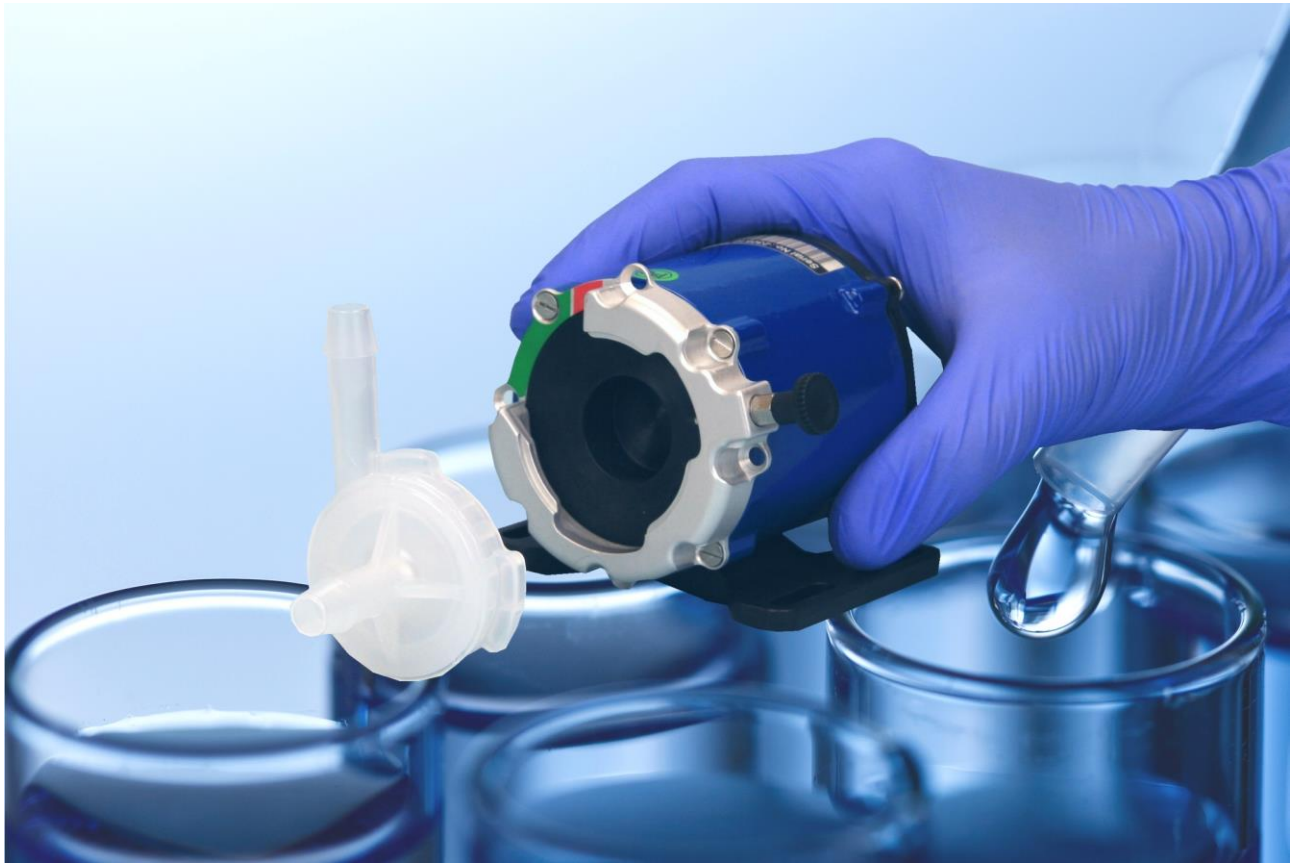
PuraLev® i30SU

1.0 bar (14.5 psi)
7.7 liters/min (2.0 gallons/min)

USER MANUAL



This manual contains information necessary for the safe and proper use of the *PuraLev® i30SU*. Included are specifications for the standard configurations of the flow control system and instructions regarding its use, installation, operation, adjustment, inspection and maintenance. For special configurations of the pump system refer to accompanying information. If the pump system must be configured for other parameter settings, then the *Levitronix® Service Software* version *V2.0.5.0* or higher (with relevant manual *Levitronix®* Doc.# *PL-4043-00*) is necessary. 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 flow control system can readily refer to it at any time.

Table of Contents

1 Safety Precautions

The *PuraLev® i30SU* pump system is designed to be used in industrial production machines and laboratory equipment containing hydraulic circuits. Typical applications are Single-Use Bioprocessing manufacturing equipment. Installation shall be done by qualified personnel only. Following safety precautions and all "CAUTION", "WARNING" and "DANGER" indications in the relevant sections shall be followed.

CAUTION

Do not under any circumstances open the driver. 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 up to 24 VDC). The usage of a galvanic separated power supply, which is certified by a 3rd party (UL or CE), is highly recommended.

Do not under any circumstances open the powered driver.

⚠ WARNING

High magnetic field strength of pump impeller.

The pump system 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.

⚠ WARNING

Pump Driver for ATEX / IECEX applications.

Only specific types of integrated Pump Drivers are classified for the use in Ex classified locations. Refer to the corresponding section in the manual.

2 Specifications

2.1 Specification of Components

Figure 1: Pump systems with standard components

Figure 2: General standard accessories

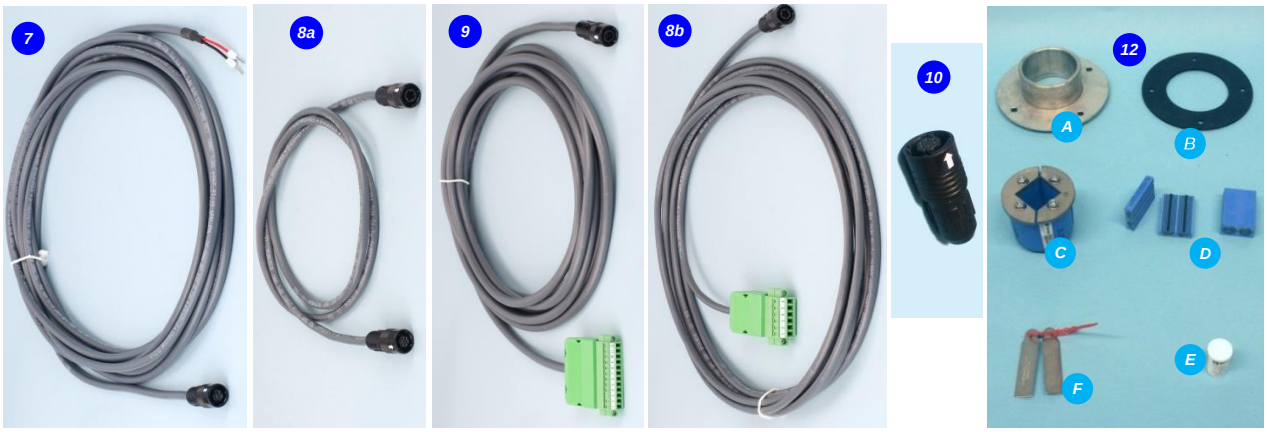


Figure 3: Standard cables

System Name	Article #	Pump Head Socket	Driver	Note
PLD-i30SU.1	100-90955	PHS-i30.1	IPD-30.1-50-02	*OEM - Driver, 5 m PVC cable with open wires, pump head socket*
PLD-i30SU.6	100-91514	PHS-i30.1	IPD-30.12-50-02	*OEM - ATEX/IECEx - 5 m FEP cable with open wires, pump head socket.*
PLD-i30SU.2	100-91025	PHS-i30.1	IPD-30.3-02 (MBP-i30.1 included)	*EasyConnect - Driver with interface connectors, pump head socket.*
PLD-i30SU.3	100-91026	PHS-i30.1	IPD-30.5-02 (MBP-i30.1 included)	*Stand-Alone - Driver with integrated user panel, pump head socket.*

Table 1: Standard driver system configurations

Pos.	Component	Article Name	Article #	Characteristics	Value / Feature
1a 1b	Single-Use (SU) Pump Head	DCP-30.2 (Barb) DCP-30.1 (Triclamp)	100-90968 100-90959	Material Impeller/Housing Housing Sealing In-/Outlet Fittings	*Polypropylene (FDA, USP Class VI, BSE/TSE/Animal free)* *Infrared welding* *Barb 3/8" or Triclamp 3/8" for tubing with typical ID = 1/4"*
				Max. Flow Max. Diff.-Pressure Max. Viscosity Max. Liquid Temp.	*7.7 liters/min / 2.0 gallons/min* *1.0 bar / 14.5 psi* *40 cP* *60 °C / 140 °F*
				Wet Pump Volume/Surface	*7.7 ml / 55.9 cm²*
				Sterilization Methods	*Gamma radiation up to 40kGy*
1c 1d	Irradiated SU Pump Head	DCP-30.2-G25 (Barb) DCP-30.1-G25 (Tricl.)	100-91071 100-91170	Applied Gamma Dosage	≥ 25 kGy
1e	Irradiated SU Pump Head with Sterile Fittings	DCP-30.2-SF1-G25	100-91234	Pump Type (A) / Tubing (C) Sterile Fittings (B) Fitting Compatibility Applied Gamma Dosage	*DCP-30.2 (Barb) / Silicone* *AseptiQuik® S from CPC® with part # AQS17006* [3] *Various sizes and types including autoclavable versions available at CPC®* *≥ 25 kGy*
2a	Integrated Pump Driver ("OEM Model")	IPD-30.1-50-02	100-10088	Voltage, Power Housing / Cable Interfaces Standard Firmware	*24 VDC ±10%, 35 W* *Epoxy coated Alu., PP for bottom lid, IP65*[1] */ PVC jacket, open wires, cable 5 m* *PLC and RS485 with Modbus protocol* *H2.48*
2b	Integrated Pump Driver ("EasyConnect" Model)	IPD-30.3-02 (MBP-i30.1 included)	100-10097	Housing Interfaces Standard Firmware	*Epoxy coated Aluminum, PP for bottom lid, IP65* *2x Fieldbus RS485 with Modbus protocol, PLC and power supply* *H2.48* [2]
2c	Integrated Pump Driver ("Stand-Alone" Model)	IPD-30.5-02 (MBP-i30.1 included)	100-10098	Housing Interfaces Standard Firmware	*Epoxy coated Aluminum, PP for bottom lid, IP65* *User panel with 3 user buttons, PLC and power supply* *H2.25*
2d	Integrated Pump Driver ATEX /IECEx ("OEM Model" only)	IPD-30.12-50-02	100-10203	Housing / Cable Interfaces ATEX / IECEx Marking Standard Firmware	*ETFE coated Alu., IP65*[1] */ FEP jacket, open wires, cable length 5 m* *PLC and RS485 with Modbus protocol* CE Ex *II 3G Ex ec h mc IIC T4 Gc* / CE Ex *II 3D Ex h tc IIIC T90°C Dc* *H2.48*
3	Pump Head Socket	PHS-i30.1	100-90947	Mounting Type Material Assembly Screws	*Bayonet type with locking pin* *Anodized Aluminum* *4 pcs M3 x 6 mm (Stainless Steel, INOX A4)*

Table 2: Specification of standard components

Note 1: Designed and tested for IP67. Note 2: Special firmware for serial pumping as one unit (Figure 6) available on request. Note 3: CPC® and AseptiQuik® are registered marks of the Colder Product Company.

Pos.	Component	Article Name	Article #	Characteristics	Value / Feature
4	Mounting Base Plate	MBP-i30.1	190-10313	Material / Mounting Screws	*PP + 30% GF / 2 pieces, stainless steel FEP coated, M3 x 10 mm*
5a	AC/DC Power Supply	TPC 055-124 (Traco)	100-40014	Voltage Output / Input Basic Dimensions Certification or Standards	*24 VDC with 55 W / 85 – 264 VAC, 47-63 Hz* *45 x 90 x 96.5 mm (mountable on DIN rail 35 mm)* *UL, CSA, CB, Semi F47*
5b	Desktop AC/DC Power Supply	AC/DC Power Supply VEC50US24 HR30	100-40015	Voltage Output / Input Basic Dimensions Safety Approvals Note	*24VDC, 50W / 90 – 264 VAC, 47-63 Hz* *116 x 52 x 31 mm* *IEC60950-1, EN60950-1, UL/cUL60950-1* *Connector for direct connection to power supply of driver with 1.2m cable.*
5c	AC Mains Cables (for Desktop power supply 5b)	AMC-1.1 (2m) AMC-1.2 (2.5m) AMC-1.3 (2.5m) AMC-1.4 (2.5m) AMC-1.5 (2.5m)	190-10331 190-10332 190-10333 190-10334 190-10335	Approvals and Country Approvals and Country Approvals and Country Approvals and Country Approvals and Country Cable Specifications	*UL, cUL, US, Canada* *CB, Germany, Denmark, Norway, Finland, Belg., Netherl., Sweden, Austria* *PSE, Japan* *Switzerland* *CE, United Kingdom* *Black color, ROHS*
6	USB to RS485 Adaptor-TR Isolated	YN-485I-TR	100-30392	Structure/Design Purpose	*USB connector (A) with termination resistor and cable (2m) with connector pair (B and C) for external RS485 wire connection. Magnetically isolated. Cable length is 2m. Included is a USB space saver cable (D).* *Communication over fieldbus of driver with PC*
7	IPS Cable Power 3 Wires	ICP-1.1-50 (5 m)	190-10342	Cable Material / Wires Connection In / Out Main Purpose	*PVC jacket / 3x 0.5 mm² (only 2 wires used, 1 is cut)* *Open wires / Circular Hirose type to driver* *Connection of power supply to "Stand-Alone" and "EasyConnect" drivers*
8a	IPS Cable Signal 6 Wires	ICS-1.1-01 (0.1 m) ICS-1.1-10 (1 m) ICS-1.1-30 (3 m)	190-10343 190-10344 190-10345	Cable Material / Wires Connection In / Out Main Purpose	*PVC jacket / 6x 0.08 mm² and shielding* *Circular Hirose type / Circular Hirose type* *Fieldbus connection between "EasyConnect" drivers (e.g. multi-pump arrays)*
8b	IPS Cable Signal 6 Wires	ICS-1.2-50 (5 m)	190-10346	Cable Material / Wires Connection In / Out Main Purpose	*PVC jacket / 6x 0.08 mm² and shielding* *Connector with screw type plug for open wire connection / Circular Hirose type* *Fieldbus connection to "EasyConnect" and to PLC of "Stand-Alone" drivers.*
9	IPS Cable Signal 12 Wires	ICS-2.1-50 (5 m)	190-10347	Cable Material / Wires Connection In / Out Main Purpose	*PVC jacket / 12x 0.14 mm² and shielding* *Connector with screw type plug for open wire connection / Circular Hirose type* *General connection to PLC of "EasyConnect" drivers.*
10	Fieldbus Termination Connector	FTC-1.1	190-10348	Materials Main Purpose	*PPS for connector housing and FPM for sealing.* *Termination of fieldbus.*
11	User Panel	LUI-B.1-01	100-30448	Interface / Housing Rating Standard Firmware	*RS485 / IP65* *A3.00*
12	ATEX Cable Sealing System	ACS-A.1 (Roxtec)	100-90292	Sleeve (A) and Gasket (B) Frame (C) 2x Cable Module (D)	*Stainless Steel and EPDM* *Roxylon (EPDM rubber)* *Roxylon (EPDM rubber)* — *Note: Lubricant (E) and measurement plates (F) are included.*

Table 3: Specification of accessories

Note 1: Designed and tested for IP67.

2.2 System Overview and General Specification

2.2.1 System Configuration for *Stand-Alone* Model

Figure 4 illustrates the system configuration of the *Stand-Alone* model with integrated user panel and buttons to set the speed manually. The driver also contains a PLC interface for remote speed control by analog and digital signals. Various accessories are available like a desktop power supply with relevant power cable and signal cables to connect to the PLC.

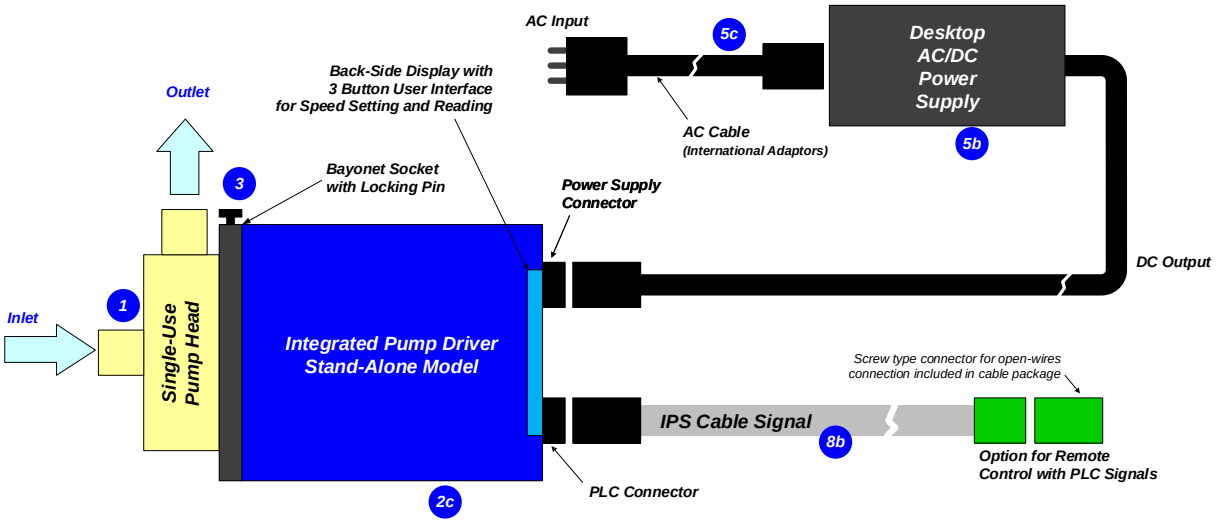


Figure 4: Standard system configuration for Stand-Alone model

2.2.2 System Configurations for *EasyConnect* Model

The *EasyConnect* model (see *Figure 5* and *Figure 6*) with relevant cable accessories is designed to realize various interface configurations with minimal setup effort. The PLC interface allows not only remote control by analog/digital signals but also connections of external sensors hence enabling for example a precise flow or pressure control (see notes below).

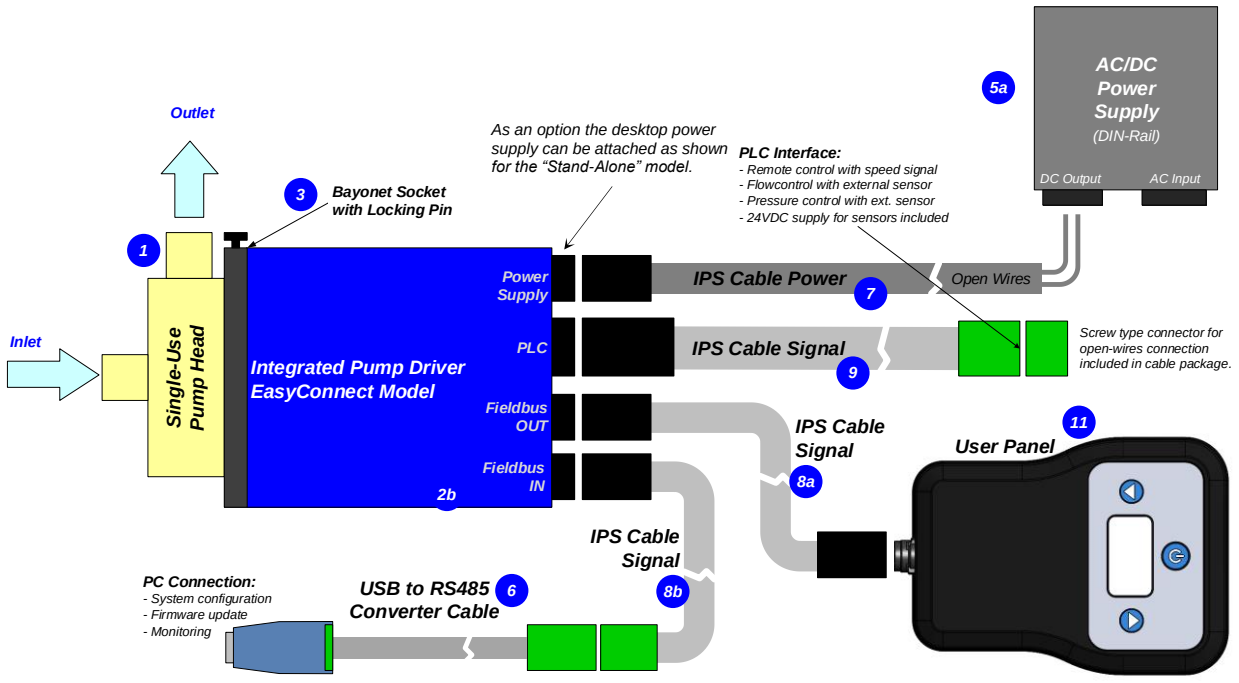


Figure 5: Standard system configuration for EasyConnect model

Two Fieldbus connectors (IN and OUT) allow to setup arrays of multiple pumps. Therefore serial pumping configurations as shown in *Figure 6* can be realized.

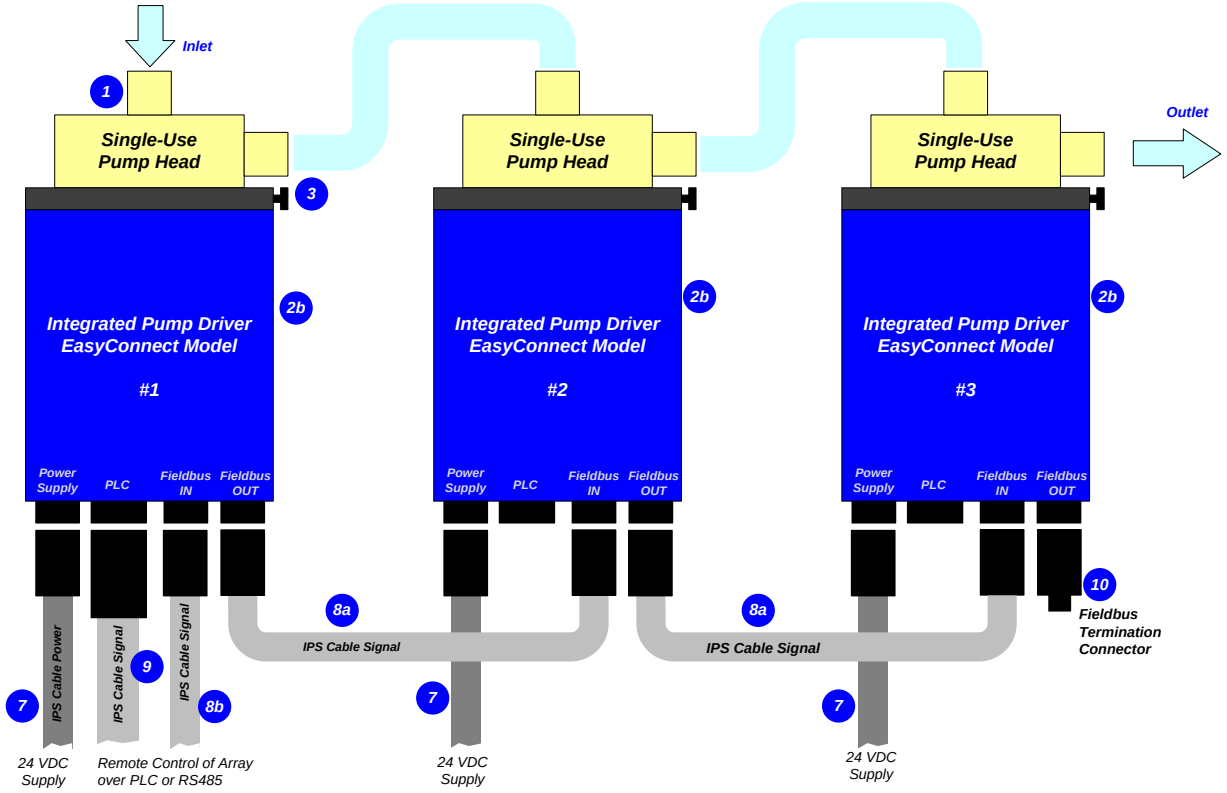


Figure 6: Multi-pump array for serial pumping with EasyConnect models

Note: Specific firmware for serial pumping as one unit available on request.

2.2.3 System Configurations for *OEM* Models

The *OEM* model, with one integrated cable only, is design for compact integration into an equipment. When using the pump system in speed control mode, the speed can precisely be set via an analog input. Various digital inputs and outputs allow controlling and monitoring of the system. A *RS485* enables communication with a PC with the *Levitronix® Service Software*. Hence parameterization, firmware updates and failure analysis are possible. The *RS485* can also be used as a fieldbus to implement more intelligent concepts of pump control.

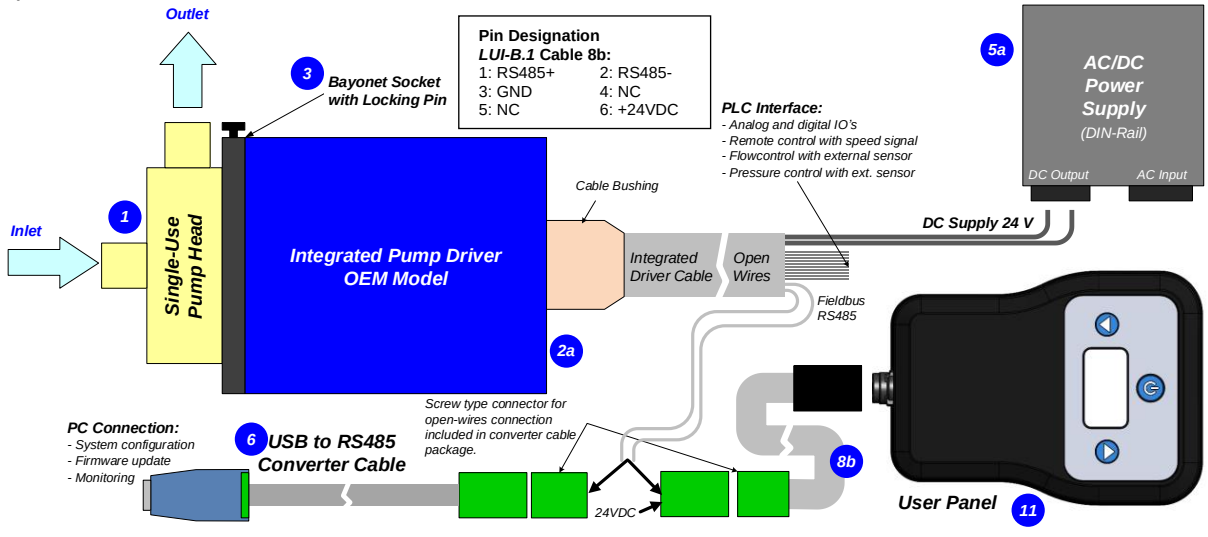


Figure 7: System configuration of OEM model for speed control

The *PLC* interface of the *OEM* model enables the implementation of precise closed loop flow or pressure control in connection with either a flow or pressure sensor (see *Figure 8*). Precise ultrapure flow control systems can be realized in combination with *LEVIFLOW*® flowmeters.

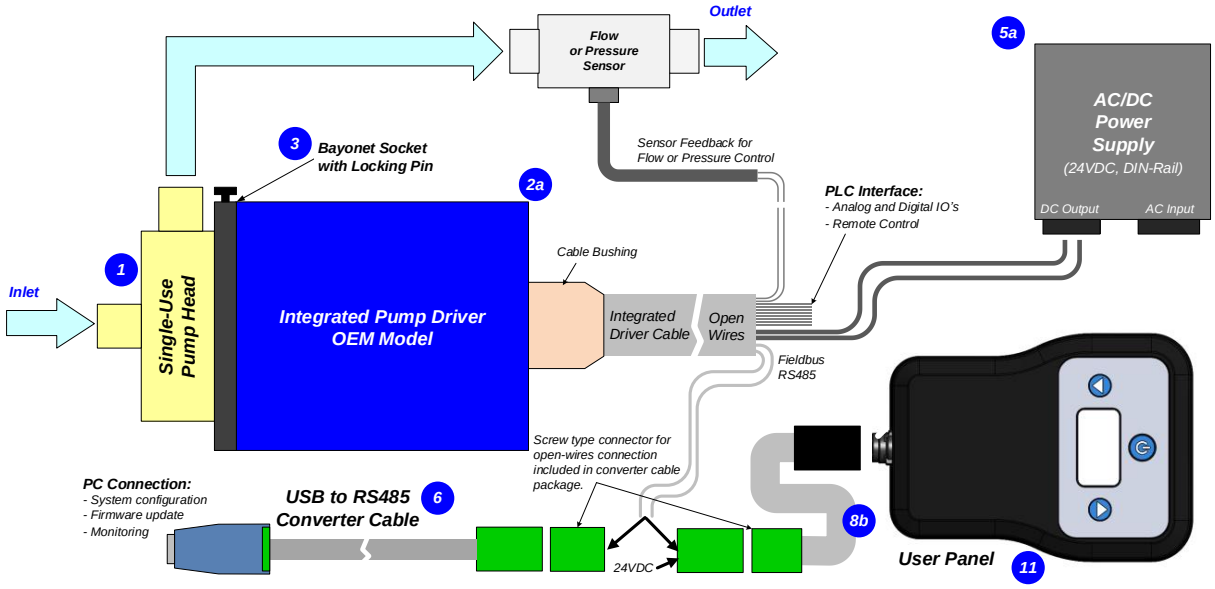


Figure 8: System configuration of OEM model for process control
(Pressure or flow control with external sensor, details in Section 4.3.1)

2.2.4 System Configuration for OEM ATEX / IECEx Models

Together with the defined pump heads an ATEX / IECEx certified pump driver allows installation of the pump within an Ex classified area (see *Figure 9* and *Figure 10*). One option to lead the driver cable outside of the Ex area is to use an Ex certified cable sealing system as listed in *Table 3*.

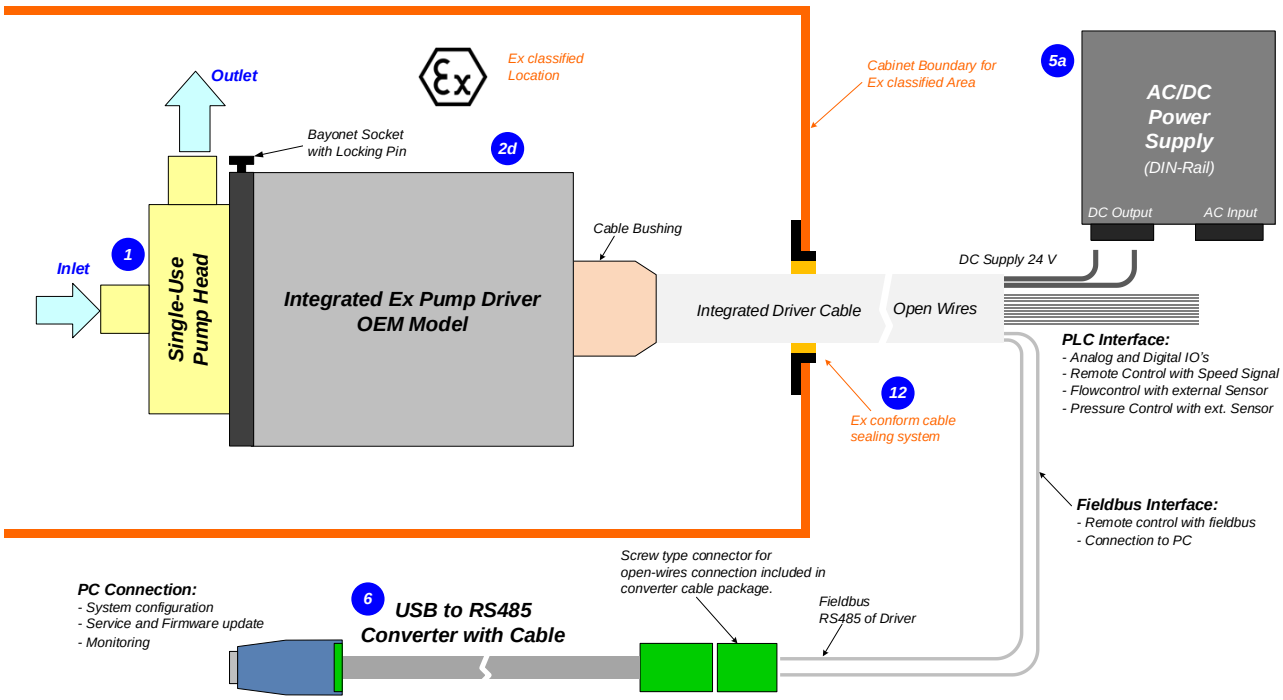


Figure 9: System configuration of OEM Ex model for speed control

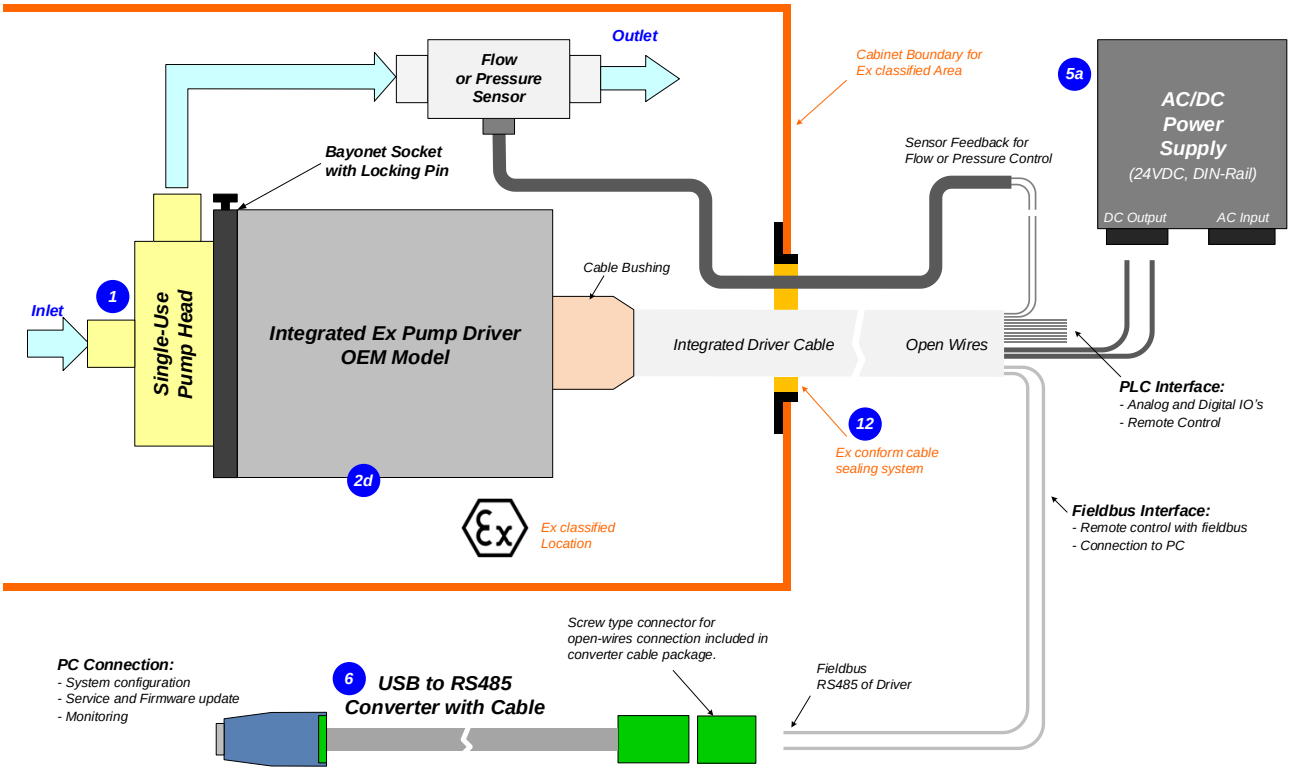


Figure 10: System configuration of OEM Ex model for process control
(Pressure or flow control with external sensor.)

2.3 General Environmental Conditions

Usage	Indoor
Altitude	Up to 2000 *m*
Operating ambient temperature	0 to 40 °*C*
Storage ambient temperature (Extremes for Transportation)	-20 to 80 °*C* -20 to 70 °*C* for single-use pump head
Operating humidity range (relative humidity)	15 – 95% (non-condensing)
Storage humidity range (relative humidity) (Extremes for Transportation)	15 – 95% (non-condensing)
Normal storage conditions	Ambient temp.: 20 to 30 °*C* Relative humidity: 50% (non-condensing)
DC supply fluctuations	± 10% of nominal voltage
Transient over-voltages typically present on the mains supply	Surge immunity according to EN 61000-4-5 (tested together with certified AC/DC power supply)
Pollution degree	2

Table 4: Environmental conditions for pump system

2.4 Pressure-Flow Curves

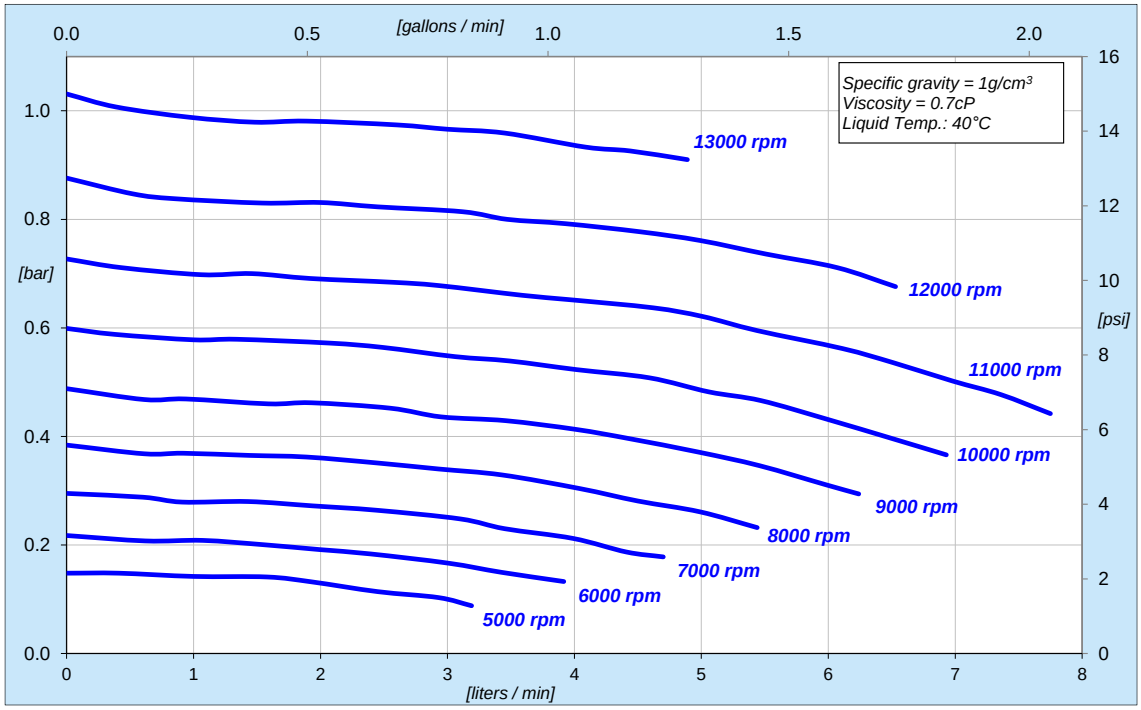


Figure 11: Pressure/flow rate curves of DCP-30 pump head

2.5 Maximum Static Pressure for Pump Heads

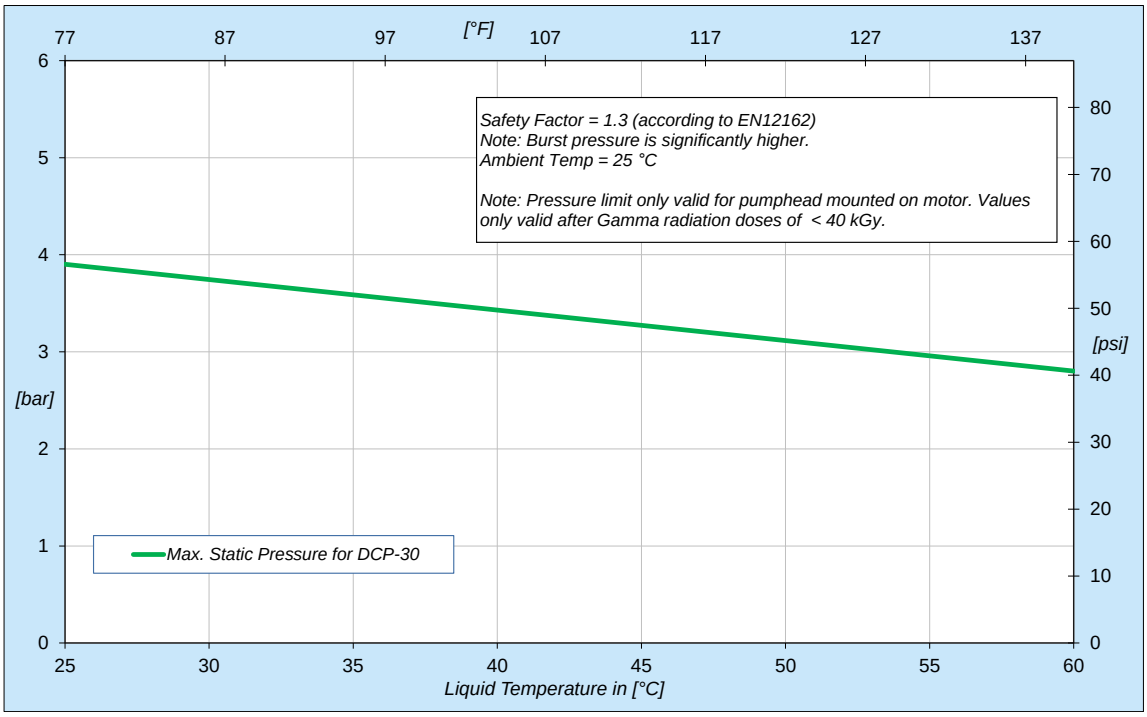


Figure 12: Specification for maximum static pressure of pump head DCP-30

Note 1: Pressure limits only valid for pump head mounted on motor and do not account for tubing limits attached to the fittings.
Note 2: The above chart is also applicable to the DCP-30.2-SF1-G25 with sterile fittings.

2.6 Basic Dimensions of Main Components

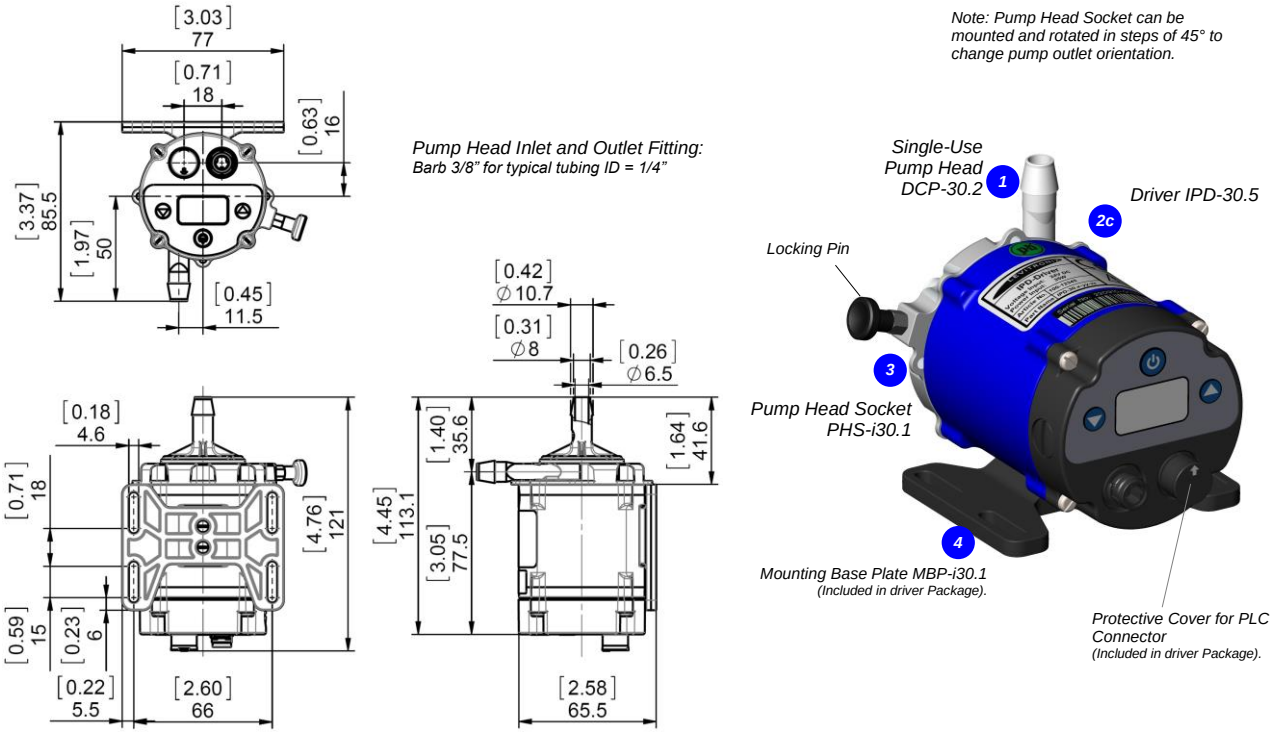


Figure 13: Basic dimensions (in [mm] and [inch]) of Stand-Alone model
Note 1: Drawings with DCP-30.1 (Triclamp) and DCP-30.2-SF1 (Sterile Fittings) are available on request.

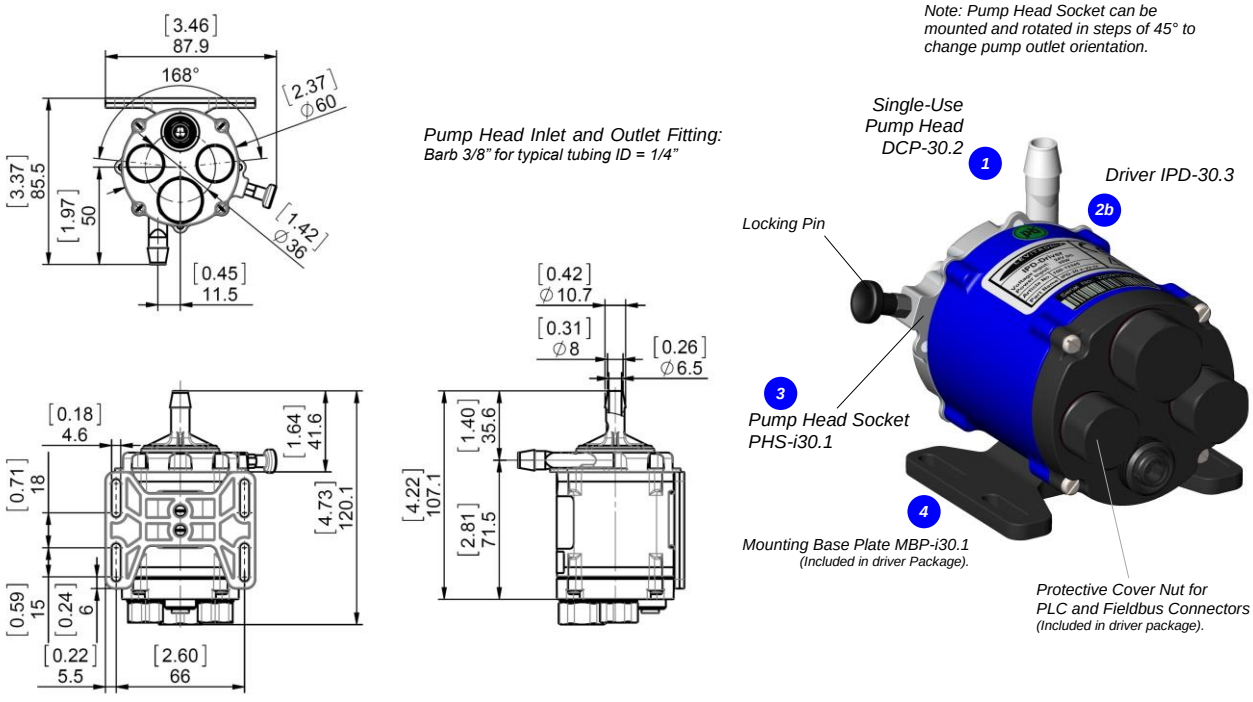


Figure 14: Basic dimensions (in [mm] and [inch]) of EasyConnect model
Note 1: Drawings with DCP-30.1 (Triclamp) and DCP-30.2-SF1 (sterile fittings) are available on request.

Pump head inlet and outlet fitting:
Barb 3/8" for typical tubing ID = 1/4"

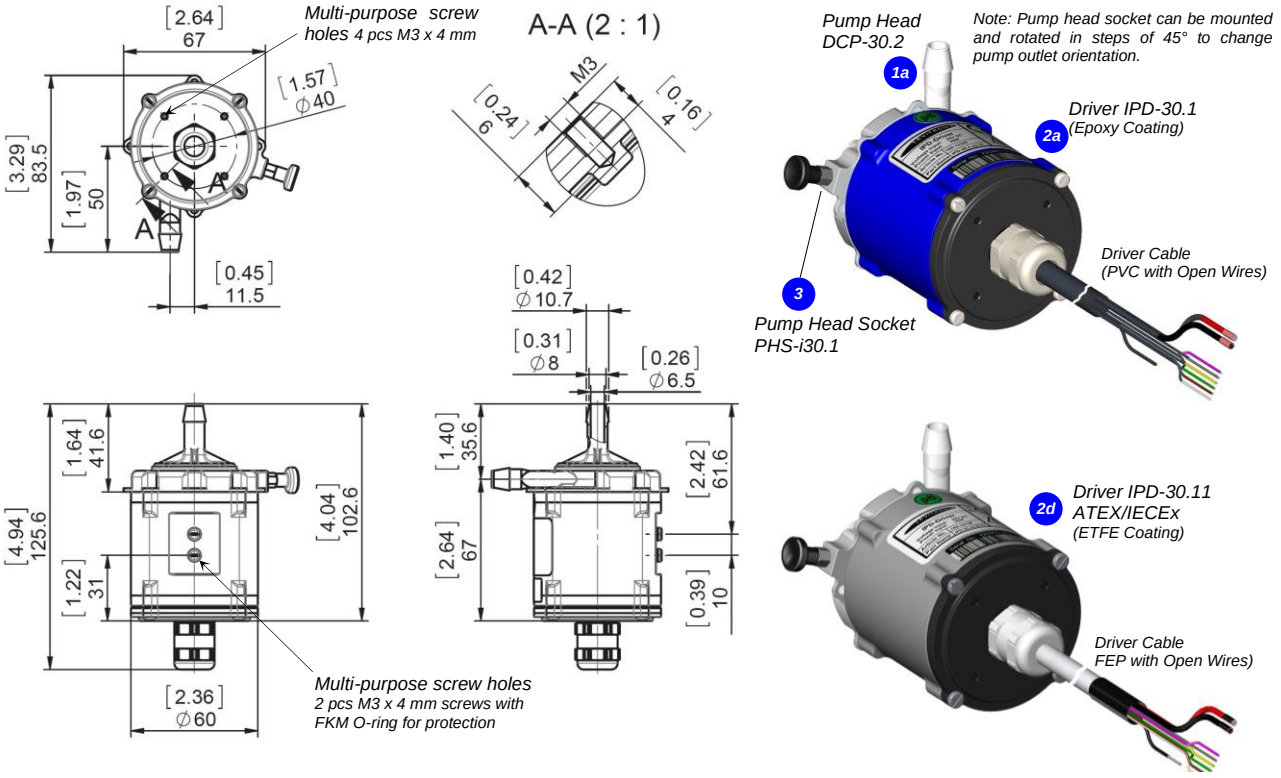


Figure 15: Basic dimensions (in [mm] and [inch]) of OEM model

Note 1: Drawings with DCP-30.1 (Triclamp) and DCP-30.2-SF1 (sterile fittings) are available on request

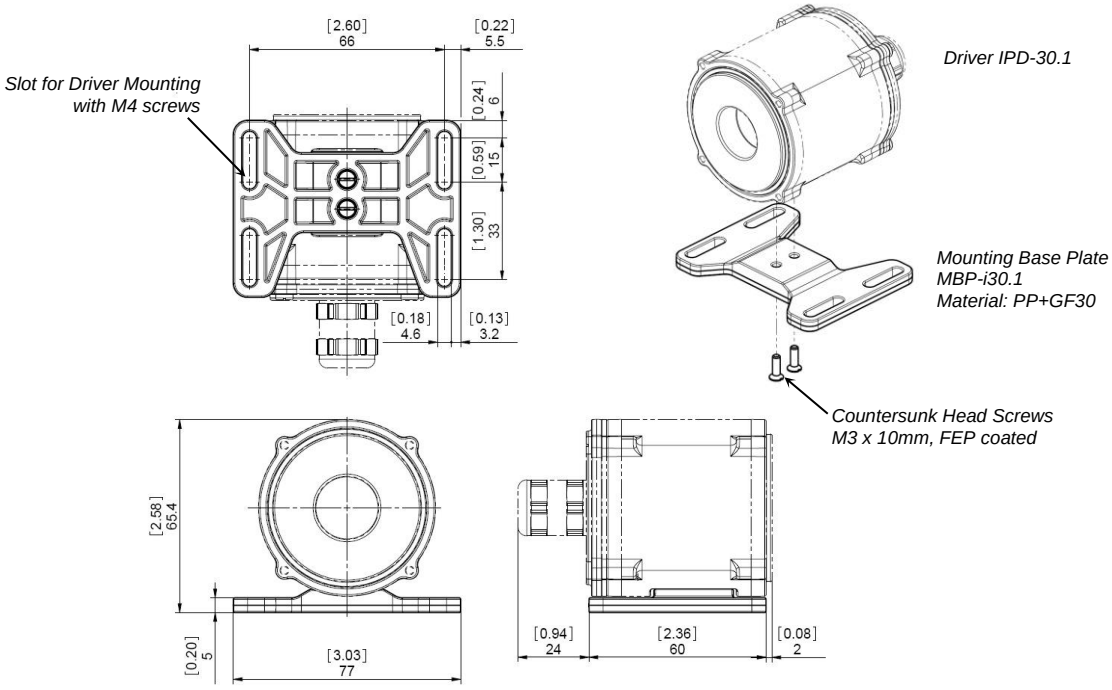


Figure 16: Basic dimensions (in [mm] and [inch]) of OEM driver of mounting base plate MBP-i30

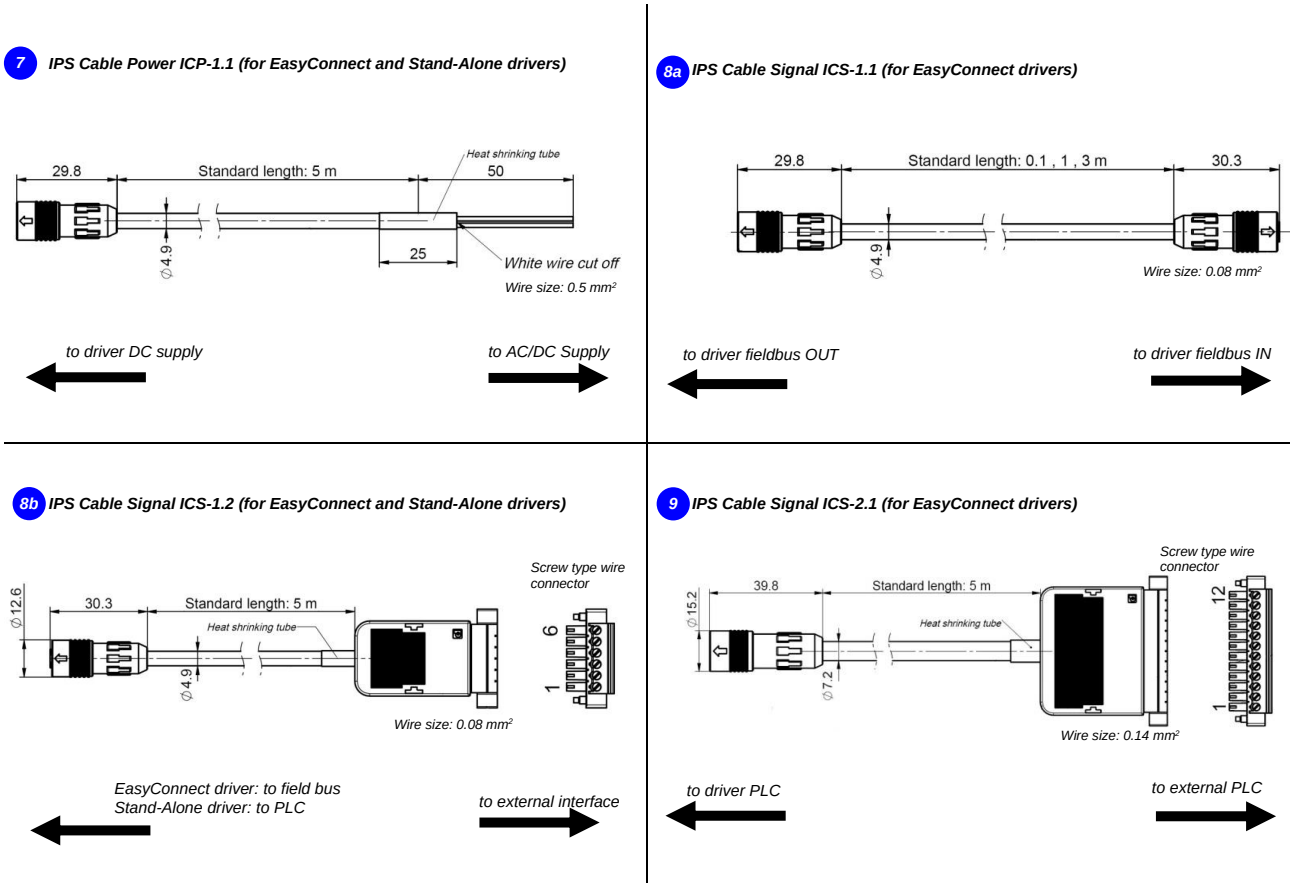


Figure 17: Basic dimensions and specifications of standard cables

Cable Jacket	Cable Diameter	Minimum Bending Radius Permanent Installation	Minimum Bending Radius Sometimes Moved
PVC	8.4 mm	7x Cable OD	15 x Cable OD

Table 5: Specifications for min. bending radius of cables

Note: If not mentioned explicitly all the cables are not suited for constant dynamic bending and movement!

3 Engineering Information

3.1 Power Supply and Consumption

3.1.1 Power Consumption

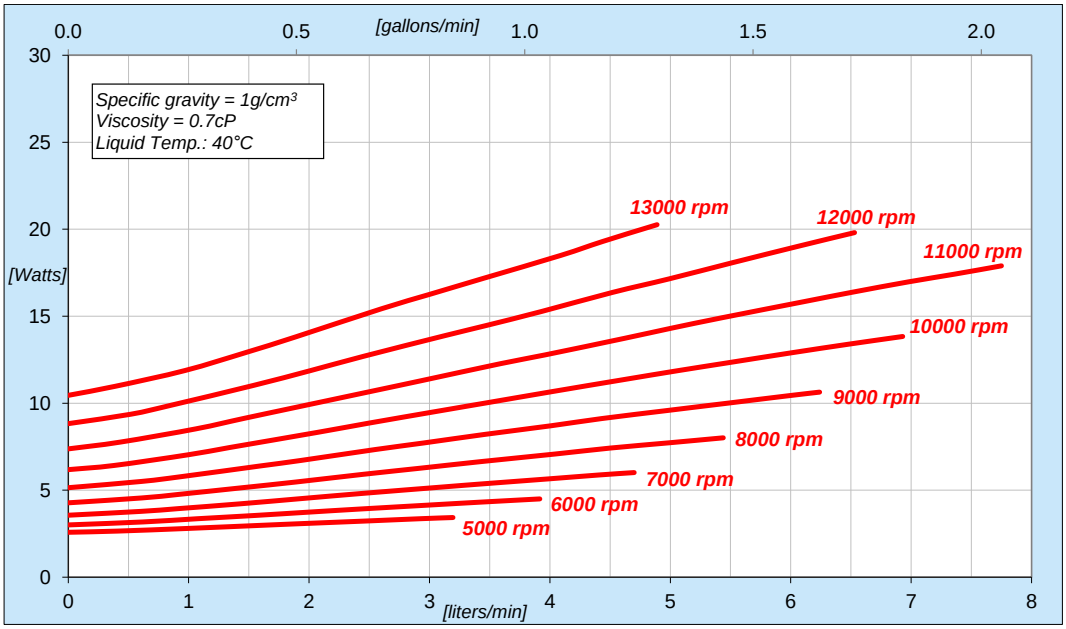


Figure 18: Electrical power consumption
(Measured on OEM model with DCP-30 pump head but also representative for EasyConnect and Stand-Alone models)

3.1.1 Inrush Current

When selecting a AC/DC power supply the inrush currents (currents during power-on) shown in *Table 6* shall be considered. If the specifications of the power supply are unclear a test with multiple power-on cycles is recommended to assure proper operation.

Situation	I^2t Value in [A^2s]	Peak Value in [A]
Driver with 0.5m cable length	3.5	216
Driver with 5 m cable length	1.7	114

Table 6: Inrush currents of power supply driver during power on of driver
(Measured at 24 VDC + 10% on OEM model but also representative for EasyConnect and Stand-Alone models)

3.1.2 Evaluation of Power Supplies

If other power supplies than the standard specified ones are used, it is recommended to evaluate them under demanding operating situations like fast braking from maximum speed and during power on and take-off of the impeller.

3.2 Temperature Monitoring

To avoid overheating of the system, the controller and motor temperatures within the driver are monitored. If one of both temperatures exceeds *80°C (176°F)* for a period of more than 10 minutes, the system goes into an error state and the pump stops. At *90°C (194°F)*, the system stops immediately.

If *65°C* is exceeded a warning is given within the driver announcing to the user that the driver is running near the thermal limit (see explanation in *Section 3.3*). For the *EasyConnect* and *OEM* models the warning signal can be monitored with the *Levitronix® Service Software* or configured on one of the digital outputs. For the *Stand-Alone* model the temperature can be monitored on the display.

3.3 Thermal Management

The driver temperature depends on the ambient and liquid temperature, as well as on the hydraulic operation point. *Figure 19* and *Figure 20* illustrate the temperature characteristics of the motor depending on these parameters.

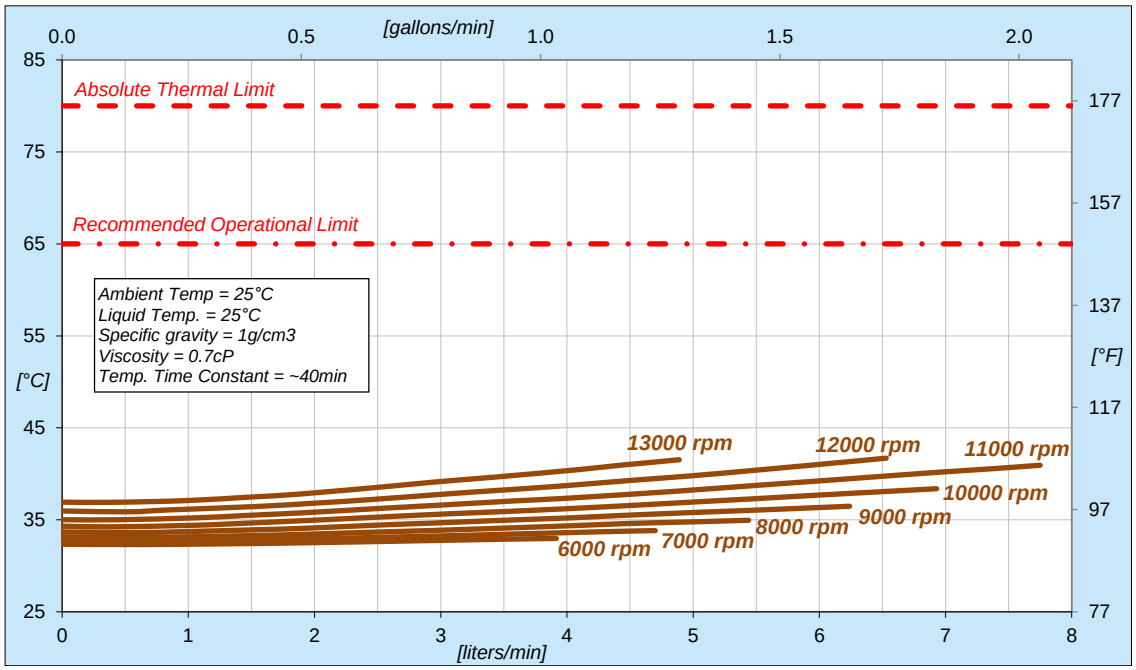


Figure 19: Temperature curves for the IPD-30.1-50 driver @ 25°C liquid temperature
(Pumping with pump head DCP-30, temperature is measured inside of the integrated motor and controller, contact temperature of surface is below this temperature)

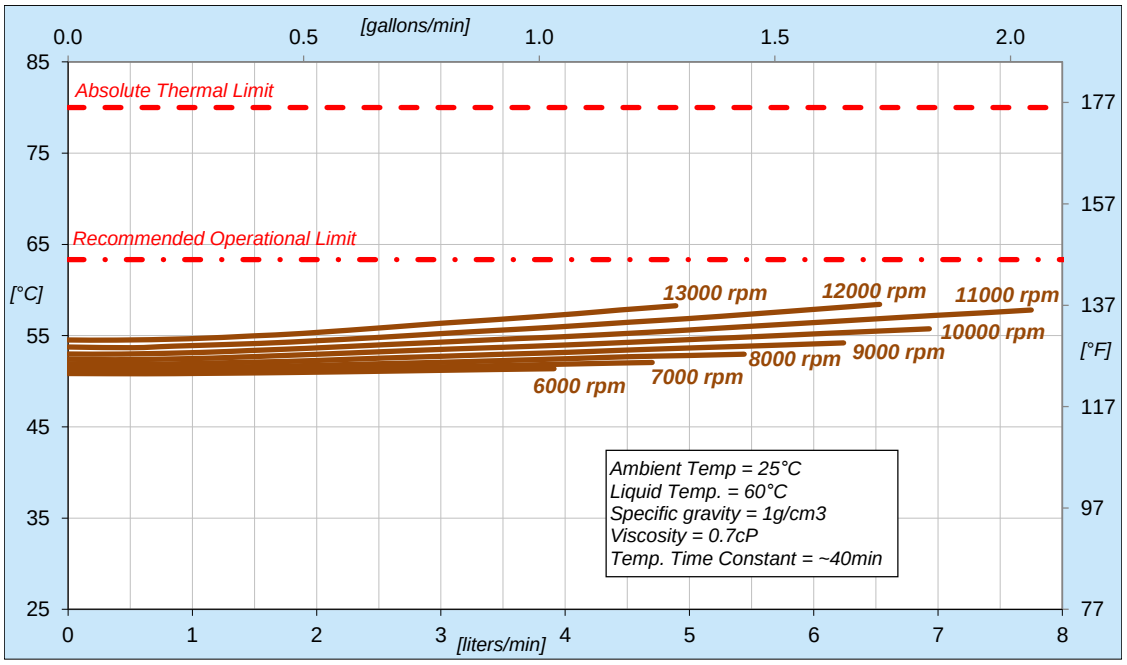


Figure 20: Temperature curves for the IPD-30.1-50 driver @ 60°C liquid temperature
(Pumping with pump head DCP-30, temperature is measured inside of the integrated motor and controller, contact temperature is below this temperature)

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.

$$T_M(T_L, T_A) \approx T_M \underbrace{(T_L = 25°C, T_A = 25°C)}_{see\ Figure\ 17} + (T_L - 25°C) \cdot \underbrace{tg_{LM}}_{\substack{\approx 0.59 \\ for\ convection \\ cooling}} + (T_A - 25°C) \qquad \textbf{(Eq. 1)}$$

T_M = $Motor\ temperature\ [°C]$ $\quad$ T_L = $Liquid\ temperature\ [°C]$

T_A = $Ambient\ temperature\ [°C]$ $\quad$ tg_{LM} = $Temperature\ gradient\ liquid/motor$

All above presented thermal data are typical values, which are partly based on measurements and partly on interpolations with a simplified thermal model and are therefore only guideline values and are suitable for a first layout of the basic thermal concept. It is recommended to check the thermal values with the motor placed on the final location and under worst case performance conditions of the application.

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 15°C safety distance to the absolute thermal limit of the driver (80°C) when designing the thermal concept of the pump system.

It is recommended to avoid thermal stagnation in the room or cabinet where the driver is placed. Any type of circulation decreases the driver temperature significantly.

3.4 Hydraulic Circuit Design

Following general design rules help to operate the pump system optimally considering efficiency, optimum priming behavior and low shear forces:

1. The general rule for minimum shear forces and optimum priming behavior is to minimize the pressure drop in the inlet circuit and avoid negative pressure at the inlet of the pump head.

2. Minimize tubing length at the inlet of the pump head and maximize the ID (not smaller than the pump head inlet ID of 1/4" = 6.5 mm is recommended). This reduces the pressure drop and the tendency of cavitation.

3. Avoid any restrictions, valves, elbows, bended tubing and sharp edges at the inlet circuit of the pump head, which potentially cause cavitation resulting in higher shear forces and bubble collection in the pump head with the danger of priming loss.

4. Place the pump at the lowest point of the hydraulic circuit. Optimum is as much as possible below a tank or reservoir. This optimizes priming behavior and keeps the inlet pressure positive for low shear forces.

5. Keep the liquid level in the reservoir tank or bag as high as possible, which increases the inlet pressure of the pump head and minimized heat up of the liquid.

6. When horizontal mounting of the driver the optimum outlet angle of the pump head is 45 degree (see *Figure 28*) hence allowing gas bubbles to leave the pump head and keep it primed.

7. To minimize heat up of the liquid the overall pressure drop in the hydraulic circuit shall be reduced as much as possible.

8. It shall be avoided to pump longer times against a closed valve, which can cause heat-up of the liquid and higher shear forces.

9. At higher liquid temperature rules mentioned above become more important due to higher cavitation tendency of the liquid.

Contact the *Levitronix® Technical Service* department (see *Section 8*) for more detailed considerations and support on the design of the hydraulic circuit.

4 Installation

4.1 Electrical Installation of *Stand-Alone* Model

4.1.1 Overview of Connections and Designations

Figure 21: Electrical connections to Stand-Alone driver IPD-30.5

Pin #	Pin Name	Wire Color [1]	Description	Standard Designation [2]	Specifications Typical Levels	Note
2	P +	red	+ 24 VDC	*Power Supply*	Voltage: 24 VDC ±10% Power: 35 W	"P -" shall be connected to earth
1	P -	black	Ground/Earth			
3	NC	white	Not connected	--	Wire of compatible cables is cut.	Wire of compatible cables is cut.

Table 7: Power supply connector of Stand-Alone driver model

1: Wire colors of compatible cables: ICP-1.1-xx. *2: Designations for standard firmware. For other firmware refer to relevant documentation.*

Pin #	Pin Name	Wire Color [1]	Description	Standard Designation [2]	Typical Levels	Note
6	Ain1	pink blue	Analog Input	*Remote Speed*	4..20 mA = 0..16000 rpm -> Speed limit = 13000rpm -> Cut-off (min.) speed = 0 rpm	450 Ohm shunt input, no galvanic isolation.
5	Ain_GND	red	Analog Input Ground	--	--	Reference to Ain1.
1	Dout1	white	Digital Output	*Status*	Closed circuit ⇒ active, system on Open circuit ⇒ not active, system off	Open drain, max. 24V, 100mA This signal indicates the state of the pump system.
3	GND	brown black Shield	Ground	--	--	Reference to Dout1
2	Din1	yellow	Digital Input	*PLC Enable*	Edge triggered: 0 V ⇒ 5-24 V ⇒ Enable 5-24 V ⇒ 0 V ⇒ Disable	For enabling of the system with external signal. Galvanic separation with optocoupler and 2.2 kΩ input resistance.
4	Din_COM	grey	Common Digital Input	--	--	Reference to Din1.

Table 8: PLC connector of Stand-Alone driver model

1: Wires of compatible cables: ICS-1.1-xx and ICS-1.2-xx.
2: Designations for standard firmware H2.25. For other firmware refer to relevant documentation.

4.1.2 Overview Electrical Schematics of Driver Interface

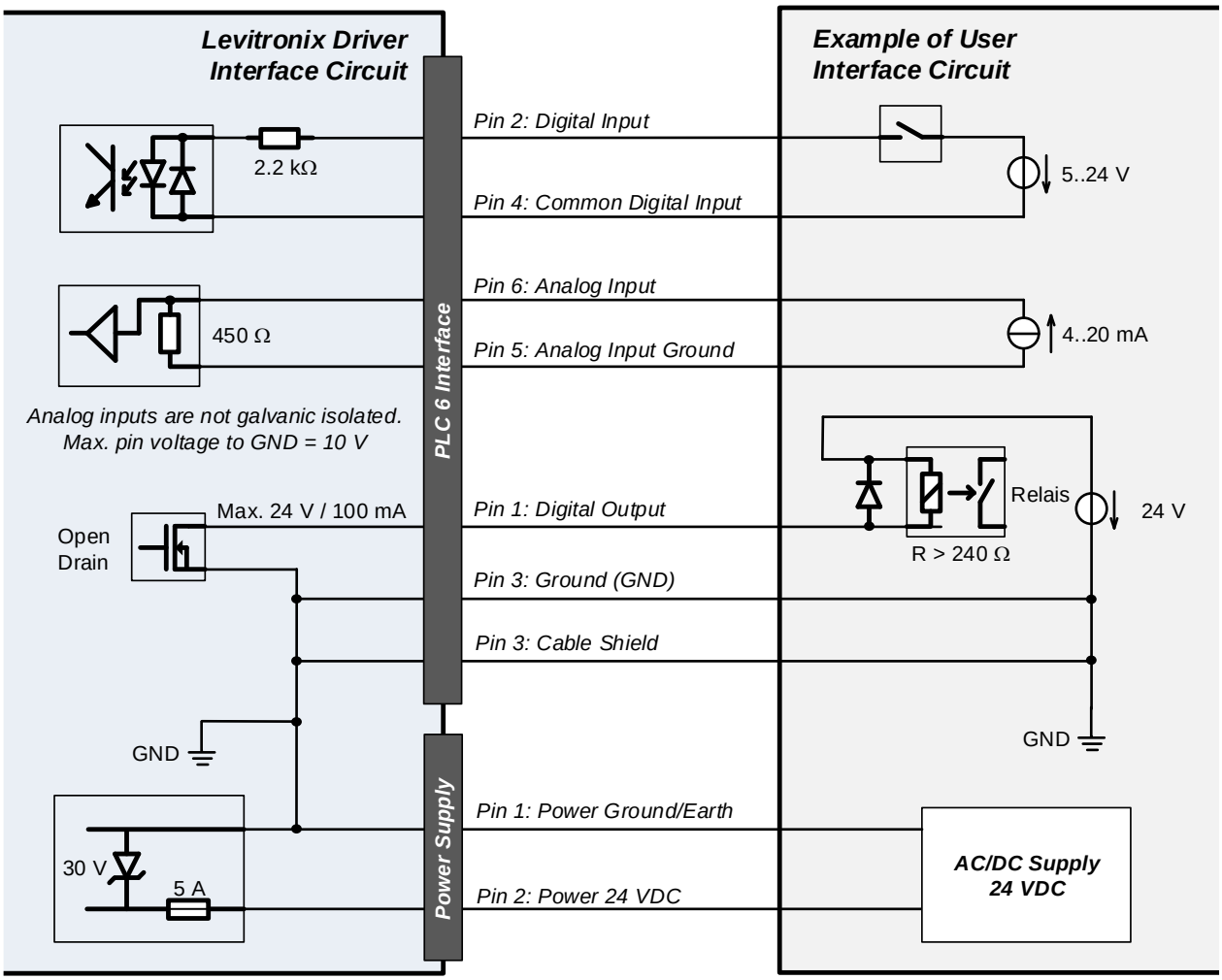


Figure 22: Electrical schematics of interfacing for Stand-Alone driver model

4.1.3 Installation Instructions for Power Supply

⚠ 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 24 VDC). The usage of a galvanic separated power supply, which is certified by a 3rd party (UL or CE), is highly recommended.

1. A certified and tested desktop power supply with a specific connector is available as an accessory (see **Error! Reference source not found.**), which allows simple direct connection to t he driver.
2. For other power supplies an open wire power cable for connection to the driver is specified in *Table 3* (cable type *ICP-1.1*). Depending on the required hydraulic operational point (see *Figure 11*), the pump system requires 24V with a maximum power of 35 W. At a lower performance power supplies with smaller power or bigger supplies to supply several pump systems simultaneously may be used. Consult *Figure 18* to get the power consumption depending on the flow. If other power supplies are used, than the one recommended by *Levitronix®*, it is highly recommended to test these under dynamic conditions (acceleration and braking of the pump rotor speed).
3. Make sure that the polarity is correct and that AC/DC power supply is off.

4.1.4 Installation *PLC* Interface Signals

To operate the pump system with a *PLC* the analog input can be used to set the speed. The digital output can be used to monitor the pump status and operating parameters (see *Table 8*).

CAUTION

The analog is not galvanically isolated from the controller electronics. To avoid ground loops and malfunctions, use floating analog signals.

1. Power off the system.
2. A signal cable with driver connector is available to simplify PLC wire connections (see *Table 3* cable type *ICS-1.2*). Connect the designated PLC wires according to *Table 8.*
3. Follow *Figure 22* as reference for hardware configuration of the PLC in/outputs.
4. Protect the un-used wires against short-circuit to each other

4.2 Electrical Installation of *EasyConnect* Model

4.2.1 Overview of Connections and Designations

Figure 23: Electrical connections to EasyConnect driver IPD-30.3

Pin #	Pin Name	Wire Color [1]	Description	Standard Designation [2]	Specifications Typical Levels	Note
2	P +	red	+ 24 VDC	*Power Supply*	Voltage: 24 VDC ±10% Power: 35 W	"P -" shall be connected to earth
1	P -	black	Ground/Earth			
3	NC	white	Not connected	--	Wire of compatible cables is cut.	Wire of compatible cables is cut.

Table 9: Power supply connector of EasyConnect driver

1: Wire colors of compatible cables: ICP-1.1-xx. *2: Designations for standard firmware. For other firmware refer to relevant documentation.*

Pin #	Pin Name	Wire Color [1]	Description	Standard Designation	Typical Levels	Note
3	GND	brown black shield	Ground	--	--	--
6	NC	pink-blue	Not connected	--	--	--
1	RS485+	white	RS485+	*Field Bus*	Modbus protocol.	For remote control with other devices. Usage of *Levitronix® Service Software* with a RS485 to USB adaptor cable (see **Error! Reference source not found.**).
2	RS485-	yellow	RS485-			
4	Internal	grey	Internal	*Do not connect.*	--	Internal bus needed to connect pumps for serial pumping.
5	Internal	red	Internal			

Table 10: Fieldbus IN connector of EasyConnect driver

1: Wires of compatible cables: ICS-1.1-xx and ICS-1.2-xx

Pin #	Pin Name	Wire Color [1]	Description	Standard Designation	Typical Levels	Note
3	GND	brown black shield	Ground	*Supply Output*	24VDC 10%, 200 mA (Max. current is together with Pout of *PLC* connector in *Table 12*)	For supply of external devices (displays etc.). Internally protected.
6	Pout	pink-blue	Output 24VDC			
1	RS485+	white	RS485+	*Field Bus*	Modbus protocol.	For remote control with other devices. Usage of *Levitronix® Service Software* with a RS485 to USB adaptor cable (see **Error! Reference source not found.**). Feed through for multi-pump arrays (for example serial pumping, see *Figure 6*)
2	RS485-	yellow	RS485-			
4	Internal	grey	Internal	*Do not connect.*	--	Internal bus needed to connect pumps for serial pumping.
5	Internal	red	Internal			

Table 11: Fieldbus OUT connector of EasyConnect driver

1: Wires of compatible cables: ICS-1.1-xx and ICS-1.2-xx

Pin #	Pin Name	Wire Color [1]	Description	Standard Designation	Typical Levels	Note
7	Ain1	violet	Analog Input (Current)	*Actual Process Value*	4..20 mA = 0..100%	450 Ohm shunt input, no galvanic isolation. The designation of the analog inputs can be changed with *Levitronix® Service Software.*
8	Ain2	grey-pink	Analog Input (Voltage)	*Reference Value*	0..10 V = 0..16000 rpm (*Speed Mode*) -> Speed limit = 13000rpm -> Cut-off (min.) speed = 0 rpm 0..10 V = 0..100% *(Process Mode)*	Analog voltage input: 0 – 10V (7.9 kOhm, no galvanic isolation). *Note: Max. input voltage of 11 V shall not be exceeded.* The designation of the analog inputs can be changed with *Levitronix® Service Software.*
6	Ain_GND	blue	Analog Input Ground	--	--	Reference to Ain1/2.
9	Aout1	blue-red	Analog Output	*Actual Speed* *Actual Process Value*	0..10 V = 0..16000 rpm *(Speed Mode)* 0..10 V = 0..100% (*Process Mode*)	Direct connection, no protection. Galvanic isolation on user side is required. GND is reference. The configuration of the analog output can be changed with *Levitronix® Service Software.*
10	GND	white-green shield	Ground	--	--	Reference for Aout1, Dout1, Dout2 and Pout.
2	Dout1	brown	Digital Output	*Status*	Closed circuit ⇒ active, system on Open circuit ⇒ not active, system off	Open drain, max. 24V, 100mA This signal indicates the state of the pump system. The configuration of the digital outputs can be changed with *Levitronix® Service Software.*
1	Dout2	white	Digital Output	*Error*	Closed circuit ⇒ not active, system on Open circuit ⇒ active, system off	Open drain, max. 24V, 100mA When active, the system drives the impeller to zero rpm and shuts down. With a reset pulse (see "*Enable*" description) the system can be re-initialized. The configuration of the digital outputs can be changed with *Levitronix® Service Software.*
5	Din1	pink		*Enable (Reset)*	5-24 V ⇒ active 0 *V* ⇒ not active	Galvanic separation with optocoupler and 2.2 kΩ input resistance. The "*Enable*" signal switches the pump system on and off. Resets pump from error state with 300-700ms pulse.
4	Din2	grey		*Process Mode*	5-24 V ⇒ active 0 *V* ⇒ not active	Galvanic separation with optocoupler and 2.2 kΩ input resistance. Switch between process mode and speed mode. In process mode the closed loop PI controller can be configured with *Levitronix® Service Software*.
3	Din_COM	yellow	Common Digital Input	--	--	Reference to Din1 and Din2.
11	Pout	red	Output 24 VDC	*Supply Output*	24VDC ±10%, 200 mA (Max. current is together with Pout of *Fieldbus OUT* connector in *Table 11*)	For supply of external devices (displays etc.). Internally protected. Reference is GND.
12	NC	black	Not connected	--	--	--

Table 12: PLC connector of EasyConnect driver

1: Wires of compatible cables: ICS-2.1-xx 2: Designations are for standard firmware.

4.2.2 Overview Electrical Schematics of Driver Interface

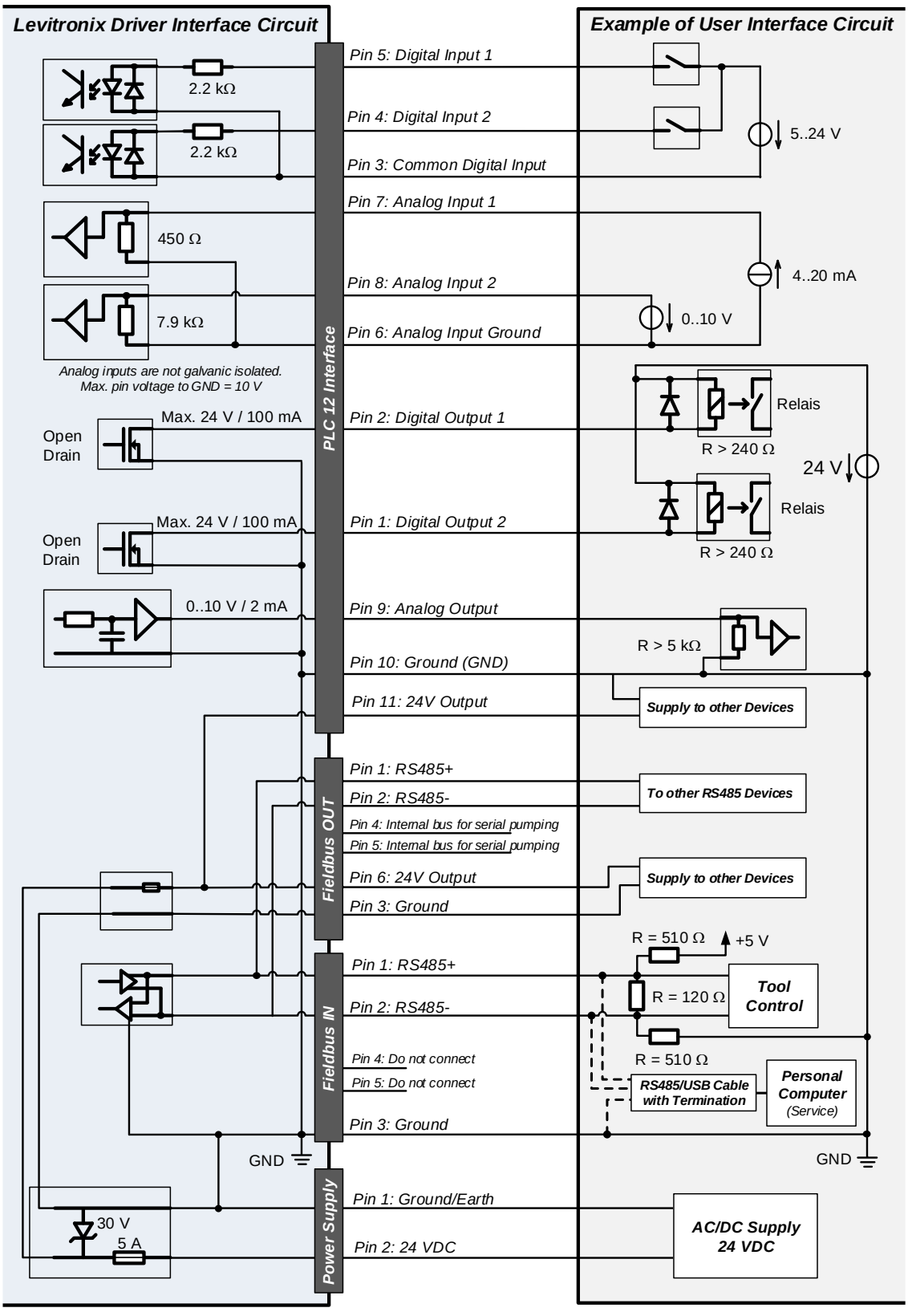


Figure 24: Electrical schematics of EasyConnect driver interfacing

- RS485/USB converter cable with termination resistors to be ordered according to ***Error! Reference source not found.****.*

- Do not use multiple master devices on the RS485 at the same time.

4.2.3 Installation Instructions for Power Supply

⚠ 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 24 VDC). The usage of a galvanic separated power supply, which is certified by a 3rd party (UL or CE), is highly recommended.

1. Certified and tested power supplies (desktop and DIN rail version) are available as an accessory (see **Error! Reference source not found.**).
2. For other power supplies an open wire power cable for connection to the driver is specified in *Table 3* (cable type *ICP-1.1*). Depending on the required hydraulic operational point (see *Figure 11*), the pump system requires 24 VDC with a maximum power of 35 W. At a lower performance power supplies with smaller power or bigger supplies to supply several pump systems simultaneously may be used. Consult *Figure 18* to get the power consumption depending on the flow. If other power supplies are used than the one recommended by *Levitronix®*, it is highly recommended to test these under dynamic conditions (acceleration and braking of the pump rotor speed).
3. Make sure that the polarity is correct and that AC/DC power supply is off.

4.2.4 Installation PLC Interface Signals

To operate the pump system with a PLC the analog input can be used to set either the speed or the process value (flow or pressure). The digital and analog outputs can be used to monitor the pump status and operating parameters (see *Table 12*).

CAUTION

The analog inputs and outputs are not galvanically isolated from the controller electronics. To avoid ground loops and mal-functions, use floating analog signals.

1. Power off the system.
2. A signal cable with driver connector is available to simplify PLC wire connections (see *Table 3* cable type *ICS-2.1*). Connect the designated PLC wires according to *Table 12.*
3. Follow *Figure 26* of the OEM model as reference for hardware configuration of the PLC in/outputs.
4. Protect the un-used wires against short-circuit to each other.

4.2.5 Installation Fieldbus Interfaces

For usage of the *RS485* (*Fieldbus IN*) as a control or service interface, an initialization resistor network according to *Figure 25* shall be used in order to have a stable communication and avoid disturbance effects. The *RS485* protocol for master communication is available at *Levitronix®* on request.

For *Service* and *Debugging* purposes with the *Levitronix® Service Software* and PC a USB/RS485 converter cable with integrated initialization resistors can be ordered according to **Error! Reference source not f ound.**. Do not use multiple master devices at the same time.

The *Fieldbus OUT* interface can be used to feed through the *RS485* bus to other devices.

4.2.6 Installation of *RS485* Fieldbus Multi-Pump System Arrays

Figure 25 shows a typical multi-pump system arrangement with the *RS485* fieldbus and its basic specifications for the *EasyConnect* Model.

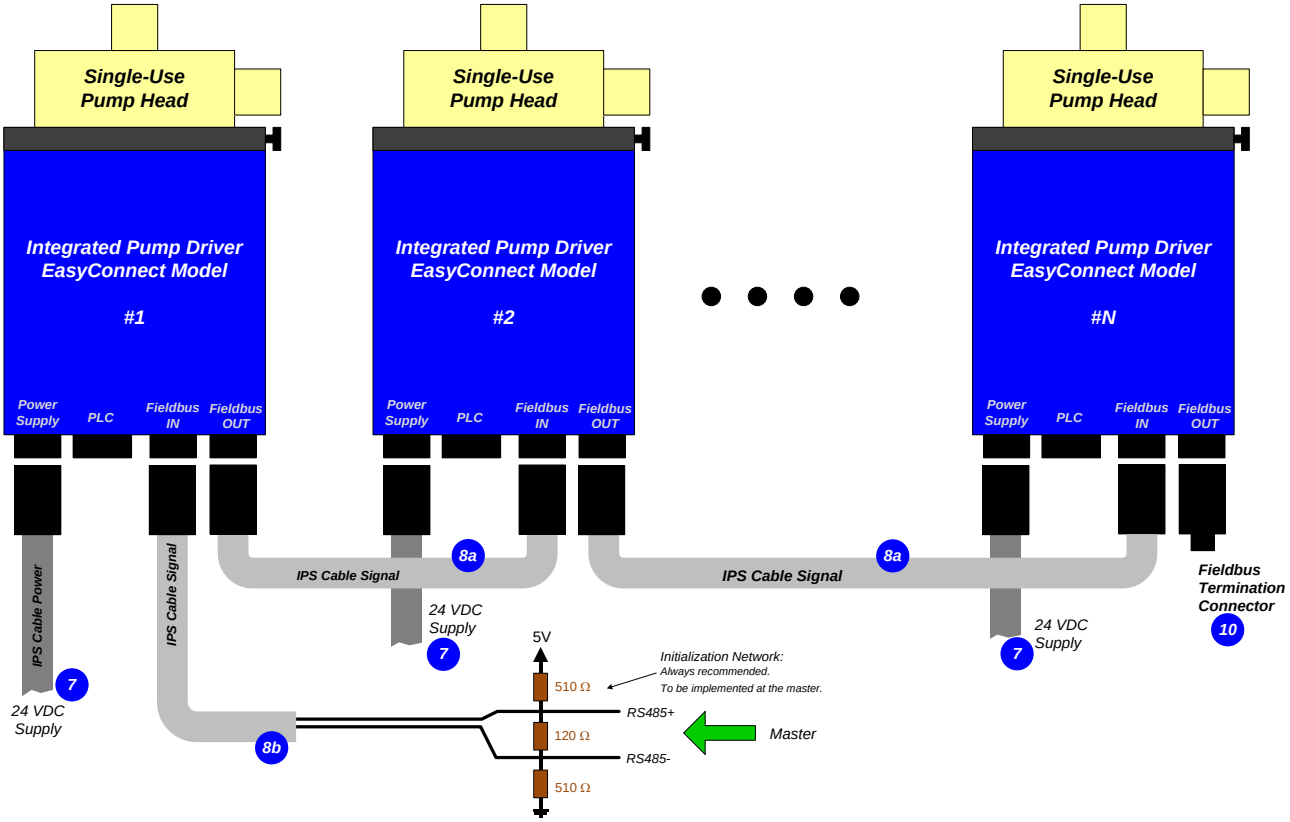


Figure 25: Multi-pump system arrangement with EasyConnect models with RS485 fieldbus
(See Table 3 for cable specifications)

Following points and information shall be considered:

- ➔ Various standard cables (see *Table 3*) are available to simplify the installation of a fieldbus array as illustrated in *Figure 25*.
- ➔ Testing has been done with arrangements of 8 pump systems. Higher number is possible but it is recommended to contact *Levitronix® Technical Service* department (see *Section 8*) for details and support.
- ➔ Address setting of the pump units can be done with the *Levitronix® Service Software* and a PC. A USB/RS485 converter cable with integrated initialization network can be ordered according to **Error! Reference source not found.**.
- ➔ The fieldbus array must be terminated as illustrated in *Figure 25*. A dedicated connector with integrated termination resistor (see *Table 3*) is available.
- ➔ The *RS485* protocol for master communication is available at *Levitronix®* on request.
- ➔ Do not use multiple master systems at the same time and do not use closed ring arrangements.

4.2.7 Installation of Fieldbus for Serial Pumping

Serial pumping setup with up to 3 pumps can be done as shown in *Figure 6.* Same instructions can be followed as mentioned in *Section 4.2.6*. A dedicated firmware for operating the array with one unit (including redundancy behavior) is available on request.

4.3 Electrical Installation of *OEM* Model

4.3.1 Overview Wire Designation of Driver Cable

Wire Name	Wire Color UL Cable	Description	Standard Designation	Typical Levels	Note
P+	red	+ 24 VDC	*Supply*	Voltage: 24 VDC ±10%	P- to be connected to earth.
P-	black	Power Input Ground / Earth			
Ain1	violet	Analog Input 1 (Current Input)	*Actual Process Value*	4..20 mA = 0..100%	The configuration of the analog inputs can be changed with *Levitronix® Service Software*
Ain2	grey-pink	Analog Input 2 (Voltage Input)	*Reference Value*	0..10 V = 0..16000 rpm (*Speed Mode*) -> Speed limit = 13000 rpm -> Cut-off (min.) speed = 0 rpm 0..10 V = 0..100% *(Process Mode)*	The configuration of the analog inputs can be changed with *Levitronix® Service Softw. 2.0* *Note: Max. input voltage of 11 V shall not be exceeded.*
Ain_GND	blue	Analog Input Ground	--	--	Reference for analog inputs.
Din1	pink	Digital Input 1	*Enable (Reset)*	5-24 V ⇒ active 0 *V* ⇒ not active	The "*Enable*" signal switches the pump system on and off. Resets pump from error state with 300-700ms pulse.
Din2	grey	Digital Input 2	*Process Mode*	5-24 V ⇒ active 0 *V* ⇒ not active	Switch between process mode and speed mode. In process mode the closed loop PI controller can be configured with *Levitronix® Service Software*
Din_COM	yellow	Common Digital Input	--	--	--
Aout1	blue-red	Analog Output (Voltage Output)	*Actual Speed* *Actual Process Value*	0..10 V = 0..16000 rpm *(Speed Mode)* 0..10 V = 0..100% (*Process Mode*)	Direct connection, no protection. Galvanic isolation on user side is required. AGND is reference. The configuration of the analog output can be changed with *Levitronix® Service Software*.
Dout1	brown	Digital Output 1	*Status*	Closed circuit ⇒ active, system on Open circuit ⇒ not active, system off	This signal indicates the state of the pump system. The configuration of the digital outputs can be changed with *Levitronix® Service Software.*
Dout2	white	Digital Output 2	*Error*	Closed circuit ⇒ not active, system on Open circuit ⇒ active, system off	When active, the system drives the impeller to zero rpm and shuts down. With a reset pulse (see "*Enable*" description) the system can be re-initialized. The configuration of the digital outputs can be changed with *Levitronix® Service Software.*
GND	white-green	Analog Ground	--	--	Reference for Aout1, Dout1 and Dout2
RS485+	brown-green	RS485 +	*Field Bus*	Modbus protocol	Termination resistors recommended
RS485-	white-yellow	RS485 -			
Internal	yellow-brown	Internal	*Do not connect.*	--	For internal usage.
Internal	white-grey	Internal	*Do not connect.*	--	For internal usage.
Shield	shield wire	Shielding	*Shielding*		To be connected to earth (see wire P-, black)

Table 13: Signals of the driver cable with designation for standard firmware
Note 1: For other configurations of PLC Inputs and Outputs refer to alternate firmware documentation
Note 2: Configurations can be done with Levitronix® Service Software.
Note 3: Power wires (P+, P-) have cross section 1.5 mm^2 and all others 0.14 mm^2

4.3.2 Overview Electrical Schematics of OEM Driver Interface

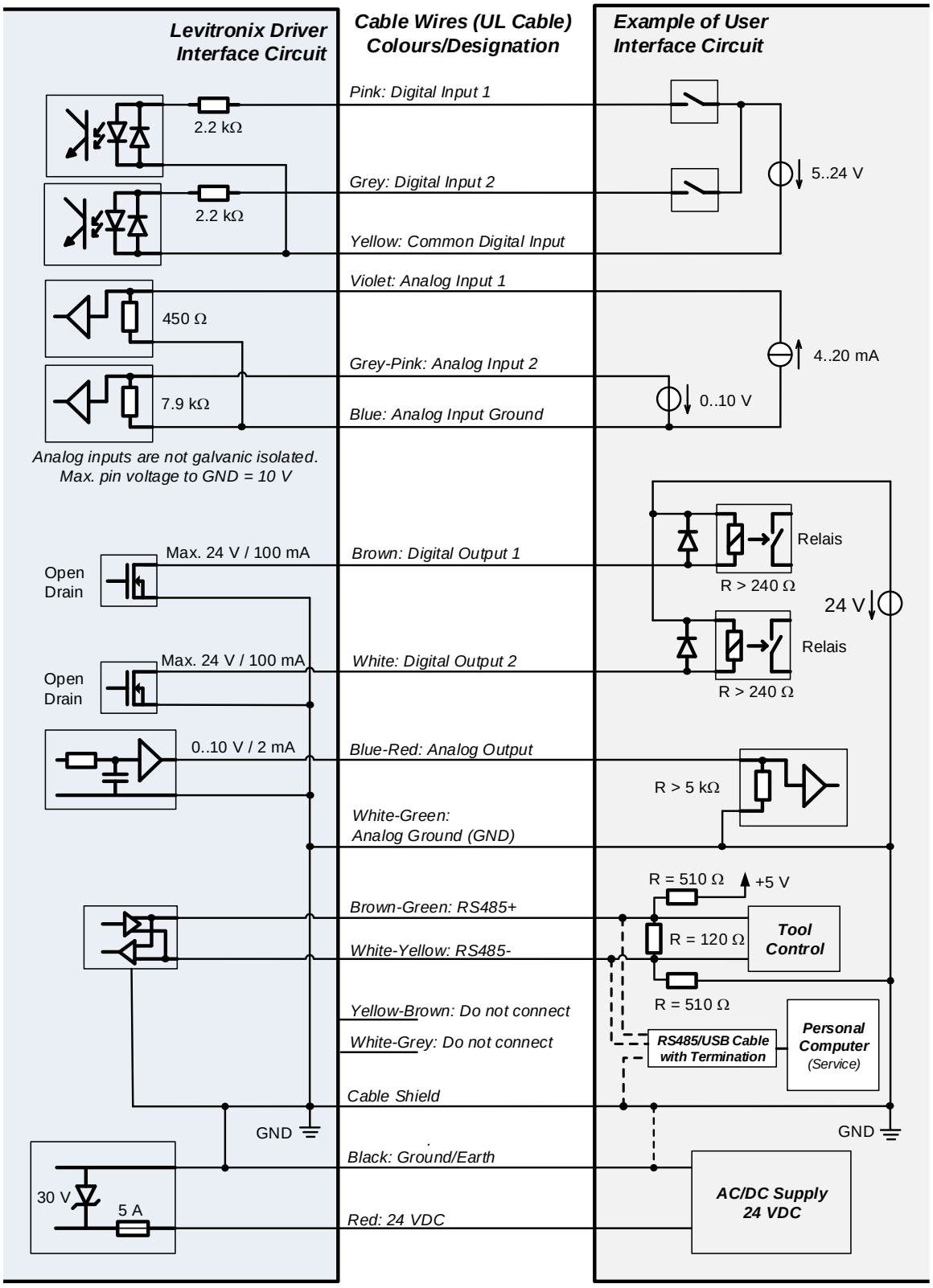


Figure 26: Electrical schematics of interfacing for OEM driver model

Note 1: RS485/USB converter cable with termination resistors to be ordered according to ***Error! Reference source not found.****.*
Note 2: Do not use multiple master devices on the RS485 at the same time.
Note 3: Wire colors are defined for UL cable. For non UL cable see Table 13.

4.3.3 Installation Instructions for Power Supply

⚠ 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 24 VDC). The usage of a galvanic separated power supply, which is certified by a 3rd party (UL or CE), is highly recommended.

1. Depending on the required hydraulic operational point (see *Figure 11*), the pump system requires 24V with a maximum power of 35 W. At a lower performance power supplies with smaller power or bigger supplies to supply several pump systems simultaneously may be used. Consult
   Figure 18 to get the power consumption depending on the flow. If other power supplies are used, than the one recommended by Levitronix, it is highly recommended to test these under dynamic conditions (acceleration and braking of the pump rotor speed).
2. Make sure that the polarity is correct and that AC/DC power supply is off.

4.3.4 Installation *PLC* Interface Signals

To operate the pump system with a *PLC* the analog input can be used to set either the speed or the process value (flow or pressure). The digital and analog outputs can be used to monitor the pump status and operating parameters (see *Table 13*).

CAUTION

The analog inputs and outputs are not galvanically isolated from the controller electronics. To avoid ground loops and mal-functions, use floating analog signals.

1. Power off the system
2. Connect the designated wires of the driver cable according to *Table 13.* Assignments and functions of the I/Os can be changed with the controller firmware version (refer to according firmware documentation).
3. Follow *Figure 26* as reference for hardware configuration of the PLC in/outputs.
4. Protect the un-used wires against short-circuit to each other

4.3.5 Installation of RS485 Interface

For usage of the *RS485* as a control or service interface, an initialization resistor network according to *Figure 26* or *Figure 27* shall be used in order to have a stable communication and avoid disturbance effects. The *RS485* protocol for master communication is available at *Levitronix®* on request.

For *Service* and *Debugging* purposes with the *Levitronix® Service Software* and PC a USB/RS485 converter cable with integrated initialization resistors can be ordered according to **Error! Reference source not found.**. Do not use multiple master devices at the same time.

4.3.6 Installation of *RS485* Fieldbus Multi-Pump System Arrays

Figure 27 shows a multi-pump system arrangement with the *RS485* fieldbus and its basic specifications.

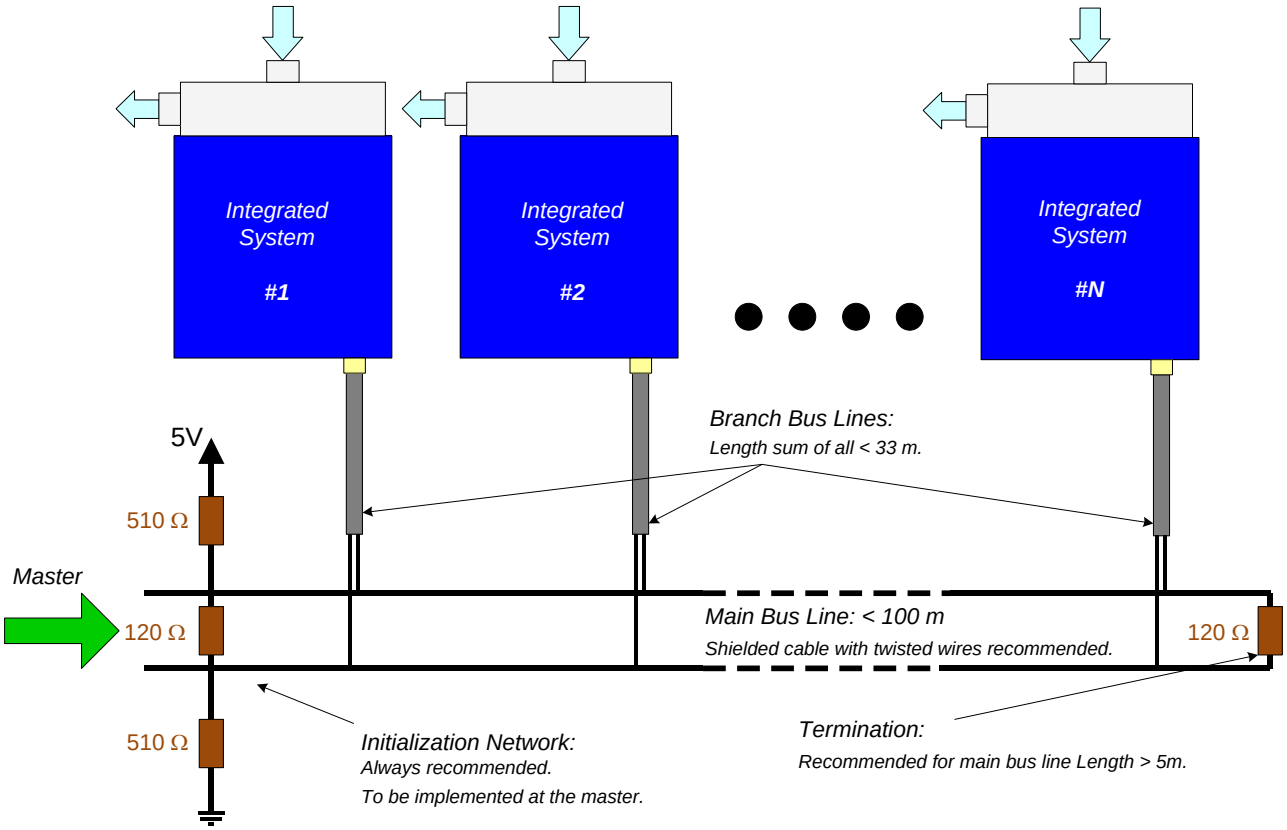


Figure 27: Multi-pump system arrangement with RS485 fieldbus

Following points and information shall be considered:

- ➔ Testing has been done with arrangements of 8 pump systems. Higher number is possible but it is recommended to contact *Levitronix® Technical Service* department (see *Section 8*) for details and support.
- ➔ Address setting of the pump units can be done with the *Levitronix® Service Software* and a PC. A USB/RS485 converter cable with integrated initialization network can be ordered according to **Error! Reference source not found.**.
- ➔ The *RS485* protocol for master communication is available at *Levitronix®* on request.
- ➔ Do not use multiple master systems at the same time.
- ➔ Do not use closed ring arrangements.

4.4 Mechanical Installation – General Instructions

⚠ WARNING

The driver is not rated to be placed next to flammable gases. Do not use the driver next to flammable gases without adequate safety precautions to fulfill the relevant regulatory requirements.

4.5 Mechanical Installation of *Stand-Alone* and *EasyConnect* Model

The *Stand-Alone* and *EasyConnect* model are delivered with the mounting base plate *MBP-i30.1*, which can be used to fix the driver with four screws on the mounting slots of the base plate (see *Figure 13* for the Stand-Alone and *Figure 14* for the *EasyConnect* model). Mounting of the driver can be done in either the horizontal or vertical position.

When mounting the pump head fittings into a circuit it has to be taken care that no mechanical stress is acting on the fittings, which can result in distorting creeping effects.

The outlet orientation of the pump head can be changed in steps of 45° by assembling the pump head socket accordingly (see *Figure 28*).

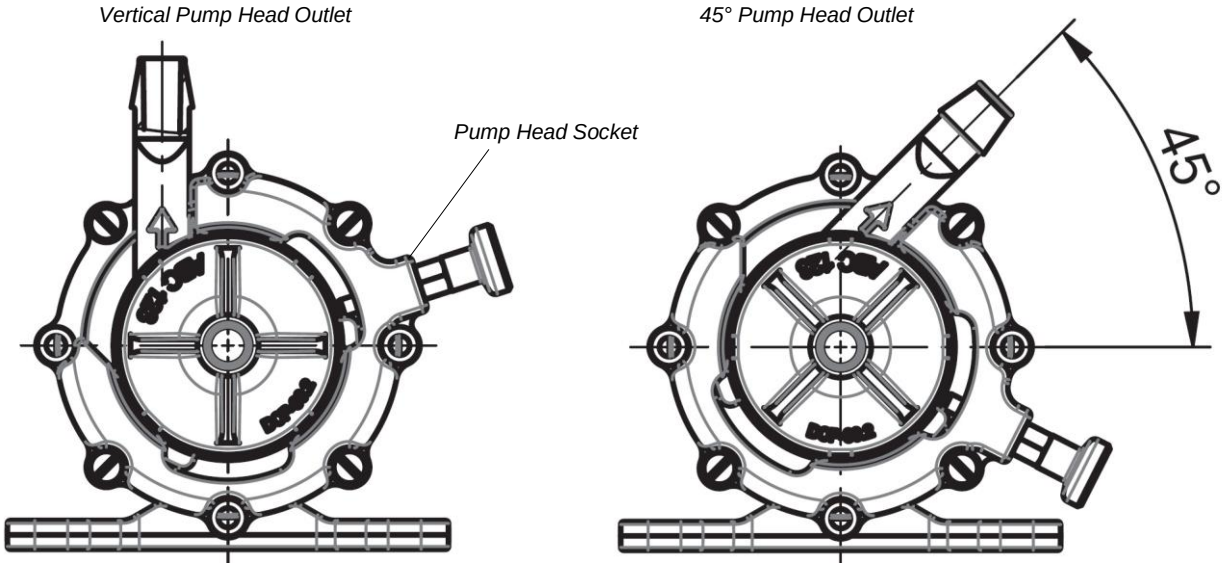


Figure 28: Vertical and 45° orientation of pump head with rotation of pump head socket

4.6 Mechanical Installation of *OEM* Model

If the mounting base plate *MBP-i30.1* is used, the driver can be fixed with four screws on the mounting slots of the base plate (see *Figure 16*). Mounting of the driver can be done in either the horizontal or vertical position.

For other mounting configurations the 2 screws on the side of the driver are an option to be used (see *Figure 15*).

When mounting the pump head fittings into a circuit it has to be taken care that no mechanical stress is acting on the fittings, which can result in distorting creeping effects.

The outlet orientation of the pump head can be changed in steps of 45° by assembling the pump head socket accordingly (see *Figure 28*).

5 Operation

5.1 Operation of *Stand-Alone* Model

5.1.1 Manual Operation

With the *Stand-Alone* model the system can be operated manually with the user panel according to *Figure 29*. The speed can be set manually with the *Down* and *Up* buttons before or after enabling it with the *On/Off* button. The *Setpoint Speed* (= Ref. Speed) is than stored in the system *EEPROM* and will stay the same, even if the system is powered off. When disabling the system by shortly pressing the *On/Off* button the *Actual Speed* is first reduced to zero before an impeller touch down is made by disabling the radial levitation. After an *Error* (see details in *Section 5.1.4*) the system can be restarted by the *On/Off* button or by removing and reattaching the power supply.

Figure 29: User panel of stand-alone model for manual operation

5.1.2 Operation with PLC

When activating the digital input on the *PLC* connector the speed can be set with an analog signal (see *Table 8* for hardware details). The *Status* of the system can be monitored with a digital output signal. During analog speed control all information is shown on the display.

5.1.3 Extended Menu Functions

By pressing the *On/Off* button for more than 4 seconds an extended *Menu* can be reached, which allows

a. Monitoring of system parameters like driver temperature, axial position of rotor, supply voltage (DC-link voltage), bearing phase currents (BNG) and drive phase currents (DRV).

b. Reading of error, warning and message information and their history.

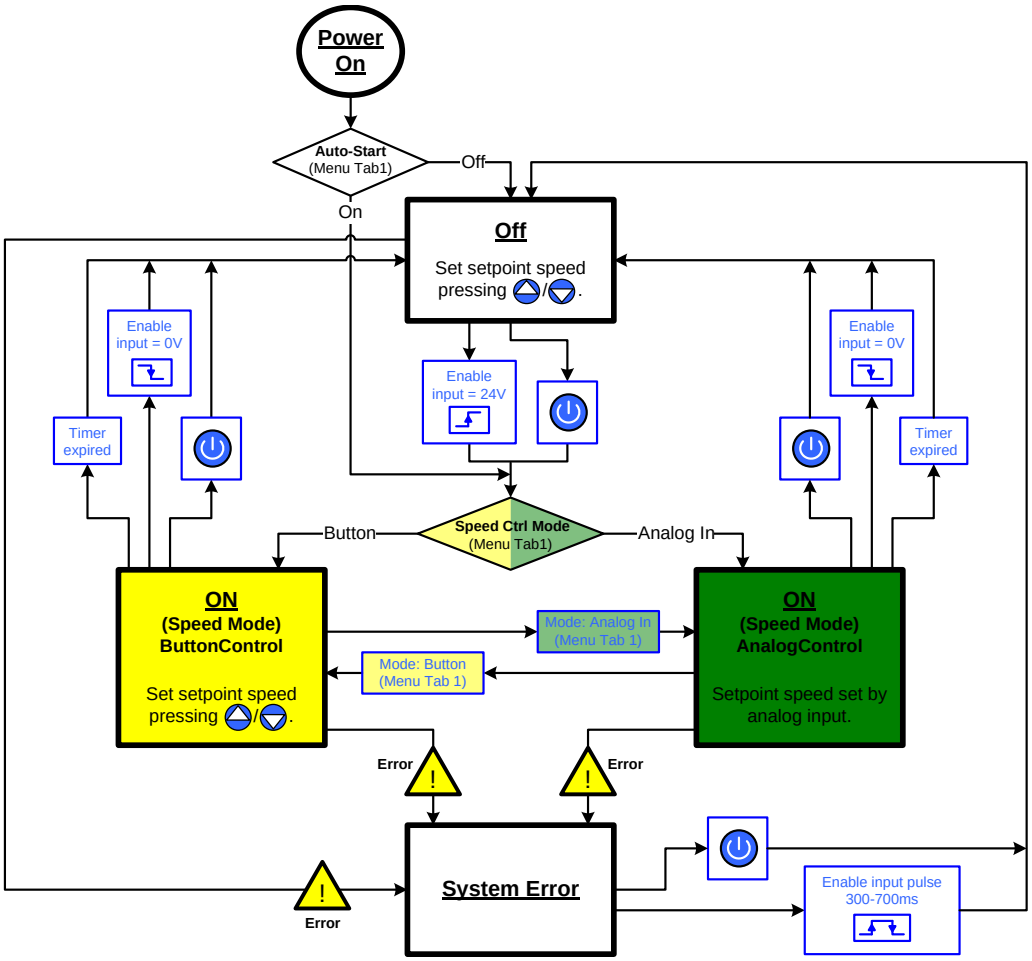
c. Reading of firmware version.

d. Setting a timer.

In the extended *Menu*, the menu tabs are browsed using the *Up* and *Down* buttons. Items are selected with the *On/Off* button, and values are modified using the *Up* and *Down* buttons. The Menu can be left by pressing the *On/Off* button for more than 2 seconds.

5.1.4 Detailed State Diagram

Figure 29 shows the detailed state diagram, which can be controlled with the manual buttons or the signals of the *PLC* interface connector.



Menu

From every system state, you reach the menu pushing > 4s.
Browse through the menu tabs using /.
The menu is exited pushing > 2s.
The menu has no influence on the system state (except change of speed control mode)

Menu tabs:

1. Set Speed control
   - Mode: (Button → Analog In)
   - Auto-start: (Off → On)
   (select with , change values with /)
2. Set Timer
   - Mode (Off → Single → Repeat)
   - Time (hh mm ss)
   (select with , change values with /)
3. Read system information
   - Temperature
   - Axial position
   - DC-link voltage
4. Read system information
   - BNG currents
   - DRV currents
5. Read actual errors, warnings and messages
6. Read history of errors, warnings and messages
7. Read firmware information

Figure 30: State diagram of stand-alone model

Note 1: Description is for standard firmware.
Note 2: For other configurations refer to alternate firmware documentation.

State "Off":
The pump system is switched off and the motor phases have no power (current). The *Setpoint Speed* can be modified with the *Up* and *Down* buttons, without any effect on the system states.

State "On (Speed Control)":
This state can be reached by manually activating the system with the *On/Off* button. The impeller is levitating and rotating with the *Setpoint Speed*, which can be manually adjusted with the *Up* and *Down* buttons. The motor has electrical power when in this state.

State "On (Controlled by PLC)":
This state can be reached by activating the digital input on the PLC connector (see *Table 8*). The pump system is switched on and the impeller is levitating and rotating with the *Setpoint Speed*, which is adjusted with the current of the analog input (see *Table 8*).). The motor phases have electrical power when in this state.

State "Error":
If an error occurs, the system switches to the *Error* state. The pump system is disabled. The system switches back to the "*Off*" state by pushing the *On/Off* button or by a pulse of 300-700ms on the digital input of the PLC interface (see *Table 8*).

"Menu":
The Menu is not a system state, but an additional tool to modify the system setup or to display system information. From any system state, the menu is reached pushing the *On/Off* button for more than 4 seconds and left by pushing it for more than 2 seconds. The following menu points are available:

Menu Tab 1: Set Timer
A timer can be set, which stops the pump, when expired. The timer can either be set as single or repetitive timer. The values are selected with the *On/Off* button, and modified with the *Up* and *Down* button.

Menu Tab 2: System Information
For trouble shooting useful information can be read like driver temperature, axial impeller position, and DC-link voltage (supply).

Menu Tab 3: System Information
For trouble shooting useful information is shown like drive (DRV) and bearing (BNG) currents.

Menu Tab 4: Errors, Warnings and Messages
Shows errors, which stop the system, warnings, which might stop the system and messages, which might be useful for proper operation.

Menu Tab 5: History of Errors, Warnings and Messages
Shows the history of error, warnings and messages, which is useful for troubleshooting.

Menu Tab 6: Firmware Information
Shows the firmware version.

5.2 Operation of *EasyConnect* and *OEM* Model

5.2.1 Operation with PLC

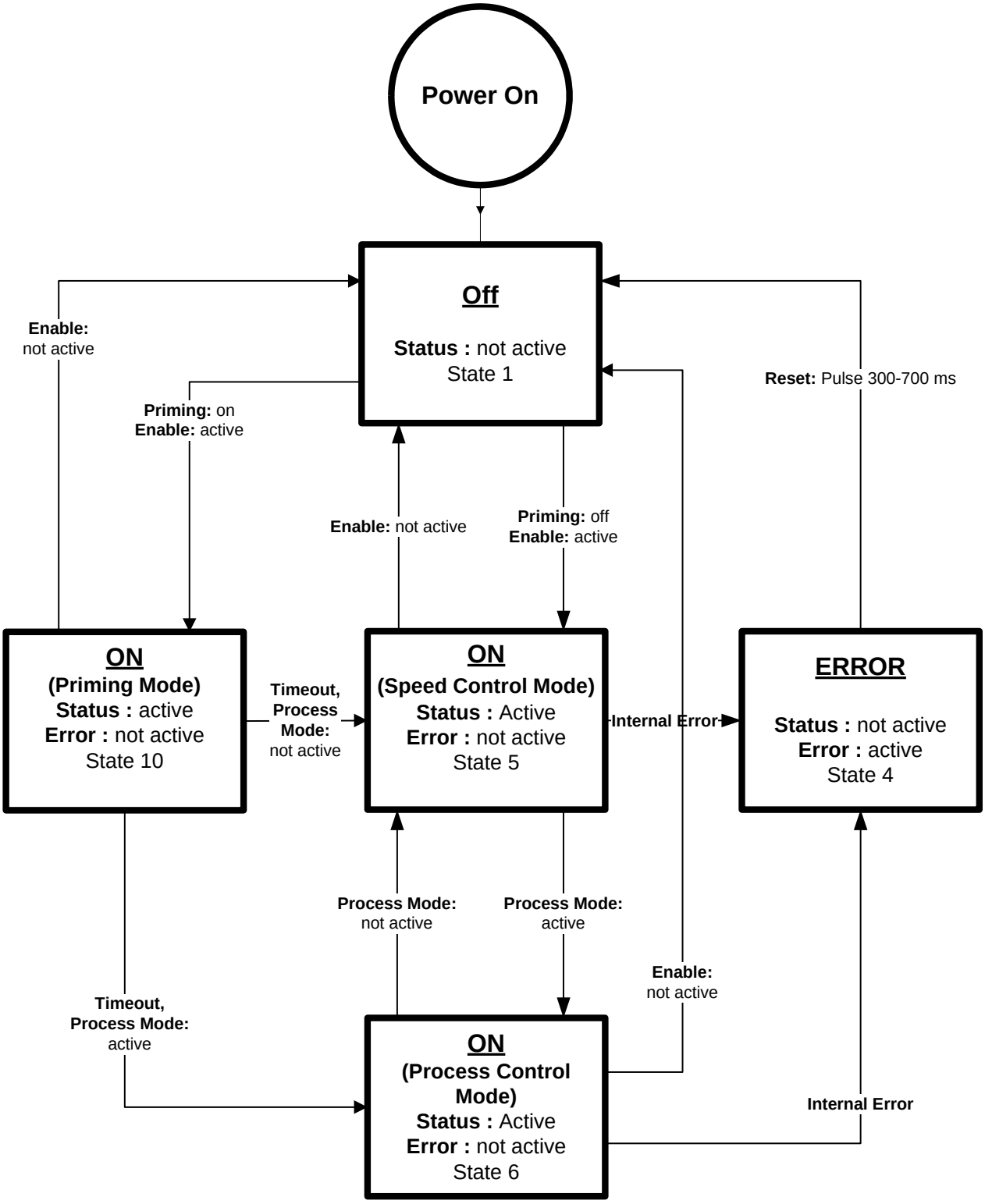


Figure 31: PLC interface state diagram for standard firmware
(For other configurations refer to alternate firmware documentation)

State "Off":
The pump system is switched off and the motor has no power. In this state, *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.

State "ON" (process control mode):
The pump system is switched ON and the impeller is rotating with the referenced flow/pressure. The motor has electrical power when in this state.

On (Priming mode):
The pump system is switched ON and the impeller is rotating with the priming speed. The motor has electrical power when in this state. This mode can only be accessed by activating priming feature within EEPROM-editor in *Levitronix® Service Software*. Priming speed and timeout can also be configured within EEPROM-editor.

State "Error":
If an error according to *Table 14* occurs in the pump system, the system defaults to the *Error* state. The according digital output on the PLC Interface Module is activated. The pump system is switched OFF. By a pulse off 300-700 ms on the *Enable/Reset* input the system gets back to the *Off* state.

Errors	**Effect on Designated Digital Output of the PLC**
No rotor	*Error = Open circuit*
Temperature over 90°C	*Error = Open circuit*
Temp. was higher than 80°C for more than 10 minutes.	*Error = Open circuit*
Over-current	*Error = Open circuit*
Power channel interrupted	*Error = Open circuit*
Internal sensor cable interrupted	*Error = Open circuit*
DC link (supply voltage) out of range (< 18 or > 30 V DC) If the voltage is out of range the system starts to reduce the speed and a warning is generated. When reaching 0 rpm and the voltage is still out of range the system is disabled and an error is generated. In case the voltage is again within the range during speed reduction the system switches to normal operation and no Error is generated.	*Error = Open circuit*

Table 14: Errors with indication on PLC interface for standard firmware
(For other configurations refer to alternate firmware documentation)

5.2.2 Operation with Fieldbus (RS485)

See *Section 4.3.5*.

5.2.3 Operation with User Panel *LUI-B.1*

The RS485 interface can also be used with the user panel *LUI-B.1*, which has the same menu functions as the *Stand-Alone* model (described in *Section 5.1*). The relevant configurations are illustrated in *Figure 7* for the *OEM* and in *Figure 5* for the *EasyConnect* driver models.

5.2.4 Operation for Serial Pumping

See *Section 4.2.7*.

5.3 Operation for ATEX / IECEx Application

Specific precautions may be considered while using the pump system in potential explosive gas atmospheres according to ATEX / IECEx category 3G/3D (*Zone 2* and *22*).

The user shall prevent priming issues during normal pump operation. Especially precautions have to be considered during installing and maintenance operations to prevent the occurrence of combustible atmospheres. The pump head must completely be filled with liquid prior to enable and operation of the pump.

CAUTION

Precautions have to be considered to prevent priming issues. Pump head must completely be filled with liquid prior to enabling and operation of the pump.

CAUTION

The user shall prevent friction on driver and on pump head surfaces as to avoid electrostatic charges during system operation.

CAUTION

The user shall prevent electrostatic charging of the system at cleaning processes by using dry cleaning cloth. User shall use wet cleaning rags to avoid issues with charging at a cleaning process.

WARNING

Opening of Driver back cover
Do not under any circumstances open the back cover of the driver unit. Driver back cover may only be opened by manufacturer.

WARNING

Operational Temperature 120°C T4
Maximum allowed pump liquid temperature is 70°C / 158°F for the use in Ex classified applications.

WARNING

Do not operate the pump against closed valves
Refer to the corresponding section in the manual.

6 Instructions for Use of Pump Head

6.1 Description and Preparation

6.1.1 Description

The *DCP-30* pump heads are designed for single use applications in the Life Science industries in connection with the *PuraLev® i30SU* pump system components. The wetted parts are made out of biocompatible materials (FDA, USP VI, Animal-Free), which can be gamma sterilized.

The *Pump Head* is mounted to the *MagLev Driver* (integrated motor and controller) via the *Pump Head Socket*. The motor is connected to a controller generating the currents for rotation and the levitation of the impeller.

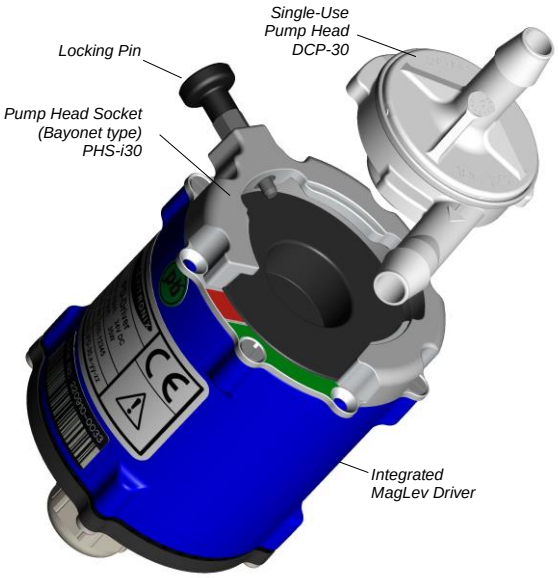


Figure 32: Single-use pump head concept

Before using the *DCP-30* pump head make yourself familiar with the following warnings, cautions and instructions.

6.1.2 Inspection Prior to Use

The pump head should be inspected prior to use for any damage. Do not use the pump head if any damage is found. Contact *Levitronix®* regarding return of any suspected pump head.

6.1.3 Traceability

For full traceability of the pump head the 6 digit serial number located on the top of the pump head shall be used. On the labels of the packaging and on the biocompatibility declaration this serial number is the one on the lid (see *Figure 33*).

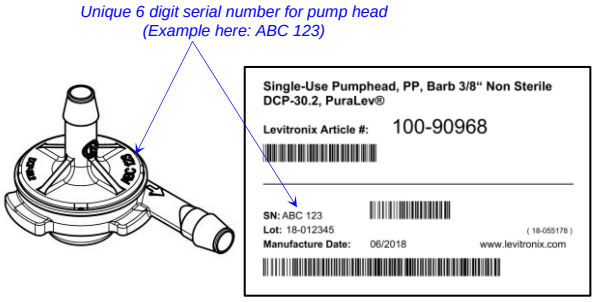


Figure 33: Serial number for traceability of pump head
(left: on pump head, right: on label of package and the biocompatibility declaration)

6.2 General Warnings and Cautions

⚠ WARNING

High Magnetic Field Strength of Impeller.

The pump head contains a rotor magnet with high field strength. Pace maker may be influenced and magnetic forces may lead to contusions. Keep distance to pace makers and handle pump heads with care.

CAUTION

Magnetic Forces

Pay attention to the magnetic forces when handling the pump head. It has to be avoided that magnetic parts are attracted resulting in contamination or damage (for example cracks) of the housing or impeller. Specifically pay attention to the magnetic forces, when handling two pump heads at the same time.

CAUTION

Gamma Sterilization

The pump heads DCP-30 have been tested to be robust against gamma radiation with a dose up to 40 kGy.

Handle the pump heads with care, especially after gamma radiation with doses above 25 kGy, since the radiation exposure decreases the flexibility of the pump head material.

6.3 Mounting of Pump Head

6.3.1 Preparation

After removal of the pump head from its packaging assure that no metallic part is magnetically attaching. Specifically remove the *Fixation Disc*, which comes delivered within the packaging in order to magnetically fix the impeller against movements during transportation.

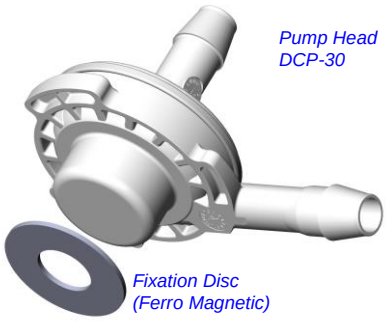


Figure 34: Pump head with Fixation Disc

Assure that the impeller speed is set to 0 rpm and that the system is disabled.

6.3.2 Step 1: Insertion

Pull the *Locking Pin* radially outwards and insert the pump head at the same time.

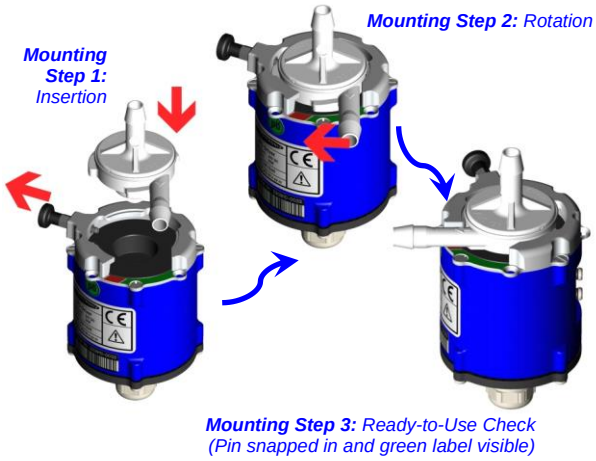


Figure 35: Intuitive 3-step pump head mounting procedure with bayonet type socket

6.3.3 Step 2: Rotation and Snap-In

Smoothly rotate the pump head clockwise until the *Locking Pin* snaps in.

6.3.4 Step 3: Ready-to-Use Check

Check that the *Locking Pin* is properly snapped in and that the green labeling on the *Pump Head Socket*, beside the outlet, is visible.

6.4 Removal of Pump Head

6.4.1 Preparation

Set the speed to 0 rpm and disable the system. After running at higher motor or liquid temperature the pump head might stick to the motor due to thermal expansion effects. Let the system cool down before starting the removal procedure.

6.4.2 Step 1: Pull Pin and Rotate

Pull the *Locking Pin* radially outwards and rotate the pump head smoothly counterclockwise as far as possible.

6.4.3 Step 2: Axial Removal

Smoothly remove the pump head axially.

6.4.4 Step 3: Usage of Fixation Disc

It is recommended to attach the *Fixation Disc* (see *Figure 34*) to the pump head bottom in order to minimize magnetic leakage fields surrounding the impeller and hence reducing the tendency to attract other magnetic parts.

6.5 Assembly into Hydraulic Circuit

The following points shall be considered, when integrating the pump head into a single-use circuit.

6.5.1 Usage of Fixation Disc

During handling, assembling and transportation of the pump head with the hydraulic circuit, it is recommended to attach the *Fixation Disc* (see *Figure 34*) to the pump head bottom. The disc holds the impeller mechanically in place and reduces the magnetic fields, which can attract other magnetic parts during handling, sterilization and transportation.

6.5.2 Handling of Multiple Pump Heads

Be aware of the magnetic forces of the impellers when handling multiple pump heads at the same time. Avoid two pump heads coming together with force due to the magnetic attraction, which might cause cracks.

6.5.3 Avoidance of Mechanical Stress

Avoid applying too much mechanical stress to the pump head for example, by excessively squeezing it with the other parts of the circuit to a packaging or an enclosed space of limited size, or by applying too much tension or perpendicular force to the fittings.

7 Troubleshooting

7.1 Trouble Shooting with *Stand-Alone* Model

For troubleshooting and failure analysis with the *Stand-Alone* model the integrated display gives advice about status and potential failure details.

If the PLC is used the digital output (“Status”) indicates if the system is active. However, the source of an error cannot be identified by this signal.

7.2 Trouble Shooting with *EasyConnect* and *OEM* Models

7.2.1 Troubleshooting for Operation with Driver

The integrated *PLC* provides a *Status* and *Error* signal feedback according to *Table 14*. However, the source of error cannot be identified by these signals.

For more detailed analysis the *Levitronix® Service Software* can be used with a PC and a USB to RS485 interface cable.

7.2.2 Troubleshooting with *Levitronix® Service Software*

The *Levitronix® Service Software* allows communication with the pump system in connection with a PC and a USB interface. The USB to RS485 adaptor cable as specified in **Error! Reference source not found.** can b e used to setup communication. The software can be used for performing detailed troubleshooting.

7.2.3 Troubleshooting with User Panel *LUI-B.1*

For troubleshooting and failure analysis with the user panel *LUI-B.1* the integrated display gives advice about status and potential failure details.

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: TechSupport@levitronix.com

9 Appendix

9.1 Regulatory Status

9.1.1 CE Marking

We herewith declare that the ***Centrifugal Pump System Family PuraLev® i30SU***, in its various configurations, is in conformity with the below mentioned *European Directives*.

Machinery Directive 2014/35/EC:
The machinery directive essentially has been followed by a risk analysis, according mitigation actions and a user manual for safe operation. For the design and testing the following standards are used as a guideline:

EN809	Pumps for Fluids: basic requirements are followed.
EN12162	Procedure for hydrostatic pressure testing in fluid pumps: used for max. pressure testing of pump head.
ISO12100	Safety for machinery – principles for risk assessments: used for system risk analysis.

EMC Directive 2014/30/EC:
The following standards of the EMC directive are tested and confirmed at a certified laboratory:

EN61000-6-2	Generic standards, Immunity for industrial environments
EN61000-6-4	Generic standards, Emission standard for industrial environments

9.1.2 ATEX / IECEx Certification and Marking

Specific pump drivers with pump heads of the ***PuraLev® i30SU*** pump system together with specific accessories are in conformity with the requirements of the *Directive 2014/34EU* and the applicable IEC standards. The following standards are tested and confirmed at a certified laboratory.

IEC / EN 60079-0	Explosive atmospheres - General requirements.
IEC / EN 60079-7	Explosive atmospheres - Equipment protection by increased safety “e”
IEC / EN 60079-18	Explosive atmospheres - Equipment protection by encapsulation “m”
IEC / EN 60079-31	Explosive atmospheres - Equipment dust ignition protection by enclosure “t”
IEC / EN 80079-36	Explosive atmospheres - Non-electrical equip. for explosive atmosph. – Basic method and requirements
IEC / EN 80079-37	Explosive atmospheres - Non-electrical equipment for explosive atmospheres – Non electrical type of protection constructional safety “c”, control of ignition source “b”, liquid immersion “k”

The Levitronix Ex pump drivers are marked clearly and in accordance to the *ATEX* Directive and the relevant *IECEx* standards.

CE Ex II 3G Ex ec h mc IIC T4 Gc
II 3D Ex h tc IIIC T90°C Dc

Classification:	*Category 3GD* (*Zone 2 for Gas* and *Zone 22 for Dust)*
Thermal Classification:	Thermal classification of motor is 120°C (T4) (120°C = 248°F) for maximum full-load operating temperature at a maximum liquid temperature of 70°C / 158°F.

9.1.3 Disposal of Equipment – WEEE Directive 2012/19/EU

Follow local legislation for disposal of equipment. In the European Union (EU) marked () devices are governed by the European WEEE Directive 2012/19/EU. Do not dispose with normal waste.

9.1.4 Biocompatibility

The wet materials of the *DCP-30* pump heads, satisfy the following biocompatibility specifications:

FDA 21 CFR
All wet raw materials used in the above mentioned pump heads meet specifications according to *FDA 21 CFR* (section *177.1520* for *Olefin Polymers*). This statement is based on a declaration provided by our raw material supplier.

USP VI

The wet raw materials used in the above mentioned pump heads meet the specifications of *USP Class VI*. The statement is based on a declaration provided by our raw material supplier.

BSE/TSE and Animal Free
Based on declaration provided by our raw material supplier, we believe that the wet materials of the above mentioned pump heads have been manufactured without coming into contact with animal derived materials and that they do not contain potential spongiform or transmissible spongiform encephalopathy (BSE/TSE) risk components.

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
	No pacemakers	Hazard avoidance Prohibition	SEMI S1-0701
	ATEX Logo	Used for hazard identificat. in warnings	--

Table 15: Safety symbols and signal words