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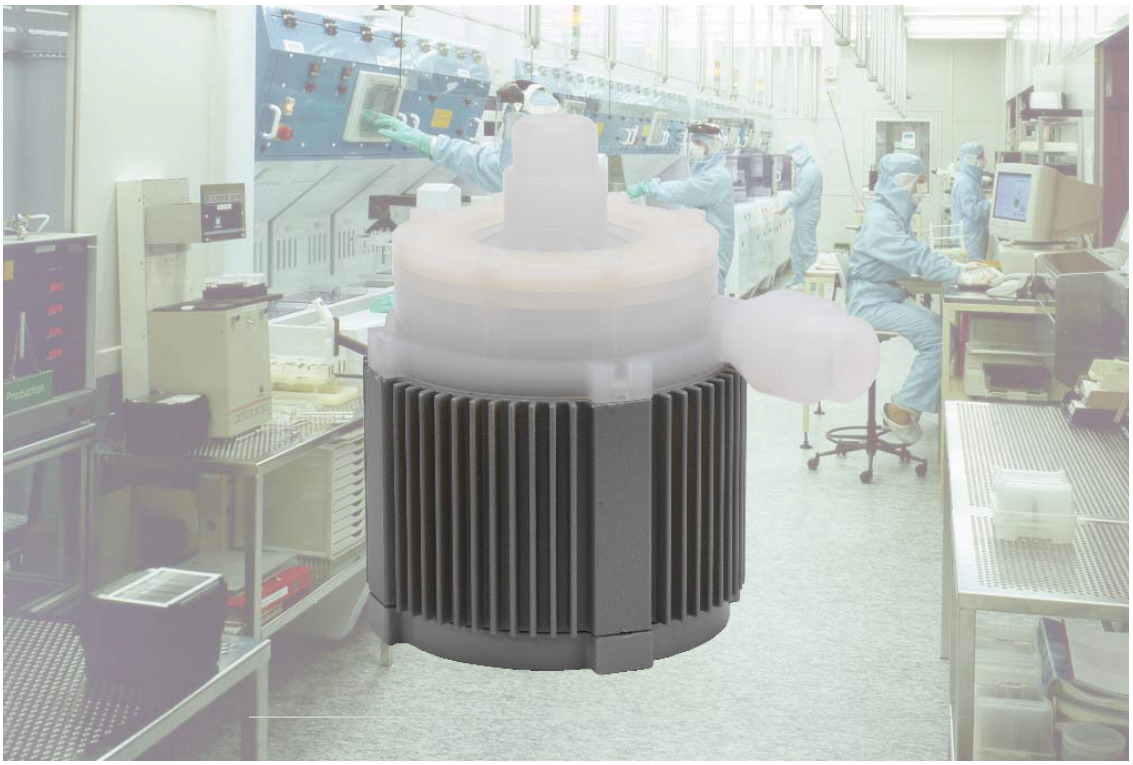
Find the *Levitronix LC48* at our website: ***Click HERE***

Bearingless Pump System BPS-3

2.5 bar (36 psi)
75 liters/min (20 gallons/min)

USER MANUAL

Not to be used for new applications.
Alternative: BPS-600.



This manual contains information necessary for the safe and proper use of the *BPS-3*. Included are specifications for the standard configurations of the pump system and instructions regarding its use, installation, operation, adjustment, inspection and maintenance. For special configurations of the pump system refer to accompanying information. Please familiarize yourself with the contents of the manual to ensure the safe and effective use of this product. After reading this manual, please store the manual where the personnel responsible for operating the pump system can readily refer to it at any time.

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1 Safety Precautions

CAUTION

Do not under any circumstances open the controller or PLC-Interface Module. Levitronix does not assume responsibility for any damage, which occurs under such circumstances.



CAUTION

***High magnetic field strength of pump impeller**.*

The pump system contains a rotor magnet with high field strength. This may alter or damage the calibration of sensitive electronic devices and measuring instruments in the immediate surroundings.

Keep at a safe distance from computers, monitors and all magnetic data storage media (e.g. disks, credit cards, audio and video tapes etc.)



⚠ WARNING

Hazardous voltage may be present.

In case of the usage of an inadequate AC/DC power supply, mains voltages may be present (even if the system is designed for 48VDC).

The controller must be grounded and placed in a spill protected environment. Do not under any circumstances open the powered controller. The usage of galvanic separated AC/DC supply is highly recommended.



⚠ WARNING

High magnetic field strength of pump impeller.

The Bearingless Pump System BPS-3 contains a rotor magnet with high field strength. Pacemakers may be influenced and magnetic forces may lead to contusions.

Keep distance to pacemakers and handle impeller with care.





⚠ WARNING

TOXIC CHEMICALS may be present.

When using the system to pump chemicals skin contact and toxic gases may be hazardous to your health.

Wear safety gloves and other appropriate safety equipment.



2 Specifications

2.1 System Overview and General Specification

Figure 1 shows the *Bearingless Pump System BPS-3*, its components and tools. The *BPS-3* can be controlled by digital and analog signals or with the optional Levitronix® handheld user interface via RS-232. When the system is operated by analog and digital signals, the *PLC* interface module is required.

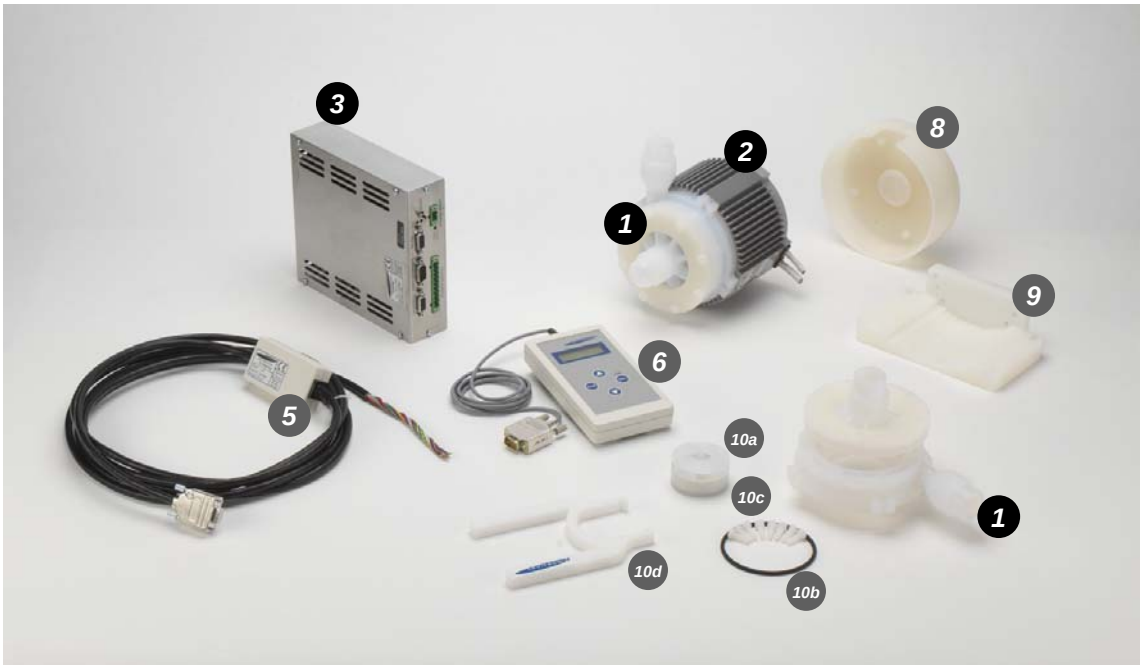


Figure 1: Bearingless Pump System BPS-3 and its components

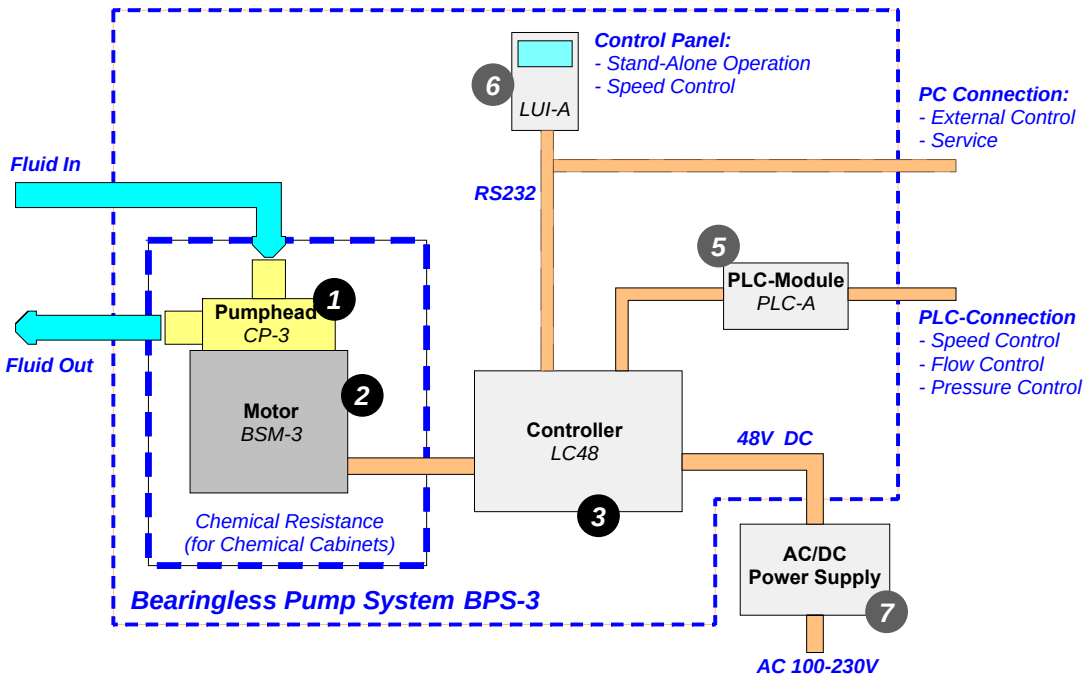


Figure 2: Block diagram of the pump system

Pos.	Component	Article Name	Article #	Characteristics	Value / Feature
1	Pump Head	CP-3.5	100-90206	Impeller Pump Casing Sealing Ring	*PFA* *PFA* *Kalrez® perfluoroelastomer* [1]
				Fittings	*Flaretek 1"*
				Max. Flow Diff.-Pressure Max. Viscosity	*75 liters/min* *20 gallons/min* *2.5 bar* *36 psi* *50 cP*
				Max. Static Pressure (mounted on motor)	*7.7 bar / 112 psi* *@ 25 °C / 77 °F liquid temp.* *3.8 bar / 55 psi* *@ 90 °C / 194 °F liquid temp.*
				Max. Liquid Temp.	*90 °C / 194 °F*
2a	Motor	BSM-3.2	100-10001	Housing	*ETFE coated Aluminum* *waterproofed (IP67 if pumphead is mounted)*
				Max. Speed	*For standard firmware R3.48 with Revison = 00:* *8000 RPM, for dry running recommended max. set speed is 5000 rpm* *For standard firmware R3.48 with Revision > 00:* *8000 RPM, with automatic limitation to 5000 rpm during dry running*
				Thermal Protection	*Internal temperature sensor with max temperature = 90°C (194°F)*
				Noise Level	*47dBA @ 8000 rpm and 1m distance*
				Cable / Connectors	*2x 6m cables with FEP jacket / D-SUB and COMBICON* *(direct connection to controller, no adaptor cable needed)*
2b	Motor	BSM-3.4-30	100-10015	Cable / Connectors	*2x 3m cables with FEP jacket / 2x Circular Connectors (IP-67)* *(extension cables according to Table 2 needed)*
2c	Motor	BSM-3.4-05	100-10010	Cable / Connectors	*2x 0.5m cables with FEP jacket / 2x Circular Connectors (IP-67)* *(extension cables according to Table 2 needed)*
3	Controller	LC48	100-30008 (Controller with power supply cable PSC-3.1 included in 100-90318)	Elec. Power / Voltage	*600 W / 48V DC*
				Interfaces	*Analog and digital I/Os for PLC-Interface module, RS232 for service PC or handheld user interface*
				Thermal Protection	*Internal temperature sensor with max temperature = 70°C (158°F)*
				Accessories	*Power supply cable PSC-3.1 incl. in article package 100-90318*

Table 1: Specification of standard components

1: Kalrez® is a registered trademark of DuPont Dow Elastomers

Pos.	Component	Article Name	Article #	Characteristics	Value / Feature
4a	Extension Adaptor Cable Sensor	MCAS-3.1-05 (0.5m) MCAS-3.1-10 (1m) MCAS-3.1-30 (3m) MCAS-3.1-50 (5m) MCAS-3.1-70 (7m) MCAS-3.1-100 (10m)	190-10013 190-10077 190-10014 190-10007 190-10039 190-10067	Jacket and Connectors	*PUR-jacket and circular Hummel to D-SUB connector*
4b	Extension Adaptor Cable Power	MCAP-3.1-05 (0.5m) MCAP-3.1-10 (1m) MCAP-3.1-30 (3m) MCAP-3.1-50 (5m) MCAP-3.1-70 (7m) MCAP-3.1-100 (10m)	190-10011 190-10078 190-10012 190-10006 190-10079 190-10066	Jacket and Connectors	*PUR-jacket and circular Hummel to D-SUB connector*
5	PLC Module	PLC-A.1	100-30200	Digital Inputs Digital Outputs	*3x 24V DC (typical), galvanic isolated* *3x closing relay (30V, 1A)*
				Analog Inputs Analog Outputs	*2x 4-20mA, not galvanic isolated* *2x 0-5V, not galvanic isolated*
6	Manual Control. for Stand-Alone Operation	LUI-A.1	100-30300	Interface	*RS232*
7	AC/DC Power Supply	TIS 600-148 (Traco)	100-40002	Power / Voltage Output	*600W / 48V*
				Voltage Input	*93-132V, 187-264V (switchable, 50/60Hz)*
8	Air Cooling Module	ACM-3.1	190-10001	Material / Connection Port	*PVDF / NPT ¼"*
				Cooling Medium	*Compressed air or N2*
				Inlet Pressure Air Consumption	*~1 -3 bar (14 – 43 psi)* *140 Liter/min @ 1.5 bar (22psi)*
9	Mounting Base Plate	MBP-3.1	190-10002	Material	*PVDF*
10 (a+b+ c+d)	Impeller Exchange Kit	IEK-3.4	100-90504	Impeller (a)	*IMP-3.3 (PFA)*
				O-Ring (b)	*Kalrez® (compound 6375), 72.62x3.53*
				Screws (c)	*8 PVDF screws, M6 x 25*
				Exchange Tool (d)	*IET-3.1*

Table 2: Specification of accessories

System Name	Article #	Pumphead	Motor	Controller	Note
BPS-3.7	100-90114	CP-3.5	BSM-3.2	LC48	*Accessories have to be ordered as separate article according to Table 2*
BPS-3.11	100-90124	CP-3.5	BSM-3.4-05	LC48	*Adaptor/Extension cable (0.5 - 10m) and other accessories have to be ordered as separate article according to Table 2*
BPS-3.12	100-90224	CP-3.5	BSM-3.4-30	LC48	

Table 3: Standard system configurations

2.2 Pressure-Flow Curves

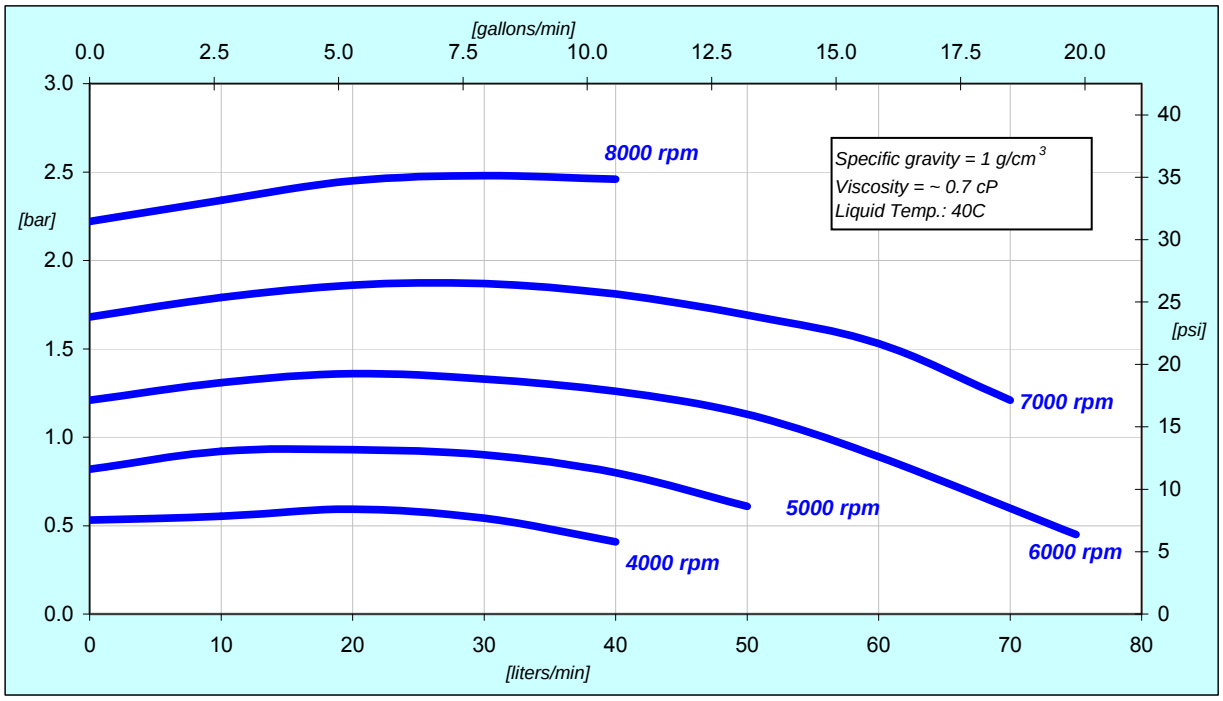


Figure 3: Pressure and flow rate chart
(For pump head CP-3.5, pressure is differential pressure between in- and outlet)

2.3 NPSHR of Pumphead

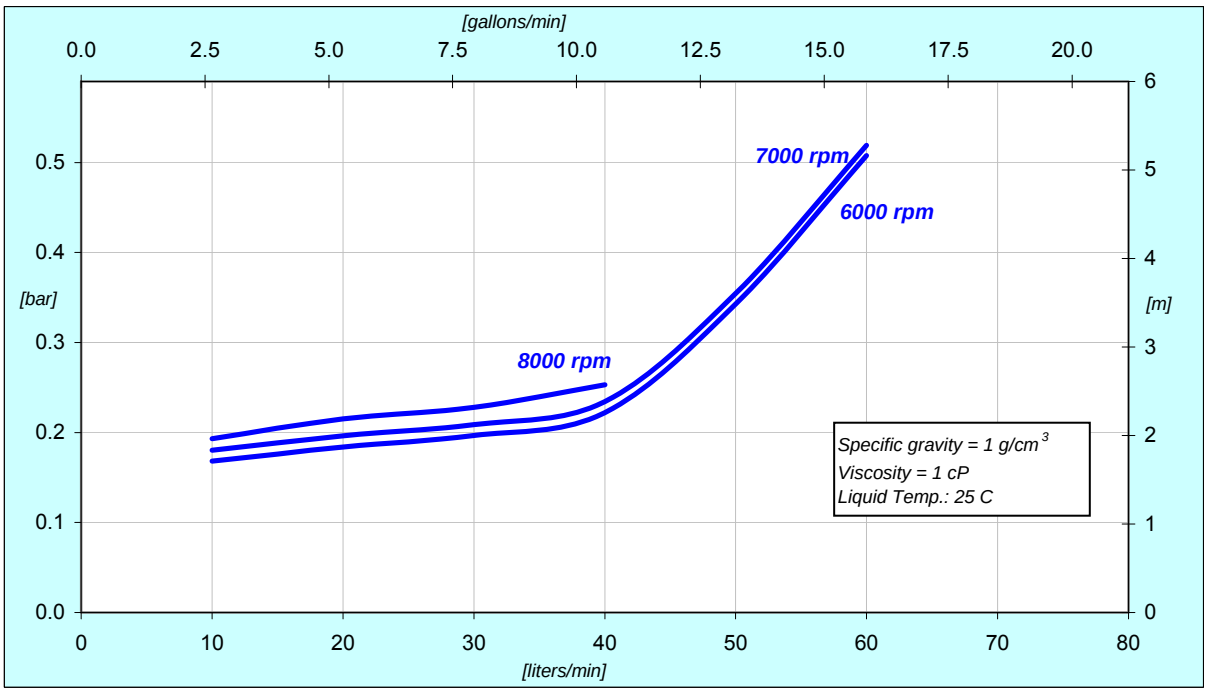


Figure 4: NPSHR of the pump
(Measured with pump head CP-3.5)

2.4 Overview of System Electronics

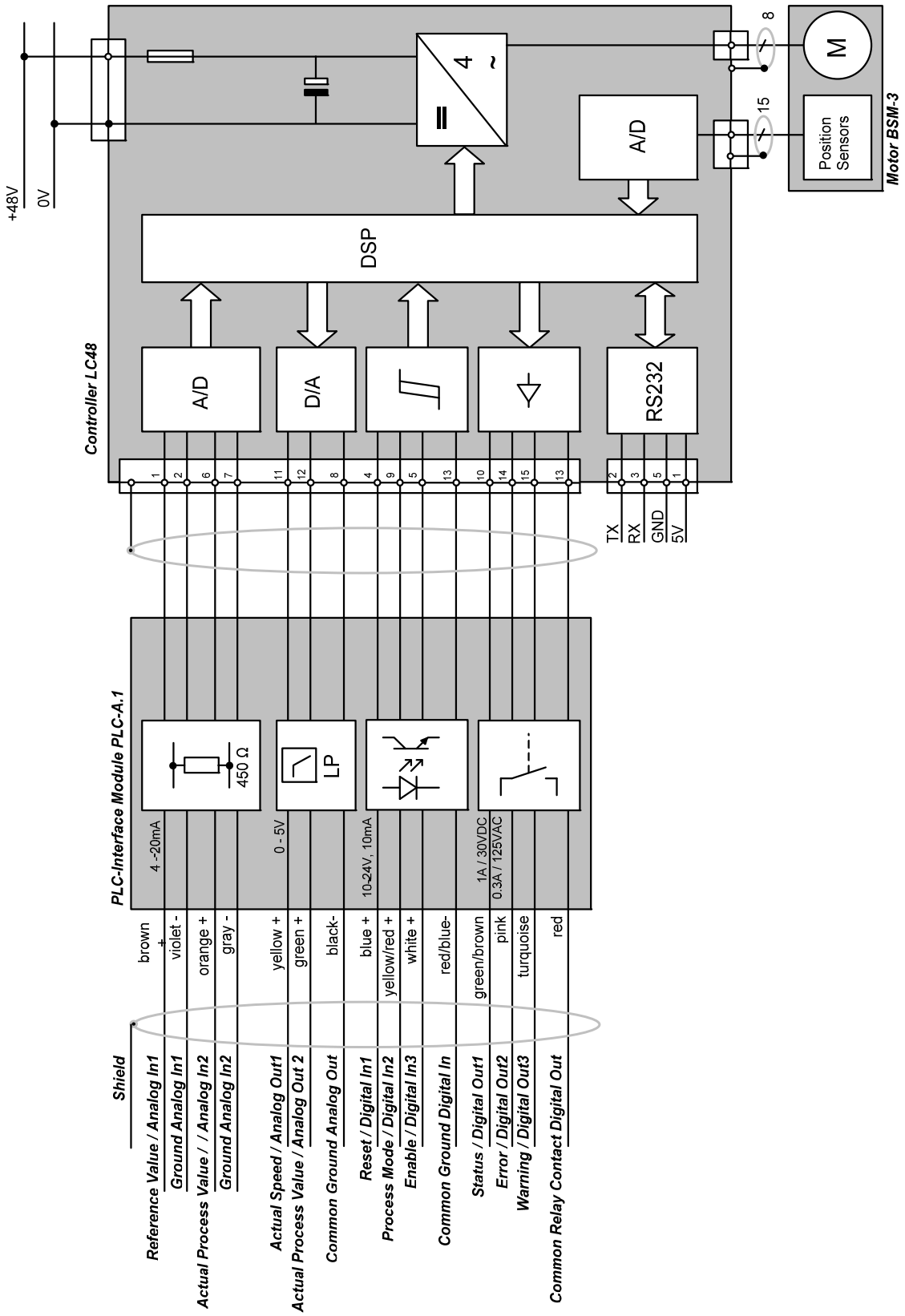


Figure 5: Block diagram and wiring pattern of the BPS-3 electronics

- PLC configuration for standard firmware R3.48
- For other configurations of PLC Inputs and Outputs refer to corresponding firmware doc.

2.5 Basic Dimensions of Main Components

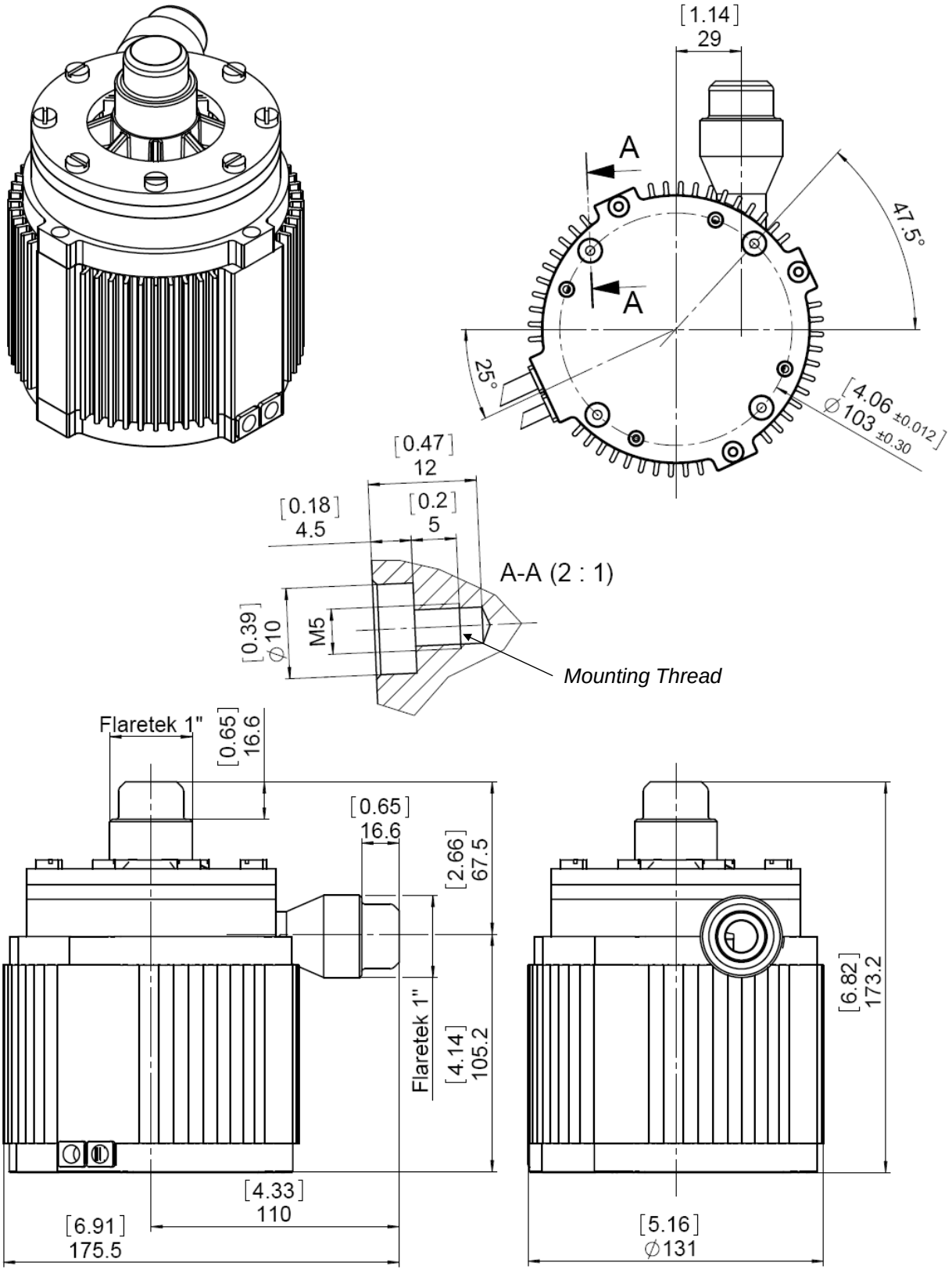


Figure 6: Dimensions of Motor BSM-3

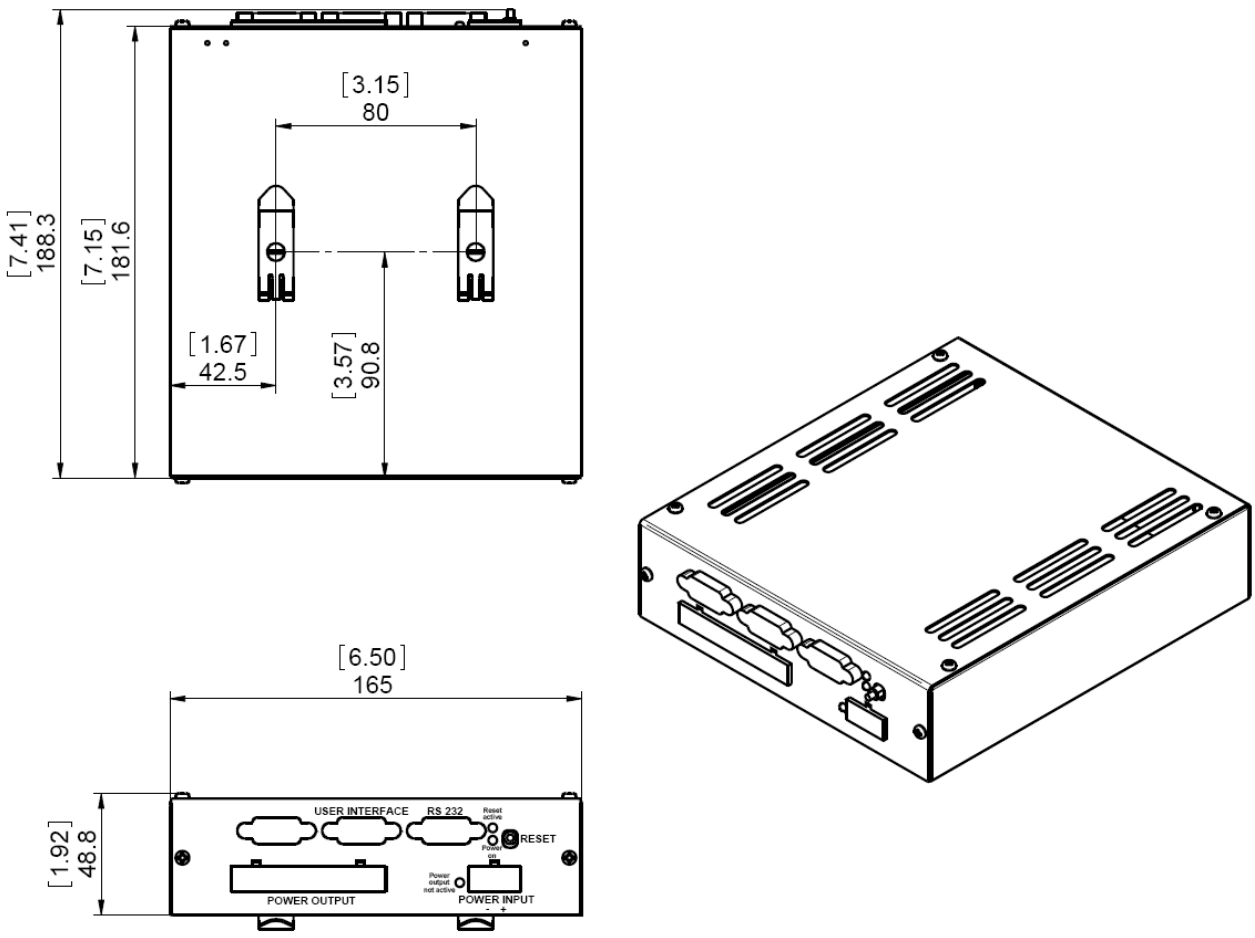


Figure 7: Dimensions of Controller LC48

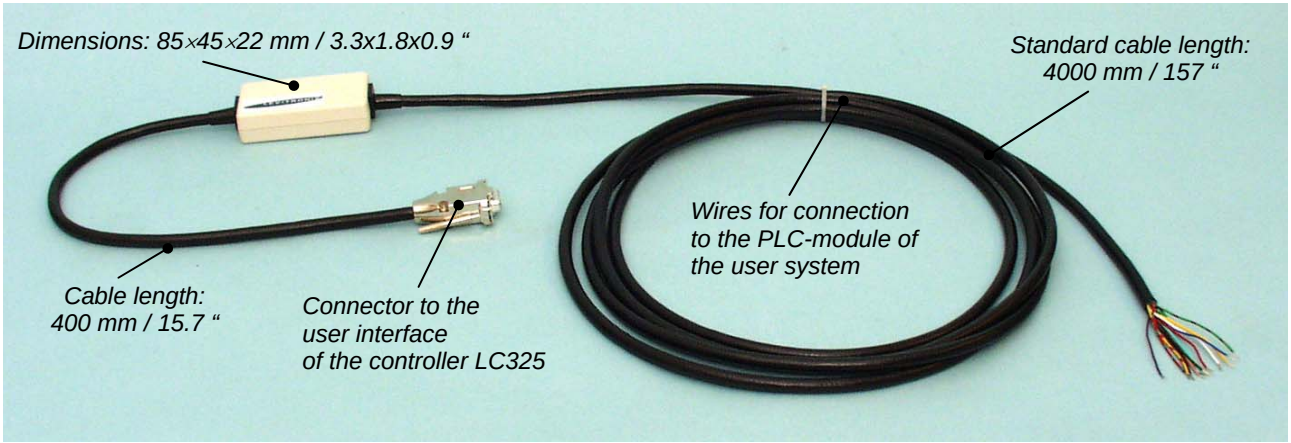


Figure 8: PLC-Interface-Module PLC-A

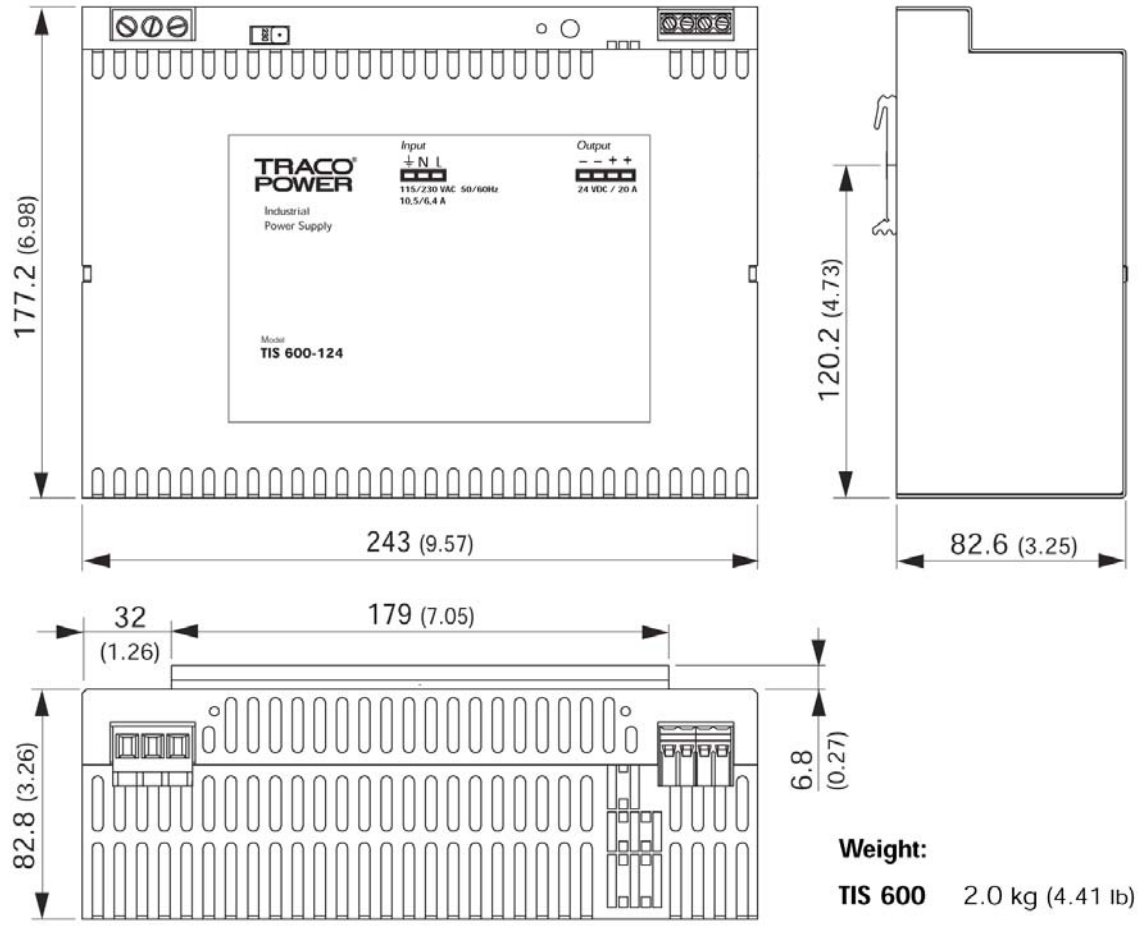


Figure 9: Power supply TIS 148-600

2.6 General Environmental Conditions

Usage	Indoor
Altitude	Up to 2000 *m*
Operating ambient temperature	0 to 40 ^{0}C
Storage ambient temperature	-20 to 80 ^{0}C
Operating humidity range (relative humidity)	15 – 95% (non condensing)
Storage humidity range (relative humidity)	15 – 95% (non condensing)
Mains supply fluctuations	± 10% of nominal voltage
Transient over-voltages typically present on the mains supply	Surge immunity according to EN 61000-4-5 (with power supply TSL 600-148)
Pollution degree	2

Table 4: Environmental conditions for BPS-3 pump system

3 Engineering Information

3.1 Sealing and Material Concept

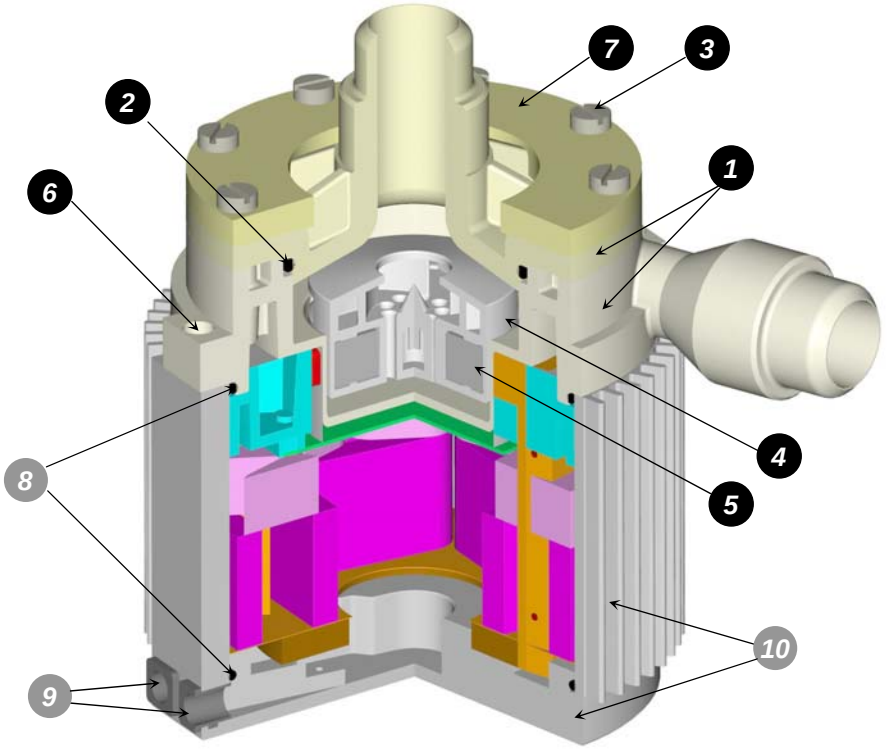


Figure 10: Sealing and material concept

System Component	Item		Materials
	No	Description	
Pump head *CP-3.5*	1	Pump casing (lid and bottom) *PCA-3.3*	High purity PFA
	2	Static sealing O-ring of pump casing	Kalrez® (compound 6375)
	3	Screws for pump casing	PVDF
	4	Impeller *IMP-3.3*	High purity PFA
	5	Rotor magnet	Neodymium (with primary coating)
	6	Screws for pump/motor mounting	PEEK
	7	Reinforcing ring	PVDF
Motor *BSM-3.x*	8	Sealing O-ring for motor housing	FEP-O-SEAL
	9	Cable bushing	FPM, cables jacket is FEP
	10	Motor housing	ETFE coating, waterproof Coils and electromagnetic circuit potted with an epoxy compound (UL94 V0).

Table 5: Materials used in the BSM-3.x motor and CP-3.5 pump head
(For other configurations see accompanying literature)

3.2 Power Consumption

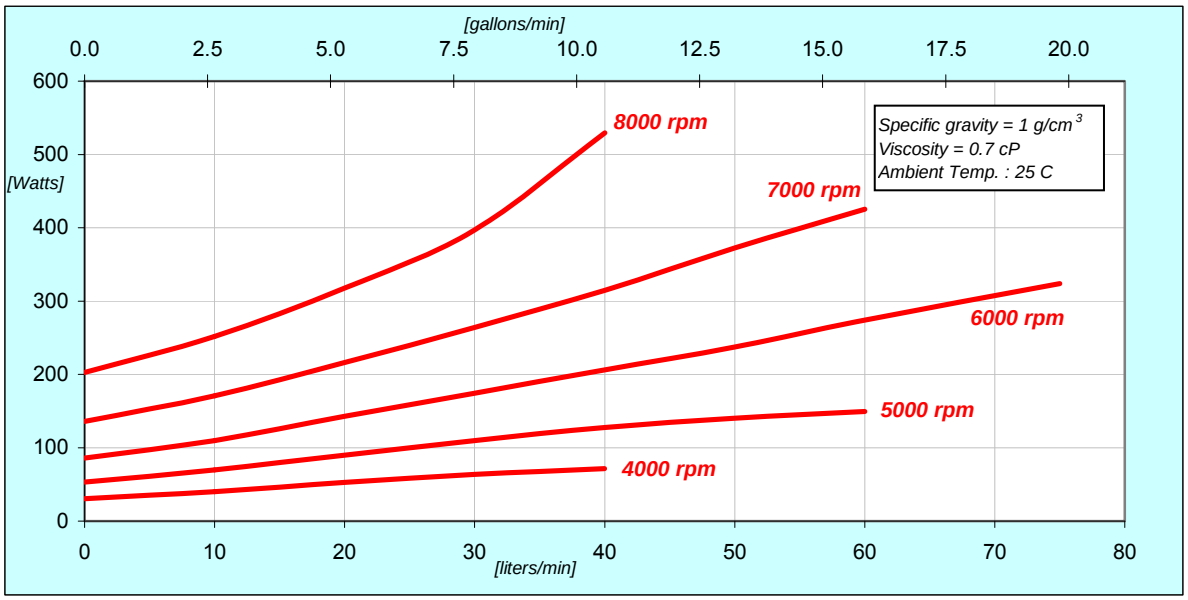


Figure 11: Electrical power consumption of controller LC48
(Measured on DC input of controller LC48 with pump head CP-3.5)

3.3 Temperature Monitoring

To avoid overheating of the system, the controller and motor temperatures are monitored. If the controller temperature exceeds *70°C (158°F)* or the motor temperature *90°C (194°F)* for duration of more than ten minutes, the system goes into an error state and the pump stops. At *80°C (176 F)* controller temperature or *100°C (212°F)* motor temperature, the system stops immediately.

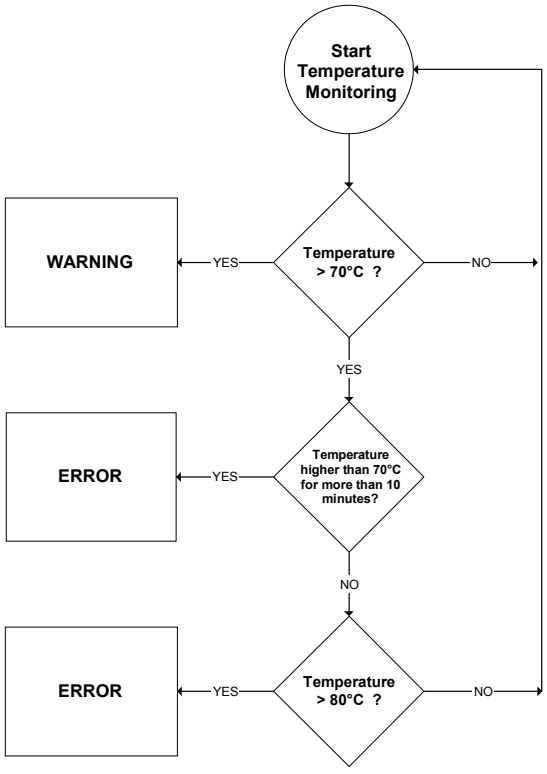


Figure 12: Controller temp. monitoring

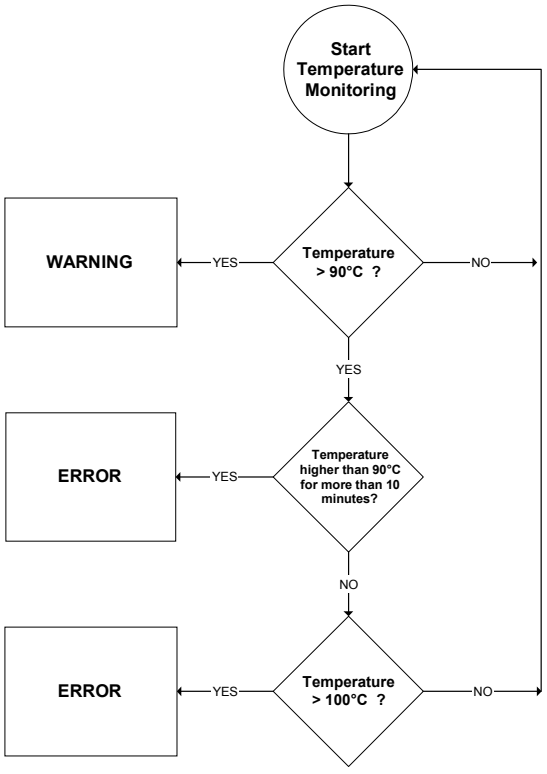


Figure 13: Motor-temperature monitoring

3.4 Thermal Management

3.4.1 Motor Temperature

The motor temperature depends on the ambient and liquid temperature, as well as on the hydraulic operation point. *Figure 14*, *Figure 15* and *Figure 17* illustrate the temperature characteristics of the motor depending on these parameters. For higher liquid temperatures and hydraulic operating points active cooling is recommended for example with the air cooling module *ACM-3.1* (see *Figure 16 and Table 2*).

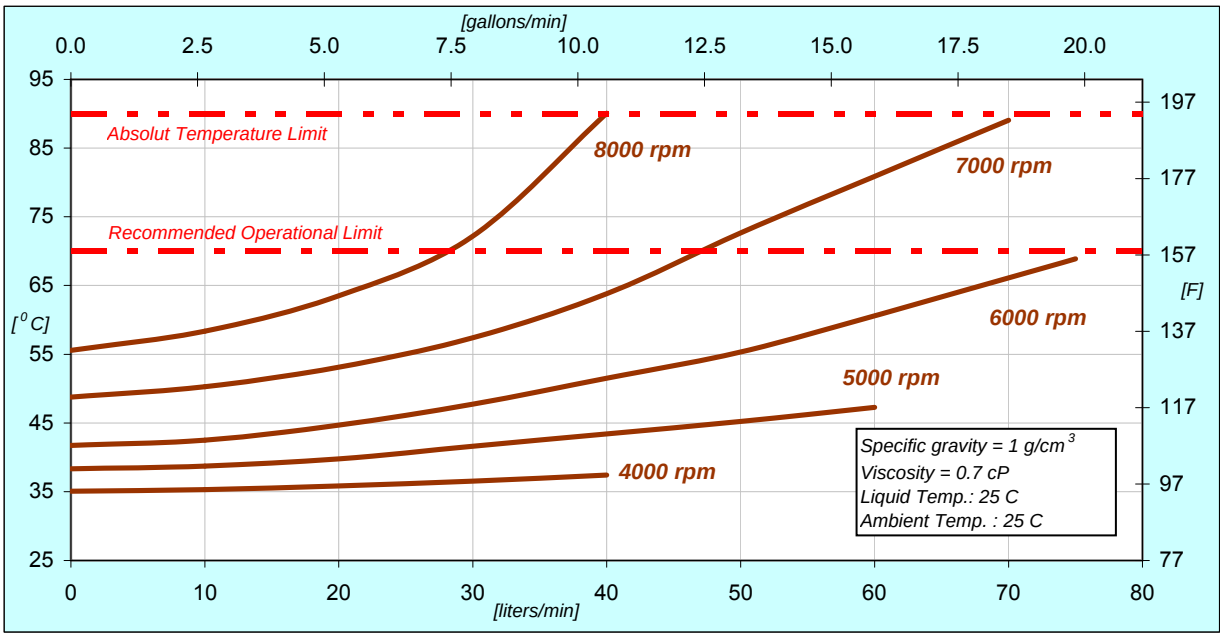


Figure 14: Temperature curves for the BSM-3 motor @ 25 C liquid temperature
(Pumping with pump head CP-3.5, temperature is measured inside of the motor, contact temperature of surface is below this temperature)

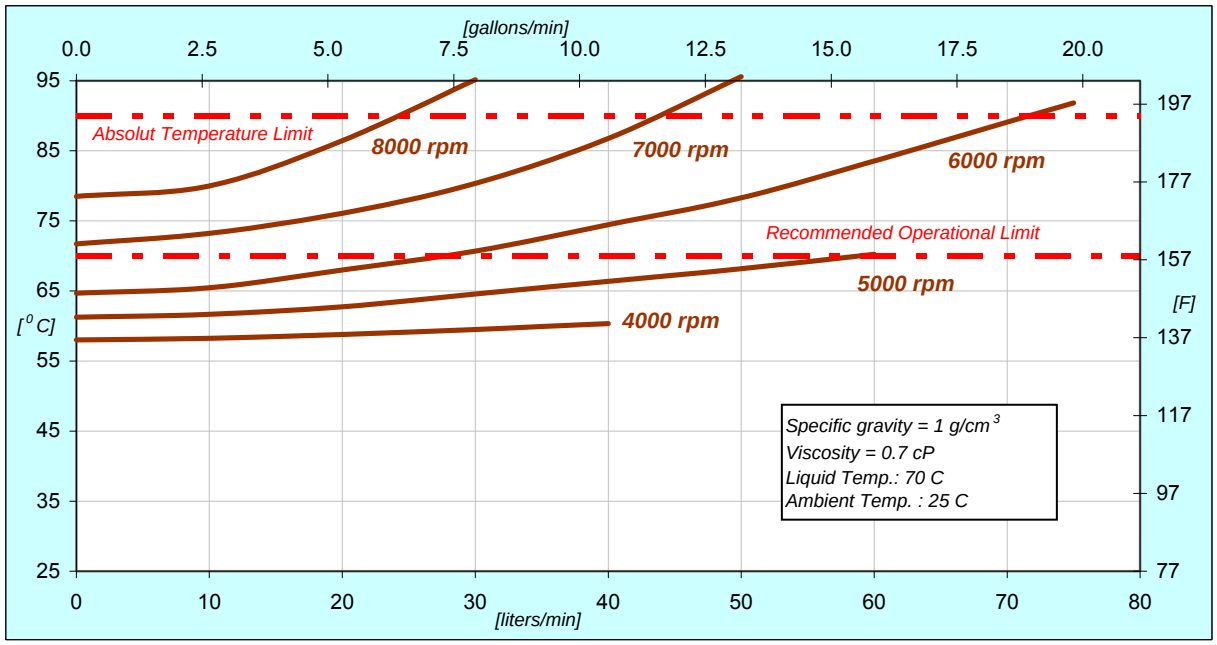


Figure 15: Temperature curves for the BSM-3.x motor @ 70 C liquid temperature
(Pumping with pump head CP-3.5, temperature is measured inside of the motor, contact temperature is below this temperature)

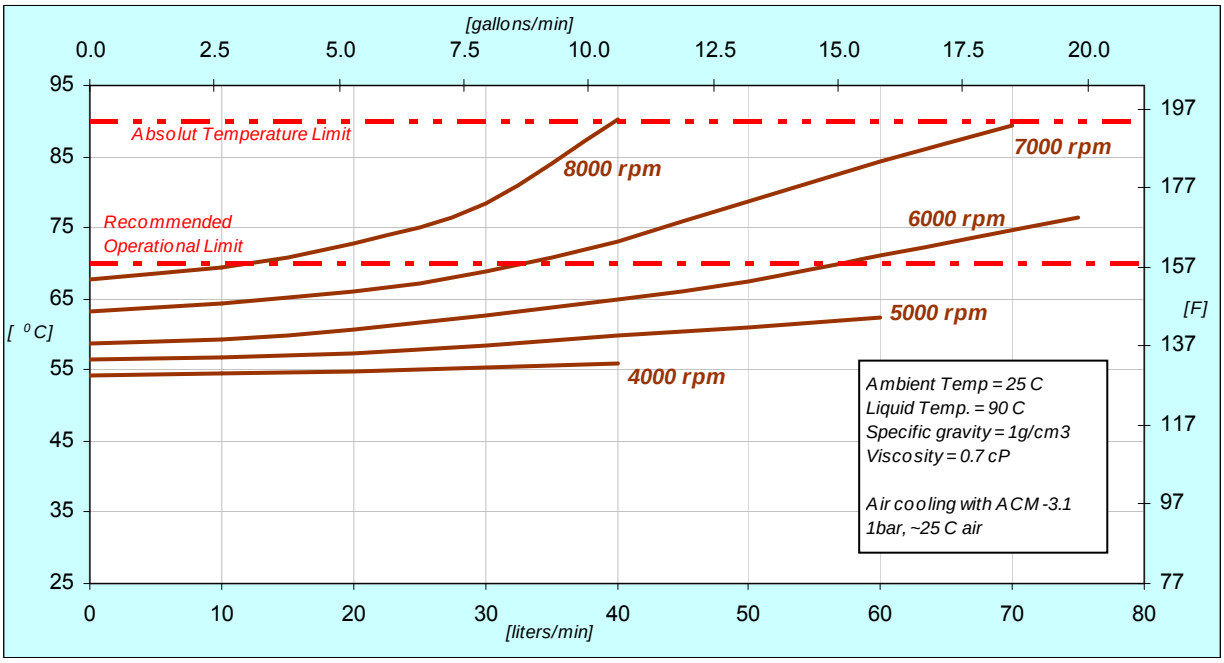


Figure 16: Temperature curves of motor BSM-3.x with air cooling module ACM-3.1
(With Pumphead CP-3.5)

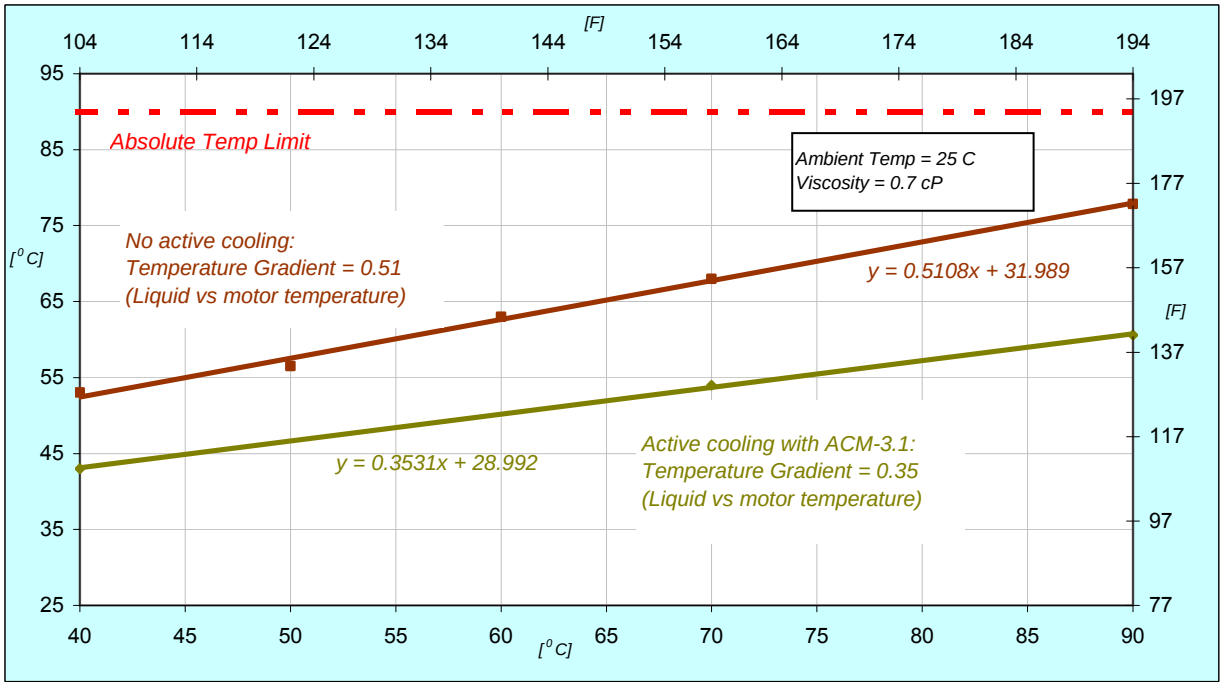


Figure 17: Influence of liquid temperature on motor temperature
(Measurement at 6000 rpm 20 lpm but gradiants are representative for other operational points)

The above curves are measurements of the motor temperature at certain liquid and ambient temperatures. Equation *(Eq. 1)* shows how to calculate the motor temperature for other liquid and ambient temperatures based on these curves.

$$T_M(T_L,T_A) \approx \underbrace{T_M(T_L = 25^0C, T_A = 25^0C)}_{see\ Figure\ 12} + (T_L - 25^0C) \cdot \underbrace{tg_{LM}}_{see\ Figure\ 15} + (T_A - 25^0C)$$

(Eq. 1)

T_M = *Motor temperature* T_L = *Liquid temperature*

T_A = *Ambient temperature* tg_{LM} = *Temperature gradient liquid/motor*

In order to account for thermal variations (like ambient temperature, closed chemical cabinets or corners without ventilations) and to not significantly reduce the MTBF of the motor it is recommended to keep about 20 ^0C safety distance to the absolute thermal limit of the motor (90 ^0C) when designing the thermal concept of the pump system.

3.4.2 Controller Temperature

Depending on the ambient temperature and the placement of the controller additional cooling may be required (see *Figure 18*). To improve cooling of the controller, place the device into a moving air stream. If the controller is mounted in a compact area or adjacent to additional heat sources (e.g. a 2nd controller) ensure that there is sufficient ventilation.

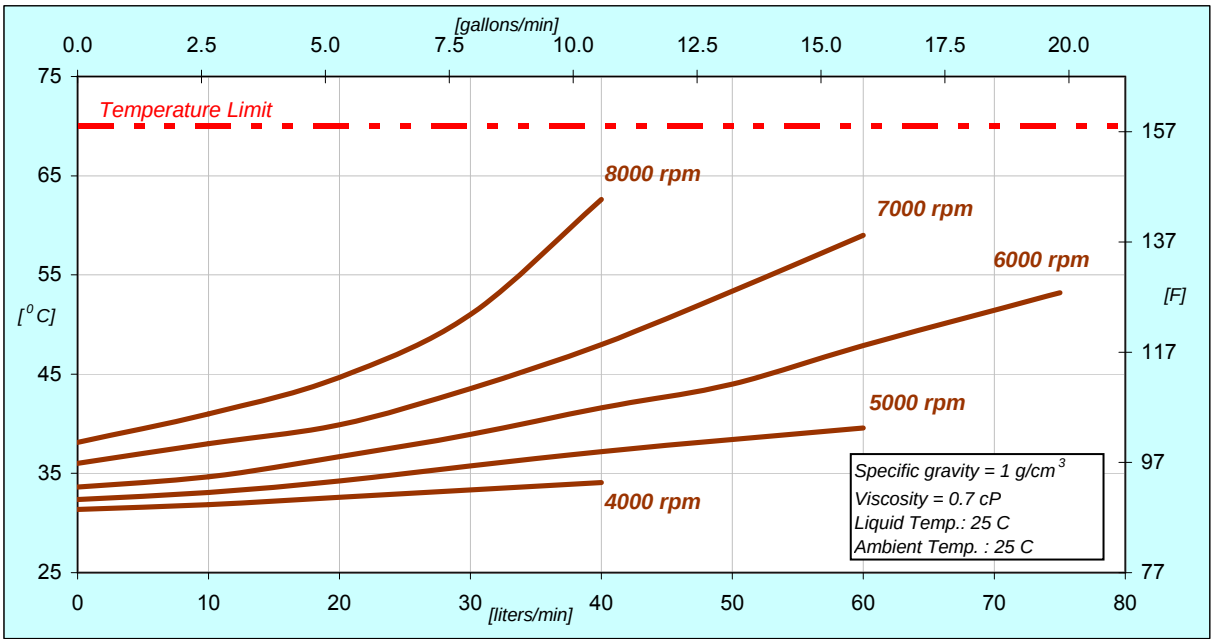


Figure 18: Temperature curves of controller LC48 vs. flow and speed
(for pumping with pump head CP-3.5 and motor BSM-3.x)

The above curves are measurements of the controller temperature at 25^0C ambient. Equation *(Eq. 2)* shows how to calculate the controller temperature for at other ambient temperatures based on this curve.

$$T_C(T_A) \approx \underbrace{T_C(T_A = 25^0C)}_{see\ Figure\ 18} + (T_A - 25^0C)$$

T_C = *Controller temperature*

T_A = *Ambient temperature*

(Eq. 2)

4 Installation

4.1 Electrical Installation of Controller

4.1.1 Overview

The controller *LC48* has signal processor controlled power converters with four switched inverters for the drive and the bearing coils of the motor. The signal processor allows precise control of pump speed and impeller position.

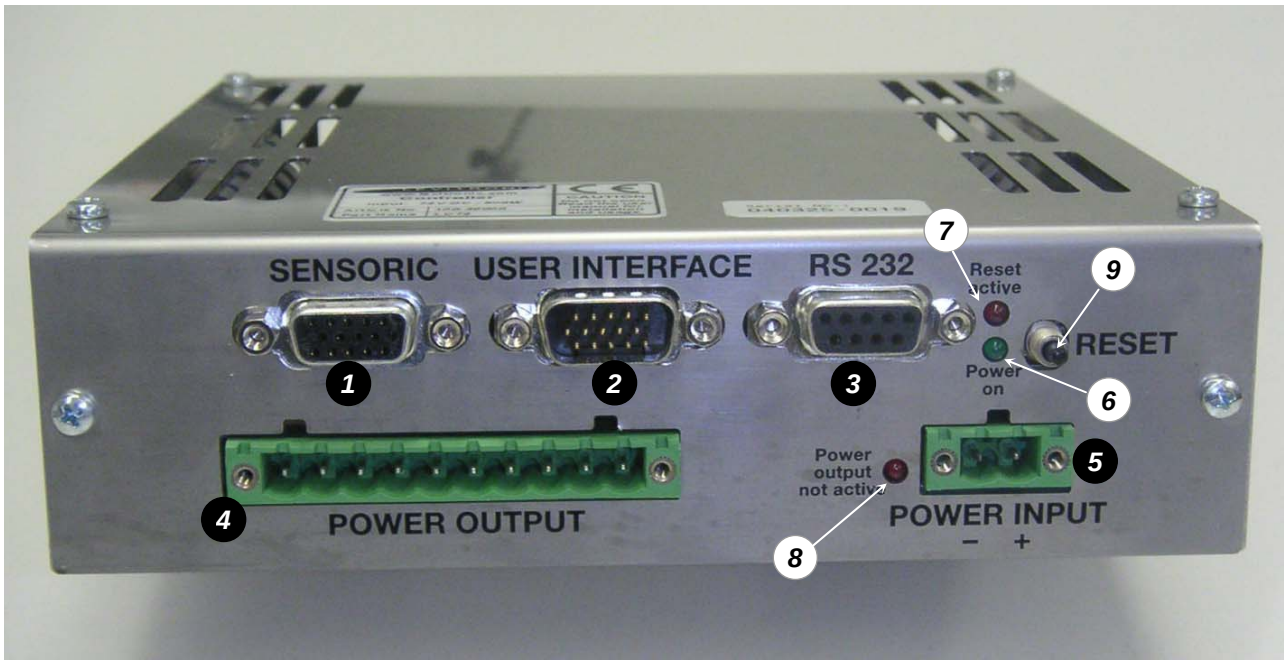


Figure 19: Connections, RESET and LED's of Controller LC48

	Designation	Description
1	**"SENSORIC" connector**	Sensor (radial position, field, temperature) signals from motor.
2	**"USER INTERFACE" connector**	Digital and analog I/Os. Interface for Levitronix PLC-interface-module.
3	**"RS232" connector**	Serial communication for service and operation purposes. Interface to the control panel *LUI-A* or to the PC.
4	**"POWER OUTPUT" connector**	Drive and bearing currents of the motor.
5	**"POWER INPUT" connector**	DC power Input.
6	**Red LED "Reset active"**	LED is on during the startup of the Digital Signal Processor and when the reset button is pressed.
7	**Green LED "Power output not active"**	LED is on if the switched output stages of the controller are disabled.
8	**Red LED "Power on"**	LED is on if the voltage supply (5V and 12V DC) for the power drivers is present.
9	**"Reset" knob**	Knob has to be pressed to reset of the controller.

Table 6: Connector, RESET and LED description of the LC48 controller

4.1.2 General Installation Instructions



⚠ WARNING

Hazardous voltage may be present.

Always isolate the electrical power supply before making or changing connections to the unit.

In case of the usage of an inadequate AC/DC power supply, mains voltages may be present (even if the system is designed for 48VDC).





⚠ WARNING

Hazardous voltage may be present.

The controller housing must be properly grounded. Use one of the DIN-rail screws on the back side of the controller housing.

1. The controller and the power supply casings must be grounded (The DIN-rail bracket can be used for grounding).
2. Connect the two motor connectors to the controller.
3. Connect the PLC Module *PLC-A* (or handheld *LUI-A*) to the controller (see *Section 4.3*)
4. Connect the DC power supply connector. Make sure that the polarity is correct (see Figure below) and that AC/DC power supply is off.
5. To secure the connectors, tighten all retaining screws.

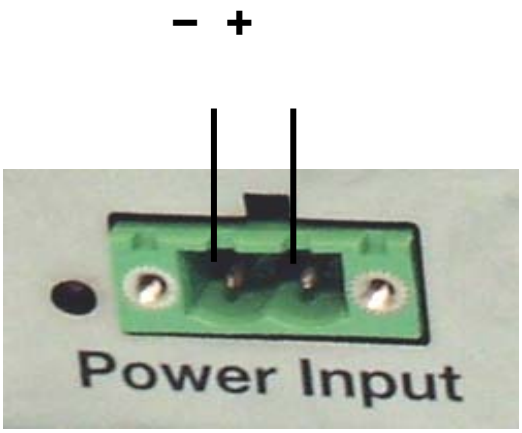


Figure 20: Power connector

4.2 Installation of the Power Supply (TIS 600-148)

The BPS-3 pump system requires 48V DC supply voltage at a maximum power of 600W. Most applications can be covered with a standard 600W AC/DC supply. The power supply *TIS 600-148V* is available as accessory from Levitronix (see *Table 2*). The user may use a different power supply that meets the power- and voltage- specifications.

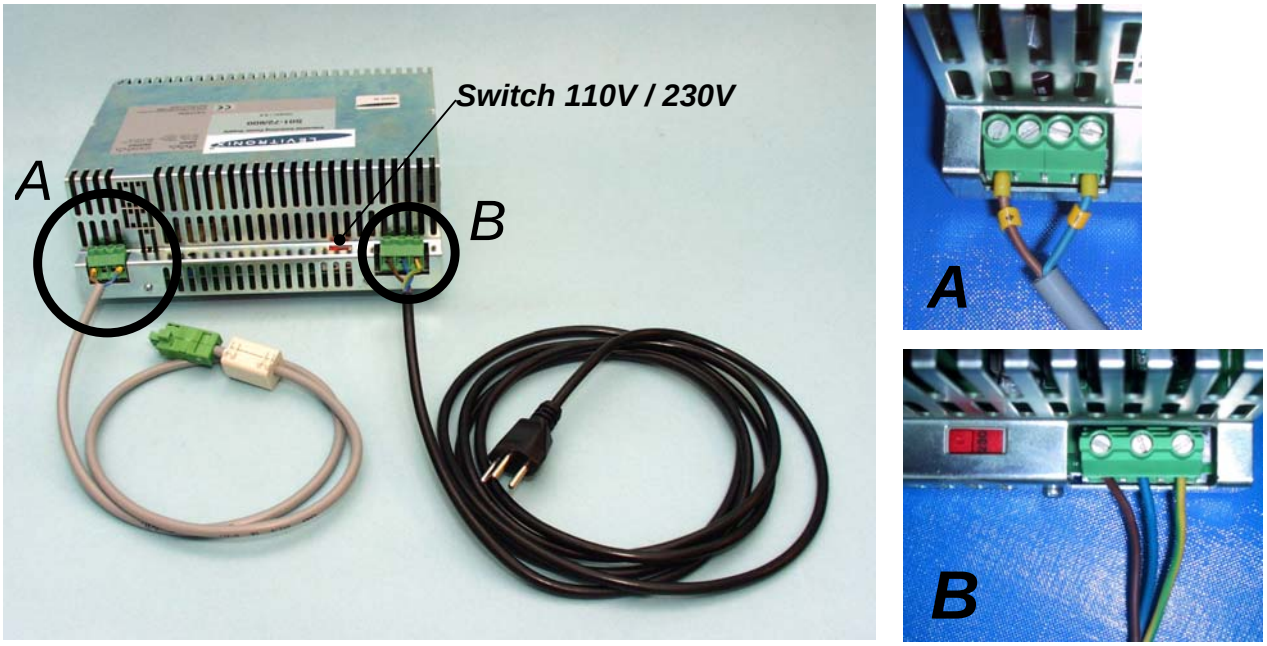


Figure 21: Cables for AC/DC power supply TIS 600-148

1. Use the DIN-rail bracket to mount the power supply.
2. Connect the single-phase main input (see *Figure 21 B*).
3. Connect the Levitronix DC-input cable to the power output. Connect the brown wire to positive pole and the blue wire to negative pole (for other colors see polarity labeling in *Figure 21 A*).

4.3 Electrical Installation of the *PLC-A* PLC-Interface Module

4.3.1 Overview

To operate the pump system in the standard configuration, a minimum set of two digital inputs and one analog input is needed. The digital and analog outputs can be used to monitor the pump status and operating parameters.

CAUTION

The analog inputs and outputs are not galvanic isolated from the controller electronics. To avoid ground loops and malfunctions, use floating analog signals.

I/O	Specifications
2x Analog Input	Analog current input: 4 – 20 mA. Direct connection, no galvanic isolation Input resistance: R_{IN} = 450 Ω
2x Analog Output	Analog voltage output: 0 – 5 V Direct connection, no galvanic isolation Max. Output current: 10mA
3x Digital Input	Galvanic isolation with optocoupler Switching Voltage / Current: Minimal 10 V / 7 mA, Typical 24 V / 16 mA, Maximal 30 V / 20 mA Input Resistance: R_{IN} = 2.2 kΩ
3x Digital Output	Galvanic isolation (relay) Relay: 1A / 30VDC, 0.3A / 125 VAC

Table 7: Electrical specifications of the PLC-A.1 interface module

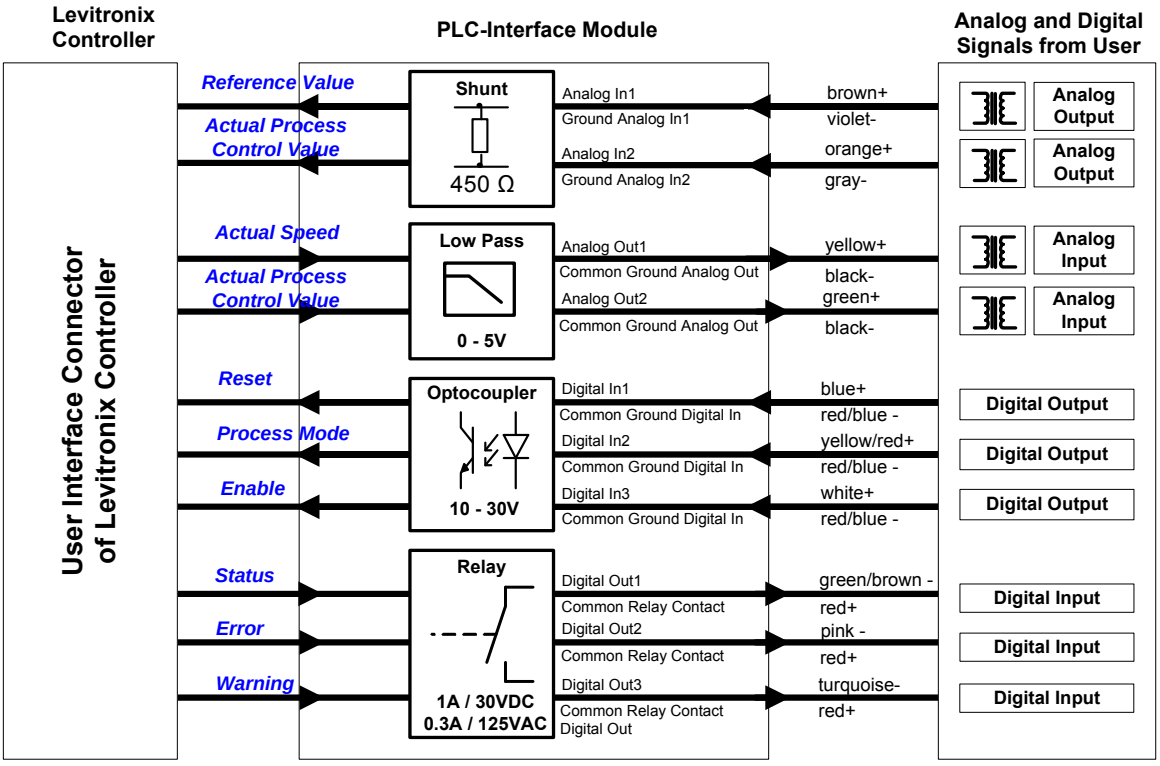


Figure 22: Standard configuration of the PLC-A.1 interface module for Firmware R3.48
(For other configurations refer to corresponding firmware documentation)

4.3.2 Installation Instructions



⚠ WARNING

Hazardous voltage may be present.

Always isolate the electrical power supply before making or changing connections to the unit.



1. Make sure the *PLC-Interface Module* is not connected to the controller.
2. Connect the digital and analog inputs and outputs according to *Table 8*. Assignment and functions of the I/Os can be changed with the controller firmware version (refer to according firmware documentation).
3. Connect the D-SUB connector of the *PLC-Interface Module* to the controller.

Wire name	Wire color	Designation	Levels	Note
Analog In1, (Signal)	Brown	*Ref Value*	4..20 mA = 0..10000 rpm *(speed mode)* -> Speed Limit = 8000 rpm ≙ 16.4mA -> Cut-off (min.) speed = 300 rpm 4..20 mA = 0..100% *(process mode)*	--
Ground Analog In1	Violet			
Analog In2, (Signal)	Orange	*Actual Process Control Value*	4..20 mA = 0..100%	--
Ground Analog In2	Gray			
Analog Out1, (Signal)	Yellow	*Actual Speed*	0..5 V = 0..10000 rpm	Direct connection, no protection. Galvanic isolation on the user side is required.
Analog Out2, (Signal)	Green	*Actual Process Control Value*	0..5 V = 0..100%	Direct connection, no protection. Galvanic isolation on the user side is required.
Common Ground Analog Out	Black	--	--	--
Digital In1, (Signal)	Blue	*Reset*	24 *V* ⇒ active 0 *V* ⇒ not active	Resets fault state
Digital In2, (Signal)	Yellow / Red	*Process mode*	24 *V* ⇒ active 0 *V* ⇒ not active	Switches between process mode and speed mode
Digital In3, (Signal)	White	*Enable*	24 *V* ⇒ active, system on 0 *V* ⇒ not active, system off	The Enable signal switches the pump system on and off.
Common Ground Digital In	Red / Blue	--	--	--
Digital Out1	Green / Brown	*Status*	Relais closed ⇒ active, system on Relais open ⇒ not active, system off	This signal indicates the state of the pump system.
Digital Out2	Pink	*Error*	Relais closed ⇒ not active, system on Relais open ⇒ active, system off	When active, the system drives the impeller to zero rpm and shuts down. With a reset pulse the system can be re-initialized.
Digital Out3	Turquoise	*Warning*	Relais closed ⇒ not active, system o.k. Relais open ⇒ active, system not o.k.	The warning signal indicates if a system fault has been detected. The warning signal indicates a system fault but the system does not shut down
Common Relay Contact Digital Out	Red	--	--	--

Table 8: Signals of the PLC-A.1 PLC-interface module for standard R3.48
(For other configurations of PLC inputs and outputs refer to alternate firmware documentation.)

4.4 Mechanical Installation of the Pump/Motor

- The motor can be mounted with four screws
- There are four tapped holes (size M5) in the bottom of the motor *BSM-3* (see *Figure 6*)
- The motor can be mounted in either the horizontal or vertical position
- To simplify mounting of the motor the Mounting Base Plate *MBP-3.1* is available at *Levitronix®* as an accessory (see *Figure 1* and *Table 2*)

4.5 Mechanical Installation of the Controller



WARNING

Hazardous voltage may be present.

In order to avoiding fluid spills shorting mains or other voltages within the controller, place the controller in a spill protected environment (for example protected electronic cabinets).

If explosive flammable gases are present, place the controller in an explosion-proof cabinet.

CAUTION

Make sure the controller is mounted in a position that allows free air circulation around the controller. A minimum distance of 10cm (4") to other objects above or below the controller casing is recommended.

- Use a Din-Rail bracket to mount the controller (see *Figure 7*).
- If no forced air-cooling is used, mount the controller in upright position.

5 Operation

5.1 Overview of Main Operation Modes

The bearingless pump system *BPS-3* can be driven in two main modes: “speed control” and “process (flow, pressure) control”. *Figure 23* illustrates the configuration of the system for speed control, where the speed can be set by the user over various interfaces. If process parameters like flow or pressure have to be controlled precisely, the system can be configured according to *Figure 24* with an external pressure or flow-sensor.

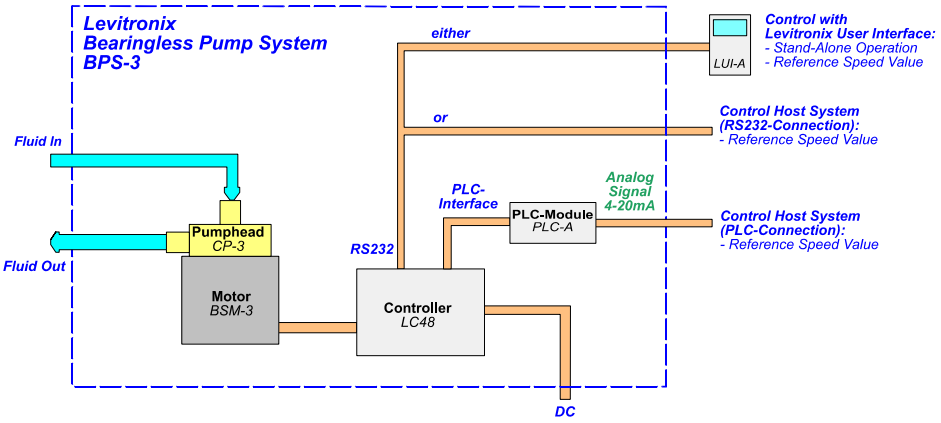


Figure 23: System operation for “speed control”

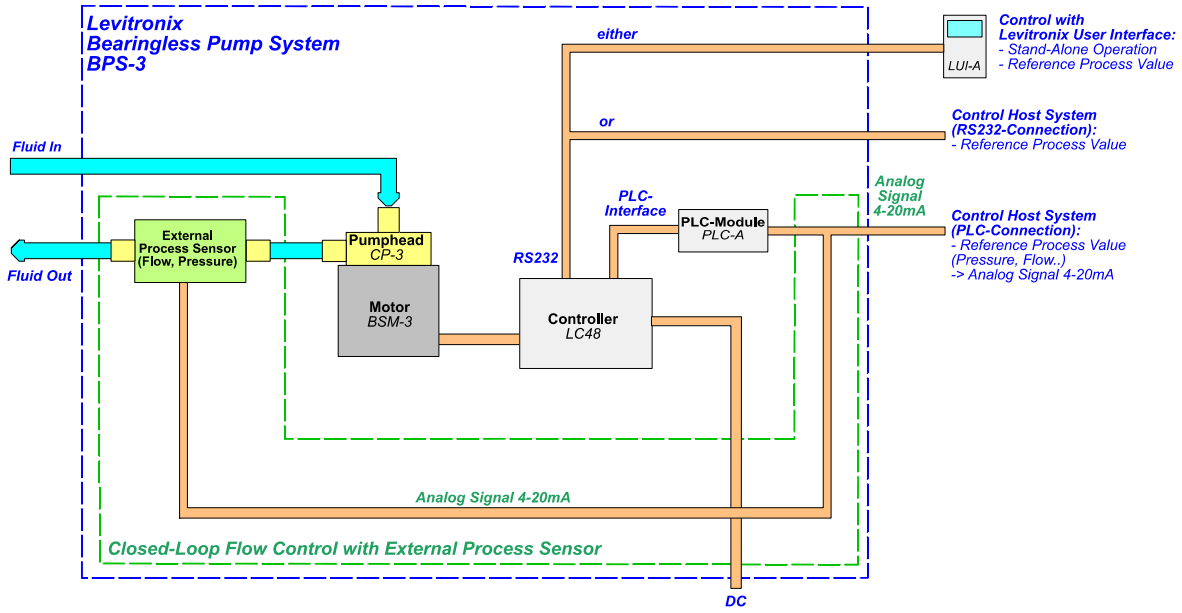


Figure 24: System operation for closed loop “process control” with a pressure or flow sensor

CAUTION

To be considered for Firmware R3.48 with Revision = 0 or other Firmware with no “dry running” algorithm implemented:

Standard speed limit is set to 8000 rpm. However, in case of dry running conditions (for example during priming) the set speed should not exceed 4000 rpm as the impeller could become unstable, which can result in the abrasion of the encapsulation of the impeller.

5.2 System Operation with the *LUI-A* Levitronix User Interface

The handheld *LUI-A Levitronix User Interface* provides basic operational functions. For troubleshooting or error handling see *section 7.2*.

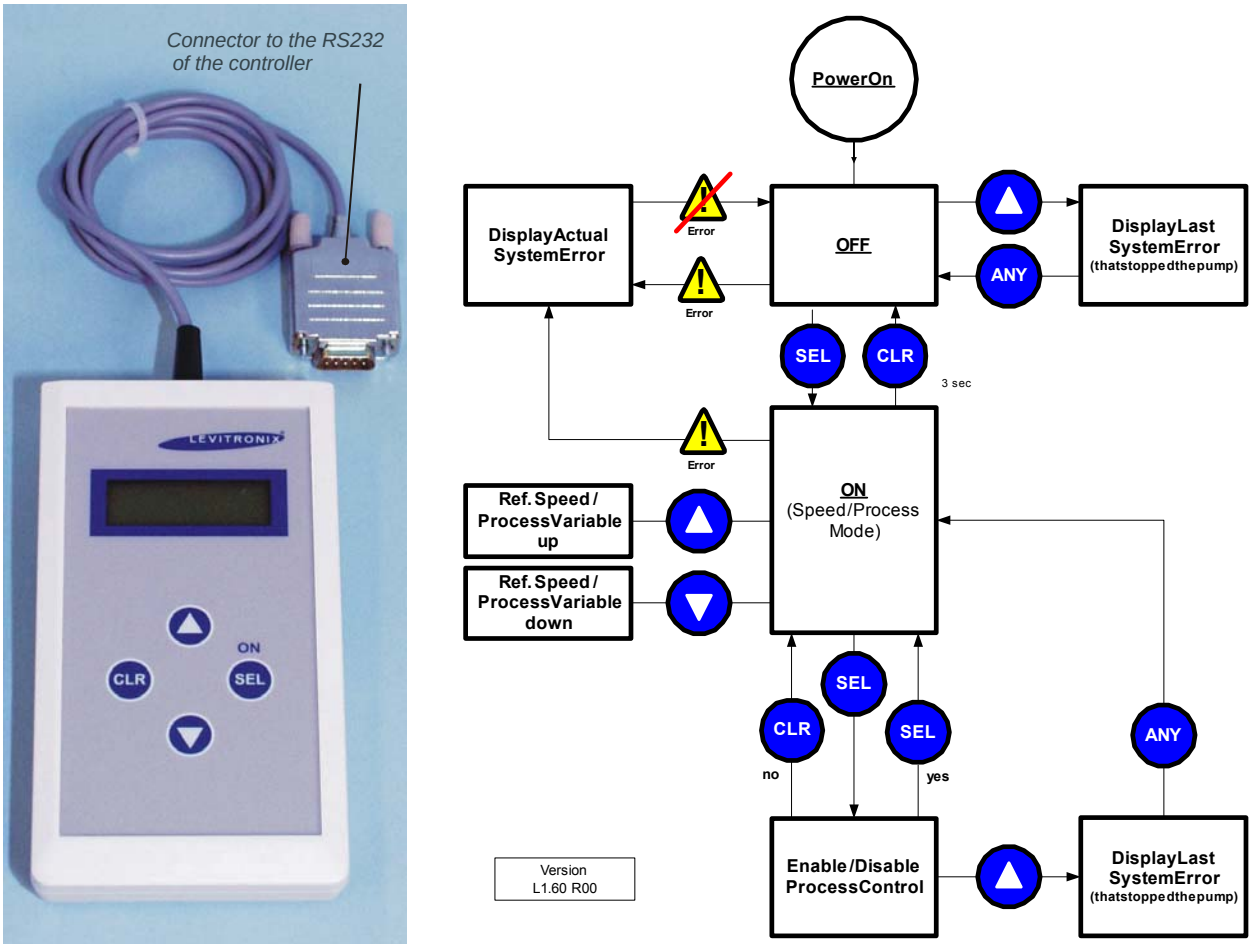


Figure 25: State diagram LUI-A.1 Levitronix User Interface
(For other configurations see separate firmware documentation)

5.3 System Operation with *PLC-A* PLC Interface-Module

CAUTION

This chapter describes the analog and digital I/Os in the standard configuration with the firmware R3.47. State diagram and signal names can vary with other controller firmware versions. Please verify, which firmware version is on the controller and refer to separate firmware documentation.

- *Figure 26* shows the state diagram for pump operation with the *PLC-Interface Module*.
- In the "Off" state the system can be operated via RS-232 (handheld *Levitronix User Interface* or *Levitronix Service Software*) without affecting the *PLC-Interface Module* state diagram. In all other states RS-232 commands are ignored.
- To set reference speed a current signal has to be feed to Analog Input 1 (*Figure 2* and *Table 8*).

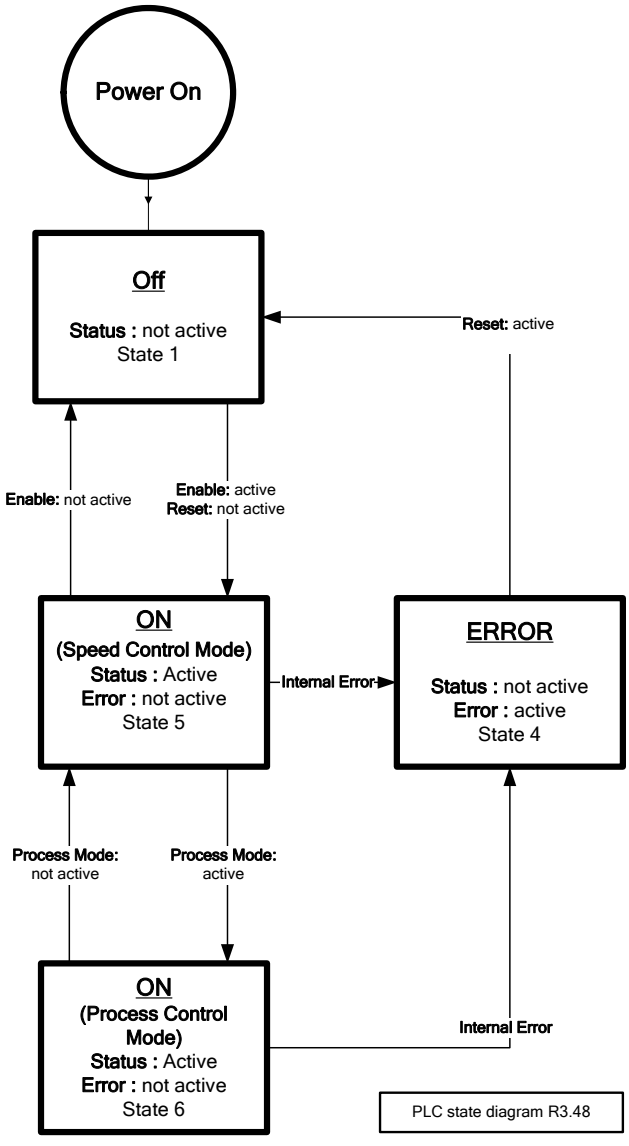


Figure 26: PLC-A.1 PLC-interface module, state diagram for firmware R3.48
(For other configurations of see according firmware documentation)

State "Off":

The pump system is switched off and the motor has no power. In this state, the Manual User Interface LUI is enabled or the Levitronix Service Software has full control.

State "ON" (speed control mode):

The pump system is switched ON and the impeller is rotating with the referenced speed. The motor has electrical power when in this state. In this state, the Manual User Interface LUI is disabled and RS232 commands are ignored.

State "ON" (process control mode):

The pump system is switched ON and the impeller speed is controlled in order to get the referenced flow/pressure. The motor has electrical power when in this state. In this state, the Manual User Interface LUI is disabled and RS232 commands are ignored.

State "Error":

If an error according to *Table 9* occurs in the pump system, the system defaults to the *Error* state. The designated digital output on the PLC Interface Module is set to 0 *V*. The pump system is switched OFF. By activating the "*Reset*" input the system gets back to the "*Off*" state.

Error source	Errors	Effect on designated digital output of the PLC-Interface-Module
Motor	No rotor	*Error = relay open*
Motor	Temperature > 100°C (212°F)	*Error = relay open*
Motor	Temperature > 90°C (194°F) for more than 10 minutes.	*Error = relay open*
Motor	Temperature > 90°C (194°F)	*Warning = relay open*
Motor	No motor temperature signal	*Warning = relay open*
Motor	Motor power cable not connected to the controller	*Error = relay open*
Motor	Motor sensor cable not connected to the controller	*Error = relay open*
Motor	Short circuit	*Error = relay open*
Controller	Over current in the bearing coils	*Error = relay open*
Controller	DC-link voltage out of range	*Error = relay open*
Controller	Error in current measurement	*Error = relay open*
Controller	Power channel interrupted	*Error = relay open*
Controller	Temperature > 80°C (176°F)	*Error = relay open*
Controller	Temperature > 70°C (158°F) for more than 10 minutes.	*Error = relay open*
Controller	Temperature > 70°C (158°F)	*Warning = relay open*

Table 9: Errors and warnings of operation with PLC for firmware R3.48
(For other configurations of see separate firmware documentation)

6 Inspection and Maintenance

6.1 Replacement Interval of the Impeller

The impeller has a limited lifetime depending on the chemical type, concentration and temperature of the fluid which is pumped. Therefore a preventive periodical exchange of the impeller is recommended. Contact the *Levitronix Technical Service Department* (see *Section 8*) for further information on replacement times.

6.2 Impeller Replacement Procedure

6.2.1 Preparation

Before starting the impeller exchange procedure the parts and tools illustrated in *Figure 27* should be prepared. Impeller exchange kits, which contain this parts and tools are available at Levitronix (see *Table 2*).

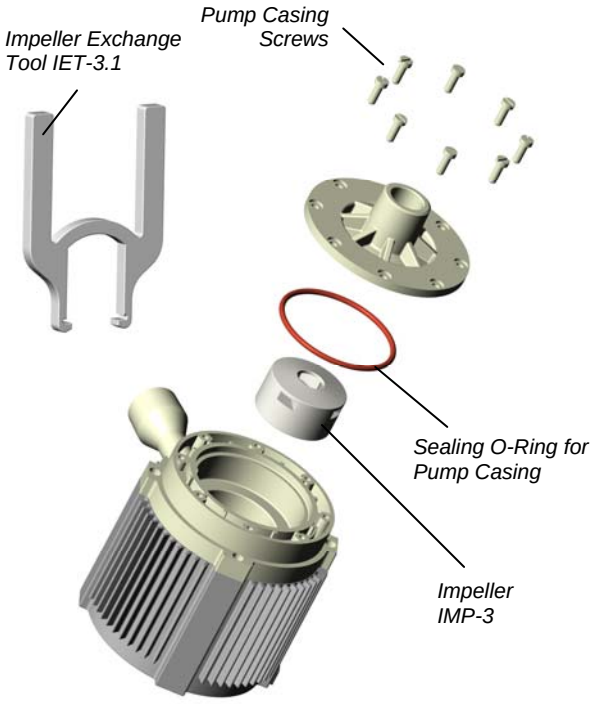


Figure 27: Parts for impeller change-out

The following warnings and cautions should be read carefully before starting the exchange of the impeller.

⚠ WARNING



The impeller could splash toxic or corrosive chemicals because of the strong magnetic forces. Flush the pump housing before opening it.

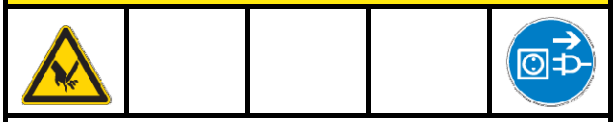
⚠ WARNING



Harmful chemicals may be present.

Skin contact and toxic gases may be hazardous to your health. Wear safety gloves and other appropriate safety equipment.

⚠ CAUTION



The rotating impeller could cause injury. Do not run the pump system when opening the pump head.

CAUTION



Pay attention to the magnetic forces when handling the impeller. The attraction of magnetic parts and particles should be avoided in order to keep the impeller and the pump head clean and free of contamination.

6.2.2 Instructions for Replacement

1. Power down the pump system and remove the AC power. If necessary, allow the housing to cool down to a workable.

2. Unscrew the top of the pump head and remove it along with the sealing ring.



3. Remove the impeller with the *Impeller Exchange Tool*. Hook the claws of the *Impeller Exchange Tool* into two opposing orifices of the impeller.



4. Inspect the wet area of the pump head carefully. In case of material damage, also replace the pump casing.

5. Place the new impeller into the pump casing using the *Impeller Exchange Tool*.

6. If necessary, remove the existing *O-Ring* and gently press the new *O-Ring* into the lid of the pump casing.

CAUTION

Use the correct O-Ring type for your process. If necessary, consult the Levitronix Technical Service Department.

Do NOT twist or roll the O-Ring as this may cause leaking to occur.

7. Press the lid with the O-ring flush into the bottom of the pump casing.



8. Carefully tighten the *8 PVDF* screws. The screws should not be used to press the lid with the O-ring into the bottom of the pump casing. Do not apply too much torque. The torque specifications are:

Maximum torque for pump screws
PVDF M5: 20Ncm
PVDF M6: 30Ncm

9. Start up the system and check if the impeller is rotating properly and the pump head doesn't leak.

10. If the pump head leaks, check and make sure the lid and the O-Ring are properly pressed into the bottom of the pump casing. It may be necessary to change the O-Ring if it has been damaged.

7 Troubleshooting

7.1 Troubleshouting using the PLC-Interface-Module *PLC-A*

The *PLC-Interface-Module* provides a Warning and an Error signal. The source of error, however, cannot be identified. In case of a system error, use the *Levitronix Service Software*.

7.2 Troubleshouting using the Levitronix User Interface *LUI-A*

The *Levitronix Handheld User Interface* does not display warnings. In case of an error the pump stops and the handheld displays a specific error message. It is also possible to read the last error that stopped the pump. After a controller restart or reset the error information is removed. After a reset or restart the error information is canceled (this can be different for other firmware configurations).

7.3 Troubleshouting with Status LEDs of Controller *LC48*

The controller has 3 status LEDs:

LED Designator	Color	Description
"Power on"	Green	LED is on if supply voltage of signal electronics is present.
"Reset active"	Red	LED is on during startup of the Digital Signal Processor and when the reset button is pressed.
"Power output not active"	Red	LED is off if the switched output stage of the controller is enabled. If the LED is on, the bearing and drive coils of the motor carry no current.

Table 10: Controller status LEDs

7.4 Troubleshooting with Service Software

The *Levitronix® Service Software* allows communication with the pump system in connection with a PC and the RS232 interface of the LC48 controller. The software can be used for performing detailed troubleshooting. For usage of the Service Software refer to the *Service Software User Manual* (Document #: *PL-2034-00*), which is available in the download section on the Levitronix Web-page or contact the *Levitronix® Technical Service Department* (see under *Section 8*).

8 Technical Support

For troubleshooting, support and detailed technical information contact *Levitronix® Technical Service Department*:

Levitronix®
Technical Service Department
Technoparkstr. 1
CH-8005 Zurich
Switzerland

Phone for US: 888-569 07 18
Phone for outside US: +1 888-569 07 18
E-Mail: support@levitronix.com

9 Appendix

9.1 Regulatory Status

9.1.1 CE Marking

The Bearingless Pump System BPS-3, in its various configurations, is in conformity with the essential requirements of the *EMC Directive 2004/108/EC* and the *Machinery Directive 2006/42/EC*. The following particular harmonized standards of the *EMC Directive 2004/108/EC* are tested and confirmed at a certified laboratory (Siemens Switzerland, Test Laboratory, CH-8047 Zürich, Switzerland, Swiss Certification No.: STS 014):

EN55011	Limits and methods of measurement of electromagnetic disturbance characteristic of industrial, scientific and medical (ISM) radiofrequency equipment.
EN61000-4-2	ESD
EN61000-4-3	Radiated RF Immunity
EN61000-4-4	Fast transient / Burst
EN61000-4-5	Surge
EN61000-4-6	Immunity to conducted disturbances, induced by RF
ENV 50204	Radiated RF Immunity
EN61000-6-2	Generic standards, Immunity for industrial environments
EN61000-6-4	Generic standards, Emission standard for industrial environments

The following particular standards of the *Machinery Directive* are followed for the design, validation and risk assessment:

EN809	Pumps for Fluids: basic requirements are followed.
EN12162	Procedure for hydrostatic pressure testing in fluid pumps: max. pressure testing.
EN1050	Safety for machinery – principles for risk assessments.

9.2 Symbols and Signal Words

Symbol / Signal Word	Description	Type	Source
DANGER	Indication of an imminently hazardous situation that, if not avoided, will result in death or severe injury. Limited to the most extreme situation	Signal word	SEMI S1-0701
WARNING	Indication of a potentially hazardous situation which, if not avoided, could result in death or severe injury.	Signal word	SEMI S1-0701
CAUTION	Indication of potentially hazardous situations which, if not avoided, could result in moderate or minor injury. Also alert against unsafe practice. Without safety alert indication of hazardous situation which, if not avoided, could result in property damage.	Signal word	SEMI S1-0701
	Safety alert for “Warning” and “Caution”	Safety alert	SEMI S1-0701
	Safety alert for “Danger”	Safety alert	SEMI S1-0701
	Caution (refer to accompanying documents) (is used on article labels for reference to manual)	Refer to manual	ISO 3864
	Toxic material, poison	Hazard identification	IEC 61310
	Corrosive material, corrosion	Hazard identification	IEC 61310
	Cut/sever hand, sharp object	Hazard identification	ANSI Z535.3
	Strong magnetic field	Hazard identification	SEMI S1-0701
	Danger: electricity, electrical hazard	Hazard identification	IEC 61310, ISO 3864
	Wear safety gloves	Hazard avoidance Mandatory action	IEC 61310
	Wear face shield	Hazard avoidance Mandatory action	SEMI S1-0701
	Unplug power line	Hazard avoidance Mandatory action	SEMI S1-0701
	No pacemakers	Hazard avoidance Prohibition	SEMI S1-0701

Table 11: Safety symbols and signal words

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