. Fit the protective equipment. Overall length ≥ 180 mm: Fit the supplied thermal insulation shell at the pump casing.

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 the IEC 61557 regulations as well as any regional regulations.
	<p>⚠ DANGER</p> <p>Electrostatic charging Danger of death from electric shock!</p> <ul style="list-style-type: none"> ▷ Provide potential equalisation between the pump set and the foundation.
	<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>Heat damage to the cable sheath Danger from electric shock!</p> <ul style="list-style-type: none"> ▷ Make sure the cables are never laid in contact with hot casings/housings or pipelines.
	<p>⚠ DANGER</p> <p>Hazardous electrical voltage when the covers of the terminal wiring compartments are removed Danger of death from electric shock!</p> <ul style="list-style-type: none"> ▷ For working on the terminals, switch off the power supply at least 5 minutes prior to commencing work and ensure that it cannot be switched on again unintentionally. ▷ If applicable, switch off the external power supply to message relays and control cables and make sure it cannot be switched on again unintentionally. ▷ Keep the covers of the terminal wiring compartments closed during operation as well as during maintenance work.
	<p>⚠ WARNING</p> <p>Incorrect connection to the mains Damage to the power supply network, short circuit!</p> <ul style="list-style-type: none"> ▷ Observe the technical specifications of the local energy supply companies.
	<p>CAUTION</p> <p>Fluid entering cable glands or power supply installation Electronics failure, short circuit!</p> <ul style="list-style-type: none"> ▷ Lay cables in a loop so any water dripping onto the cables will run off.



NOTE

Using a permanently installed power cable of type H05VV-F 3G1.5 or similar is recommended.

Residual current device Using a universal AC/DC sensitive residual current device to DIN VDE 0160 is recommended. Conventional residual current devices might either fail to trip or trip erroneously.

Discharge current per pump < 3.5 mA

5.6.1 Connecting the electric cable

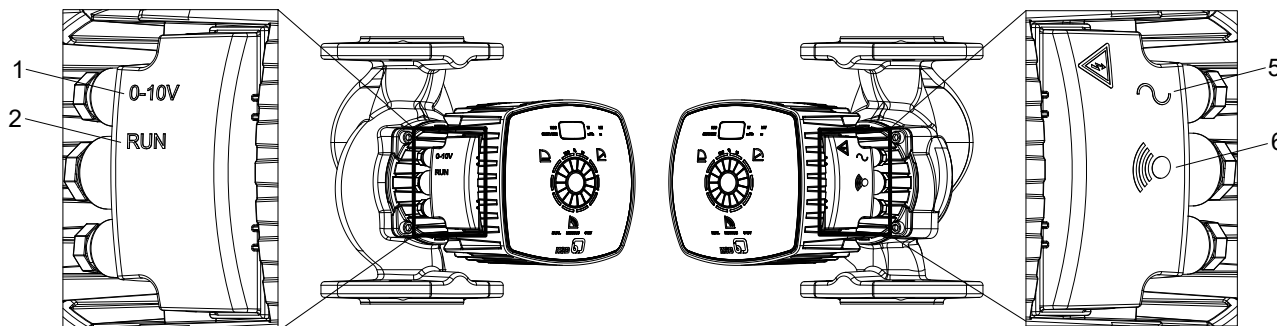
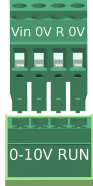
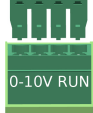



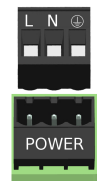


Fig. 4: Connecting the electric cable

1	Connection for external analog signal, 0-10 V DC	3	Connection of power supply 1~ 230 V AC +/- 10 %, 50 Hz/60 Hz
2	Connection for remote ON/OFF signal	4	Connection for general fault message

- ✓ The mains voltage at the site has been verified against the data on the name plate.
 - ✓ The pump set has been de-energised and secured against unintentional start-up.
 - ✓ The wiring diagram is available.
1. Unscrew the cable glands (IPX4D).
 2. Undo and store the 2 screws of the cover of the terminal wiring compartment.
 3. Remove the cover of the terminal wiring compartment.
 4. Knock out and remove the closing disc of the required cable gland with a suitable tool (e.g. screwdriver).
 5. Lay the required electric cable in a loop so any water will drip off, then guide it through the corresponding cable gland and connect it to the terminal provided.
 6. Fit the cover of the terminal wiring compartment. Fasten it with the 2 screws.
 7. Tighten the cable glands.

Table 7: Symbols key

Function	Symbol	Terminal pair	Terminal cross-section	Terminal code	Frequency of starts	Contact rating
External analog signal 0-10 V DC	0-10 V		1,5 mm ²	Vin = 0-10 V (+) 0 V = GND (-)	-	-
Signal for remote ON/OFF (supplied bridged)	RUN		1,5 mm ²	R = RUN contact 0 V = GND	-	Max: 5 mA at closed contact

Function	Symbol	Terminal pair	Terminal cross-section	Terminal code	Frequency of starts	Contact rating
Power supply 1~ 230 V AC +/- 10 %, 50 Hz/60 Hz			1,5 mm ²	⊥ PE N = N L = L	< 20 / 24 hours	-
General fault message			1,5 mm ²	-	-	Min: 12 V DC at 10 mA Max: 250 V at 1 A

5.6.1.1 Power supply

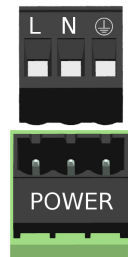


Fig. 5: Power supply 1~230 V AC +/- 10 %, 50 Hz/60 Hz

L	Conductor / phase (230 V)
N	Neutral conductor
⏏	Earthing

✓ The wiring diagram is available.

1. Connect the power supply to the terminal pair L, N, PE integrated in the pump set.

5.6.1.2 General fault message

The pump set signals a general fault message by means of the integrated, volt-free relay contact.

- General fault message = rotor not rotating, no flow (alarm not active).

The information can be accessed at the alarm terminal pair with terminals NC / COM / NO.

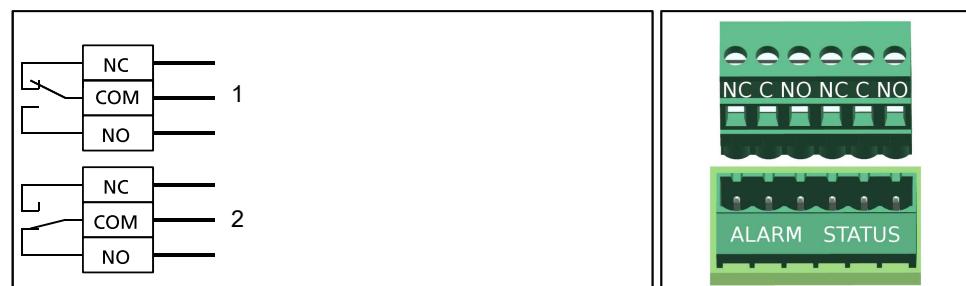


Fig. 6: Wiring diagram for the general fault message

1	No general fault message or no power supply / no alarm active
2	General fault message (rotor not rotating) / alarm active
NC	NC contact, normally closed and electrically conductive connection to COM
COM	Reference potential for either contact that is closed
NO	NO contact, normally open and not electrically conductive connection to COM

5.6.1.3 External analog 0 - 10 V DC signal

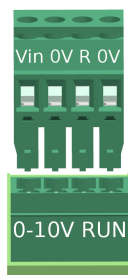


Fig. 7: Terminal pair 0 - 10 V

Vin	0-10 V (+)
0 V	GND (-)

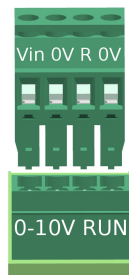
Table 8: Technical data

Characteristic	Value
Input impedance	> 150 k Ω
Accuracy	1 % of full-scale value
Signal delay	< 10 ms
Resolution	12 bit
Reverse polarity protection	Available

✓ The wiring diagram is available.

1. Connect the external analog signal to the 0 -10 V terminal pair integrated in the pump set.

5.6.1.4 Remote ON/OFF


Fig. 8: RUN terminal pair

R	Signal 5 V (+)
0 V	GND (-)

✓ The wiring diagram is available.

1. Unscrew the cable glands (IPX4D).
2. Wire the external signal (volt-free switching contact) to the RUN terminal pair integrated in the pump set. The terminal pair is supplied bridged.
3. Tighten the cable glands (IPX4D).

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. (⇒ Section 5.6, Page 22)
- The system piping has been cleaned. (⇒ Section 5.4, Page 20)
- The suction line and inlet tank, if any, have been primed with the fluid to be handled.
- The covers of the terminal wiring compartments have been closed and fastened with screws.

6.1.2 Priming and venting the pump

	<div style="background-color: #e67e22; color: white; padding: 5px;">⚠ DANGER</div> <p>Non-compliance with the permissible pressure and temperature limits if the pump is operated with the suction and discharge lines closed.</p> <p>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.
	<div style="background-color: #f1c40f; color: black; padding: 5px;">CAUTION</div> <p>Increased wear due to dry running</p> <p>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. ▷ Observe the specified minimum pressure for operating the pump set. ▷ Always operate the pump set within the permissible operating range.
	<div style="background-color: #2980b9; color: white; padding: 5px;">NOTE</div> <p>The pump is self-venting.</p>


1. Fully open the shut-off elements in the suction line.
2. Slightly or fully open the shut-off element in the discharge line.

6.1.3 Start-up


	<div data-bbox="507 232 683 277"> DANGER</div> <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.
	<div data-bbox="507 562 683 607"> DANGER</div> <p>Excessive temperatures due to insufficient lubrication of the plain bearings Damage to the pump set!</p> <ul style="list-style-type: none"> ▷ Never operate the pump set without liquid fill. ▷ Prime the pump as per operating instructions. ▷ Always operate the pump within the permissible operating range.
	<div data-bbox="507 853 703 898"> WARNING</div> <p>Hot surfaces (pump and piping take on the temperature of the fluid handled). Risk of burns!</p> <ul style="list-style-type: none"> ▷ Do not touch hot surfaces. ▷ Use appropriate personal protective equipment.
	<div data-bbox="507 1099 639 1144">CAUTION</div> <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 set, suction line and inlet tank, if fitted, have been vented and primed with the fluid to be pumped.
- ✓ The priming lines and venting lines have been closed.
 1. Fully open the shut-off element in the suction line.
 2. Close or slightly open the shut-off element in the discharge line.
 3. Start up the pump set.

6.2 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.

6.2.1 Frequency of starts

	CAUTION
	<p>Excessively high frequency of starts Damage to the pump set!</p> <ul style="list-style-type: none"> ▸ Do not exceed the values for the frequency of starts.

Maximum 20 starts per hour via the power supply.

6.2.2 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 9: Permissible ambient temperatures specified for the fluid temperature

Fluid temperature	Permissible ambient temperature
[°C]	[°C]
≤ +90	+40
> +90	+30

6.2.3 Minimum inlet pressure


The minimum inlet pressure p_{\min} at the pump suction nozzle serves to avoid cavitation noises at the indicated fluid temperature T_{\max} .

The indicated values are applicable up to 300 m above sea level. For installation at altitudes > 300 m, an allowance of 0.01 bar / 100 m must be added.

Table 10: Minimum inlet pressure p_{\min} specified for the fluid temperature T_{\max} .

Fluid temperature	Minimum inlet pressure
[°C]	[bar]
≤ 80	0,5
81 to 95	1,5
96 to 110	2,5



6.2.4 Maximum operating pressure


	CAUTION
	<p>Permissible operating pressure exceeded Damage to connections and seals!</p> <p>▷ Never exceed the operating pressure specified in the data sheet.</p>

The maximum operating pressure equals 6, 10 or 16 bar, depending on the design variant. See name plate.

6.2.5 Fluid handled


6.2.5.1 Permissible fluids

	 DANGER
	<p>Use for drinking water or foodstuff applications Danger of poisoning!</p> <p>▷ Never use the pump for drinking water or foodstuff applications.</p>

	CAUTION
	<p>Unsuitable fluids Damage to the pump!</p> <p>▷ Never use the pump to handle corrosive, combustible or explosive fluids.</p> <p>▷ Never use the pump to handle waste water or abrasive fluids.</p> <p>▷ Do not use the pump for foodstuff applications.</p>

- Heating water to VDI 2035
- Higher-viscosity fluids (water/glycol mixture up to a mixing ratio of 1:1)

6.2.5.2 Density of the fluid handled

	CAUTION
	<p>Impermissibly high density of the fluid handled Motor overload!</p> <p>▷ Observe the information on fluid density in the data sheet.</p>

The power input of the pump set will change in proportion to the density of the fluid handled.

6.2.5.3 Fluid temperature


	CAUTION
	<p>Incorrect fluid temperature Damage to the pump (set)!</p> <p>▷ Only operate the pump (set) within the temperature limits indicated.</p>


Table 11: Temperature limits of the fluid handled

Permissible fluid temperature	Value
Maximum	+110 °C
Minimum	-10 °C

The fluid temperature has an impact on the minimum inlet pressure.
(⇒ Section 6.2.3, Page 29)

6.3 Shutdown/storage/preservation


6.3.1 Shutdown

	NOTE
	<p>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.</p>

✓ 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 pump set.

For prolonged shutdown periods

	CAUTION
	<p>Risk of freezing during prolonged pump shutdown periods Damage to the pump!</p> <p>▷ Drain the pump and the cooling/heating chambers (if any) or otherwise protect them against freezing.</p>

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

6.3.2 Measures to be taken for shutdown

The pump (set) remains installed

✓ Sufficient fluid is supplied for the functional 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 8.2, Page 48) and the safety instructions for dismantling the pump have been observed.

1. Observe any additional instructions and information provided.
(⇒ Section 3, Page 11)

6.4 Returning to service

	<div data-bbox="507 235 703 280"> WARNING</div> <div data-bbox="494 297 1083 327">Failure to re-install or re-activate protective devices</div> <div data-bbox="494 333 1064 365">Risk of injury from moving parts or escaping fluid!</div> <div data-bbox="517 374 1434 432"><ul style="list-style-type: none">▸ As soon as the work is completed, properly re-install and re-activate any safety-relevant devices and protective devices.</div>
---	--

For returning the equipment to service, observe the sections on commissioning/start-up (⇒ Section 6.1, Page 27) and the operating limits (⇒ Section 6.2, Page 29) .

In addition, carry out all servicing/maintenance operations before returning the pump (set) to service. (⇒ Section 8, Page 48)

7 Operation

7.1 Control panel

All settings are made using the control element on the housing front. The control element consists of a dial and a control button. The control button is arranged in the middle of the dial and can be pressed down. Setpoint values can be adjusted by turning the dial in increments down to a minimum of 0 %. The setpoint value is shown as a numerical value on the display. 10 LED segments are arranged around the dial. These segments represent setpoint values ranging from 0 - 100 % in increments of 10 %. The LED segments light up in blue when settings are being made at the pump. In the following example the setpoint = 40 %.

	NOTE
If set to 100 %, the performance limits may cause the actual value to be slightly below the maximum characteristic curve, depending on the pump and operating point.	

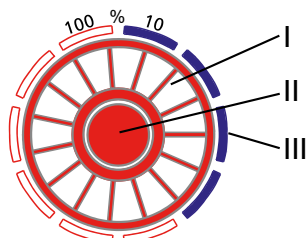


Fig. 9: Control element

I	Dial
II	Control button
III	10 LED segments (lit up in blue when pump settings are being made)




Settings overview

Table 12: Overview of settings using the control button

Menu	Time to open menu	Details
Operating modes	Press and hold the control button for 3 seconds.	(⇒ Section 7.2, Page 35)
Functions	Press and hold the control button for 5 seconds.	(⇒ Section 7.3, Page 43)
Resetting to factory settings	Press and hold the control button for 30 seconds.	(⇒ Section 7.4, Page 47)

7.1.1 Locking the control panel

Table 13: Locking / unlocking the control panel

	Step 1: Activating the function <ul style="list-style-type: none"> Press the control element for 10 seconds. <ul style="list-style-type: none"> The current status of the control panel is shown.
	Step 2: Locking / unlocking the control panel <ul style="list-style-type: none"> Turn the dial and select the required status. <ul style="list-style-type: none"> H-L = control panel locked H-O = unlock control panel
	Step 3: Confirming the setting <ul style="list-style-type: none"> Press the control element. <ul style="list-style-type: none"> The pump size and the current firmware version are briefly shown on the display.



NOTE

Only when the control panel is unlocked can operating modes and functions be set and settings be reset to factory settings.

7.1.2 Display

The flow rate, the electrical input power and the head are shown as 3-digit numbers on the integrated display. The display alternates in 5-second intervals between these values with the corresponding units. The flow rate and the head are displayed as numbers with one decimal place; the power input is displayed as a number without any decimal places. The setpoint is indicated in [%] without any decimal places.



Fig. 10: Display





Symbols

The symbols on the front panel indicate operating modes and settings. A lit symbol signifies:

- The active operating mode
- An external 0 - 10 V signal
- A general fault message

Table 14: Symbols key

Symbol	Description	Unit
m³/h	Calculated flow rate <ul style="list-style-type: none"> Symbol lights up. Display shows the flow rate. 	m³/h
W	Measured electrical input power <ul style="list-style-type: none"> Symbol lights up. Display shows the electrical power. 	W

Symbol	Description	Unit
m	Calculated head	mWC
	Constant-pressure Control operating mode ▪ Symbol lights up when this operating mode is active.	-
	Proportional-pressure Control operating mode ▪ Symbol lights up when this operating mode is active.	-
	Open-loop Control operating mode ▪ Symbol lights up when this operating mode is active.	-
 ECO	ECO operating mode (energy-saving mode) ▪ Symbols light up when this operating mode is active.	-
0-10 V	0 - 10 V operating mode ▪ Symbol lights up when this operating mode is active. ▪ Symbol flashes when this operating mode sends a stop command. E.g. voltage signal < 1.5 V.	VDC
SERVICE	General fault message ▪ An error code (E01 - E08) is shown on the display.	-

7.2 Operating modes

7.2.1 Information on settings

The pump set is fitted with a hydraulic controller for setting the head setpoint, based on which the pump set's speed is calculated and adjusted. The head setpoint is determined by the set operating mode and the selected setpoint.

For common applications such as two-pipe 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 to Constant-pressure Control ($\Delta p-c$). Depending on the balancing of branch circuits, undersupply may occur at a consumer installation.

The Constant-pressure Control operating mode ($\Delta p-c$) can be selected as an option (e.g. for underfloor heating systems). If noises are audible at low flow rates, select the Proportional-pressure Control operating mode ($\Delta p-v$).

The setting of the discharge head setpoint depends on the piping curve of the system and on the heat requirements. As standard the default settings are Proportional-pressure Control ($\Delta p-v$) and medium output (setpoint 50 %).

7.2.2 Constant-pressure control

Applications

- Underfloor heating systems
- Solar pumps

Solar pumps require a high operating pressure to pump sufficient fluid through the heat exchanger. Proportional-pressure Control is not necessary as the thermostatic valves do not impact on the characteristic curve.

Function

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

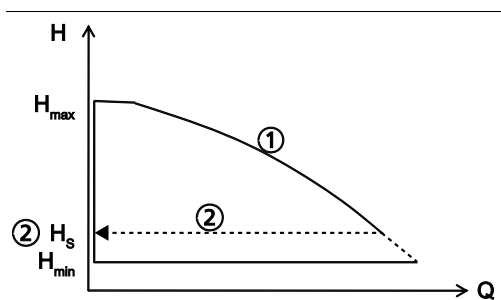


Fig. 11: Constant-pressure Control function

Setting

Press the control button to activate the display from idle mode. The display will show the current operating mode as well as, in alternation, the electrical input power and the flow rate. If 5 minutes pass without any settings being made or the control button being pressed, the display will revert to idle mode.

Table 15: Selecting Constant-pressure Control and the setpoint

	<p>Step 1: Activating the setting mode</p> <ul style="list-style-type: none"> Press and hold the control button for 3 seconds. <ul style="list-style-type: none"> The operating mode which has last been selected will start flashing.
	<p>Step 2: Selecting the Constant-pressure Control operating mode</p> <ul style="list-style-type: none"> Turn the dial and select the required operating mode. The symbol will light up.
	<p>Step 3: Activating the Constant-pressure Control operating mode</p> <ul style="list-style-type: none"> Press the control button. <ul style="list-style-type: none"> The number of flashing LED segments shows the setpoint which has last been set.
	<p>Step 4 a: Confirming the current setpoint</p> <ul style="list-style-type: none"> Press the control button.
	<p>Step 4 b: Changing the setpoint</p> <ul style="list-style-type: none"> Turn the dial and set the required setpoint in increments of 1 % within the range from 0 % to 100 %. <ul style="list-style-type: none"> Turning it clockwise increases the setpoint; turning it anti-clockwise decreases the setpoint. The LED segments will light up in increments of 10 %. Press the control button to save the setpoint.



NOTE

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

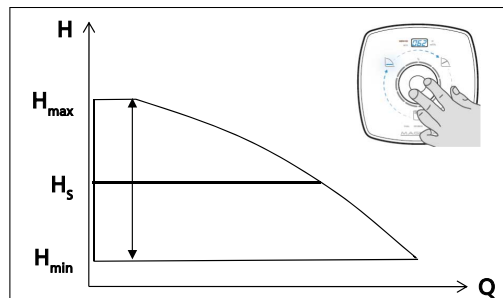


Fig. 12: Constant-pressure Control settings



NOTE

To start the pump the "RUN" terminal pair must be bridged (factory setting) or the terminal pair must receive the START signal.

7.2.3 Proportional-pressure control

Application

- Heating systems with a radiator

The higher the flow rate, the higher the system's resistance. This is corrected by the pump set automatically increasing the head setpoint.

When setting the setpoint ensure that the selected control curve is suitable for the system characteristic curve:

- If the system characteristic curve is known (e.g. hydraulic balancing), select a control curve that is minimally above the characteristic curve. See type series booklet.
 - Control curve too low: undersupply
 - Control curve too high: increased energy input
- If the system characteristic curve is unknown, dynamic control is recommended.
 - The pump set automatically recognises the system characteristic curve via the variable speed system and optimises the operating point accordingly.

Function

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

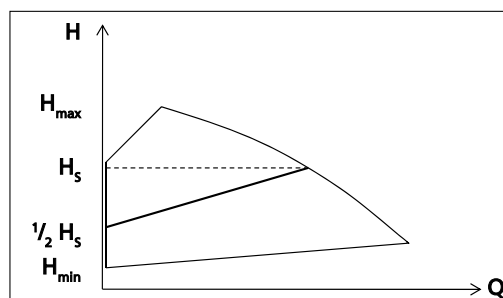




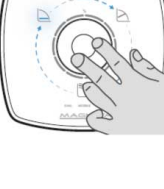


Fig. 13: Proportional-pressure Control function

Setting

Press the control button to activate the display from idle mode. The display will show the current operating mode as well as, in alternation, the electrical input power and the flow rate. If 5 minutes pass without any settings being made or the control button being pressed, the display will revert to idle mode.

Table 16: Selecting Proportional-pressure Control and the setpoint

	<p>Step 1: Activating the setting mode</p> <ul style="list-style-type: none"> Press and hold the control button for 3 seconds. <ul style="list-style-type: none"> The operating mode which has last been selected will start flashing.
	<p>Step 2: Selecting the Proportional-pressure Control operating mode</p> <ul style="list-style-type: none"> Turn the dial and select the required operating mode. The symbol lights up in blue.
	<p>Step 3: Activating the Proportional-pressure Control operating mode</p> <ul style="list-style-type: none"> Press the control button. <ul style="list-style-type: none"> The number of flashing LED segments shows the setpoint which has last been set.
	<p>Step 4 a: Confirming the current setpoint</p> <ul style="list-style-type: none"> Press the control button.
	<p>Step 4 b: Changing the setpoint</p> <ul style="list-style-type: none"> Turn the dial and set the required setpoint in increments of 1 % within the range from 0 % to 100 %. <ul style="list-style-type: none"> Turning it clockwise increases the setpoint; turning it anti-clockwise decreases the setpoint. The LED segments will light up in increments of 10 %. Press the control button to save the setpoint.



NOTE

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

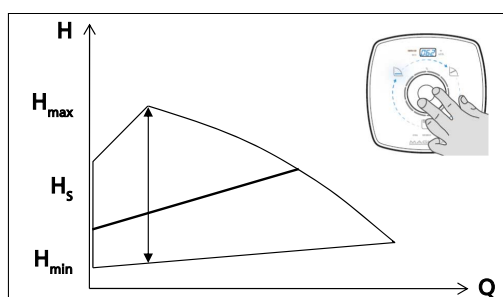


Fig. 14: Proportional-pressure Control settings



NOTE

To start the pump the "RUN" terminal pair must be bridged (factory setting) or the terminal pair must receive the START signal.

7.2.4 Eco Mode

Function

Eco Mode operating mode is an energy-efficient alternative to Proportional-pressure Control. Eco Mode is based on a linear characteristic curve rather than a quadratic one. The consequences on the process are illustrated at the example of size 25-100 in the figure below:

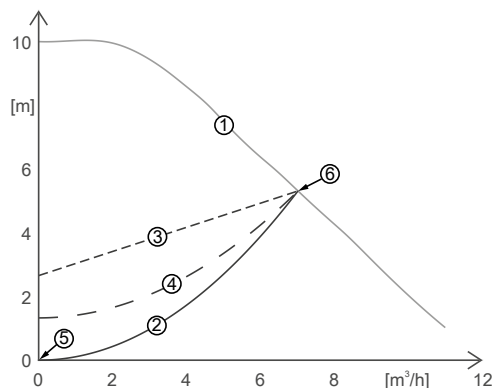


Fig. 15: Eco Mode and Proportional-pressure Control at the example of a size 25-100 pump

1	Maximum operating range	4	Eco Mode characteristic curve (setpoint 50 %)
2	System characteristic curve	5	Origin
3	Proportional-pressure Control characteristic curve	6	Maximum characteristic curve

From a physical point of view, the system characteristic curve (2) is always a parabola through the origin (5) of the coordinate system. When selecting the setpoint make sure that the intersection of the maximum operating range (1) and the characteristic curve of the selected control mode (3)/(4) is above or on the system characteristic curve (2). This prevents undersupply. If, at the same setpoint, the Eco Mode operating mode is selected, the Eco Mode characteristic curve (4) is a parabola instead of a straight line. The characteristic curves of both Eco Mode and Proportional-pressure Control intersect the maximum characteristic curve (6) in the same point. At zero flow rate the set head in Eco Mode is 50 % lower than in Proportional-pressure Control operating mode. The system characteristic curve (2) always passes through the origin (5); it is a parabola, like the characteristic curve of the Eco Mode (4). This ensures sufficient supply over the entire operating range and markedly reduces the power input. We recommend using Eco Mode rather than Proportional-pressure Control. This results in power savings of a maximum of 53 % and an average of 36 %. The power savings are illustrated in the figure below:

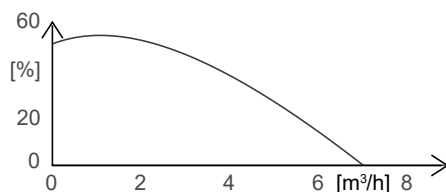








Fig. 16: Savings potential of Eco Mode compared to Proportional-pressure Control at the example of a size 25-100 pump

Setting

Press the control button to activate the display from idle mode. The display will show the current operating mode as well as, in alternation, the electrical input power and the flow rate. If 5 minutes pass without any settings being made or the control button being pressed, the display will revert to idle mode.

Table 17: Selecting Eco Mode and the setpoint

	<p>Step 1: Activating the setting mode</p> <ul style="list-style-type: none"> Press and hold the control button for 3 seconds. <ul style="list-style-type: none"> The operating mode which has last been selected will start flashing.
	<p>Step 2: Selecting the Eco Mode operating mode</p> <ul style="list-style-type: none"> Turn the dial and select the required operating mode. <p> ECO</p>
	<p>Step 3: Activating the Eco Mode operating mode</p> <ul style="list-style-type: none"> Press the control button. <ul style="list-style-type: none"> The number of flashing LED segments shows the setpoint which has last been set.
	<p>Step 4 a: Confirming the current setpoint</p> <ul style="list-style-type: none"> Press the control button.
	<p>Step 4 b: Changing the setpoint</p> <ul style="list-style-type: none"> Turn the dial and set the required setpoint in increments of 1 % within the range from 0 % to 100 %. <ul style="list-style-type: none"> Turning it clockwise increases the setpoint; turning it anti-clockwise decreases the setpoint. The LED segments will light up in increments of 10 %. Press the control button to save the setpoint.


NOTE

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


NOTE

To start the pump the "RUN" terminal pair must be bridged (factory setting) or the terminal pair must receive the START signal.

7.2.5 Open-loop control

Function

In Open-loop Control operating mode the pump runs at a set speed. The speed can be set to one of 100 speed levels.

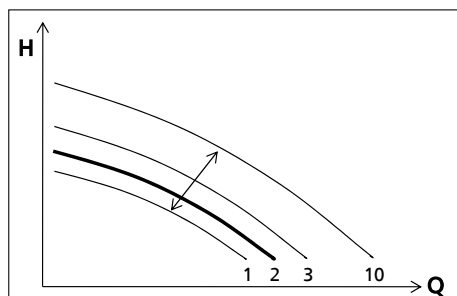


Fig. 17: Open-loop Control function, running at speed level 2

Setting

Press the control button to activate the display from idle mode. The display will show the current operating mode as well as, in alternation, the electrical input power and the flow rate. If 5 minutes pass without any settings being made or the control button being pressed, the display will revert to idle mode.

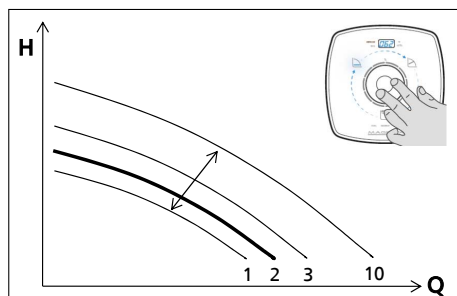

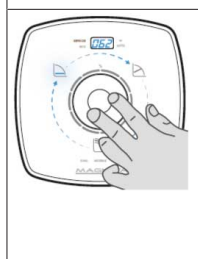


Fig. 18: Open-loop Control settings

Table 18: Selecting Open-loop Control and the setpoint

	<p>Step 1: Activating the setting mode</p> <ul style="list-style-type: none"> Press and hold the control button for 3 seconds. <ul style="list-style-type: none"> The operating mode which has last been selected will start flashing.
	<p>Step 2: Selecting the Open-loop Control operating mode</p> <ul style="list-style-type: none"> Turn the dial and select the required operating mode.
	<p>Step 3: Activating the Open-loop Control operating mode</p> <ul style="list-style-type: none"> Press the control button. <ul style="list-style-type: none"> The number of flashing LED segments shows the setpoint which has last been set.

	<p>Step 4 a: Confirming the current setpoint</p> <ul style="list-style-type: none"> ▪ Press the control button.
	<p>Step 4 b: Changing the setpoint</p> <ul style="list-style-type: none"> ▪ Turn the dial and set the required setpoint in increments of 1 % within the range from 0 % to 100 %. <ul style="list-style-type: none"> – Turning it clockwise increases the setpoint; turning it anti-clockwise decreases the setpoint. – The LED segments will light up in increments of 10 %. ▪ Press the control button to save the setpoint.





	<p>NOTE</p> <p>If 10 seconds pass without any settings being made or saved, the control unit will revert to the previous settings.</p>
	<p>NOTE</p> <p>To start the pump the "RUN" terminal pair must be bridged (factory setting) or the terminal pair must receive the START signal.</p>

Table 19: Speeds

Size	Speed	
	Minimum speed Setpoint input 0 %	Maximum speed Setpoint input 100 %
	[rpm]	[rpm]
25-60	1000	3500
30-60	1000	3500

7.3 Functions

7.3.1 Remote ON/OFF (digital input)


	CAUTION
	External voltage applied to the RUN terminal Damage to the printed circuit board! ▷ Always use a volt-free contact for the RUN terminal.
	CAUTION
	Using digital inputs for safety-relevant shutdown Pump does not stop! Damage to the electronics! ▷ For safety-related shutdown always separate the unit from the power supply network (e.g. by installing an Emergency OFF system).

The digital input is factory-set to start up and stop the pump set.

Table 20: Pump start and stop

Contact	Response
Contact closed / terminals bridged	Pump set starts up.
Contact open / terminals not bridged	Pump set stops.

7.3.2 External analog 0 - 10 V DC signal

	CAUTION
	<p>External voltage applied to the RUN terminal</p> <p>Damage to the printed circuit board!</p> <p>► Always use a volt-free contact for the RUN terminal.</p>

Function

An external analog 0 - 10 V DC signal serves as setpoint input. If the Constant-pressure Control, Proportional-pressure Control or Eco Mode operating modes are active, the pump set processes the current external analog signal as a setpoint. If the Open-loop Control operating mode is active, the pump set processes the external analog signal as a speed setpoint. If the signal level < 1.5 V DC, the pump will stop and the last LED segment will extinguish.

Table 21: Setpoint settings at the pump set for signal level 0 - 10 V

Signal level	Setpoint input at the pump set
10 V DC	100 % of the setpoint
2 V DC	0 % of the setpoint
< 1.5 V DC	Pump stops.
≥ 2 V DC	Pump starts up.

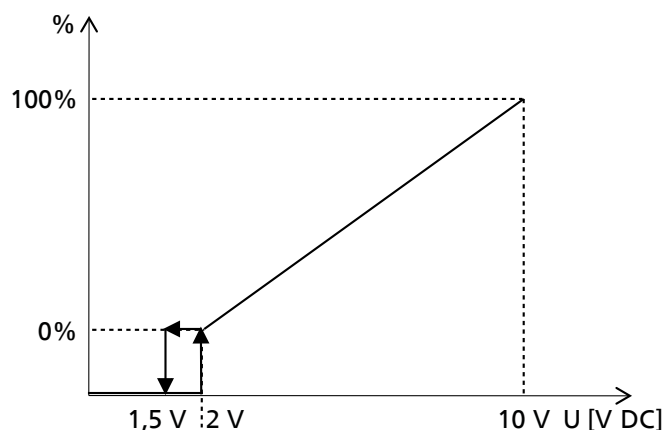





Fig. 19: Analog 0 - 10 V signal as setpoint input for the pump set

Setting

Press the control button to activate the display from idle mode. The display will show the current operating mode as well as, in alternation, the electrical input power and the flow rate. If 5 minutes pass without any settings being made or the control button being pressed, the display will revert to idle mode.

Table 22: Starting and stopping 0 - 10 V

	Step 1: Activating the 0 - 10 V sub-mode <ul style="list-style-type: none"> Press and hold the control button for 6 seconds. <ul style="list-style-type: none"> The sub-mode symbol 0-10 V will start flashing.
	Step 2: Selecting the 0 - 10 V operating mode <ul style="list-style-type: none"> Turn the dial and select the required operating mode. 0-10 V
	Step 3: Activating or deactivating the 0 - 10 V operating mode <ul style="list-style-type: none"> Press the control button. <ul style="list-style-type: none"> The symbol will light up. When the signal is activated, the circular segments will indicate the value of the input signal.


NOTE

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

Table 23: Number of lit LED segments assigned to voltage

Number of lit LED segments	Voltage
	[V]
0	2,4
1	3,2
2	4,0
3	4,8
4	5,6
5	6,4
6	7,2
7	8,0
8	8,8
9	9,6
10	10,0


NOTE

To start the pump the "RUN" terminal pair must be bridged (factory setting) or the terminal pair must receive the START signal.

7.3.3 Setback operation

Function

When the Setback Operation function is active, the pump set identifies minimum heat demand when the fluid temperature sinks continuously. The pump set automatically reduces the setpoint. When heat demand rises again, the pump set reverts to its previous setpoint.

When the Setback Operation function is active, the pump set switches between night mode and day mode.

Night mode is active in the following cases:


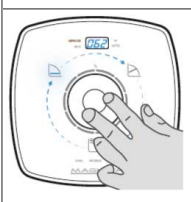

- The fluid temperature sinks by 15 °C within 2 hours.

Day mode is active in the following cases:

- The fluid temperature rises by 3 °C.
- The pump set has been in night mode for more than 7 hours.

Settings

Table 24: Activating and disabling Setback Operation

	<p>Step 1: Activating the setting mode</p> <ul style="list-style-type: none"> ▪ Press and hold the control button for 15 seconds. <ul style="list-style-type: none"> – The current status of the setback operation mode is displayed.
	<p>Step 2: Selecting the Setback Operation status</p> <ul style="list-style-type: none"> ▪ Turn the dial and select the required status. <ul style="list-style-type: none"> – nd0 = Setback operation disabled – nd1 = Setback operation activated
	<p>Step 3: Activating/disabling the Setback Operation status</p> <ul style="list-style-type: none"> ▪ Press the control button.

7.3.4 Deblocking the impeller

Function

The pump is started up at maximum torque to remove any mechanical blocking which may occur (at the impeller or motor shaft). The pump's current input is limited in this case (protective function). If the blocking cannot be removed, the pump will stop the start-up attempt, and error code E04 will be displayed. After a short interval the pump will try to start up again. The start-up attempts are limited to 24 hours. Once the pump has started up successfully, it will acknowledge the error message; error code E04 will disappear from the display.

Settings

None

7.3.5 Saving data

Function

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

Settings

None

7.3.6 General fault messages

Table 25: Error codes, causes and response

Error code on the display	Cause	Status	Response
E01	Excessive temperature	Alarm	Pump stops.
E02	Overcurrent	Alarm	Pump stops.
E03	Internal fault	Alarm	Pump stops.
E04	Pump rotor blocked	Alarm	Pump stops.
E05	Temperature limit reached	Warning	Speed is reduced.
E06	Voltage error	Alarm	Pump stops.
E08	Motor fault	Alarm	Pump stops.
E11	Broken wire of temperature sensor (NTC thermistor) in the motor	Warning	Speed is reduced.
E12	Firmware update required	Alarm	Pump stops.
E13	No pump model stored	Alarm	Pump stops.
E17	Externally forced flow	Alarm	Pump stops.
I18	Externally forced flow in pumping direction	Information	Pump keeps running.
I19	Externally forced flow in reverse direction	Information	Pump keeps running.

7.4 Resetting the factory setting


To reset the factory setting of the pump press the control button for more than 30 seconds.

This comprises the following settings:

Operating mode	Proportional-pressure Control
Functions	Deactivates the 0-10 V function
Setpoints	50 %


8 Servicing/Maintenance

8.1 Servicing/inspection

	<p>NOTE</p> <p>Any repairs on the pump must only be performed by one of our authorised service partners. Find your contact in the attached Addresses booklet or visit https://www.ksb.com/en-global/contact.</p>
---	---


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



8.2 Drainage/cleaning







	<p>WARNING</p> <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. Flush and clean the pump before transporting it to the workshop.
2. Provide a certificate of decontamination for the pump.

8.3 Removing the pump set from the piping



	<p>DANGER</p> <p>Hazardous electrical voltage when the covers of the terminal wiring compartments are removed Danger of death from electric shock!</p> <ul style="list-style-type: none"> ▷ For working on the terminals, switch off the power supply at least 5 minutes prior to commencing work and ensure that it cannot be switched on again unintentionally. ▷ If applicable, switch off the external power supply to message relays and control cables and make sure it cannot be switched on again unintentionally. ▷ Keep the covers of the terminal wiring compartments closed during operation as well as during maintenance work.
---	---

 	<p>DANGER</p> <p>Strong magnetic field in the pump 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.
--	---

	<div data-bbox="507 190 683 235">  DANGER </div> <div data-bbox="494 253 1324 358"> <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. </div>
	<div data-bbox="507 394 702 439">  WARNING </div> <div data-bbox="494 456 1364 817"> <p>Strong magnetic field Danger of crushing injuries when pulling out the pump rotor! Strong magnetic field can suddenly pull the pump rotor back into its original position! Danger of magnetic parts near the pump rotor being attracted!</p> <ul style="list-style-type: none"> ▷ The pump rotor must be removed from the electronic system housing by authorised specialist personnel only. ▷ 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. </div>
	<div data-bbox="507 855 702 900">  WARNING </div> <div data-bbox="494 918 1204 1023"> <p>Hot surface Risk of injury!</p> <ul style="list-style-type: none"> ▷ Allow the pump set to cool down to ambient temperature. </div>

- ✓ 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.

9 Trouble-shooting

	 WARNING
	Improper work to remedy faults Risk of injury! <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 customer service is required.

- A** Pump is running, but does not deliver
- B** Pump starts up but stops again immediately
- C** Noises during pump operation

E01 to E17 Shown on the display

Table 26: Trouble-shooting

Error value	Possible cause	Remedy ²⁾
A	<ul style="list-style-type: none"> ▪ Master switch switched off ▪ Defective fuse ▪ Electrical connection incorrect or not connected (alarm displayed) 	<ul style="list-style-type: none"> ▪ Check master switch. ▪ Check fuse. ▪ Check electrical connection of the pump.
B	<ul style="list-style-type: none"> ▪ Remote ON/OFF contact has been removed. ▪ Overcurrent at the motor (alarm displayed) 	<ul style="list-style-type: none"> ▪ Fit connecting bridge for remote ON/OFF function.
C	<ul style="list-style-type: none"> ▪ Air in the system ▪ Shut-off elements closed 	<ul style="list-style-type: none"> ▪ Vent the system and the pump. (⇒ Section 6.1.2, Page 27) ▪ Open the shut-off elements.
E01	<ul style="list-style-type: none"> ▪ Excessive temperature 	<ul style="list-style-type: none"> ▪ Let the pump cool down for some minutes. Manually interrupt power supply for a short period. Check that the pump starts up again. ▪ Verify that the fluid temperature and ambient temperature are within the permissible temperature ranges.
E02	<ul style="list-style-type: none"> ▪ Overcurrent ▪ In the case of externally forced flow, alarm E17 is active in addition. 	<ul style="list-style-type: none"> ▪ De-energise the pump for 1 minute; then re-energise it.
E03	<ul style="list-style-type: none"> ▪ Internal fault 	<ul style="list-style-type: none"> ▪ De-energise the pump for 1 minute; then re-energise it. ▪ Carry out a firmware update.
E04	<ul style="list-style-type: none"> ▪ Pump rotor blocked 	<ul style="list-style-type: none"> ▪ De-energise the pump for 1 minute; then re-energise it. ▪ If the pump is still blocked, properly dismantle and deblock it.
E05	<ul style="list-style-type: none"> ▪ Temperature limit reached 	<ul style="list-style-type: none"> ▪ To prevent a temperature increase inside the pump the speed has been reduced. ▪ Once the pump has cooled down, it will revert to its normal operating data. If the temperature continues to rise, E01 will be indicated on the display. ▪ Verify that the fluid temperature and ambient temperature are within the permissible temperature ranges.

²⁾ Release pump set pressure before attempting to remedy faults on parts which are subjected to pressure.

Error value	Possible cause	Remedy ²⁾
E06	<ul style="list-style-type: none"> Voltage error 	<ul style="list-style-type: none"> Verify that the supply voltage matches the data on the name plate. Measure the mains voltage.
E08	<ul style="list-style-type: none"> Motor fault Incorrect rotor angle caused by blocked rotor, for example. Incorrect rotor angle caused by externally forced flow. Alarm E17 is active. 	<ul style="list-style-type: none"> De-energise the pump for 1 minute; then re-energise it. If the faults/alarms have not been cleared, have the motor checked by KSB's service.
E11	<ul style="list-style-type: none"> Broken wire of temperature sensor (NTC thermistor) in the motor 	<ul style="list-style-type: none"> Have it check by KSB's service.
E12	<ul style="list-style-type: none"> Firmware not compatible 	<ul style="list-style-type: none"> Carry out a firmware update.
E13	<ul style="list-style-type: none"> No pump model stored. Pump stops. 	<ul style="list-style-type: none"> Reset to factory settings. (⇒ Section 7.4, Page 47) Carry out a firmware update. Enter pump size as indicated on the name plate.
E17	<ul style="list-style-type: none"> Externally forced flow 	<ul style="list-style-type: none"> Prevent or reduce externally forced flow.

10 Related Documents

10.1 Sectional drawing with list of components

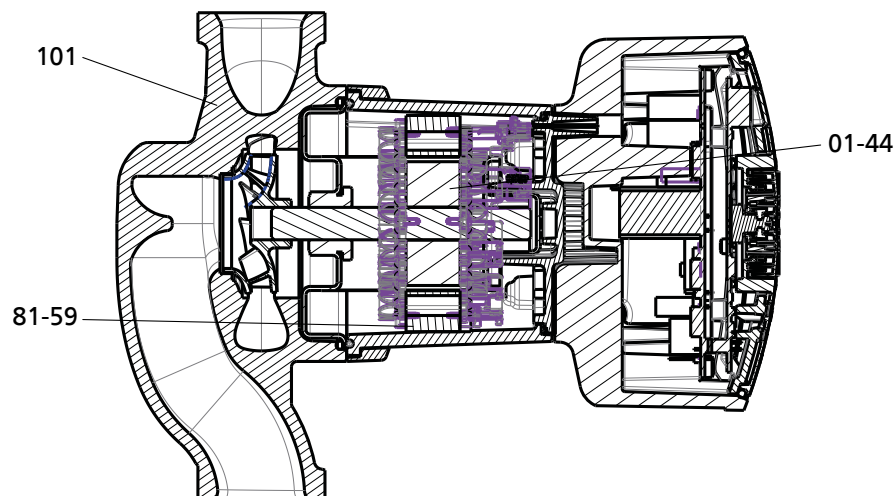


Fig. 20: Sectional drawing

Table 27: List of components

Part No.	Description	Part No.	Description
01-44	Rotor	101	Volute casing
81-59	Stator		

10.2 Wiring diagram

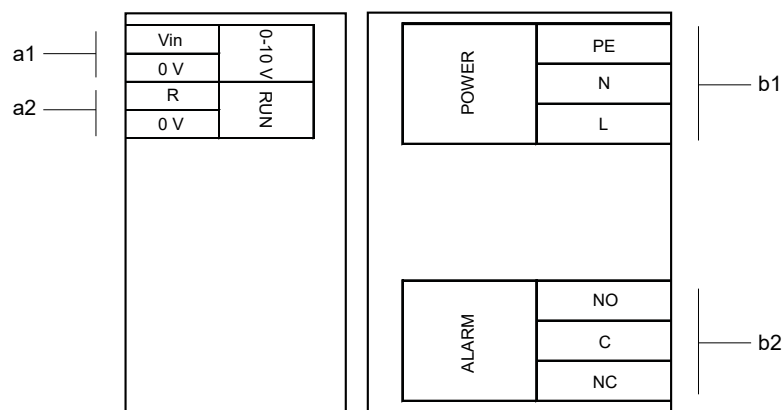


Fig. 21: Wiring diagram

Connections for control cables	
a1	External 0 - 10 V
a2	Remote ON/OFF
Connections for power supply and general fault message	
b1	Power supply 1~230 V AC +/- 10 %, 50 Hz/60 Hz
b2	General fault message

11 UK Declaration of Conformity

Manufacturer:

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

This UK Declaration of Conformity is issued under the sole responsibility of the manufacturer.

The manufacturer herewith declares that **the product**:

Calio S BMS

From serial number: xxxxxxxx-A201930-00041

- is in conformity with the provisions of the following directives / regulations as amended from time to time:
 - Supply of Machinery (Safety) Regulations 2008
(The safety objectives set out in the Electrical Equipment (Safety) Regulations 2016 are observed.)
 - Ecodesign for Energy-Related Products Regulations 2010
 - The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012
 - Electromagnetic Compatibility Regulations 2016

The manufacturer also declares that

- the following *designated standards* have been applied:
 - EN 809: 1998+A1:2009/AC:2010
 - EN 60335-1:2012+AC:2014+A11:2014+A13:2017+A1:2019+A14:2019+A2:2019+A15:2021
 - EN 60335-2-51:2003+A1:2008+A2:2012
 - EN 16297-1:2012, EN 16297-2:2012
- the following international standards have been applied:
 - EN 55014-1:2021, EN 55014-2:2021
 - EN 61000-3-2:2019+A1:2021, EN 61000-3-3:2013+A1:2019

Person authorised to compile the technical file:

Mark Griffiths
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LE11 5TF Loughborough (Great Britain)

The UK Declaration of Conformity was issued in/on:

Frankenthal, 7 February 2023



Jochen Schaab
Head of Product Development Pump Systems & Drives
KSB SE & Co. KGaA
Johann-Klein-Straße 9
67227 Frankenthal (Germany)

Index

A

Applications 8
Automatic functions 15

B

Bearings 15

C

Commissioning 27
Connections 15

D

Design 15
Designation 13
Disposal 12
Drive 15

E

Event of damage 6

F

Faults
 Causes and remedies 50
Fluid handled
 Density 30

I

Installation at site 18
Intended use 8

K

Key to safety symbols/markings 7

M

Manual functions 15

N

Name plate 14

O

Operating limits 29
Operating modes 15
Other applicable documents 6

P

Piping 21
Preservation 11, 31
Product description 13

R

Return to supplier 12
Returning to service 32

S

Safety 8
Safety awareness 9
Scope of supply 17
Shutdown 31
Signalling and display functions 15
Start-up 28
Storage 11, 31

W

Warnings 7
Warranty claims 6



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