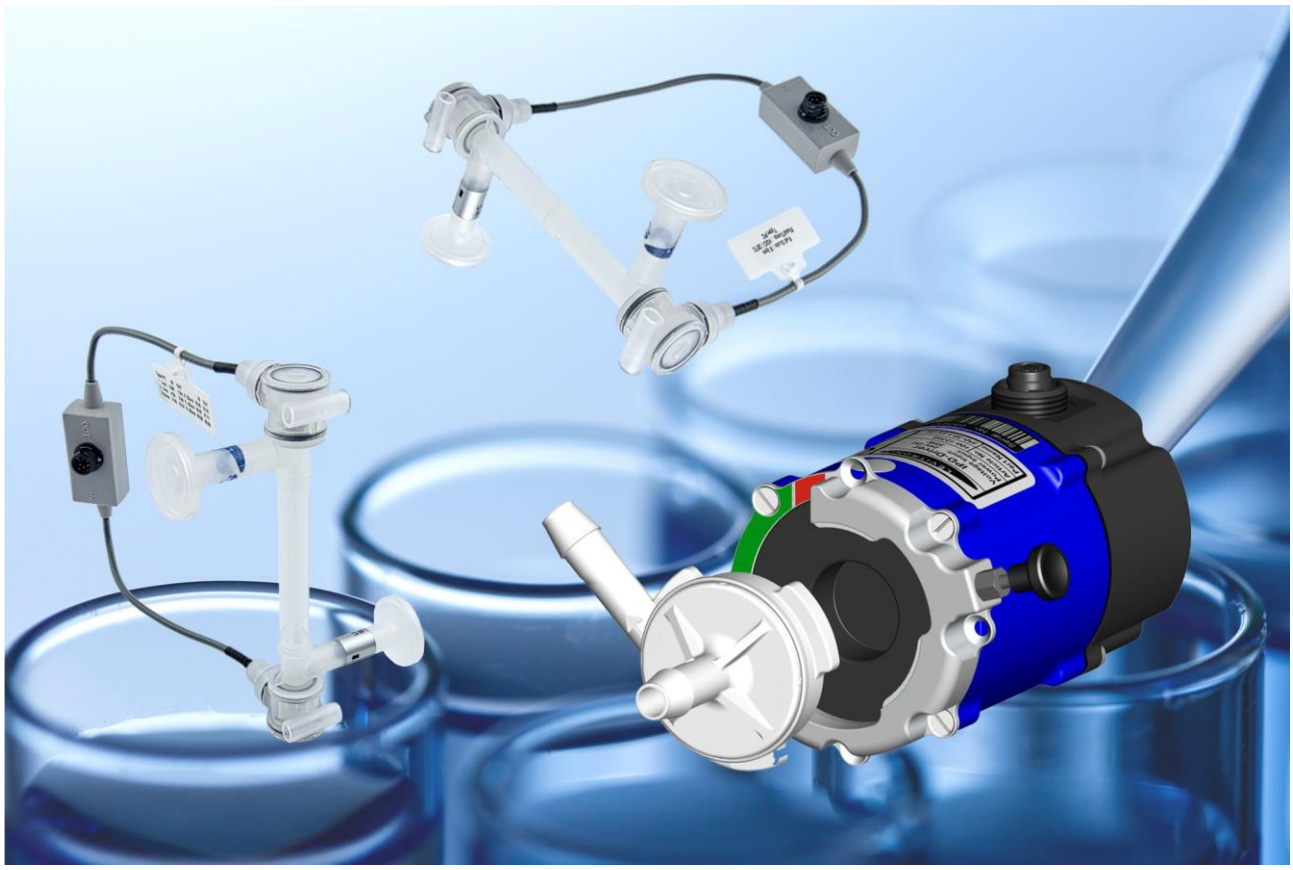
PuraLev® iF30SU

Pump Pressure / Flow: 1.0 bar / 7.7 l/min
Single-Use Flow Sensor LFS-03SU-F1: 0.8 l/min
Single-Use Flow Sensor LFS-06SU-F1: 8 l/min

USER MANUAL



This manual contains information necessary for the safe and proper use of the *PuraLev® iF30SU*. 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 flow control system refer to accompanying information. If the flowmeters must be configured for other parameter settings, then the *Levitronix® Service Software* version *V2.0.5.0* (with according manual *Levitronix®* Doc.# *PL-4047-00*) is needed. 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.

First Release: 05-Nov-2018
Last Update: 28-Sep-2023

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1 Safety Precautions

The *PuraLev® iF30SU* flow control 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 flow control 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 flow control 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.

2 Specifications

2.1 Specification of Components

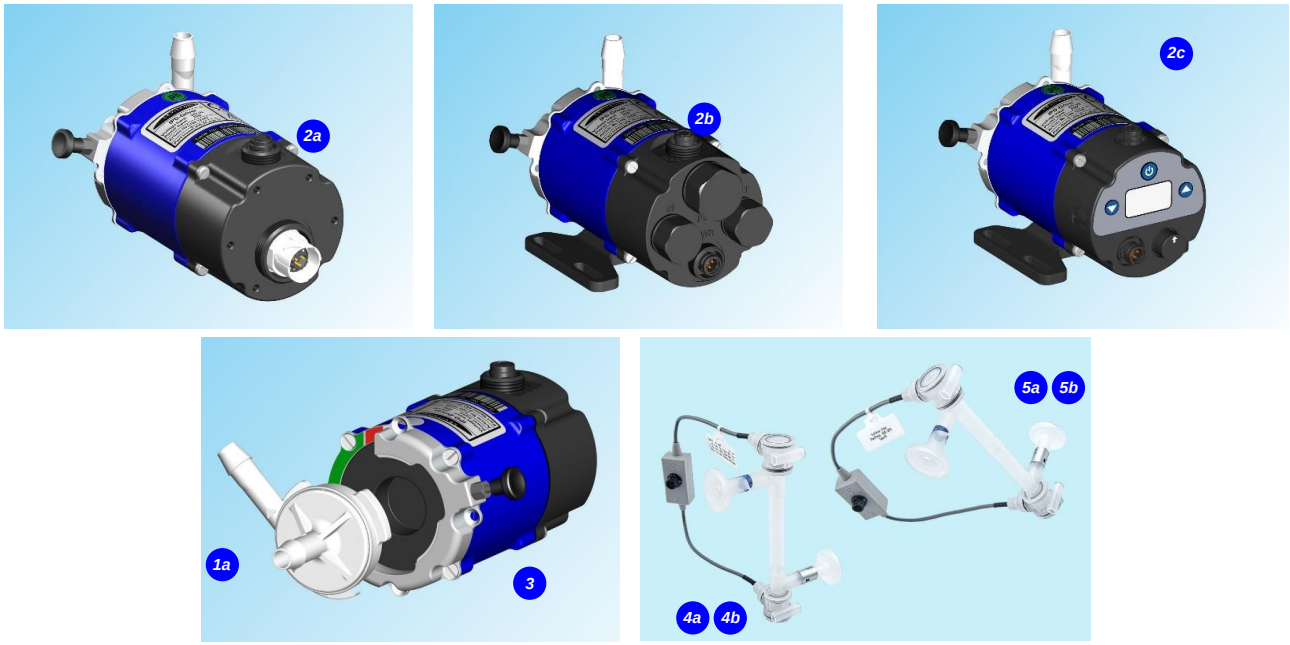


Figure 1: Flow control system with standard main components

Figure 2: General standard accessories

Figure 3: Standard cables

System Name	Article #	Pump Head Socket	Flow Control Driver	Note
PLD-iF30SU.1	100-91223	PHS-i30.1	IFD-30.3-02	*OEM - Driver, one multi-purpose connector, pump head socket.*
PLD-iF30SU.2	100-91224	PHS-i30.1	IFD-30.4-02 (MBP-i30.1 included)	*EasyConnect - Driver with interface connectors, pump head socket.*
PLD-iF30SU.3	100-91225	PHS-i30.1	IFD-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 Pump Head	DCP-30.2 (Barb) [2] DCP-30.1 (Triclamp) [2]	100-90968 100-90959	Material Impeller / Housing Housing Sealing In-/Outlet Fittings Max. Flow Max. Diff.-Pressure Max. Viscosity Max. Liquid Temp. Wet Pump Volume/Surface Sterilization Methods	*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"* *7.7 liters/min / 2.0 gallons/min* *1.0 bar / 14.5 psi* *40 cP* *60 °C / 140 °F* *7.7 ml / 55.9 cm^2* *Gamma radiation up to 40kGy*
2a	Integrated Flow Control Driver ("OEM Model")	IFD-30.3-02	100-10130	Voltage, Power Housing Interfaces Standard Firmware	*24 VDC ±10%, 35 W* *Epoxy coated Aluminum, PP+GF for bottom lid, IP65 [1]* *PLC, RS485 with Modbus RTU protocol and flow sensor* *K2.48*
2b	Integrated Flow Control Driver ("EasyConnect" Mod.)	IFD-30.4-02 (MBP-i30.1 included)	100-10131	Housing Interfaces Standard Firmware	*Epoxy coated Aluminum, PP+GF for bottom lid, IP65* *2x Fieldbus RS485/Modbus RTU protocol, PLC, power supply and flow sensor* *K2.48*
2c	Integrated Flow Control Driver ("Stand-Alone" Model)	IFD-30.5-02 (MBP-i30.1 included)	100-10132	Housing Interfaces Standard Firmware	*Epoxy coated Aluminum, PP+GF for bottom lid, IP65* *User panel with 3 user buttons, PLC, power supply and flow sensor* *K2.48*
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: Gamma irradiated and sterile fittings version available (see product literature for PuraLev-i30SU).

Pos.	Component	Article Name	Article #	Fitting	Wet Material	Note
4a 4b 5a 5b	LEVIFLOW® Single-Use Flow Sensors	LFS-03SU-Z-F1 LFS-03SU-Z-F1-SC1 [1] LFS-06SU-Z-F1 LFS-06SU-Z-F1-SC1 [1]	100-30423 100-30470 100-30425 100-30445	Triclamp 3/8"	*Polypropylene (FDA, USP Class VI, BSE/TSE/Animal free)* *Gamma stable for up to 40 kGy.*	*See Levitronix® technical brochure of LFS-SU single-use sensor series for more detailed specifications and for other configurations.*

Table 3: Specification of LEVIFLOW® single-use high-precision (1% accuracy of reading) flow sensors compatible with IFD-30 drivers
Note 1: Extended calibration for wider 1% accuracy range. Note 2: All flow sensors available with gamma irradiation (see LEVIFLOW® product literature).

Pos.	Component	Article Name	Article #	Characteristics	Value / Feature
6	Mounting Base Plate	MBP-i30.1	190-10313	Material / Mounting Screws	*PP+GF / 2 pieces, stainless steel FEP coated, M3 x 10 mm*
7a	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*
7b	Desktop AC/DC Power Supply	AC/DC Power Supply VEC50US24 HR30	100-40015	Voltage Output / Input Dimensions / Cable Spec. Safety Approvals	*24VDC, 50W / 90 – 264 VAC, 47-63 Hz* *116 x 52 x 31 mm / Cable length 1.2m* *IEC60950-1, EN60950-1, UL/cUL60950-1*
7c	AC Mains Cables (for desktop supply 7b)	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	*UL, cUL, US, Canada* *CB, Germany, Denmark, Norway, Finland, Belgium, Netherland, Sweden, Austria* *PSE, Japan* *Switzerland* *CE, United Kingdom*
8	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 (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*
9	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 mm^2 (only 2 wires used, 1 is cut)* *Open wires / Circular Hirose type to driver* *Connection of power supply to "Stand-Alone" and "EasyConnect" drivers*
10a	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 mm^2 and shielding* *Circular Hirose type / Circular Hirose type* *Fieldbus connection between "EasyConnect" drivers and flow sensor connection.*
10b 10c	IPS Cable Signal 6 Wires	ICS-1.2-50 (5 m) ICS-1.3-50 (5 m)	190-10346 190-10389	Cable Material / Wires Connection In / Out Purpose ICS-1.2 / ICS-1.3	*PVC jacket / 6x 0.08 mm^2 and shielding* *Connector with screw type plug for open wire connection / Circular Hirose type* *Fieldbus connection to "EasyConnect" driver / To PLC of "Stand-Alone" driver.*
11	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 mm^2 and shielding* *Connector with screw type plug for open wire connection / Circular Hirose type* *General connection to PLC of "EasyConnect" drivers.*
12	IPS Cable Hybrid 15 Wires	ICH-1.1-30 (3 m) ICH-1.1-50 (5 m)	190-10386 190-10341	Cable Material / Wires Connection In / Out Main Purpose	*PVC jacket / 2x 1.5 mm^2 for supply wired, 13x 0.14 mm^2 for signal and shield wire* *Open wires / Circular hybrid connector for driver connection* *General connection integrated driver connector of to "OEM" driver models.*
13	Fieldbus Termination Connector	FTC-1.1	190-10348	Materials Main Purpose	*PPS for connector housing and FPM for sealing.* *Termination of fieldbus.*
14	Mounting Kit	LMK-1.2	100-91478	Material / Structure Main Purpose	*Anodized Aluminium / Screw locking concept* *For mouting of LFS-03SU-F1 and LFS-06SU-F1 flow sensors.*
15	User Panel	LUI-B.1-01	100-30448	Interface / Housing Rating Standard Firmware	*RS485 / IP65* *A3.00*

Table 4: Specification accessories

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 flow manually. The driver also contains a PLC interface for remote control by analog/digital signals. Various accessories are available like a desktop power supply with relevant power cable and signal cables to connect to the PLC.

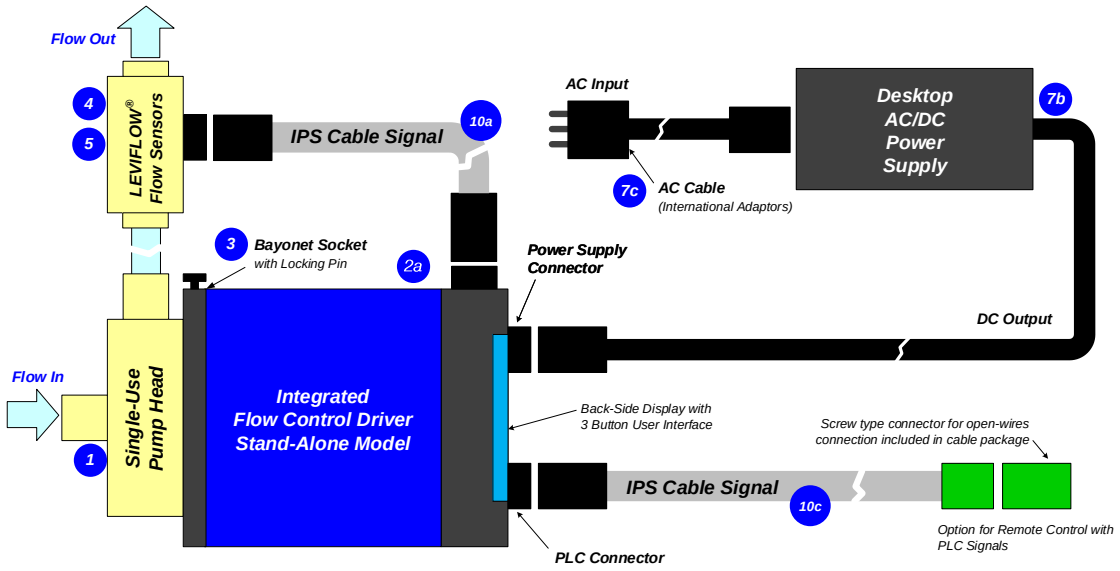


Figure 4: Standard system configuration for Stand-Alone model

2.2.2 System Configurations for *EasyConnect* Model

The *EasyConnect* model with relevant cable accessories is designed to realize various interface configurations with minimal setup effort. The PLC interface allows remote control by analog/digital signals. The Fieldbus interface enables remote control over a user panel, PC or other devices with Modbus protocol.

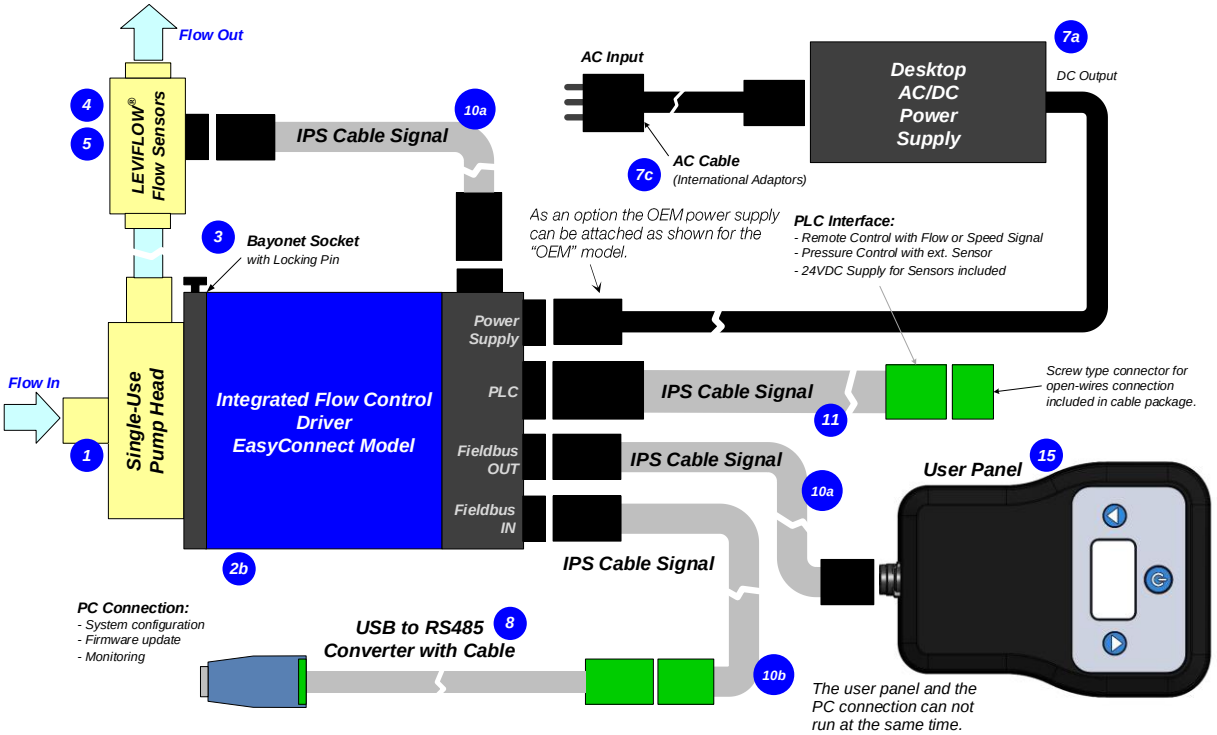


Figure 5: Standard system configuration for EasyConnect model

Two Fieldbus connectors (IN and OUT) allow to setup arrays of multiple flow controllers. Therefore, blending configurations as shown in *Figure 6* can be realized.

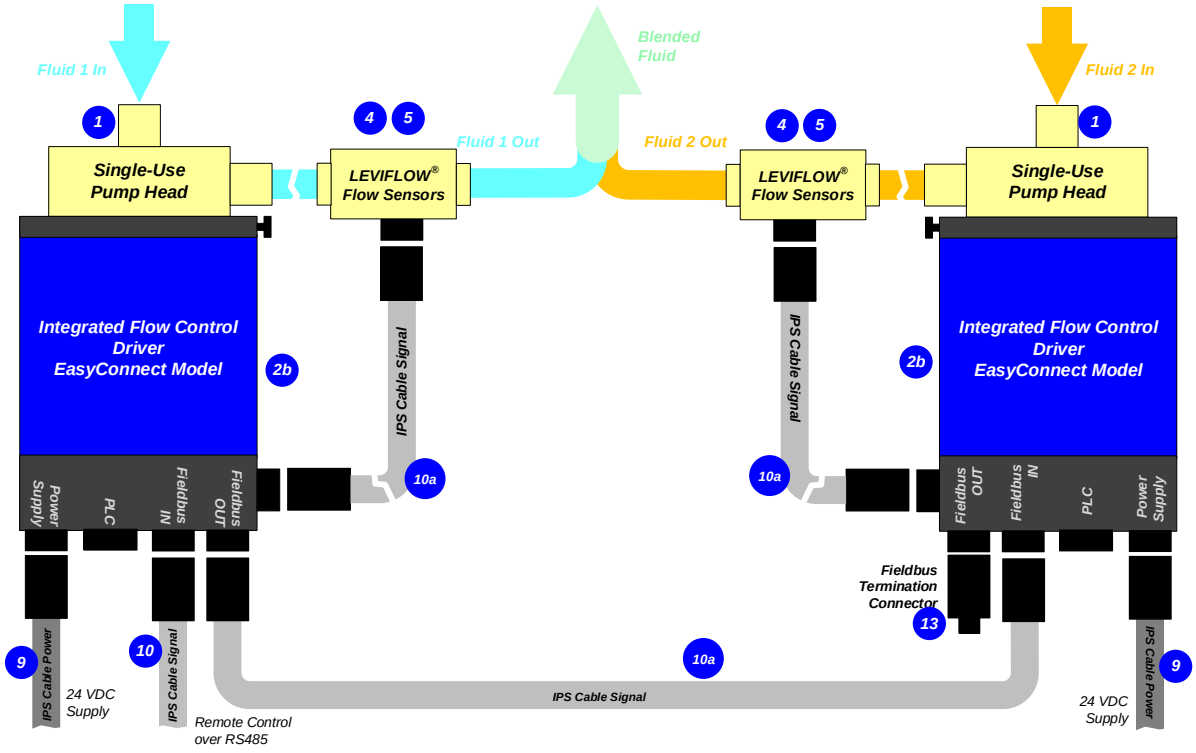


Figure 6: Flowcontrol array for blending applications with EasyConnect models

2.2.3 System Configurations for *OEM* Models

The *OEM* model, with one integrated driver connector only, is designed for compact integration into an equipment. The flow can precisely be set via an analog input. Various digital inputs and outputs allow controlling and monitoring of the system. A *RS485 (Modbus)* enables communication with a user panel or 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.

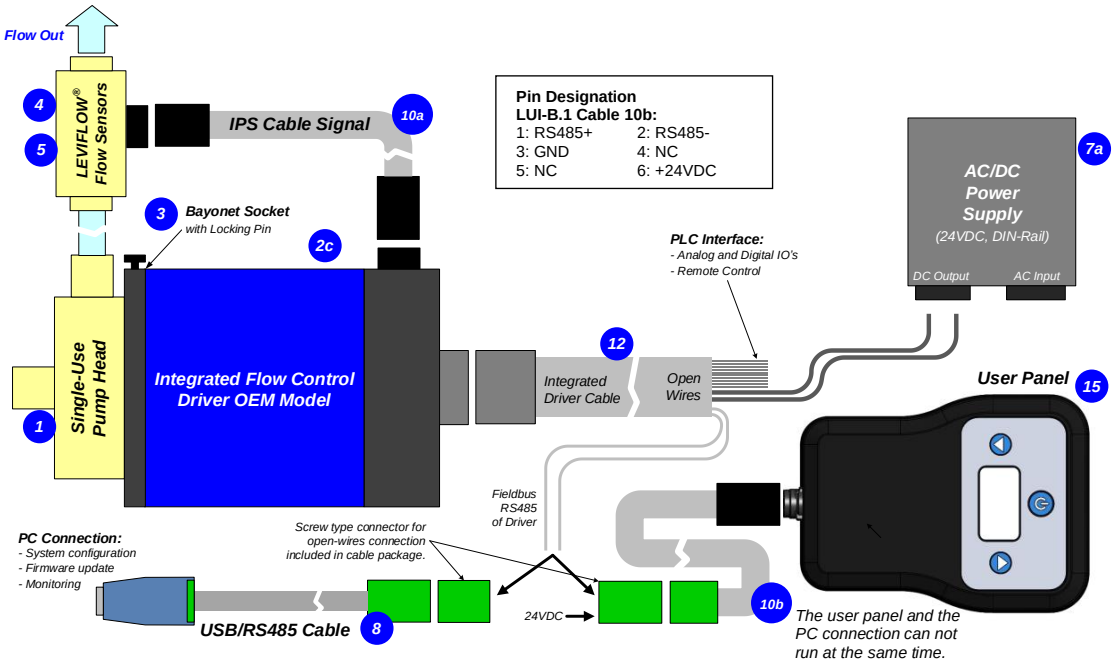


Figure 7: System configuration of OEM model

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 5: Environmental conditions for flow control system

2.4 Pressure-Flow Curves

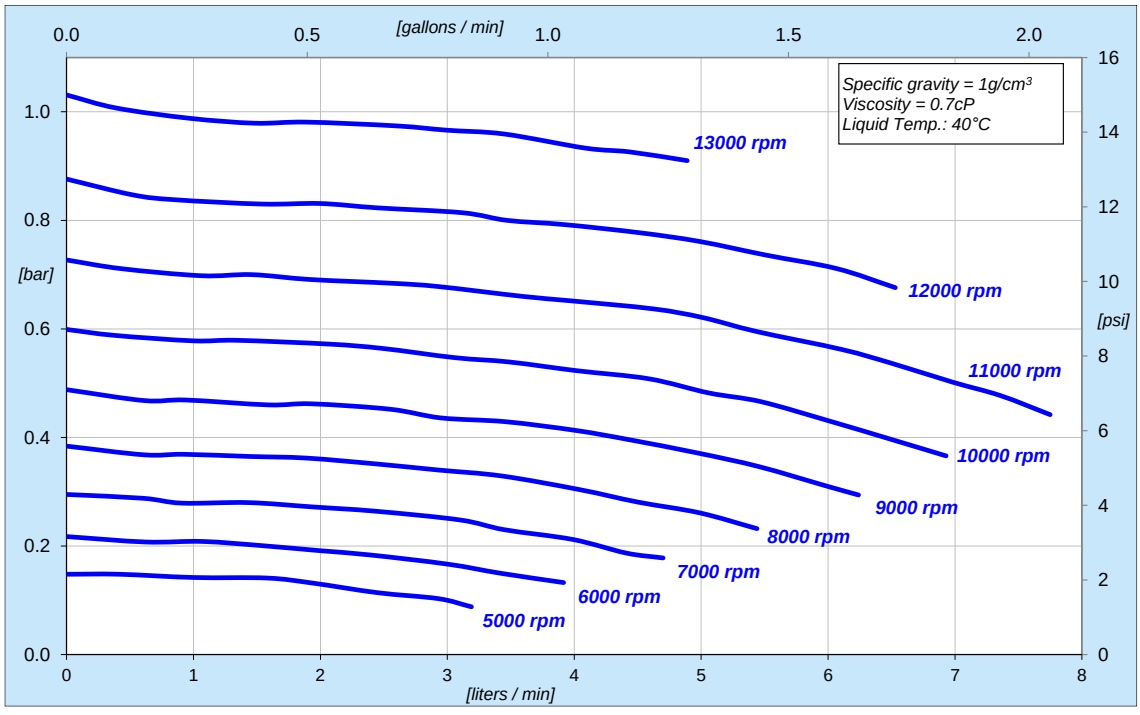


Figure 8: Pressure/flow rate curves
(Typical curves measured with DCP-30.1 pump head.)

2.5 Maximum Static Pressure for Pump Heads

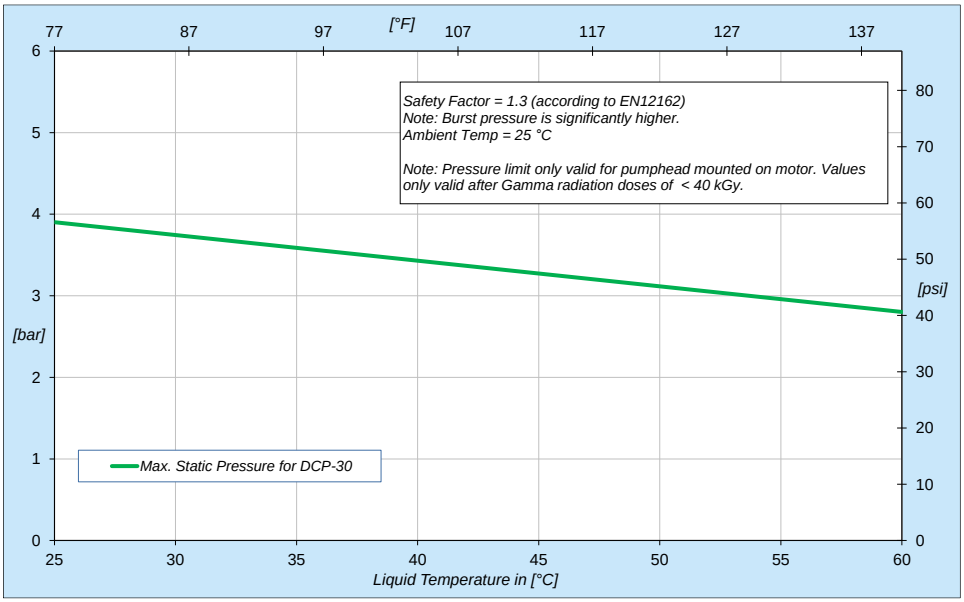


Figure 9: Specification for maximum static pressure of pump head DCP-30

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 Flow Control Specifications

Type / Characteristics	PuraLev® iF30SU with LFS-03SU-F1	PuraLev® iF30SU with LFS-03SU-F1-SC1	PuraLev® iF30SU with LFS-06SU-F1	PuraLev® iF30SU with LFS-06SU-F1-SC1
Flow Range [l/min]	0 – 0.8	0 – 0.8	0 – 8 (7.7 for pump)	0 – 8 (7.7 for pump)
Accuracy of Reading (at 20°C fluid temperature) Note: Repeatability < Accuracy/2	> 35 ml/min: ±1% < 35 ml/min: *Figure 10*	> 6 ml/min: ±1% < 6 ml/min: 0.06 ml/min	> 1.7 l/min: ±1% < 1.7 l/min: ±17 ml/min	> 0.075 l/min: ±1% < 0.075 l/min: 0.75 ml/min
Response Time: Step from 10 – 90% of full scale.	< 1s [1]	< 1s [1]	< 1s [1]	< 1s [1]
Fluid Temperature / Ambient Temperature	Normal range: 10 – 60 °C (50 – 140 °F) / 0 – 40 °C (32 – 104 °F)			

Table 6: Specifications of flow controller systems

Note 1: Values for flow control parameters, which are optimized to the specific hydraulic circuit. Default parameters are tuned for general flow control stability and may have higher values.

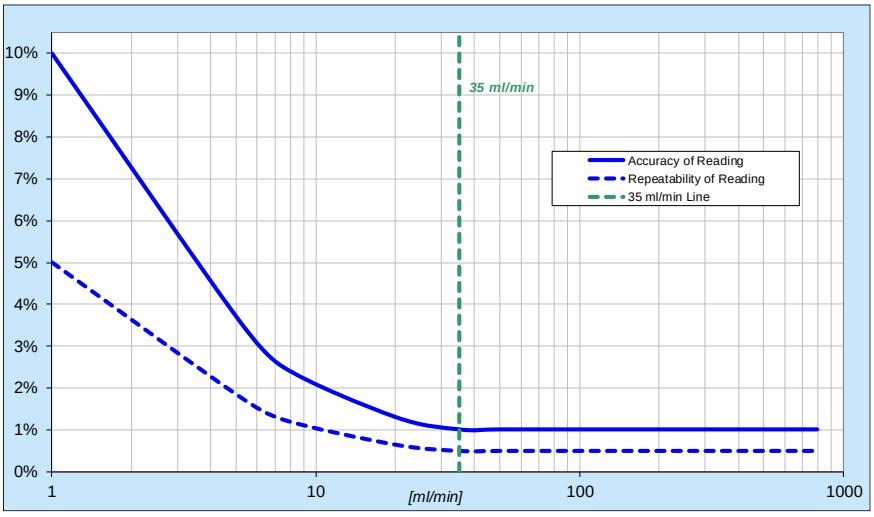


Figure 10: Accuracy and repeatability for single-use sensor LFS-03SU-F1

2.7 Basic Dimensions of Main Components

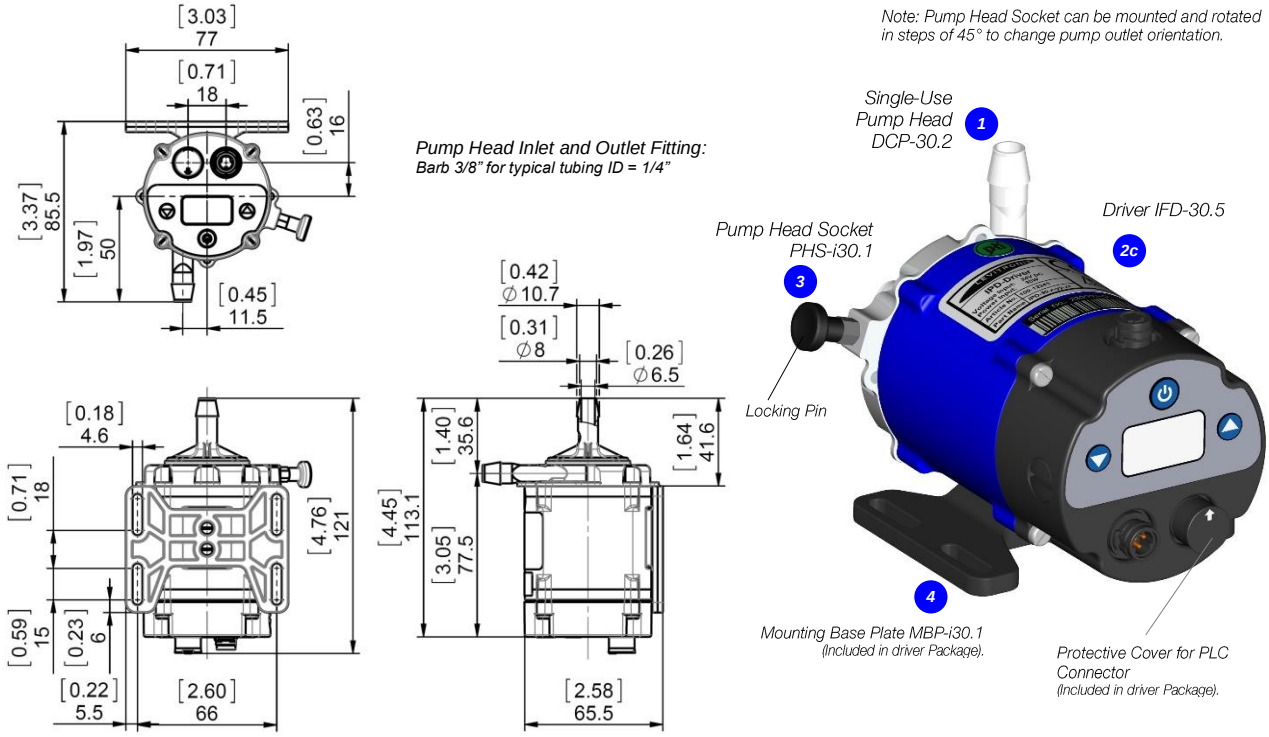


Figure 11: Basic dimensions (in mm and [inch]) of Stand-Alone model

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

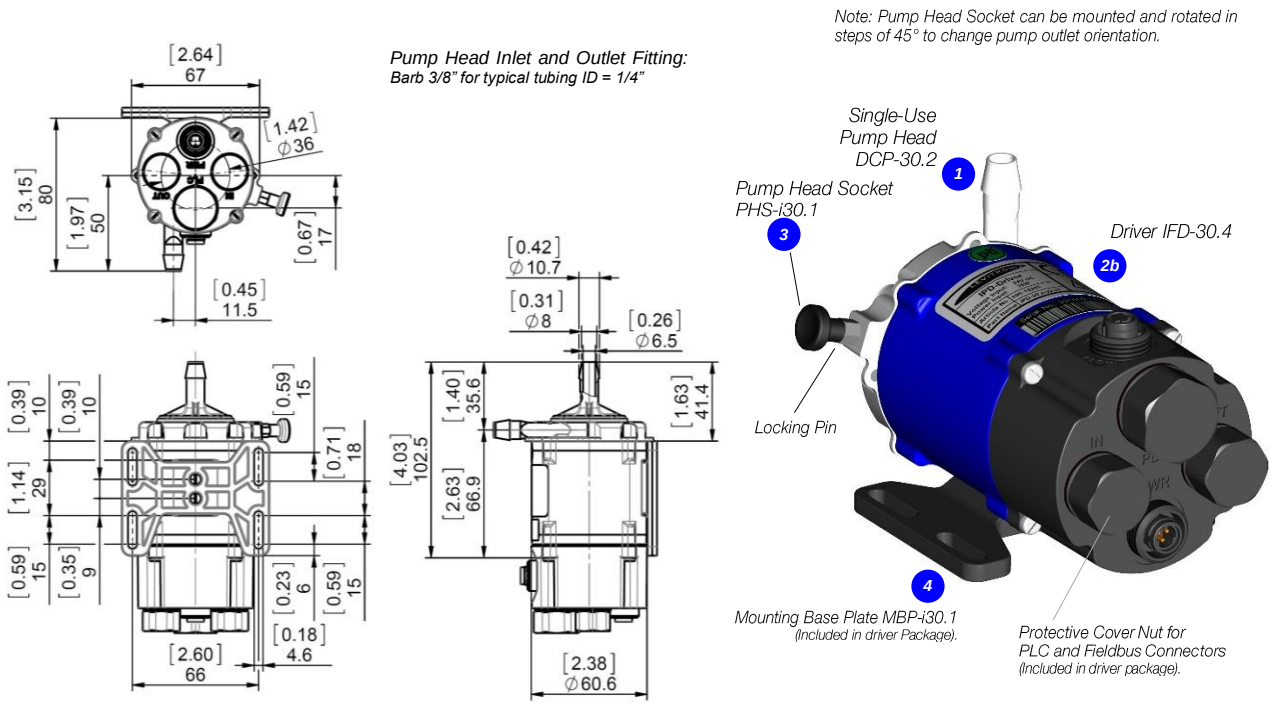


Figure 12: Basic dimensions (in mm and [inch]) of EasyConnect model

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

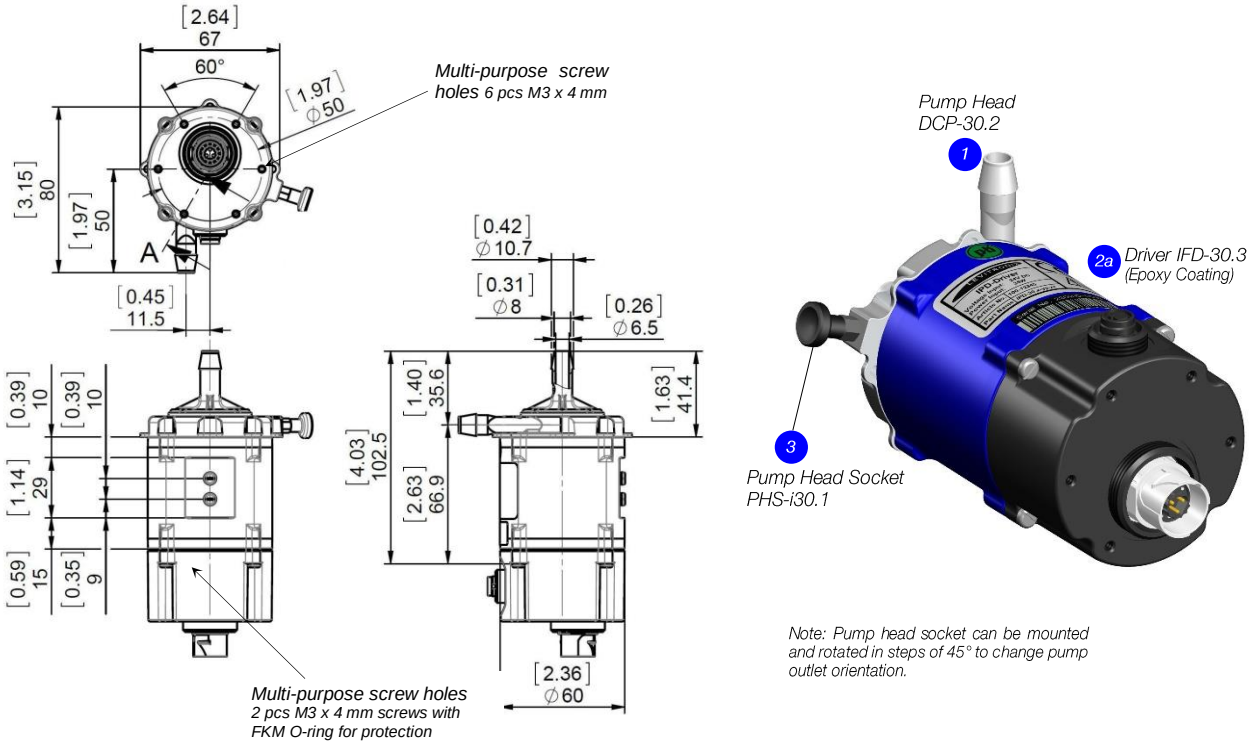


Figure 13: Basic dimensions (in mm and [inch]) of OEM model

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

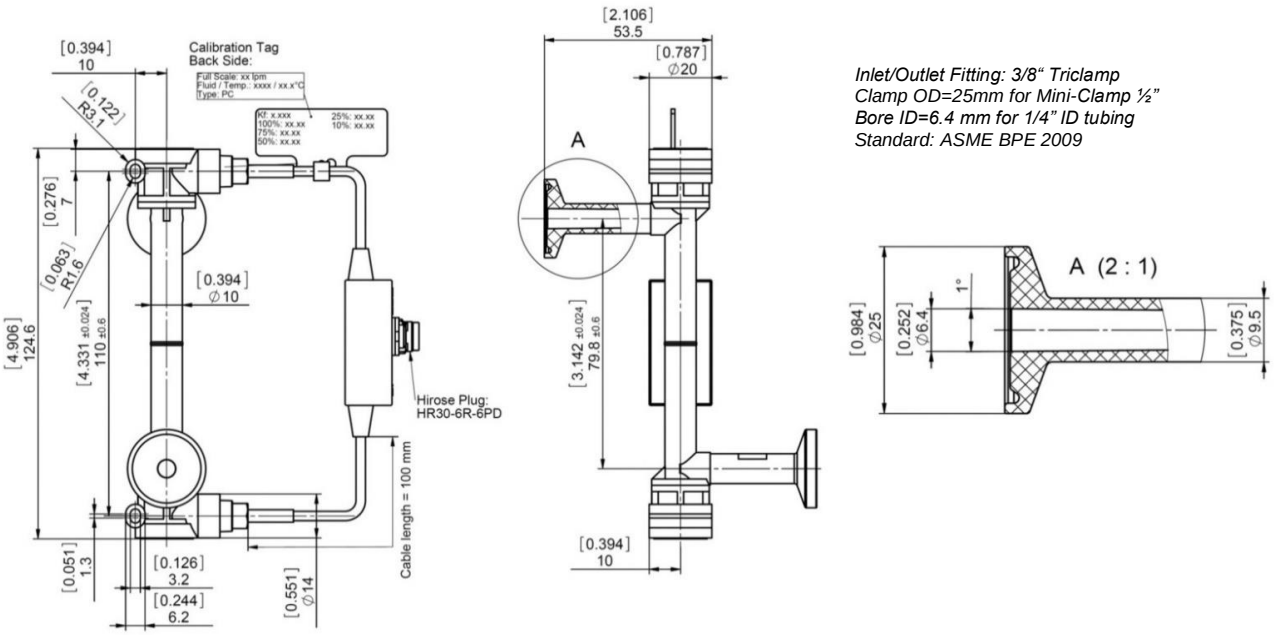
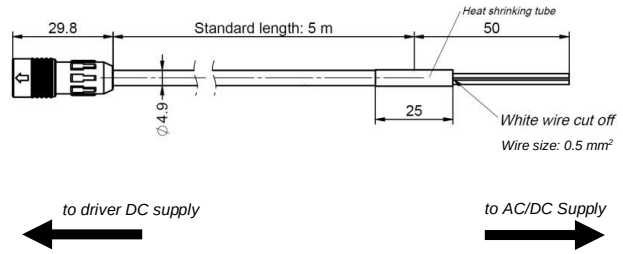
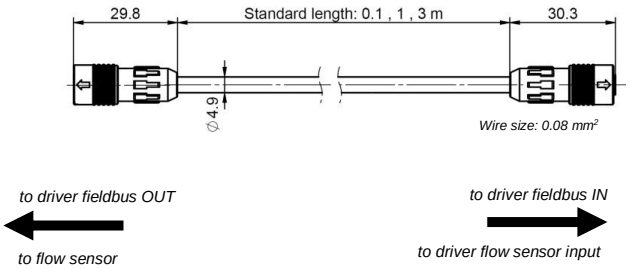


Figure 14: Dimensions for LFS-03-Z-F1 and LFS-06SU-Z-F1 flow sensors (in mm and [inch])

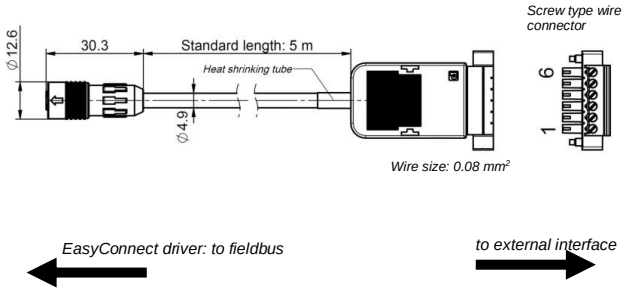
9 **IPS Cable Power ICP-1.1 (for EasyConnect and Stand-Alone drivers)**



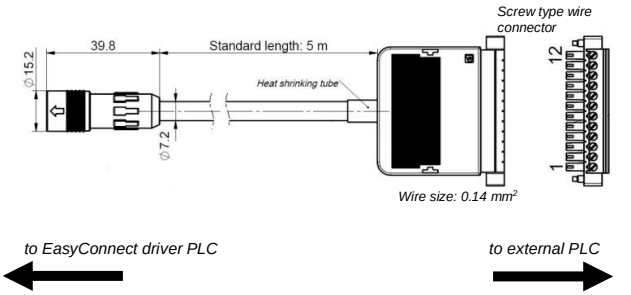
10a **IPS Cable Signal ICS-1.1 (for EasyConnect drivers)**



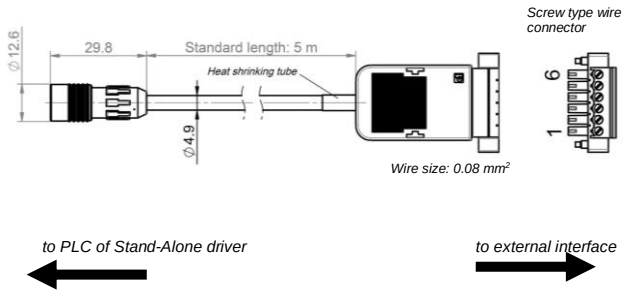
10b **IPS Cable Signal ICS-1.2 (for EasyConnect and Stand-Alone drivers)**



11 **IPS Cable Signal ICS-2.1 (for EasyConnect drivers)**



10c **IPS Cable Signal ICS-1.3 (for EasyConnect and Stand-Alone drivers)**



12 **IPS Cable Signal ICH-1.1 (for OEM driver)**

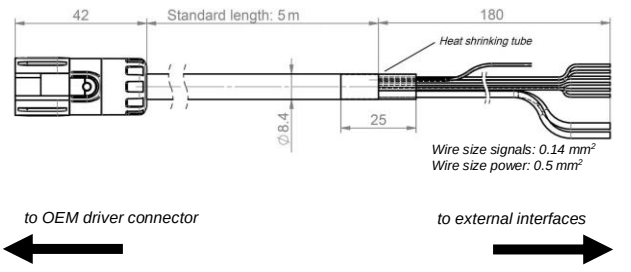


Figure 15: Basic dimensions and specifications of standard cables

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

Table 7: Specifications for min. bending radius of cables

Note 1: 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

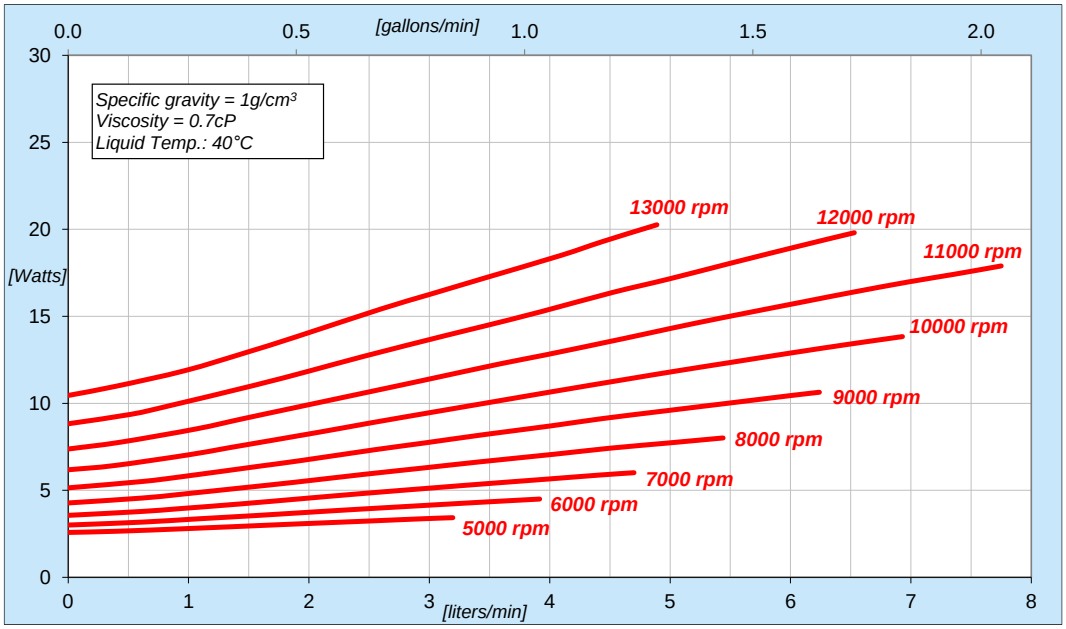


Figure 16: Electrical power consumption
Note 1: Typical curves measured with DCP-30.1 pump head.

3.1.1 Inrush Current

When selecting a AC/DC power supply the inrush currents (currents during power-on) shown in *Table 8* 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 8: Inrush currents of power supply driver during power on of driver
(Typical values measured with OEM pump driver model at 24 VDC + 10%.)

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 17* and *Figure 18* illustrate the temperature characteristics of the motor depending on these parameters.

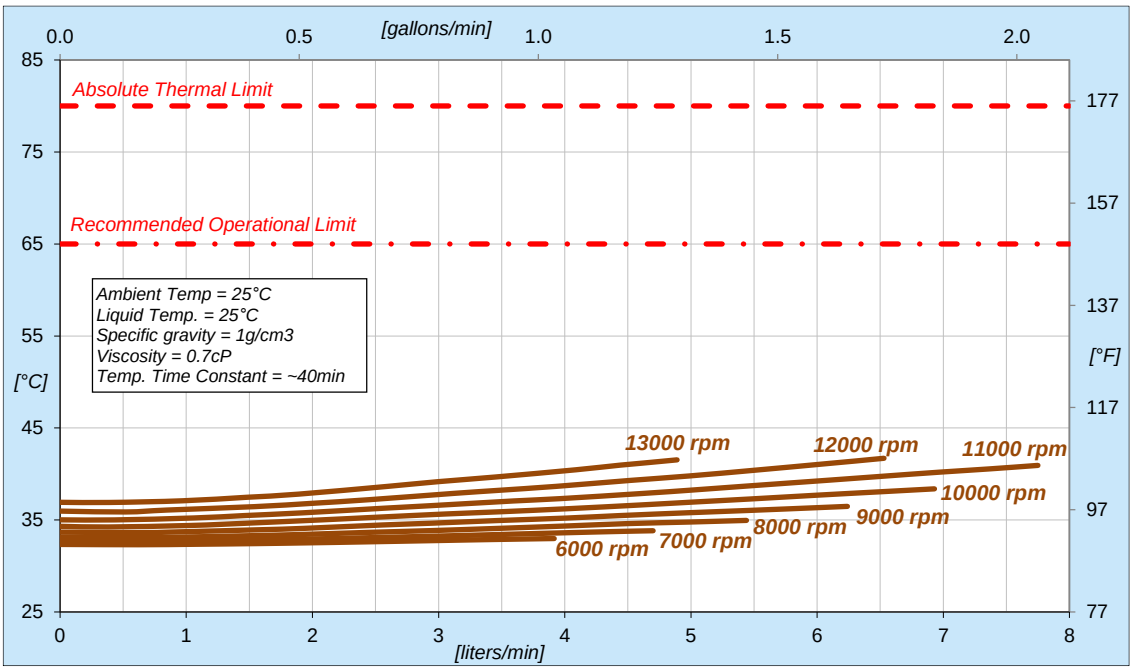


Figure 17: Temperature curves for driver @ 25°C liquid temperature

Note 1: Typical data measured with DCP-30.1 pump head. Temperature is inside of the integrated motor and controller, contact temperature of surface is below this temperature.

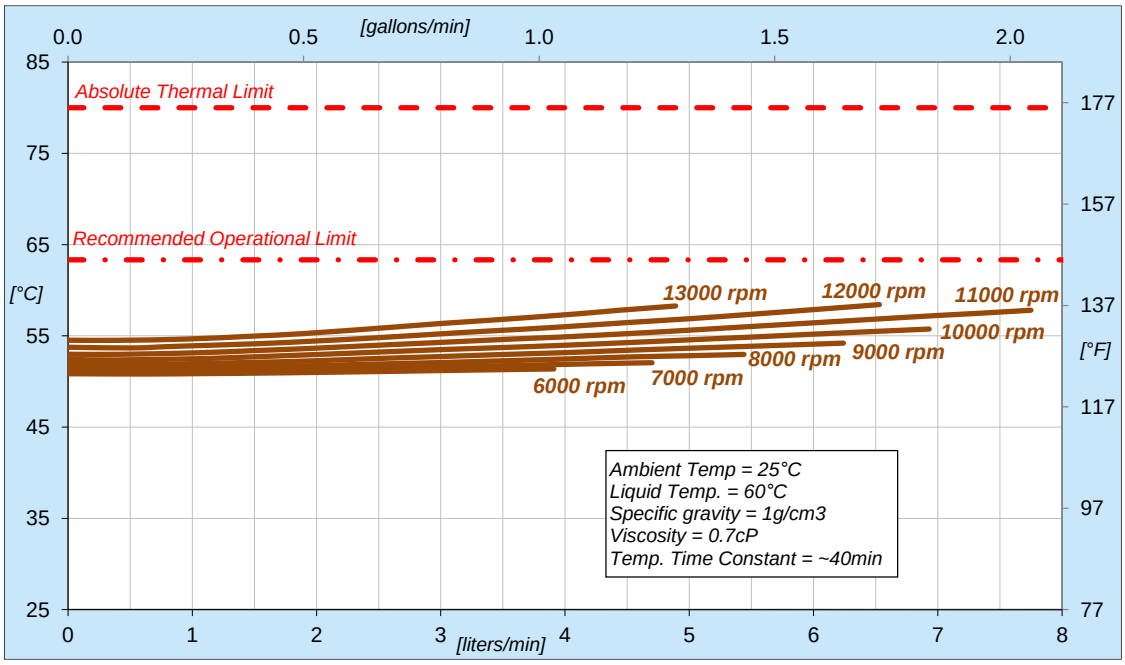


Figure 18: Temperature curves for the driver @ 60°C liquid temperature

Note 1: Typical data measured with DCP-30.1 pump head. Temperature is 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 flow control 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 flow control 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 flow control system 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 26*) 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

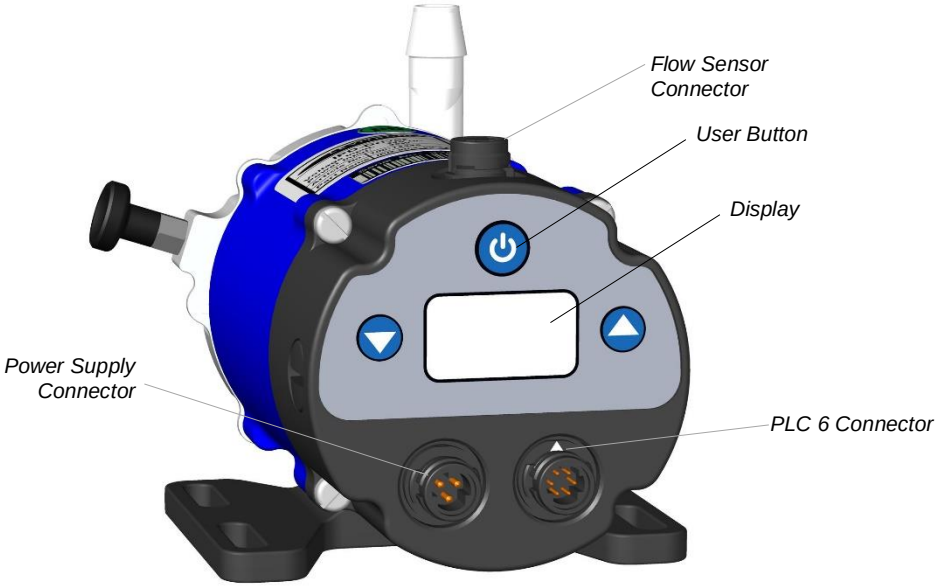


Figure 19: Electrical connections to Stand-Alone driver IPD-30.5

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 9: Power supply connector of Stand-Alone driver model

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

Pin # [1]	Pin Name	Wire Color [1]	Description	Standard Designation [2]	Typical Levels	Note
6	Ain1	pink-blue	Analog Input	*Reference Value* *(Set Flow or Speed)*	4..20 mA = 0..100% of full scale flow 4..20 mA = 0..16000 rpm Speed limit = 13000 rpm Cutt-off speed = 0 rpm	For *Flow Control* mode. For *Speed Control* mode. 450 Ohm shunt input, no galvanic isolation.
5	Ain_GND	red	Analog Input Ground	--	--	Reference for Ain1.
1	Dout1	white	Digital Output	*Status Pump*	Closed circuit ⇒ active, system on Open circuit ⇒ not active, system off	Open drain, max. 24V, 100mA This signal indicates the state of the system.
3	GND	brown black Shield	Ground	--	--	Reference for 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 for Din1.

Table 10: PLC 6 connector of Stand-Alone driver model

Note 1: Screw type connector pin-out and wires of compatible cables ICS-1.3-xx.
Note 2: Designations for standard firmware. For other firmware refer to relevant documentation.

4.1.2 Overview Electrical Schematics of Driver Interface

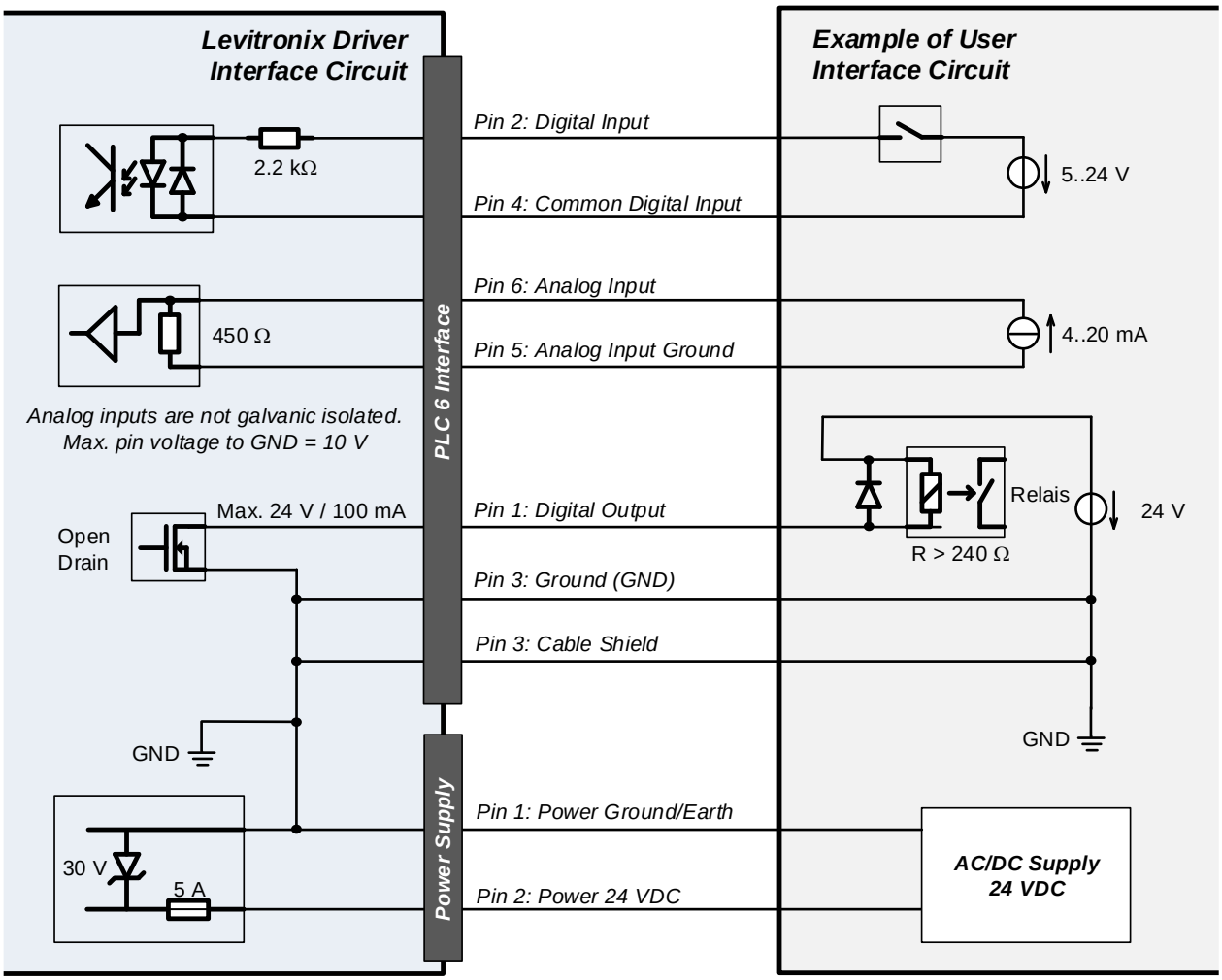


Figure 20: Electrical schematics of interfacing for Stand-Alone driver model

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 *Table 4*), which allows simple direct connection to the driver.
2. For other power supplies an open wire power cable for connection to the driver is specified in *Table 4* (cable type *ICP-1.1*). Depending on the required hydraulic operational point (see *Figure 8*), the flow control system requires 24 VDC with a maximum power of 35 W. At a lower performance power supplies with smaller power or bigger supplies to power several flow control systems simultaneously may be used. Consult *Figure 16* to get the power consumption depending on the flow. If power supplies are used other than the one defined 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 of Flow Sensor

See *Section 4.4*.

4.1.5 Installation *PLC* Interface Signals

To operate the flow control system with a *PLC* the analog input can be used to set the flow or speed. The digital output can be used to monitor the pump status and operating parameters (see *Table 10*).

CAUTION

The analog input 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 4* cable type *ICS-1.3*). Connect the designated PLC wires according to *Table 10.*
3. Follow *Figure 20* as reference for hardware configuration of the PLC inputs and 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 21: Electrical connections to EasyConnect flow control driver IFD-30.4

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 11: Power supply connector of EasyConnect driver

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

Pin # [1]	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+	*Fieldbus*	Modbus RTU protocol.	For remote control with other devices. Usage of *Levitronix Service Software* with a RS485 to USB adaptor cable (see *Table 4*).
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 12: Fieldbus IN connector of EasyConnect driver

Note 1: Screw type connector pin out and wires of compatible cables: ICS-1.1-xx and ICS-1.2-xx.

Pin # [1]	Pin Name	Wire Color [1]	Description	Standard Designation	Typical Levels	Note
3	GND	brown black shield	Ground	*Supply Output*	24VDC ±10%, 200 mA max. (Max. current is together with Pout of *PLC* connector in *Table 14*)	For supply of external devices (displays etc.). Internally protected.
6	Pout	pink-blue	Output 24VDC			
1	RS485+	white	RS485+	*Fieldbus*	Modbus RTU protocol.	For remote control with other devices. Usage of *Levitronix Service Software* with a RS485 to USB adaptor cable (see *Table 4*). Feed through for system arrays.
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 13: Fieldbus OUT connector of EasyConnect driver

Note 1: Screw type connector pin out and wires of compatible cables: ICS-1.1-xx and ICS-1.2-xx.

Pin # [1]	Pin Name	Wire Color [1]	Description	Standard Designation [2]	Typical Levels	Note
7	Ain1	violet	Analog Input (Current Input)	*Reference Value (Set Flow or Speed)*	4..20 mA = 0..100% of full scale flow 4..20 mA = 0..16000 rpm Speed limit = 13000 rpm Cutt-off speed = 0 rpm	For Flow Control mode. For Speed Control Mode. 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 Input)	*Configurable as setpoint input*	0..10 V	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 for analog inputs Ain1 and Ain2.
9	Aout1	blue-red	Analog Output (Voltage Output)	*Actual Flow Value*	0..10 V = 0..100% of full scale	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 2.0*
10	GND	white-green shield	Ground	--	--	Reference for Aout1, Dout1, Dout2 and Pout.
2	Dout1	brown	Digital Output	*Status Pump*	Closed circuit ⇒ active, pump running Open circuit ⇒ not active, system off or error	Open drain, max. 24V, 100mA This signal indicates the state of the system. If not active, pump is either in "Off" or in "Error" state. The configuration of the digital outputs can be changed with *Levitronix® Service Software.*
1	Dout2	white	Digital Output	*Status Flow Sensor*	Closed circuit ⇒ active, measurement o.k. Open circuit ⇒ not active, measure. error Slow blinking (2 Hz) ⇒ Zero Adjust error Fast blinking (10 Hz) ⇒ Zero Ad. in progress	Open drain, max. 24V, 100mA The configuration of the digital outputs can be changed with *Levitronix® Service Software.*
5	Din1	pink	Digital Input 1	*Enable Flow Control Mode (Reset)*	5-24 V ⇒ Flow control active 0 V ⇒ Flow control not active	Galvanic separation with optocoupler and 2.2 kΩ input resistance. The "*Enable*" signal switches the system on and off. Resets pump from error state with 300-700ms pulse.
4	Din2	grey	Digital Input 2	*Zero Adjust*	Edge triggered: 0 V ⎍ 5-24 V	Galvanic separation with optocoupler and 2.2 kΩ input resistance. Triggers a Zero Adjust of the flow sensor.
3	Din_COM	yellow	Common Digital Input	--	--	Reference for 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 13*)	For supply of external devices (displays etc.). Internally protected. Reference is GND.
12	NC	black	Not connected	--	--	--

Table 14: PLC 12 connector of EasyConnect driver

Note 1: Screw type connector pin out and wires of compatible cables: ICS-2.1-xx Note 2: Designations are for standard firmware.

4.2.2 Overview Electrical Schematics of Driver Interface

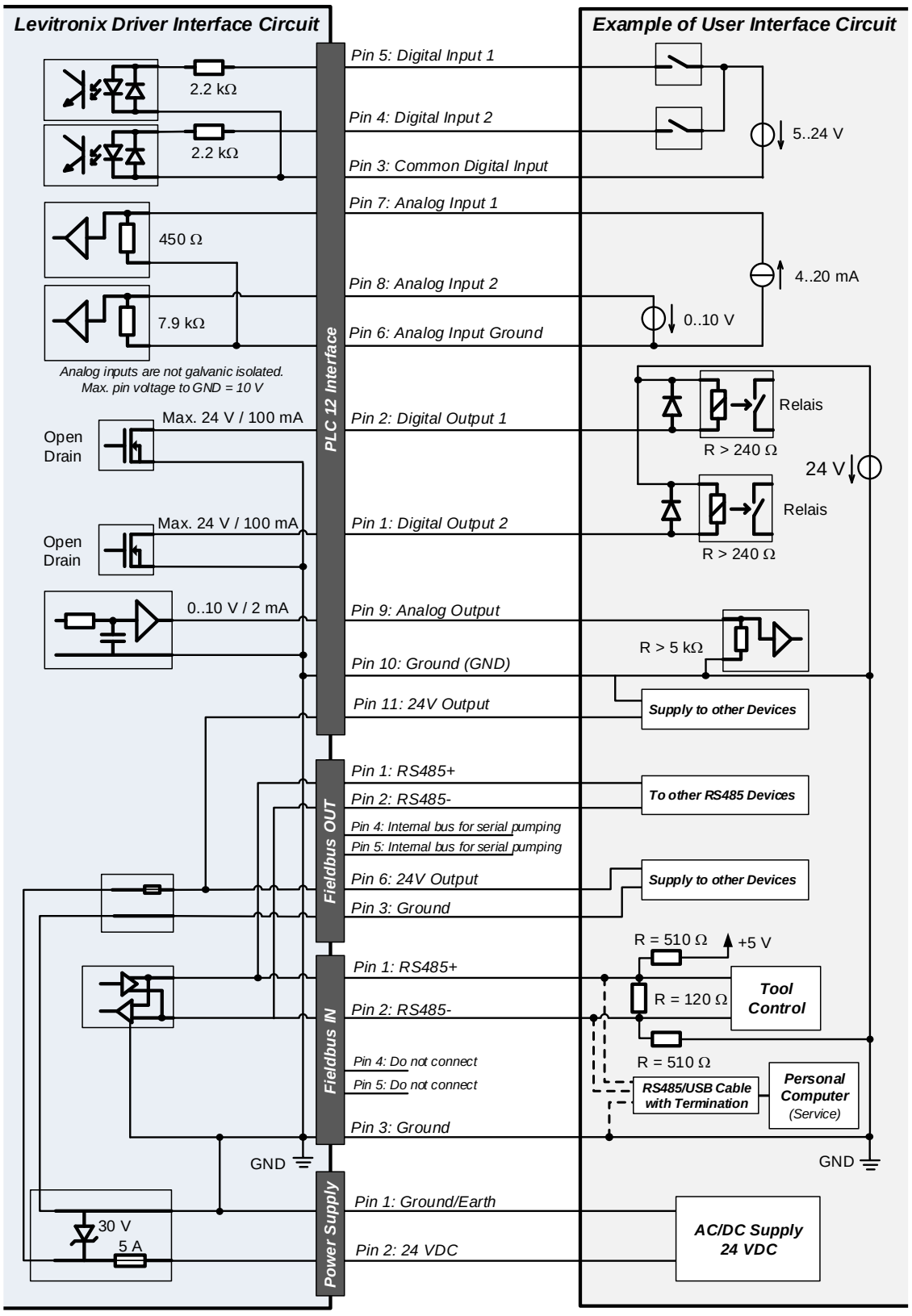


Figure 22: Electrical schematics of EasyConnect driver interfacing

Note 1: RS485/USB converter cable with termination resistors to be ordered according to Table 4.
Note 2: 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 *Table 4*).
2. For other power supplies an open wire power cable for connection to the driver is specified in *Table 4* (cable type *ICP-1.1*). Depending on the required hydraulic operational point (see *Figure 8*), the flow control 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 flow control systems simultaneously may be used. Consult *Figure 16* 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 of Flow Sensor

See *Section 4.4*.

4.2.5 Installation PLC Interface Signals

To operate the flow control 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 14*).

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 4* cable type *ICS-2.1*). Connect the designated PLC wires according to *Table 14.*
3. Follow *Figure 24* 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.

4.2.6 Installation Fieldbus Interfaces

For usage of the *RS485* (*Fieldbus IN*) as a control or service interface, an initialization resistor network according to *Figure 23* shall be used to have a stable communication and avoid disturbance effects. The *RS485 Modbus RTU* protocol for master communication is available at *Levitronix®* on request. The *Fieldbus OUT* interface can be used to feed through the *RS485* bus to other devices.

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 *Table 4*. Do not use multiple master devices at the same time.

4.2.7 Installation of *RS485* Fieldbus Flow Control System Arrays

Figure 23 shows a typical multi-system arrangement with the *RS485* fieldbus and its basic specifications for the *EasyConnect* Model.

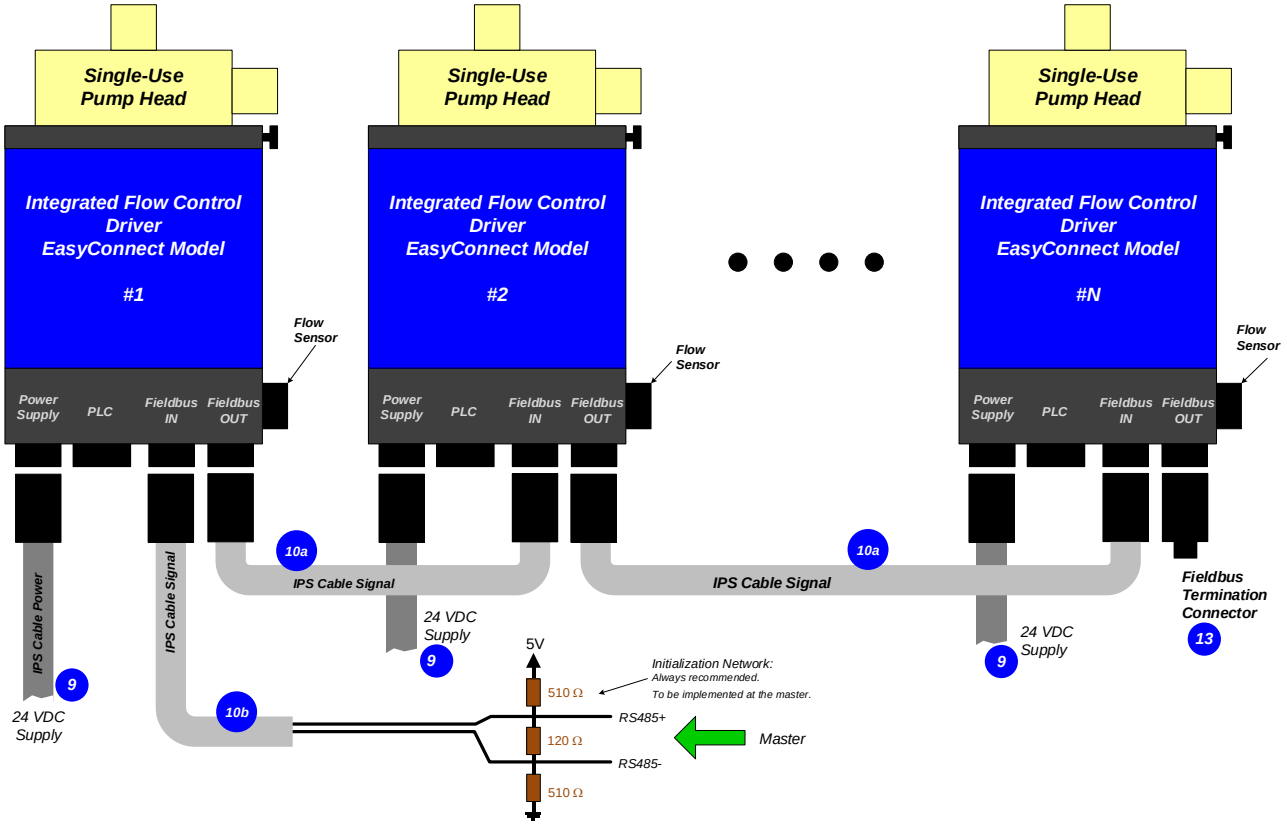


Figure 23: Multi-system arrangement with EasyConnect models with RS485 fieldbus
Note 1: See Table 4 for cable specifications.

Following points and information shall be considered:

- ➔ Various standard cables (see *Table 4*) are available to simplify the installation of a fieldbus array as illustrated in *Figure 23*.
- ➔ Testing has been done with arrangements of 8 drive 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 *Table 4*.
- ➔ The fieldbus array must be terminated as illustrated in *Figure 23*. A dedicated connector with integrated termination resistor (see *Table 4*) is available.
- ➔ The *RS485 Modbus RTU* 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.

4.2.8 Installation of Fieldbus for Blending

Blending setup with 2 pumps can be done as shown in *Figure 6.* Same instructions can be followed as mentioned in *Section 4.2.7*.

4.3 Electrical Installation of *OEM* Model

4.3.1 Overview Wire Designation of Driver Cable

Wire Name	Wire Color	Description	Standard Designation	Typical Levels	Note
P+	red	+ 24 VDC	*Supply*	Voltage: 24 VDC ±10% Power: 35 W	P- to be connected to earth.
P-	black	Power Input Ground / Earth			
Ain1	violet	Analog Input 1 (Current Input)	*Reference Value (Set Flow or Speed)*	4..20 mA = 0..100% of full scale flow 4..20 mA = 0..16000 rpm Speed limit = 13000 rpm Cutt-off speed = 0 rpm	For Flow Control mode (default mode). For Speed Control Mode. 450 Ohm shunt input, no galvanic isolation. The designation of the analog inputs can be changed with *Levitronix® Service Software.*
Ain2	grey-pink	Analog Input 2 (Voltage Input)	*Configurable as setpoint input*	0..10 V	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.*
Ain_GND	blue	Analog Input Ground	--	--	Reference for analog inputs Ain1 and Ain2.
Din1	pink	Digital Input 1	*Enable Flow Control Mode (Reset)*	5-24 V ⇒ Flow control active 0 V ⇒ Flow control not active	Galvanic separation with optocoupler and 2.2 kΩ input resistance. The "*Enable*" signal switches the system on and off. Resets pump from error state with 300-700ms pulse.
Din2	grey	Digital Input 2	*Zero Adjust*	Edge triggered: 0 V ⎍ 5-24 V	Galvanic separation with optocoupler and 2.2 kΩ input resistance. Triggers a Zero Adjust of the flow sensor.
Din_COM	yellow	Common Digital Input	--	--	--
Aout1	blue-red	Analog Output (Voltage Output)	*Actual Flow Value*	0..10 V = 0..100% of full scale	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*.
Dout1	brown	Digital Output 1	*Status Pump*	Closed circuit ⇒ active, pump running Open circuit ⇒ not active, system off or error	Open drain, max. 24V, 100mA This signal indicates the state of the system. If not active, pump is either in "Off" or in "Error" state. The configuration of the digital outputs can be changed with *Levitronix® Service Software.*
Dout2	white	Digital Output 2	*Status Flow Sensor*	Closed circuit ⇒ active, measurement o.k. Open circuit ⇒ not active, measure. error Slow blinking (2 Hz) ⇒ Zero Adjust error Fast blinking (10 Hz) ⇒ Zero Ad. in progress	Open drain, max. 24V, 100mA 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 +	*Fieldbus*	Modbus RTU protocol	Termination resistors recommended
RS485-	white-yellow	RS485 -			
Shield	shield wire	Shielding	*Shielding*		To be connected to earth (see wire P-, black)

Table 15: Signals of the driver cable with designation for standard firmware

Note 1: For other configurations of PLC Inputs and Outputs refer to relevant firmware documentation
Note 2: Configurations can be done with Levitronix® Service Software
Note 3: Power wires (P+, P-) have cross section 1.5 mm² and all others 0.14 mm²

4.3.2 Overview Electrical Schematics of OEM Driver Interface

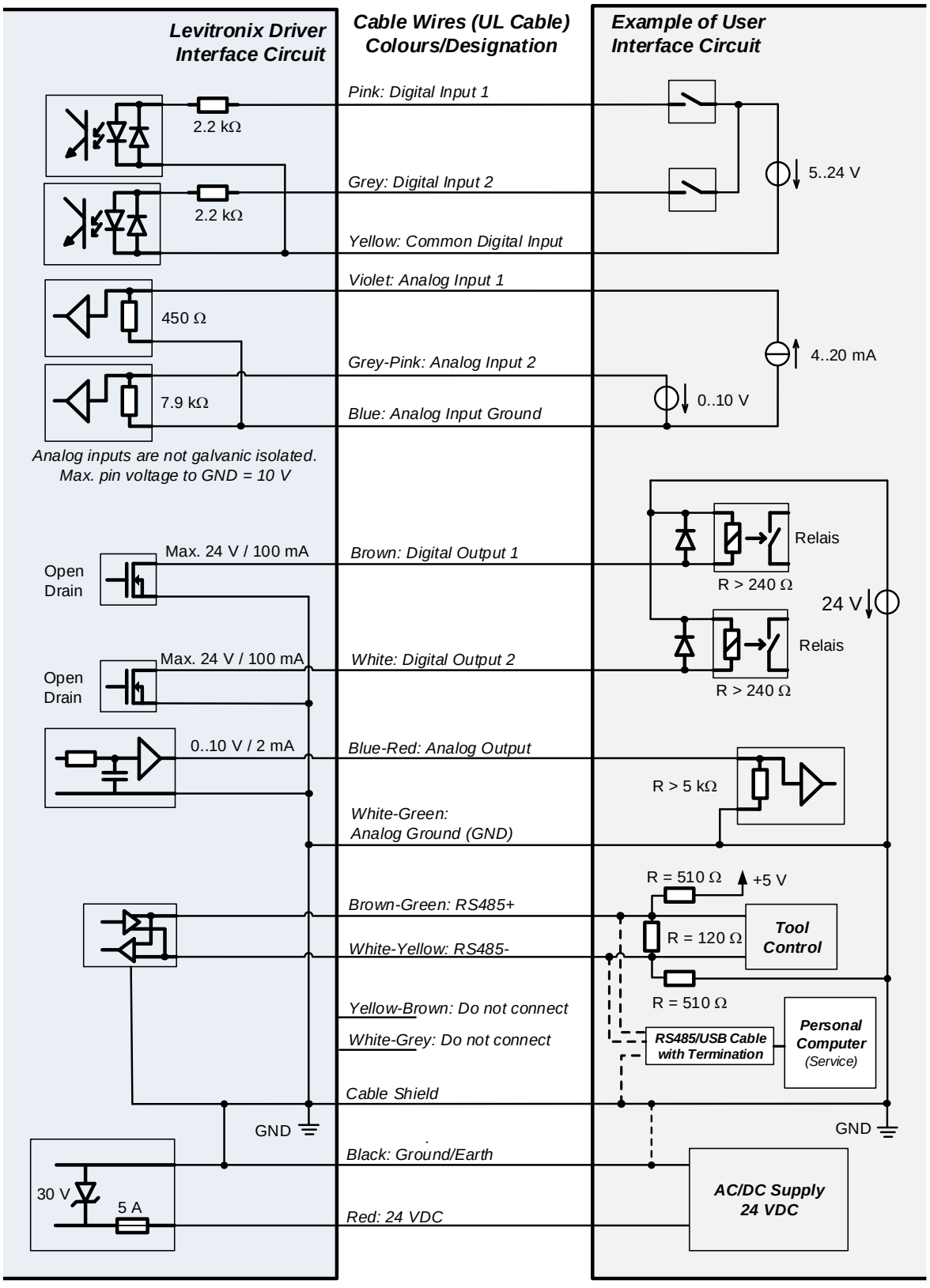


Figure 24: Electrical schematics of interfacing for OEM driver model

Note 1: RS485/USB converter cable with termination resistors to be ordered according to Table 4.
Note 2: Do not use multiple master devices on the RS485 at the same time.

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 8*), the flow control system requires 24 VDC with a maximum power of 35 W. At a lower performance power supplies with smaller power or bigger supplies to power several flow control systems simultaneously may be used. Consult *Figure 16* 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 of Flow Sensor

See *Section 4.4*.

4.3.5 Installation *PLC* Interface Signals

To operate the flow control 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 15*).

CAUTION

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

1. Power off the system
2. Connect the designated wires of the driver cable according to *Table 15.* Assignments and functions of the I/Os can be changed with the controller firmware version (refer to according firmware documentation).
3. Follow *Figure 24* as reference for hardware configuration of the PLC in/outputs.
4. Protect the un-used wires against short-circuit to each other

4.3.6 Installation of RS485 Interface

For usage of the *RS485* as a control or service interface, an initialization resistor network according to *Figure 24* or *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 *Table 4*. Do not use multiple master devices at the same time.

4.3.7 Installation of *RS485* Fieldbus for Flow Control Arrays

Figure 25 shows a flow control arrangement with the *RS485* fieldbus and its basic specifications.

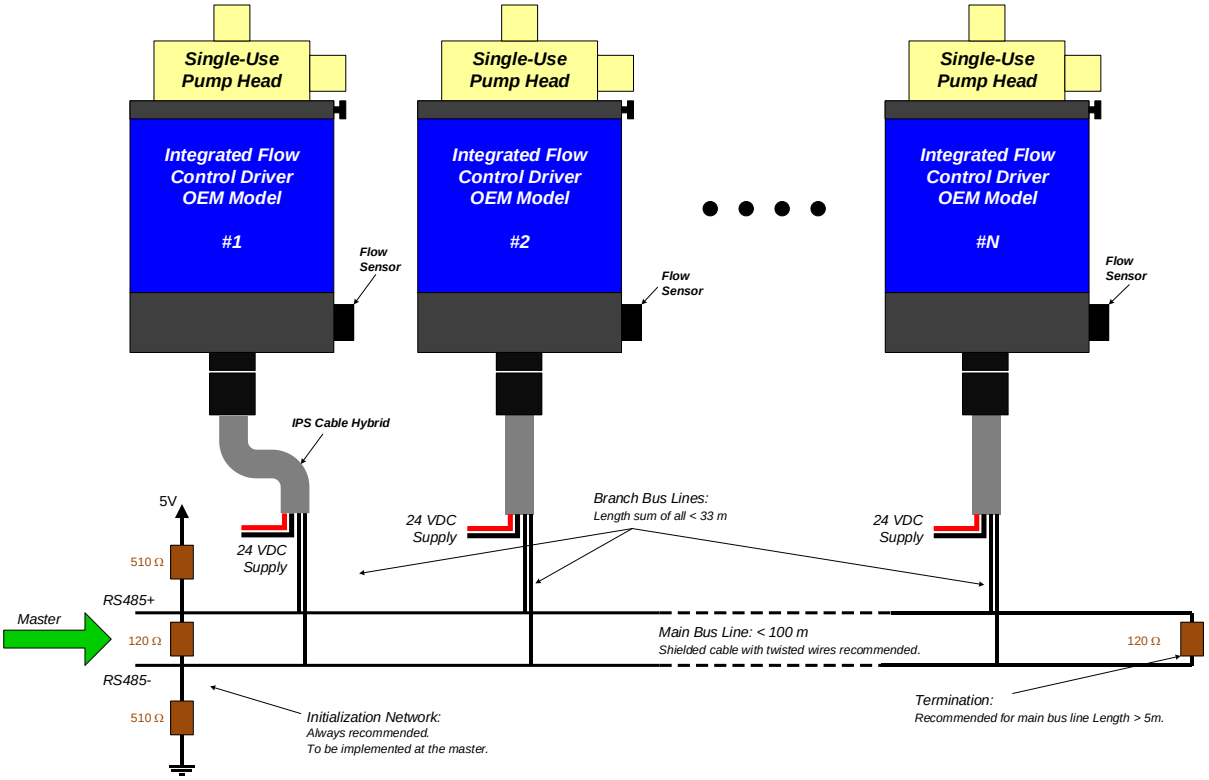


Figure 25: Flow control array arrangement with RS485 fieldbus

Following points and information shall be considered:

- ➔ Testing has been done with arrangements of 8 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 *Table 4*.
- ➔ 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 Electrical Installation of *Flow Sensor*

1. Every sensor comes delivered with a calibration sheet. Check if the S/N on the calibration sheet corresponds to the S/N on the type label of the sensor.
2. Please store the delivered calibration sheet or its data on a defined storage place in order to be able to refer to it in case of problems.
3. Attach one of the sensor extension cables (*Table 4*, *Position 10a*) coming from the driver to the sensor connector.
4. When applying power, the flow control drivers needs about 10 seconds for a start-up procedure to be ready. In order to get stable temperature and signals for flow converter and sensor 30 minutes shall be waited after power-on.
5. After start-up a Zero adjustment is recommended as described in *Section 4.8*.

4.5 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.

4.6 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 11* for the Stand-Alone and *Figure 12* 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 must 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 26*).

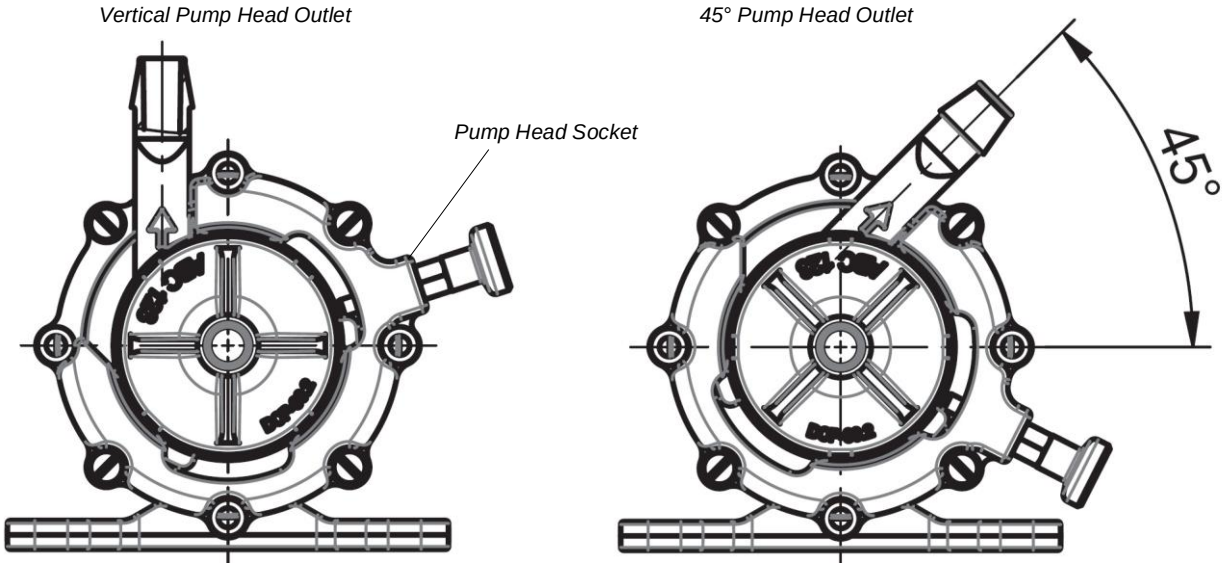


Figure 26: Vertical and 45° orientation of pump head with rotation of pump head socket

4.7 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. 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 can be used (see *Figure 13*).

When mounting the pump head fittings into a circuit it must 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 26*).

4.8 Mechanical Installation of *Flow Sensor*

1. For mounting and exchanging the sensors and assure proper operation it is recommended to use the *LMK* mounting kits, which can be ordered according to *Table 4*. Contact *Levitronix®* for detailed drawing specifications.
2. Alternatively, the sensor body can be mounted with the fixation holes as shown in *Figure 14*. Assure that the fixation of the flow sensor and that the weight of the inlet and outlet circuit on the fittings are not causing excessive forces resulting in bending the flow measurement path, which might influence the flow measurement.
3. Assure that at the mounting location the allowed ambient temperature and humidity ranges are not exceeded:
   - ➔ *Temperature range:* *0 – 40 °C (32 – 104 °F)*
   - ➔ *Humidity range:* *30 - 85% R.H. (no condensation)*
4. The flow circuit should be filled completely with fluid. The converter DSP (Digital Signal Processor) contains special algorithms, which increase the robustness of the measurement against bubbles. However, assure that excessive bubbles are avoided in the circuit.
5. Ideal mounting position for the flow sensor is 45^0 (see *Figure 27*) with upward flow direction to avoid the stagnation of bubbles and particles in the measuring tube.

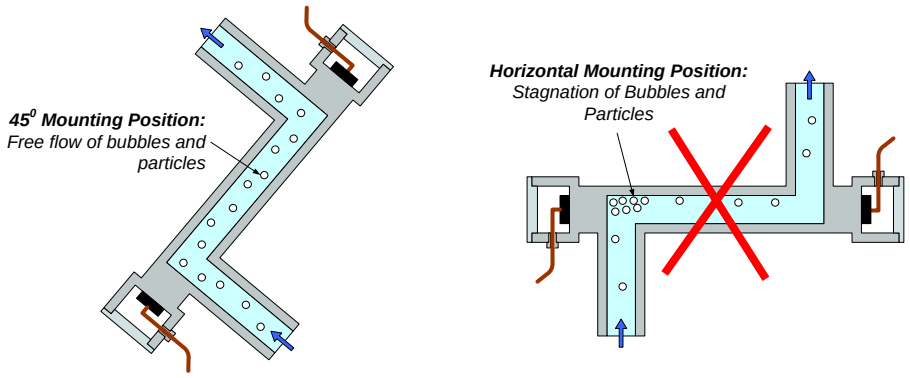


Figure 27: Mounting position of sensor

6. An arrow mark on the flow sensor indicates the flow direction. Make sure that the arrow corresponds to the direction of the flow in the hydraulic circuit.
7. Avoid excessive vibrations such as in the proximity of displacement pumps. Insufficient contact of the transducer (within the sensor) onto the pipe wall caused by vibration may result in inaccurate measurement.
8. The flowmeter measures flow velocity. In order to obtain fully developed flow pattern for accurate velocity measurement, straight run of 10x sensor ID upstream and of 5x ID downstream is recommended (see *Figure 14* for ID specifications of the sensor models). If non-uniform turbulent flow or swirl flow is expected, install longer upstream straight run and/or a flow-rectifier.
9. To install on pipe that has open end, the sensor should be mounted in lower position of the pipe line.
10. The sensor should be mounted where pressure in the pipe is above the atmospheric pressure.
11. Devices like valves are recommended to be installed downstream of the sensor in order to prevent formation of bubbles in the liquid. An upstream valve may form bubbles reducing the intensity of the ultrasound signal and interfering with measurement.
12. A bypass pipe run (including bypass valve and shutoff valve) is recommended for easy zero adjustment and maintenance.
13. Please confirm that the maximum pressure is below the flow sensor specification of < 5 bar (at 20°C).
14. After setup a zero adjustment is recommended. Assure that the sensor is filled completely with the according fluid and is free of bubbles. Stable liquid properties should be assured by flushing the circuit with the final liquid until temperature and viscosity becomes stable. After this, zero flow shall be realized. *Section 5.3* summarizes how zero adjustment can be implemented with the various models.
15. If zero adjustment is regularly necessary, automation is possible over a digital input of the PLC of the *OEM* (see *Table 15*) or *EasyConnect* (see *Table 14*) models or over the RS485 fieldbus interface.
16. In the following cases a re-zero is recommended:
    a. 30 minutes after power-on of a cool driver and flow sensor
    b. Change of fluid properties (temperature, viscosity, density)
    c. Change of chemistry
    d. Change of the hydraulic circuit

5 Operation

In this section the very basic operation of *OEM*, *EasyConnect* and *Stand-Alone* models is explained. For more extended operation modes and configurations consult the relevant *Firmware* and *Service Software* specifications.

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 28*. The flow can be set manually with the *Down* and *Up* buttons before or after enabling it with the *On/Off* button. The *Setpoint Flow* (= Ref. Flow) 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 Flow* is first reduced to zero before an impeller touch down is made by disabling the radial levitation. After an *Error* the system can be restarted by the *On/Off* button or by removing and reattaching the power supply.

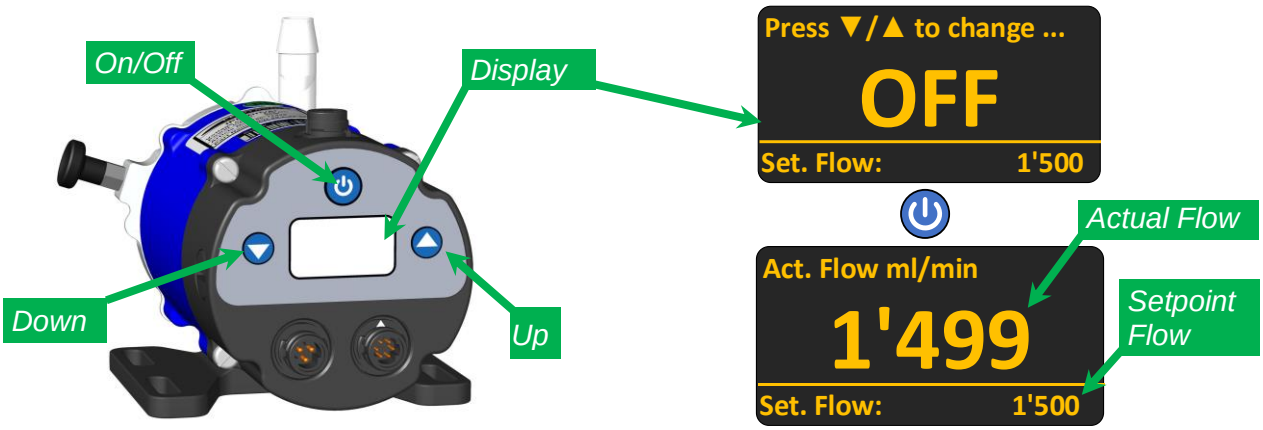
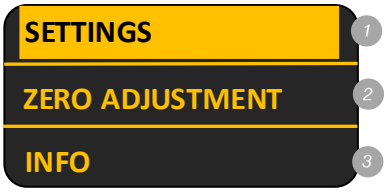


Figure 28: User panel of stand-alone model for manual operation

5.1.2 System Menu Functions

By pressing the *On/Off* button for more than 2 seconds the *System Menu* can be reached with the following basic functions:



1	a. Switch from flow to speed control mode. b. Switch manual to PLC remote mode.	c. Enable autostart mode. d. Configure and start a shutdown timer.
2	a. Zero adjustment of flow meter.	
3	a. Monitoring of parameters like driver temperature, axial position of impeller, supply voltage (DC-link voltage), motor phase currents (BNG and DRV). b. Reading of error, warning and message information and their history. c. Reading of firmware version.	

Figure 29: System Menu and its basic functions

In the *System Menu* and its sub menus, 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.

5.1.3 Operation with PLC

Remote setting of flow (or speed) with the *PLC* can be activated in the *Settings* of the *System Menu* (see *Section 5.1.2*). The flow (or speed) can be set with an analog signal (see *Table 10* for hardware details). The *Status* of the system can be monitored with a digital output signal. During *PLC* remote control all information is shown on the display.

5.2 Operation of *EasyConnect* and *OEM* Model

5.2.1 Operation with PLC

Figure 30 and *Figure 31* show the state diagram of the integrated pump and the integrated flowmeter.

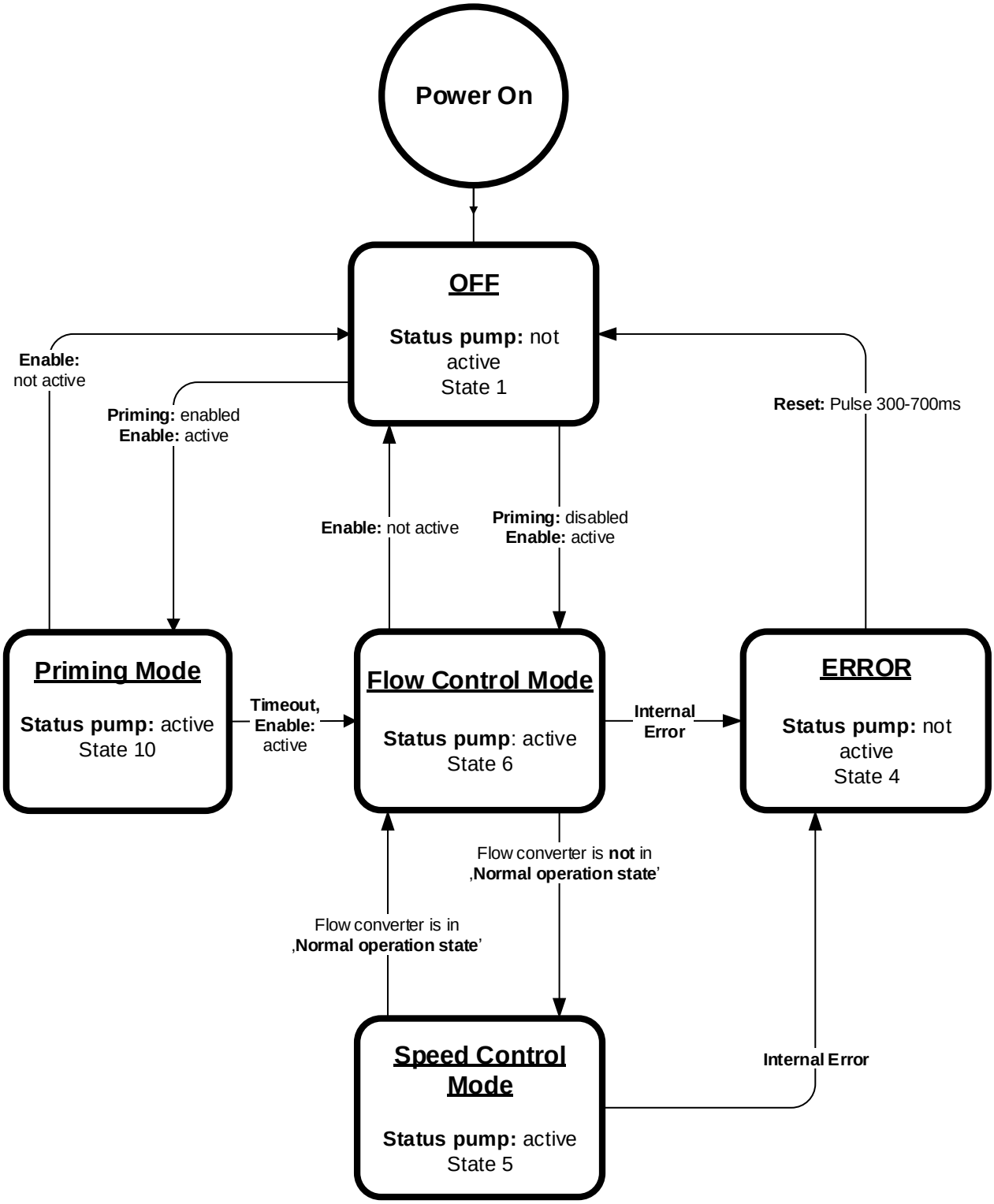


Figure 30: PLC interface state diagram of pump for standard firmware
(For other configurations refer to alternate firmware documentation)

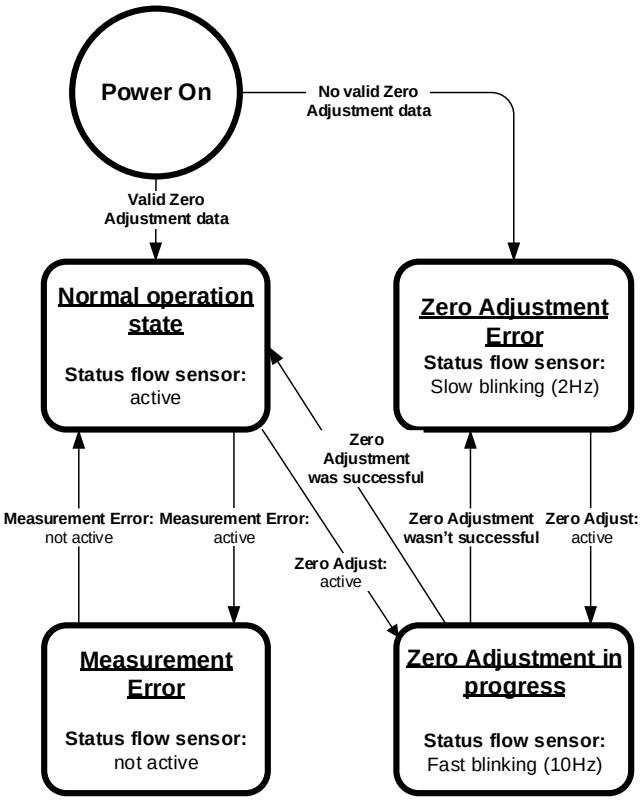


Figure 31: PLC interface state diagram of flow converter for standard firmware
(For other configurations refer to alternate firmware documentation)

The status of the integrated flow controller can be determined from both, status of integrated pump and status of integrated flowmeter and is summarized in *Table 16* with the most important state combinations, state description and possible corrective actions.

Status Pump Digital Output 1	Status Flowmeter Digital Output 2	Enable Digital Input 1	Flow Controller Status	Possible Corrective Action
Not active	**Active**	**Not active**	Flow controller measures flow but doesn't control the flow (pump is not active).	Enable flow controller by *Digital Input 1*.
Not active	**Not active**	**Not active**	Measurement error: Flow sensor cannot correctly measure the flow.	Check flow sensor cabling. Remove bubbles in flow sensor. Zero Adjust of flow converter if medium characteristics have changed.
Active	**Active**	**Active**	Normal operation. Flow controller is active.	--
Active	**Not active**	**Active**	*Speed Control Mode*. Flow controller runs at a frozen speed, because flow sensor has measurement errors. The reference speed is the last determined value before measurement errors appeared in *Flow Control Mode*.	Check flow sensor cabling and connections. Remove bubbles in flow sensor. Zero Adjust of flow converter if medium characteristics have changed.
Active	**Slow blinking at 2 Hz**	**Active**	*Speed Control Mode*. Flow controller runs at a frozen speed, because flow sensor has a zero adjustment error. The reference speed is the last determined value before the error appeared in the *Flow Control Mode*.	Stop flow controller. Make sure there is no flow through the sensor. Activate *Zero Adjust* to start a new Zero Adjust.
Active	**Fast blinking at 10 Hz**	**Active**	*Speed Control Mode*. Flow controller runs at a frozen speed. *Zero Adjust* is in progress and frozen speed is the speed before Zero Adjust was started.	Wait until Zero Adjust is finished.
Not active	*****	**Active**	Integrated pump is in error state.	Determine type of pump error with Service Software or Modbus RTU protocol. *Reset* flow controller with 300-700ms pulse.
*****	**Slow blinking at 2 Hz**	*****	Zero adjustment error: Last zero adjustment sequence failed.	Remove bubbles in flow sensor. Check flow sensor cabling and connections. Activate *Zero Adjust* to start a new zero adjustment.
*****	**Fast blinking at 10 Hz**	*****	Zero adjustment is in progress.	Wait until zero adjustment has finished.

Table 16: Overview of states for standard firmware
(Wildcard for status.) (For other configurations refer to alternate firmware documentation).*

5.2.2 Operation with Fieldbus (RS485)

The flow control driver can be operated with the fieldbus interface, which is an *RS485* with Modbus RTU protocol. Contact *Levitronix® Technical Department* (see *Section 8*) for detailed protocol specifications. The RS485 interface can be used in connection with the USB interface of a PC and the *Levitronix® Service Software*. Various accessory cables are available to connect to the *RS485* of the drivers as illustrated in *Figure 5* for the *EasyConnect* model and *Figure 7* for the *OEM* model.

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.

5.3 Zero Adjustment of Flow Sensor

5.3.1 Stand-Alone Model

Zero adjustment of the flow sensor can be done manually in the system menu functions as described in *Section 5.1.2*. It is important to prepare the flow sensor as described in *Section 4.8* and to assure that the hydraulic circuit is completely filled and zero flow is assured.

5.3.2 EasyConnect and OEM Model

Zero adjustment of the flow sensor can be started with the relevant digital input of the PLC (see *Table 15* for *OEM* and *Table 14* for *EasyConnect* model) or the *RS485* interface of the drivers (see *Section 5.2.2*).

With the user panel *LUI-B.1* zeroing can be done manually as for the *Stand-Alone* model (see *Section 5.1.2*).

It is important to prepare the flow sensor as described in *Section 4.8* and to assure that the hydraulic circuit is completely filled and zero flow is assured.

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® iF30SU* flow control system components. The wetted parts are made 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.

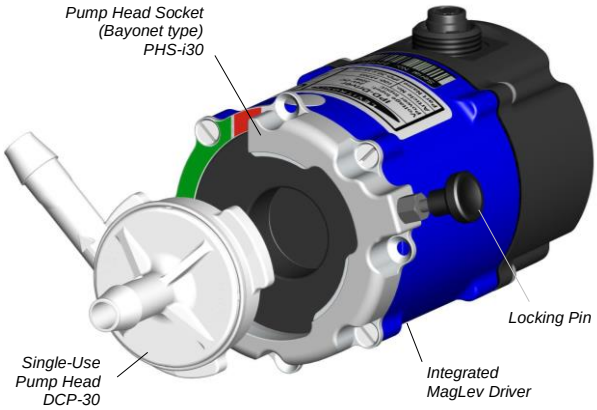


Figure 32: Single-use pump head concept

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*).

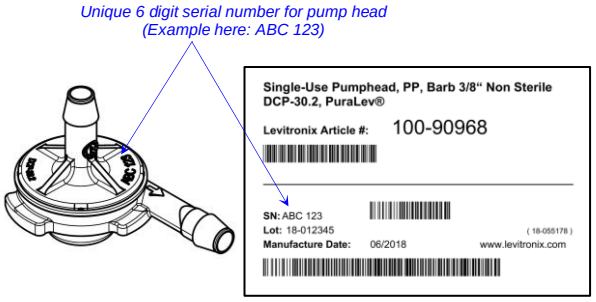


Figure 33: Serial number for traceability of pump head
(left: on pump head, right: on label of package and the biocompatibility declaration)

6.2 General Warnings and Cautions

⚠ WARNING

High Magnetic Field Strength of Impeller.

The pump head contains a rotor magnet with high field strength. Pacemaker may be influenced, and magnetic forces may lead to contusions. Keep distance to pacemakers and handle pump heads with care.

CAUTION

Magnetic Forces

Pay attention to the magnetic forces when handling the pump head. It must be avoided that magnetic parts are attracted resulting in contamination or da-mage (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.

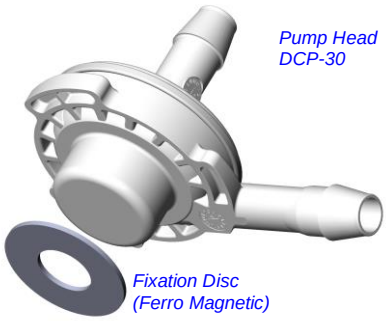


Figure 34: Pump head with Fixation Disc

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.

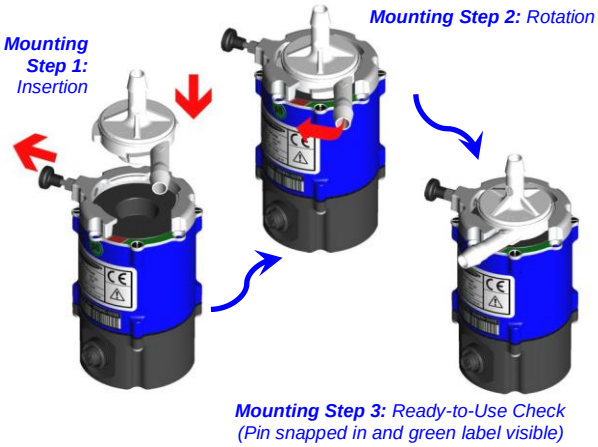


Figure 35: Intuitive 3-step pump head mounting procedure with bayonet type socket

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.

The digital output (see “Status” in *Table 10*) of the PLC 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 Based on PLC Signals

The digital outputs of the integrated *PLC* provide two *Status* signal feedbacks. Possible corrective actions based on these signals are described in *Table 16*.

7.2.2 Troubleshooting with Service Software

The *Levitronix® Service Software* allows more detailed failure analysis through communication with the flow control system in connection with a PC and a USB interface. The USB to RS485 adaptor cable as specified in *Table 4* can be used to setup communication.

The software can be used for performing detailed troubleshooting. For usage of the Service Software refer to the *Service Software User Manual*, which is available in the download section on the *Levitronix®* web-page or contact the *Levitronix® Technical Service Department* (see under *Section 8*).

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
Bändliweg 30
CH-8048 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 ***Flow Control System Family PuraLev® iF30SU***, in its various configurations, is in conformity with the below mentioned *European Directives* and *the UK Statutory Instruments*.

Machinery Directive 2014/35/EU – Machinery Regulation SI 2008 Nr. 1597:

The machinery directive/regulation 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/EU – EMC Regulation SI 2016 Nr. 1091:

The following standards of the EMC directive/regulation 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 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.

9.1.3 Biocompatibility

The wet materials of the *DCP-30* pump heads and the *LFS-SU* flow sensors satisfy the following biocompatibility specifications:

FDA 21 CFR

All wet raw materials used in the single-use pump heads and flow sensors 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 single-use pump heads and flow sensors 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 and flow sensors 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

Table 17: Safety symbols and signal words