Circulator for OEMs

Calio SI HP

Installation/Operating Manual



KSB

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Installation/Operating Manual Calio SI HP

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 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
Sub-supplier product literature	Operating manual

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

1.4 Symbols

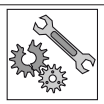
Table 2: Symbols used in this manual

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

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1.5 Key to safety symbols/markings

Table 3: 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.
	**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

DANGER

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.

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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 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.

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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 29) (⇨ Section 6.3.2, Page 29)
- 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 25)

2.8 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.

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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



CAUTION

Improper pump transport

Damage to the pump!

- ▷ Never suspend the pump/pump set from the power cable.
- ▷ Prevent the pump (set) from getting knocked or dropped.

3.3 Storage / preservation



CAUTION

Damage during storage due to humidity, dirt or vermin

Corrosion/contamination of the pump (set)!

- ▷ For outdoor storage cover the pump (set) or the packaged pump (set) and accessories with waterproof material.



CAUTION

Wet, contaminated or damaged openings and connections

Leakage or damage to the pump!

- ▷ 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.

For storing a pump (set) which has been operated, observe the instructions in (⇨ Section 6.3.2, Page 29) .

Table 4: Ambient conditions for storage

Ambient condition	Value
Relative humidity	80 % maximum
Ambient temperature	0 °C to +55 °C

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

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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.



NOTE

If required, a blank certificate of decontamination can be downloaded from the following web site: www.ksb.com/certificate_of_decontamination

3.5 Disposal



⚠ DANGER

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!

- ▹ Keep a safety distance of at least 0.3 m.



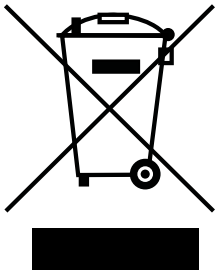
⚠ WARNING

Fluids handled, consumables and supplies which are hot and/or pose a health hazard

Hazard to persons and the environment!

- ▹ 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.



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.

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4 Description of the Pump (Set)

4.1 General description

- High-efficiency circulator pump
- Non-self-priming in-line pump

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 chemicals Regulation (EC) No. 1907/2006 (REACH), see http://www.ksb.com/reach.

4.3 Designation

Example: Calio SI HP 25-80

Table 5: Designation key

Code	Description	
Calio SI	Type series	
	HP	High-efficiency circulator pump
25	Connection	
	25	G 1 $^{1}/_{2}$
	30	G 2
80	Head [m]	
	80	Head × 10 Example: 8 m × 10 = 80

4.4 Name plate

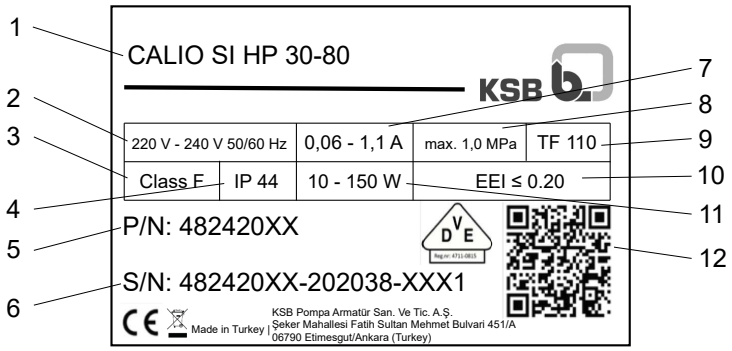


Fig. 1: Name plate (example)

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

Key to the production number

Example: 482420XX-202038-XXX1

Table 6: Key to the production number

Number	Description
482420XX	Material number
2020	Year of production

Number	Description
38	Week of production
XXX1	Consecutive number

4.5 Design details

Design

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

Drive

- Brushless permanent magnet synchronous motor, self-cooling
- 1~230 V AC
- Frequency 50 Hz/60 Hz
- Starting current 1.5 A
- Enclosure IP44
- Thermal class F
- Temperature class TF 110
- Energy efficiency index EEI ≤ 0.20
- Interference emissions EN 55014-1
- Interference immunity EN 55014-2
- IEC 60335-2-51

Bearings

- Ceramic bearings

Connections

- Screw-ended

Operating modes

- Operation controlled by external input (PWM signal or 0 - 10 V)[1)]
- Constant-pressure control
- Proportional-pressure control
- Setting the operating mode
- Setting the differential pressure setpoint
- Setting the speed level
- Vent function
- Deblocking the rotor

Signalling functions and display functions

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

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1 Optional

4.6 Configuration and function

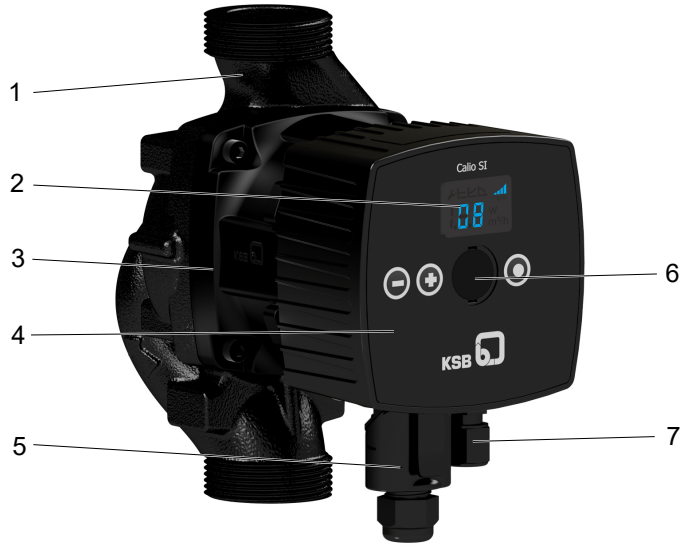


Fig. 2: Illustration of the pump set

1	Pump casing	5	Connection for power cable
2	Display	6	Vent plug
3	Impeller	7	Connection for control cable[2)]
4	Front cover		

Design The pump set is designed with a radial fluid inlet (suction nozzle) and a radial 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 motor housing has two connections, one for the power supply and one for an external control cable (data cable). The lubricating system and high-quality ceramic bearings ensure smooth running and a long service life.

Function The fluid handled enters the pump set via the suction nozzle and is accelerated outward by the rotating impeller (3). In the flow passage of the pump casing (1) the kinetic energy of the fluid handled is converted into pressure energy. The fluid handled is pumped to the discharge nozzle, where it leaves the pump set.

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2 For Calio SI HP 25-80, 30-80 with PWM / 0 - 10 V interface only

4.7 Noise characteristics

Average sound pressure level ≤ 30 dB (A)

4.8 Dimensions and weight

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

4.9 Scope of supply

- Pump set

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5 Installation at Site

5.1 Safety regulations



DANGER

Installation in potentially explosive atmospheres

Explosion hazard!

- ▷ 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.



CAUTION

Improper installation of the pump set

Damage to the pump set!

- ▷ 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).



DANGER

Calio SI Dual pump used for drinking water or foodstuff applications

Danger of poisoning!

- ▷ Never use Calio SI Dual pumps for drinking water applications or foodstuff applications.
- ▷ For drinking water applications and foodstuff applications only use the pump type Calio SI Therm.

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 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



DANGER

Leakage at the pump

Hot fluids escaping!

- ▷ Fit the sealing elements and make sure they are positioned correctly.

CAUTION

Ingress of fluid into the motor

Damage to the pump set!

- ▷ 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.

CAUTION

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.

NOTE

Installing shut-off valves upstream and downstream of the pump set is recommended. Make sure that no leakage water can drip onto the drive or terminal box.

NOTE

The direction of flow of a vertically installed pump should be upwards.

NOTE

Do not install the pump at the lowest point of the system to prevent any impurities from collecting in the pump.

Permissible installation positions

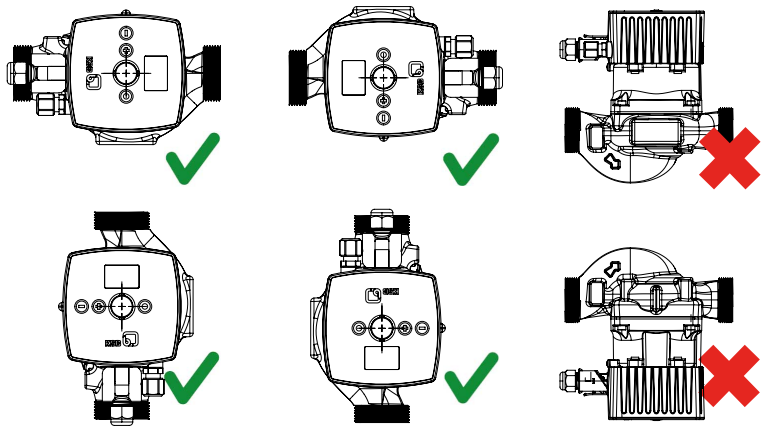


Fig. 3: Permissible installation positions

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 an assembly tool (e.g. pipe wrench).

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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



⚠ WARNING

Hot surface

Risk of burns

- ▷ Never touch a pump set when it is in operation.



⚠ WARNING

Impermissible loads acting on the pump nozzles

Risk of burns by hot fluids escaping!

- ▷ 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.



CAUTION

Contamination/dirt in the piping

Damage to the pump!

- ▷ Flush the piping prior to commissioning or replacing the pump. Remove any foreign matter.



NOTE

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.

- ✓ 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).

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5.5 Enclosure/insulation



⚠ WARNING

The pump takes on same temperature as the fluid handled

Risk of burns!

- ▷ Insulate the volute casing.
- ▷ Fit protective equipment.



CAUTION

Heat building up at motor housing and pump casing

Pump overheating!

- ▷ Never insulate the motor and electronic system housings.



NOTE

A two-piece thermal insulation shell is available as an accessory.

5.6 Electrical connection



⚠ DANGER

Electrical connection work by unqualified personnel

Danger of death from electric shock!

- ▷ Always have the electrical connections installed by a trained and qualified electrician.
- ▷ Observe regulations IEC 60364.



⚠ DANGER

Pump acting as a generator when running in reverse

Danger to life from hazardous induction voltage at the motor terminals!

- ▷ Prevent the fluid from flowing back by closing the shut-off elements.



⚠ WARNING

Incorrect connection to the mains

Damage to the mains network, short circuit!

- ▷ Observe the technical specifications of the local energy supply companies.



NOTE

Only the cables included in the scope of supply must be used for connecting the pump. Should a connection cable become defective, it must be replaced with a cable to the manufacturer's specifications.
Remove cables and/or plugs with a suitable tool.

5.6.1 Connecting the electric cables



Fig. 4: Connecting the electric cables

1	Connection for control cable[3)]	2	Connection for power cable

Connecting the power cable

Table 7: Power cable dimensions

Power cable dimensions	Values
Outside diameter	5,5 - 10,0 mm
Cross-section	0,5 - 1,5 mm² (solid or stranded[4)])

1. Verify the mains voltage at the site against the data on the name plate.
2. Switch off the power supply and make sure it cannot be switched on again unintentionally.
3. Fit the union nut and joint ring on the power cable.
4. Guide the power cable through the plug housing until the cable ends are freely accessible.
5. Strip the power cable as shown in the illustration.
   Strip about 18 mm of the earth conductor sheath. Strip about 13 mm of the neutral conductor sheath and L conductor sheath.
   Strip 6 mm of each core's sheath as a minimum.

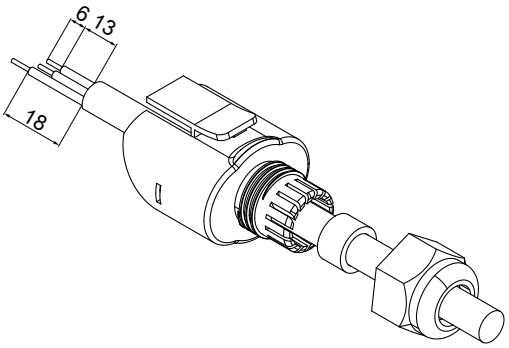


Fig. 5: Stripping the power cable [mm]

6. Connect the cores at the contact insert.

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3 For Calio SI HP 25-80, 30-80 with PWM / 0 - 10 V interface only
4 Fit wire end sleeves on stranded/flexible cores.

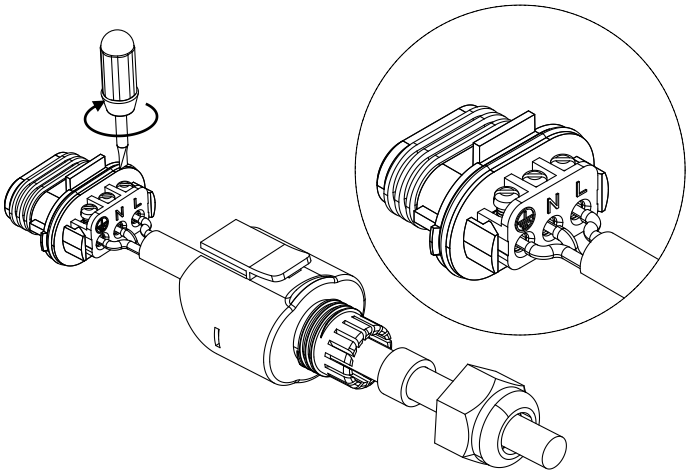


Fig. 6: Connecting the cores at the contact insert.

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

7. Slide the contact insert into the plug housing until you can hear it engage. Make sure the projection is positioned correctly.

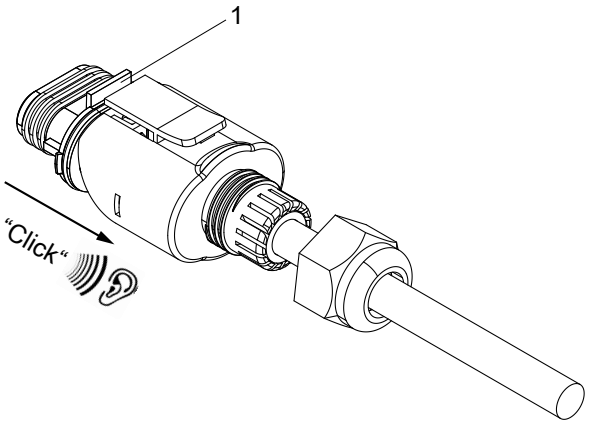


Fig. 7: Fastening the contact insert to the plug housing

1	Projection

8. Screw the union nut and joint ring hand-tight onto the thread at the plug housing.
9. Connect the plug-type connector at the pump set.

Connecting the control cable (PWM signal / 0 - 10 V)

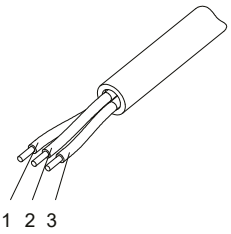


Fig. 8: Connecting the control cable (PWM signal / 0 - 10 V)

		PWM	0-10V
1	**Brown**	Input	0-10V
2	**Blue**	Ground	Ground
3	**Black**	Output	-

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 system piping has been cleaned. (⇨ Section 5.4, Page 20)
- The pump has been primed with the fluid to be handled. The pump has been vented. (⇨ Section 6.1.2, Page 25)

6.1.2 Priming and venting the pump



⚠ WARNING

Hot fluid escaping under pressure when the vent plug is opened

Risk of electric shock!

Risk of scalding!

- ▷ Loosen the vent plug; do not remove it.
- ▷ Protect the electric components against escaping fluid.
- ▷ Wear protective clothing (e.g. gloves).



CAUTION

Increased wear due to dry running

Damage to the pump set!

- ▷ 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.

1. Completely open the shut-off element in the suction line.
2. During operation at maximum speed loosen the vent plug with a suitable tool until some of the fluid handled escapes.
3. Tighten the vent plug to a maximum tightening torque of 0.5 Nm.
4. Repeat the procedure until all air has escaped.

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6.1.3 Start-up



DANGER

Non-compliance with the permissible pressure and temperature limits if the pump is operated with the suction and discharge lines closed.

Hot fluids escaping!

- 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

Excessive temperatures due to dry running

Risk of injury!
Damage to the pump set!

- 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

Abnormal noises, vibrations, temperatures or leakage

Damage to the pump!

- 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 any, 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 head line / suction lift line.
2. Close or slightly open the shut-off element in the discharge line.
3. Start up the motor.

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6.2 Operating limits



DANGER

Non-compliance with operating limits for pressure, temperature, fluid handled and speed

Hot fluids escaping!

- ▷ 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 Ambient temperature



CAUTION

Operation outside the permissible ambient temperature

Damage to the pump (set)!

- ▷ Observe the specified limits for permissible ambient temperatures.

Observe the following parameters and values during operation:

Table 8: Permissible ambient temperatures specified for the fluid temperature

Fluid temperature	Permissible ambient temperature	
	MIN	Maximum
-10 °C to +110 °C	0 °C	+55 °C[5)]

6.2.2 Minimum inlet pressure

The minimum inlet pressure p_{min} at the pump suction nozzle serves to avoid cavitation noises at an ambient temperature of +40 °C and 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 9: 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

6.2.3 Maximum operating pressure



CAUTION

Permissible operating pressure exceeded

Damage to connections and seals!

- ▷ Never exceed the operating pressure specified in the data sheet.

The maximum operating pressure is 10 bar.

5 In the boiler

6.2.4 Fluid handled

6.2.4.1 Permissible fluids to be handled



DANGER

Use for drinking water or foodstuff applications

Danger of poisoning!

- ▷ Never use the pump for drinking water or foodstuff applications.



CAUTION

Unsuitable fluids

Damage to the pump!

- ▷ Never use the pump to handle corrosive, combustible or explosive fluids.
- ▷ Never use the pump to handle waste water or abrasive fluids.
- ▷ Do not use the pump for foodstuff applications.

- Heating water to VDI 2035. If the glycol content equals or exceeds 20 %, check and verify the operating data.
- Pure, thin, non-aggressive, non-explosive and non-gaseous fluids not containing any mineral oil, solids or long fibres
- Fluids with a viscosity of max. 10 mm^2/s

6.2.4.2 Density of the fluid handled



CAUTION

Impermissibly high density of the fluid handled

Motor overload!

- ▷ Observe the information on fluid density in the data sheet.

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

6.2.4.3 Fluid temperature



CAUTION

Incorrect fluid temperature

Damage to the pump (set)!

- ▷ Only operate the pump (set) within the temperature limits indicated.

Table 10: 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.

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6.3 Shutdown/storage/preservation

6.3.1 Shutdown



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.

✓ 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.

For prolonged shutdown periods



CAUTION

Risk of freezing during prolonged pump shutdown periods

Damage to the pump!

▹ Drain the pump and the cooling/heating chambers (if any) or otherwise protect them against freezing.

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 43) and the safety instructions for dismantling the pump have been observed. (⇨ Section 8.3, Page 43)

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

6.4 Returning to service



⚠ WARNING

Failure to re-install or re-activate protective devices

Risk of injury from moving parts or escaping fluid!

▹ As soon as the work is completed, properly re-install and re-activate any safety-relevant devices and protective devices.

For returning the equipment to service, observe the sections on commissioning/start-up (⇨ Section 6.1, Page 25) and the operating limits (⇨ Section 6.2, Page 27) .

In addition, carry out all servicing/maintenance operations before returning the pump (set) to service. (⇨ Section 8, Page 43)

7 Operation

7.1 Control panel

All settings are made using the control element on the housing front. The control element comprises three control pushbuttons.

Table 11: Overview of control buttons

Control button	Function
	▪ Change the operating mode. ▪ Turn on display backlighting. ▪ Save the setpoint.
	▪ Increase the setting. ▪ Increase the setpoint.
	▪ Reduce the setting. ▪ Reduce the setpoint.

7.1.1 Display

The measured electrical input power, the flow rate and the head are shown as numerical values on the integrated display. The values are displayed with the corresponding units.

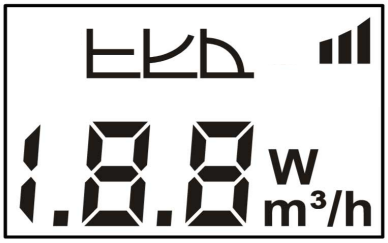


Fig. 9: Display

Symbols

The symbols indicate operating modes, functions and settings. Lit symbols indicate the active operating mode, function or setting.

Table 12: Symbols key

Symbol	Description	Unit
m³/h	Flow rate ▪ Symbol lights up. ▪ Display shows the flow rate.	m³/h
W	Measured electrical input power ▪ Symbol lights up. ▪ Display shows the electrical power.	W
m	Head ▪ Symbol lights up. Display shows the head.	m
	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.	-

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Symbol	Description	Unit
	Open-loop Control operating mode ▪ Symbol lights up when this operating mode is active. ▪ The bar diagram shows the active speed level.	-
	Operation controlled by external input ▪ Symbol lights up when this operating mode is active.	-
	Fault message (e.g. error code E8) ▪ An error code (E01 - E09) is shown on the display.	-

7.1.2 Display

The measured electrical input power, the flow rate and the head are shown as numerical values on the integrated display. The values are displayed with the corresponding units.



Fig. 10: Display

Symbols

The symbols indicate operating modes, functions and settings. Lit symbols indicate the active operating mode, function or setting.

Table 13: Symbols key

Symbol	Description	Unit
m³/h	Flow rate ▪ Symbol lights up. ▪ Display shows the flow rate.	m³/h
W	Measured electrical input power ▪ Symbol lights up. ▪ Display shows the electrical power.	W
m	Head ▪ Symbol lights up. Display shows the head.	m
	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. ▪ The bar diagram shows the active speed level.	-
eco	EcoMatch operating mode ▪ Symbol lights up when this operating mode is active.	-
	Operation controlled by external input ▪ Symbol lights up when this operating mode is active.	-
	Error message (e.g. error code E8) ▪ An error code (E01 - E09) is shown on the display.	-

7.2 Operating modes

7.2.1 Information on settings

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

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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 differential pressure setpoint H_S is constant, situated between the maximum curve ① and the permissible flow rate range.

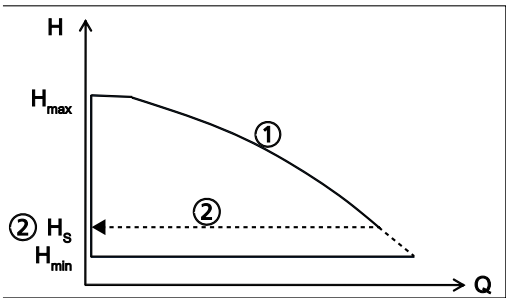


Fig. 11: Constant-pressure Control function

Setting

Table 14: Selecting Constant-pressure Control and the setpoint

	Step 1: Activating the setting mode ▪ Press and hold the control button (•) for 3 seconds – This will activate the display backlighting. – The flashing symbol indicates the active operating mode.
	Step 2: Selecting the Constant-pressure Control operating mode ▪ Press the control button (•) for a minimum of 0.5 seconds until the symbol for Constant-pressure Control flashes.
	Step 3: Changing the setpoint ▪ Increase or decrease the head setpoint by pressing the control buttons (+) or (-) respectively.
-	Step 4: Confirming the current setpoint ▪ Press and hold the control button (•) for a minimum of 3 seconds. – The set setpoint flashes and is saved.

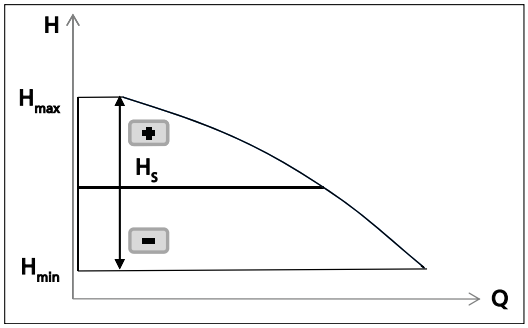


Fig. 12: Constant-pressure Control settings

7.2.3 Proportional-pressure control

Applications

- Two-pipe heating systems
- 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.
  - Control curve too low: undersupply
  - Control curve too high: increased energy input

Function

Within the permissible flow rate range the Proportional-pressure Control decreases or increases the differential pressure setpoint between $^1/_2$ H_S and H_S (factory setting).

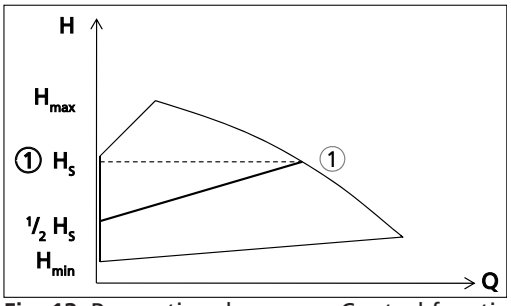


Fig. 13: Proportional-pressure Control function

Setting

Table 15: Selecting Proportional-pressure Control and the setpoint

	Step 1: Activating the setting mode ▪ Press and hold the control button (●) for 3 seconds – This will activate the display backlighting. – The flashing symbol indicates the active operating mode.
	Step 2: Selecting the Proportional-pressure Control operating mode ▪ Press the control button (●) for a minimum of 0.5 seconds until the symbol for Proportional-pressure Control flashes.
	Step 3: Changing the setpoint ▪ Increase or decrease the setpoint by pressing the control buttons (+) or (-) respectively.
-	Step 4: Confirming the current setpoint ▪ Press and hold the control button (●) for a minimum of 3 seconds. – The set setpoint flashes and is saved.

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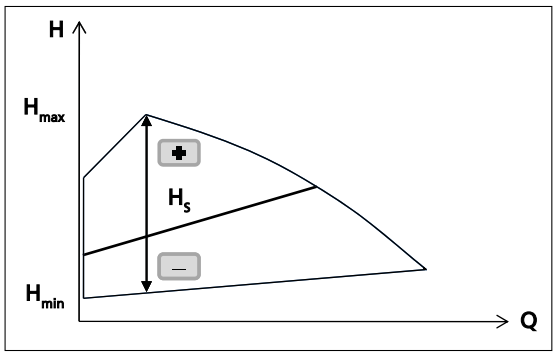


Fig. 14: Proportional-pressure Control settings

7.2.4 Open-loop control mode

Function

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

Setting

Table 16: Selecting Open-loop Control and the setpoint

	Step 1: Activating the setting mode ▪ Press and hold the control button (•) for 3 seconds – This will activate the display backlighting. – The flashing symbol indicates the active operating mode.
	Step 2: Selecting the Open-loop Control operating mode ▪ Press the control button (•) for a minimum of 0.5 seconds until the symbol for Open-loop Control flashes.
	Step 3: Changing the setpoint ▪ Increase or decrease the setpoint by pressing the control buttons (+) or (-) respectively. – The bar diagram shows the active speed level. Setpoint 1 = 1 bar flashes Setpoint 2 = 2 bars flash Setpoint 3 = 3 bars flash Setpoint 4 = 4 bars flash
-	Step 4: Confirming the current setpoint ▪ Press and hold the control button (•) for a minimum of 3 seconds. – The set setpoint flashes and is saved.

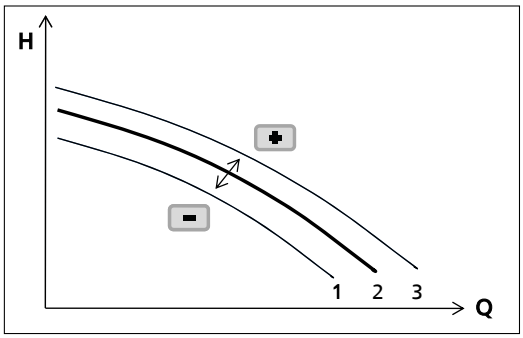


Fig. 15: Open-loop Control settings

7.2.5 Operation controlled by external input

PWM signal

The pump set communicates with an external control system via a pump-integrated 2-way PWM interface. The pump control system sends the estimated flow rate Q to the external control system and, in return, receives the maximum required differential pressure. Based on the value received, the pump control system adjusts the speed.

More information:

- PWM profile A (heating applications)
- PWM profile C (solar applications)

Analog signal 0 - 10 V

The pump set speed can be adjusted via an analog signal.

The pump set starts up with the minimum speed for its size at 3 V DC. The pump set increases the speed in a linear fashion with the increasing input signal up to the maximum readable voltage (10 V DC). When the input signal drops down to the threshold value of 3 V DC, the pump set switches to its minimum speed. When the input voltage drops below 1.5 V DC, the pump set stops. This prevents unnecessary stopping and starting of the pump set at fluctuating input signals around the stop threshold value (hysteresis).

More information:

- Operation controlled by analog signal 0 - 10 V

Setting

Table 17: Selecting the application under External Input

	Step 1: Activating the setting mode ▪ Press and hold the control button (•) for 3 seconds – This will activate the display backlighting. – The flashing symbol indicates the active operating mode.
	Step 2: Selecting the External Input ▪ Press the control button (•) for a minimum of 0.5 seconds until the symbol for External Input flashes.
	Step 3: Selecting the application ▪ Select the application by pressing the control buttons (+) or (-). – The bar diagram shows the active speed level. PA = heating applications PC = solar applications AN = analog signal 0 - 10 V
-	Step 4: Confirming the current setpoint ▪ Press and hold the control button (•) for a minimum of 3 seconds. – The set setpoint flashes and is saved.

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7.2.5.1 Operation with PWM profile A (heating applications)

PWM signals from the external control system to the pump control system

An external control system sends the following parameters:

- Pump ID
- Minimum and maximum speed

Table 18: Parameters sent by external control system

Parameter	PWM signal [%]	Comments
Maximum speed	0 - 5	No PWM signal connected: The pump set is operated at maximum speed.
Pump ID	95 - 100	-
Modulation	5 - 90	-
Stand-by	92 - 100	The pump set can also be controlled when in stand-by mode.

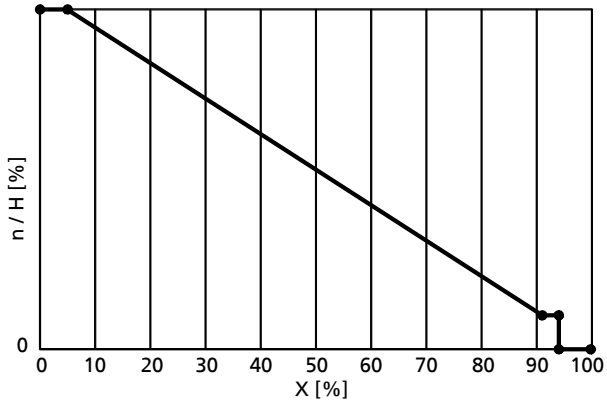


Fig. 16: PWM signal from external control system to pump control system

n	Speed	X	PWM

PWM signals from the pump control system to the external control system

The pump set sends the following parameters:

- Pump ID
- Calculated flow rate [m^3/h]
- Fault status for dry running and blocked rotor

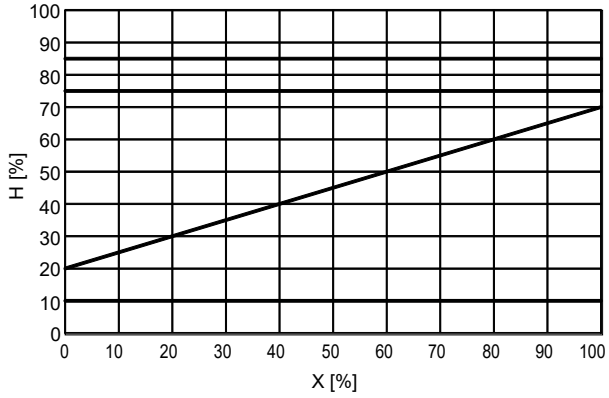


Fig. 17: PWM profile A, PWM signal from pump control system to external control system

H	Head	X	PWM

Table 19: Parameters sent by pump set

Parameter / function	PWM signal	Comments
	[%]	
Pump ID	85	-
Blocked rotor	75	-
Modulation	20 - 70	Estimated flow rate
Dry running	10	-

Table 20: Speeds depending on the size

Size	Speed	
	Minimum	Maximum
	[rpm]	[rpm]
25-80	1000	4000
30-80	1000	4000

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7.2.5.2 Operation with PWM profile C (solar applications)

PWM signals from the external control system to the pump control system

An external control system sends the following parameters:

- Pump ID
- Minimum and maximum speed
- Stand-by mode

Table 21: Parameters sent by external control system

Parameter	PWM signal [%]	Comments
Maximum speed	90 - 94	No PWM signal connected: Pump set stops.
Pump ID	95 - 100	-
Modulation	5 - 90	-
Stand-by	94 - 100	The pump set can also be controlled when in stand-by mode.

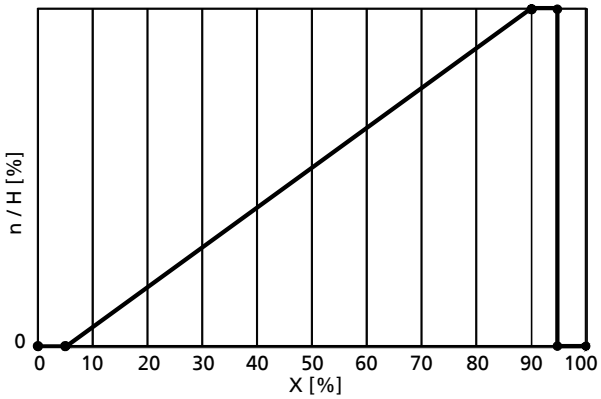


Fig. 18: PWM signal from external control system to pump control system

n	Speed	X	PWM

PWM signals from the pump control system to the external control system

The pump set sends the following parameters:

- Pump ID
- Calculated flow rate [m^3/h]
- Fault status for dry running and blocked rotor

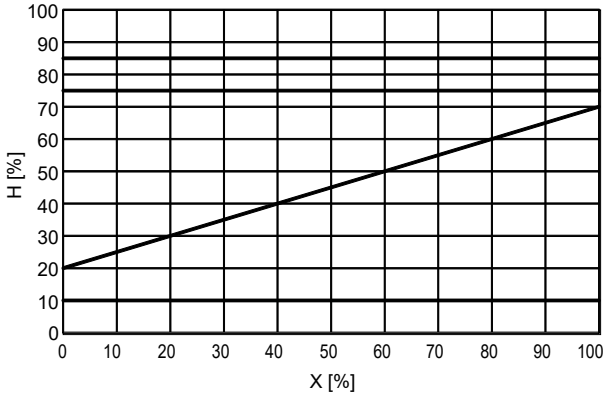


Fig. 19: PWM profile C, PWM signal from the pump to the external control system

H	Head	X	PWM

Table 22: Parameters sent by pump set

Parameter / function	PWM signal	Comments
	[%]	
Pump ID	85	-
Blocked rotor	75	-
Modulation	20 - 70	Estimated flow rate
Dry running	10	-

Table 23: Speeds depending on the size

Size	Speed	
	Minimum	Maximum
	[rpm]	[rpm]
25-80	1000	4000
30-80	1000	4000

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7.2.5.3 Operation controlled by analog signal 0 - 10 V

Operation of the pump set can be controlled by analog signal (0 - 10 V). For connecting the analog signal 0 to 10 V, use the same terminals as for the PWM signal.

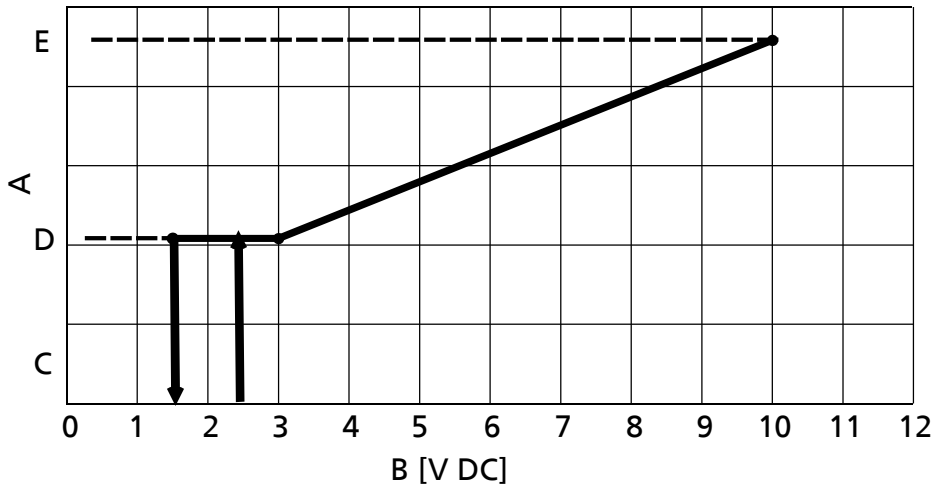


Fig. 20: Operation controlled by analog signal 0 - 10 V

A	Speed [rpm]
B	Voltage of input signal
C	Pump OFF
D	Minimum speed 1000 rpm
E	Maximum speed [rpm]

Table 24: Speeds depending on the size

Size	Speed	
	Minimum	Maximum
	[rpm]	[rpm]
25-80	1000	4000
30-80	1000	4000

7.3 Functions

7.3.1 Protective functions

Function

The electronic motor protection limits the starting current to a maximum of 4 A.

Available protective functions:

- Protection against overheating
- Blocked pump rotor (automatic re-start)

Settings

None

7.3.2 Saving data

The operating data of the pump are saved permanently. 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 settings that were active before the pump was last stopped.

7.3.3 Error messages

Function

The pump set indicates errors by showing an error code on the display.

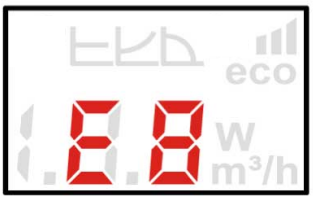


Fig. 21: Display of error code E8 (motor fault)

Example

Error E8 has occurred. The display flashes in 0.5-second intervals.
Once the error has been remedied, the display will revert to the set operating mode.
The settings of the pump set can then be changed again.

Table 25: Error codes, causes and response

Error code on the display	Cause	Status	Action
E01	Excessive temperature	Alarm	Pump stops.
E02	Overcurrent	Alarm	Pump stops.
E03	Internal fault	Alarm	Pump stops.
E04	Blocked rotor	Alarm	Pump stops.
E06	Voltage error	Alarm	Pump stops.
E08	Motor fault	Alarm	Pump stops.

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8 Servicing/Maintenance

8.1 Servicing/maintenance/inspection



⚠ WARNING

Hot water escaping under pressure when the vent plug is opened

Risk of electric shock!

Risk of scalding!

- ▹ Protect the electric components against escaping fluid.
- ▹ Wear protective clothing (e.g. gloves).



NOTE

Any repairs on the pump (set) must only be performed by an authorised service partner. In the event of damage contact the heating system engineer.

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 severely is contaminated, the pump rotor can become blocked.

Deblocking

1. Close the valves on the suction side and discharge side.
2. Remove the vent plug with a suitable tool.
3. Deblock the pump rotor at the shaft end by turning it with a suitable tool.
4. Tighten the vent plug to a maximum tightening torque of 0.5 Nm. Check that it is tightly sealed.

After maintenance work and inspection have been completed, proceed with the section on Returning to service (⇨ Section 6.4, Page 29) .

8.2 Drainage/cleaning



⚠ WARNING

Fluids handled, consumables and supplies which are hot and/or pose a health hazard

Hazard to persons and the environment!

- ▹ 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



⚠ DANGER

Work performed on an energised terminal box

Danger of death from electric shock!

- ▹ Switch off the power supply at least 5 minutes prior to commencing work and ensure that it cannot be switched on again unintentionally.



DANGER

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!

- ▹ Keep a safety distance of at least 0.3 m.



DANGER

Pump acting as a generator when running in reverse

Danger to life from hazardous induction voltage at the motor terminals!

- ▹ Prevent the fluid from flowing back by closing the shut-off elements.



WARNING

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!

- ▹ 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.



WARNING

Hot surface

Risk of injury!

- ▹ Allow the pump set to cool down to ambient temperature.



CAUTION

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!

- ▹ Remove any magnetic parts from the vicinity of the rotor.
- ▹ Keep the assembly area clean.

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CAUTION

Danger by strong magnetic field

Negative impact on or damage to electrical devices!

- ▷ 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.

9 Trouble-shooting



⚠ WARNING

Improper work to remedy faults

Risk of injury!

- ▷ 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.

If problems occur that are not described in the following table, consultation with the KSB 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 26: Trouble-shooting

Error value	Possible cause	Remedy[6)]
A	▪ See Error messages	▪ Reset the control system. Check the power supply and fuses.
B	▪ Impurities in the pump	▪ (⇨ Section 8.1, Page 43)
B	▪ Blockage in the pump	▪ (⇨ Section 8.1, Page 43)
C	▪ Air in the system ▪ Shut-off elements closed	▪ Vent the system and the pump. (⇨ Section 6.1.2, Page 25) ▪ Open the shut-off elements.
D	▪ Power too high ▪ System pressure too low ▪ Air in the system ▪ Pump running dry	▪ Reduce the differential pressure setpoint. ▪ Increase the system pressure by filling more water into the boiler. ▪ Vent the system and the pump. (⇨ Section 6.1.2, Page 25) ▪ Prime the pump. (⇨ Section 6.1.2, Page 25)

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

10 Related Documents

10.1 Sectional drawing with list of components

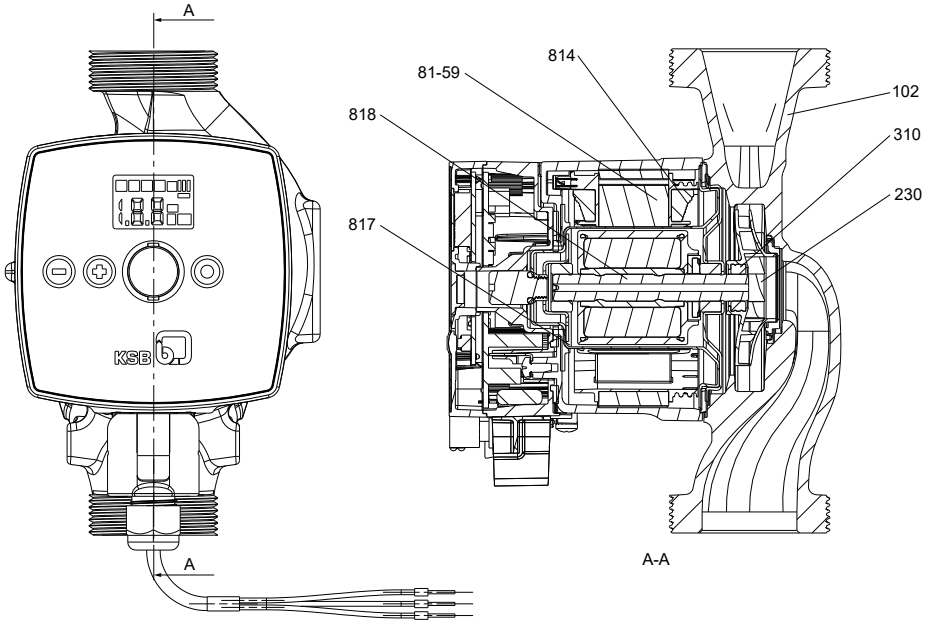


Fig. 22: Sectional drawing (example)

Table 27: List of components

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

10.2 Standards and technical codes / directives

Table 28: Standards and technical codes / directives

Type / description	Standard / Directive
VDE approval	IEC 335 PD3
Ecodesign Directive 2009/125/EC Regulation Nos. 641/2009 and/or 622/2012	EN 16297-1, EN 16297-2
Low-voltage Directive	2014/35/EU
Household and Similar Electrical Appliances – Safety – Part 1: General Requirements	DIN EN 60335-1: 2012/AC:2014
Household and similar electrical appliances – Safety – Part 2-51: Particular Requirements for Stationary Circulation Pumps for Heating and Service Water Installations	DIN EN 60335-2-51: 2003/A1:2008/A2:1012
Electromagnetic Compatibility (EMC) – Part 1: Interference Emission – Requirements for Household Appliances, Electric Tools and Similar Apparatus	DIN EN 55014-1: 2006 / A1: 2009
Electromagnetic Compatibility (EMC) – Part 2: Interference Immunity – Requirements for Household Appliances, Electric Tools and Similar Apparatus	DIN EN 55014-2: 1997/A1:2001/A2:2008
Electromagnetic Compatibility (EMC) – Part 3-2: Limits for Harmonic Current Emissions	DIN EN 61000-3-2
Electromagnetic Compatibility (EMC) – Part 3-3: Limitation of Voltage Changes, Voltage Fluctuations and Flicker in Public Low-voltage Supply Systems	DIN EN 61000-3-3
Electromagnetic Compatibility (EMC) – Part 6-2: Immunity for Industrial Environments	DIN EN 61000-6-2: 2005
Electromagnetic Compatibility (EMC) – Part 6-3: Emission Standard for Residential, Commercial and Light-industrial Environments	DIN EN 61000-6-3: 2007
Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS)	RoHS Directive 2011/65/EU RoHS Directive 2015/863/EU RoHS Directive 2017/2102/EU
Regulation No. 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)	REACH Regulation 1907/2006

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11 EU Declaration of Conformity

Manufacturer: **KSB Pompa Armatür San. ve Tic. A.Ş.**
Şeker Mahallesi Fatih Sultan Mehmet Bulvari 451/A
06930 Ankara Factory (Turkey)

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

Calio SI HP / HP Mini

Serial number range: 48242XXX-202001-XXXX to 48242XXX-202152-XXXX

- is in conformity with the provisions of the following directives / regulations as amended from time to time:
  - 2009/125/EC: Creation of a framework for the stipulation of requirements for the environmentally compatible design of energy-related products (Ecodesign Directive), Regulation No. 641/2009 and/or 622/2012
  - Electrical components[7)]: 2011/65/EU Restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)
  - 2014/30/EU: Electromagnetic Compatibility (EMC)
  - 2014/35/EU: Electrical Equipment Designed for Use within Specific Voltage Limits (Low Voltage)

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:

Ankara, 25 February 2020



Coskuner, Evren

Head of Research and Development

KSB Pompa Armatür San. ve Tic. A.Ş.
Seker Mah. Fatih Sultan Mehmet Bulv. 451/A

TR-06930 Ankara Factory

7 Where applicable

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