LEVITRONIX®

PuraLev® Life Science
Integrated Flow Controller Series

PuraLev® iF100SU (Single-Use)

Pump Pressure / Flow: 2.0 bar / 17 l/min
Single-Use Flow Sensor LFS-06SU: 8 l/min
Single-Use Flow Sensor LFS-10SU: 20 l/min

Low Shear Design - High Cell Viability

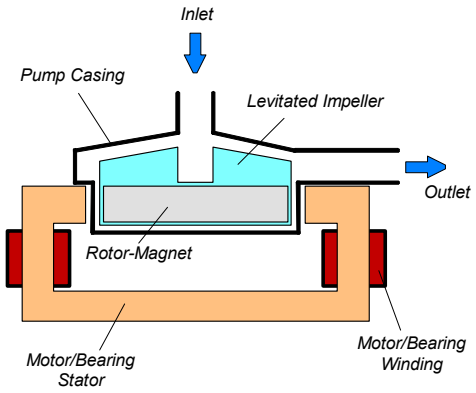
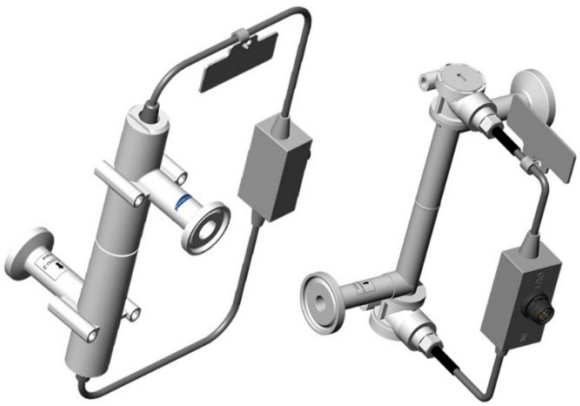


Figure 1: *Schematic of the main elements of the MagLev centrifugal pump*



LEVIFLOW® High Precision Single-Use Flow Sensors

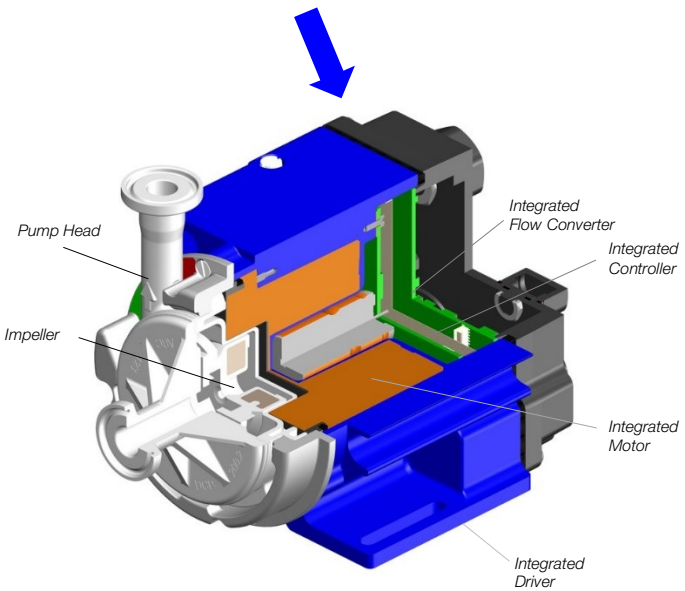


Figure 2: *Integrated flow control system with ultrasonic flow sensors*

INTRODUCTION

With the *PuraLev® iF100SU* flow control system *Levitronix®* combines its unique magnetic levitation pump technology with its ultrasonic flow measurement technology. The result is a highly integrated precise flow controller with an integrated pressure source. The centrifugal pump, as a pressure source, has no bearings to wear out or seals to break down and fail. The pump impeller is suspended, contact-free, inside a casing and is driven by the magnetic field of the motor (*Figure 1*).

The pump controller, motor and flow converter are integrated into the driver housing. This reduces cabling and setup effort significantly. Fluid flow rate is precisely controlled by electronically regulating the impeller speed without pulsation. The pump head can be easily inserted and removed with an intuitive bayonet socket.

With the lack of mechanical bearings plus the self-contained pump head design, the risk of contamination is drastically reduced. The absence of narrow gaps between the impeller and pump casing, plus the low-shear pump design allows the gentle pumping of sensitive liquids.

SYSTEM BENEFITS

- High precision, dynamics and turndown ratio.
- No dependency on external pressure source.
- Extremely low particle generation due to the absence of mechanically contacting parts.
- Reduced risk of contamination due to the self-contained design with magnetic bearings and ultrasonic technology.
- Very gentle to sensitive fluids due to low-shear design.
- No narrow gaps and fissures where particles or microorganisms could be entrapped.
- Smooth, continuous flow without pressure pulsation.
- No over-pressure situations (compared to roller pumps).
- Biocompatible and gamma sterilizable single-use parts.
- Dry running capability.
- High flow capability with compact design.
- Very low integration costs as no external controller is needed for flow control.
- Proven pump and ultrasonic flow measurement technology.

APPLICATIONS

- Pumping of shear-sensitive liquids and cells.
- Bioprocessing (for example perfusion).
- Recirculation and transfer applications in bioreactors.
- Filtration.

FLOW CONTROL CONCEPT

Figure 5 illustrates the flow control concept. Flow control, pressure generation and flow measurement is done with one unit. This allows realization of sophisticated flow control algorithms and optimizations to various situations.

There is a linear relationship between flow and speed (*Figure 4*). The speed is precisely controlled with a high resolution over a wide pump speed range. This allows a flow control with high resolution and high turndown ratio compared to non-linear flow control with valve type flow control concepts. Additionally, the highly dynamic speed controller allows fast flow step responses.

As the speed is monitored and the pressure cannot increase uncontrolled at a given speed, there is no need to protect the hydraulic circuit against over-pressure situations as for example for roller pumps in tube clogging situations.

The versatility of *Levitronix®* flow control systems goes far beyond the capabilities of simple flow controllers. In addition to the flow control function, the *Levitronix®* control firmware comes with several condition monitoring features to monitor the integrity of the fluid circuit. *Levitronix®* flow control systems can generate alarms for preventive filter exchange, no-flow conditions or line clogging. Dynamic Condition Trending (DCT) enables failure prediction and scheduling of preventive maintenance

SYSTEM CONFIGURATION – "STAND-ALONE"

Figure 6 and *Figure 10* illustrate a "Plug and Play" stand-alone system model with integrated user panel and buttons to set the flow manually. The driver also contains a PLC interface for remote flow 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.

SYSTEM CONFIGURATION – "EASYCONNECT"

The "EasyConnect" models (see *Figure 7* and *Figure 12*) with according cable accessories are designed to realize various interface configurations with minimal setup effort.

Two Fieldbus connectors (IN and OUT) allow to setup arrays of multiple flow controllers. Therefore, blending configurations as shown in ***Figure 8*** can be realized. The PLC interface allows not only remote control by analog/digital signals but also connections of external sensors hence enabling for example a precise pressure control or monitoring.

SYSTEM CONFIGURATION – "OEM"

The "OEM" models are designed for a compact integration with one integrated hybrid connector containing all available interface signals (see ***Figure 9*** and *Figure 14*). Basically, all configurations of the "EasyConnect" models are possible allowing the users with integration capabilities to adapt the cable to their needs.

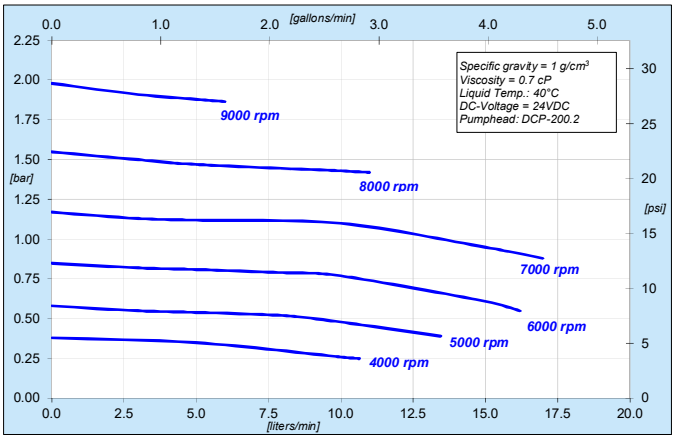


Figure 3: *Pressure/flow curves for aqueous liquids (similar to water)*

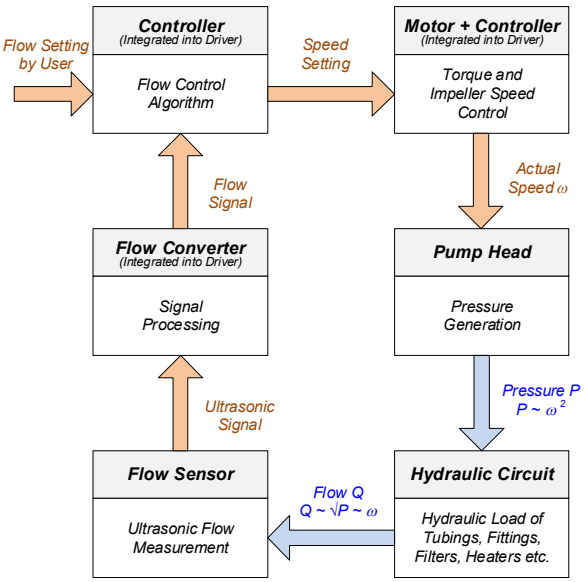


Figure 4: *Simplified block schematics of flow control system*

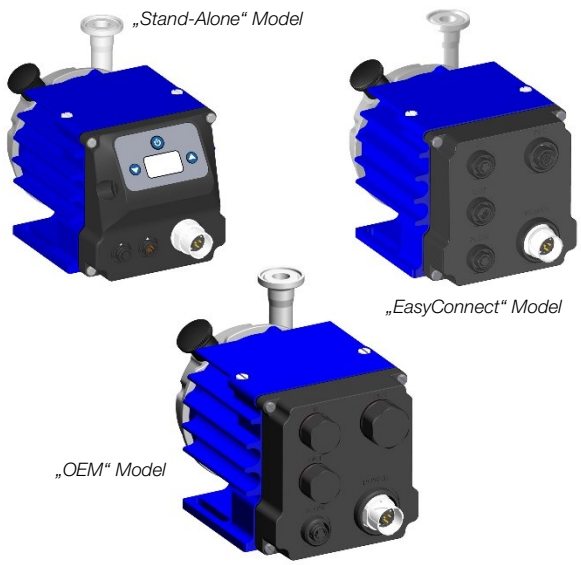


Figure 5: *Flow control system models*

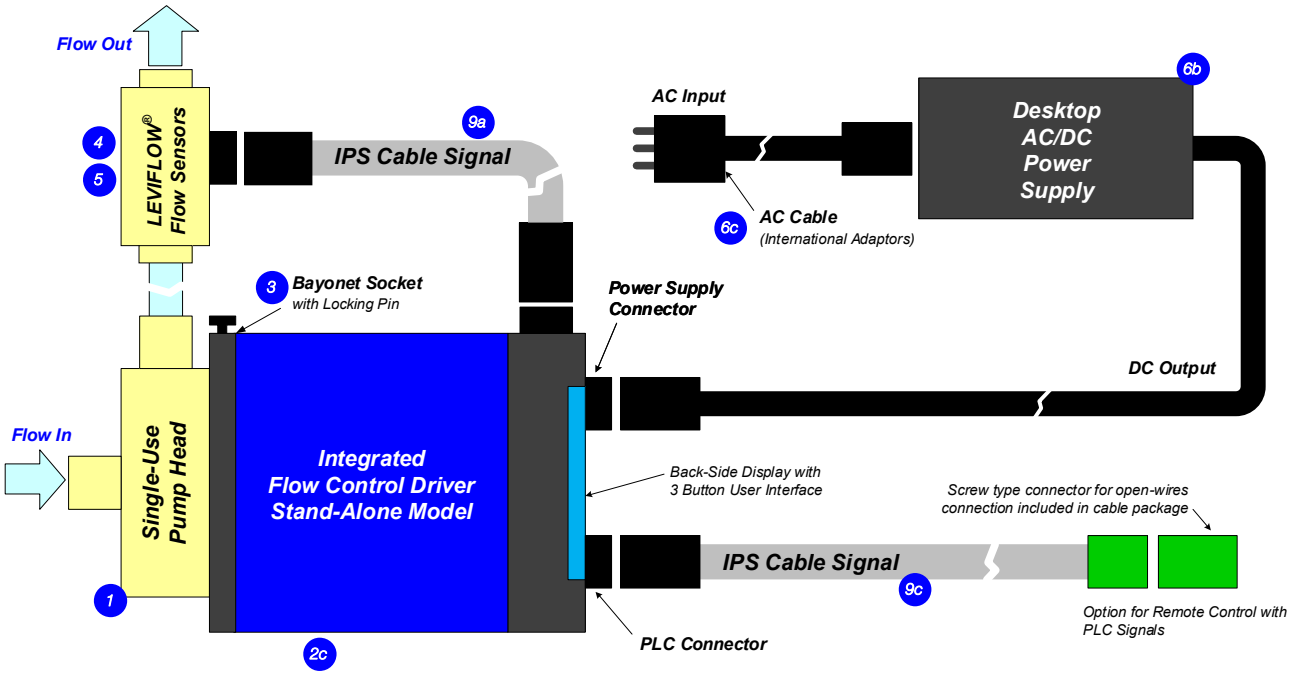


Figure 6: Standard "Stand-Alone" system configuration with main accessories
(See section "Order Information" for details to numbered components and other options)

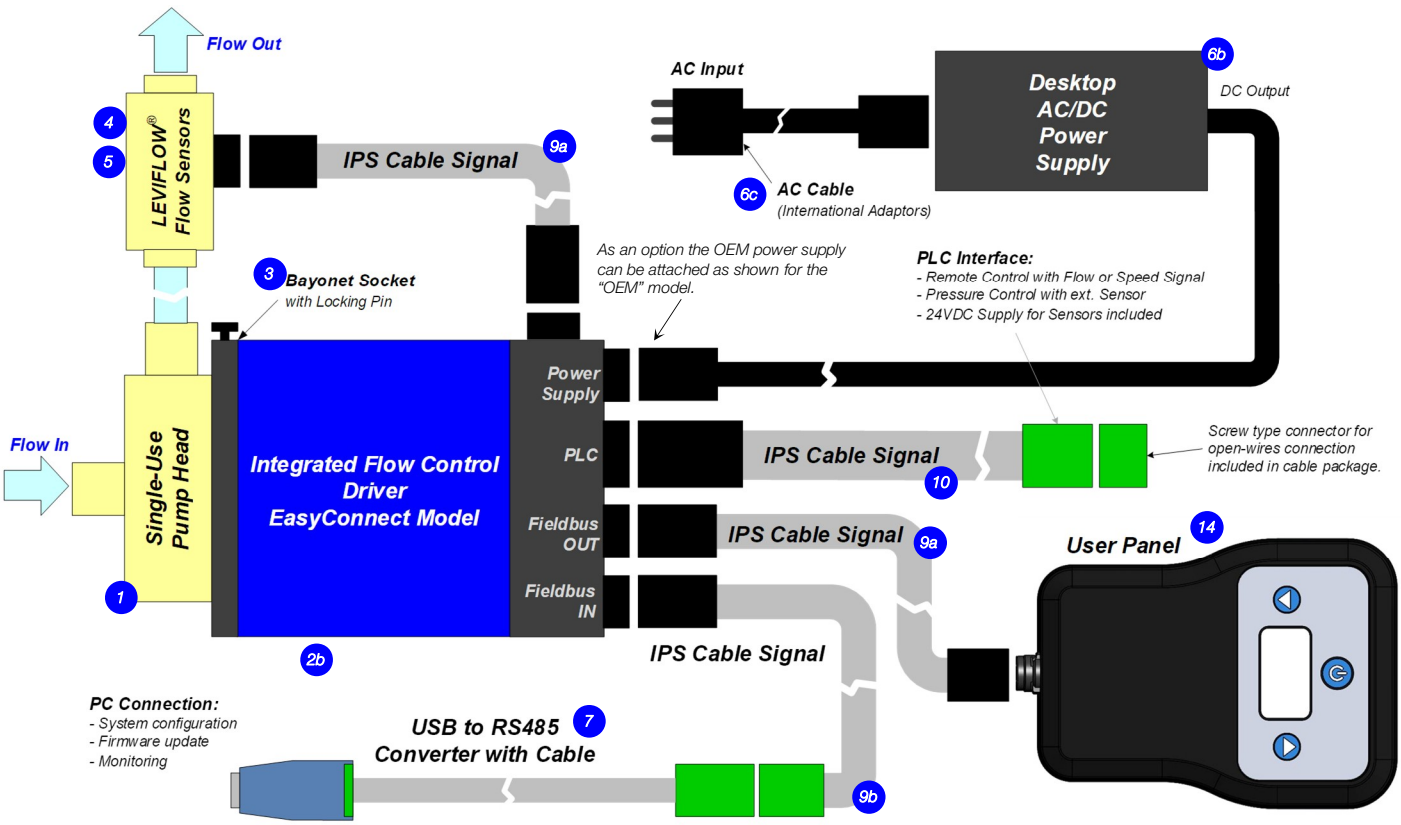


Figure 7: Standard "EasyConnect" system configuration with main accessories
(See section "Order Information" for details to numbered components and other options)

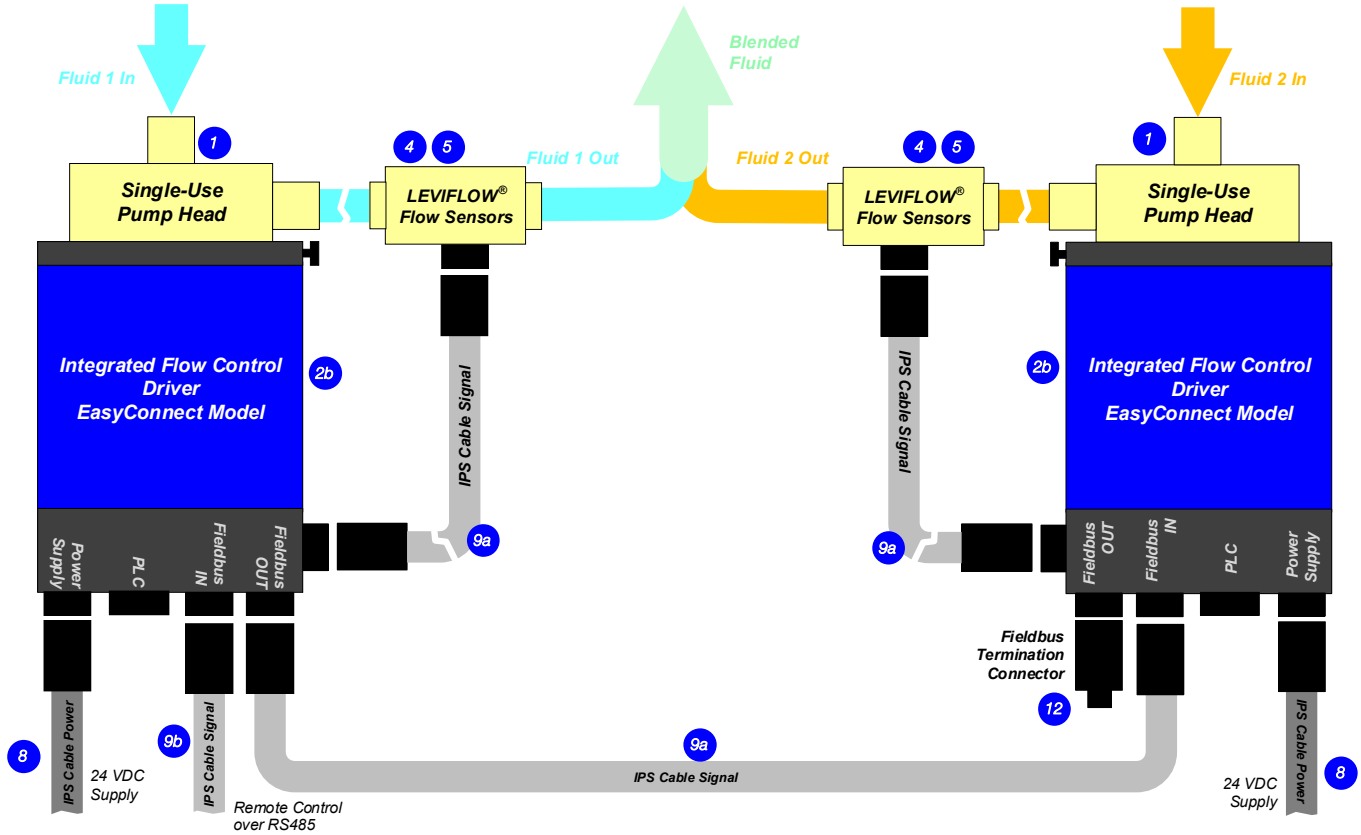


Figure 8: Flowcontrol array configuration with "EasyConnect" models for blending applications
(See section "Order Information" for details to numbered components and other options)

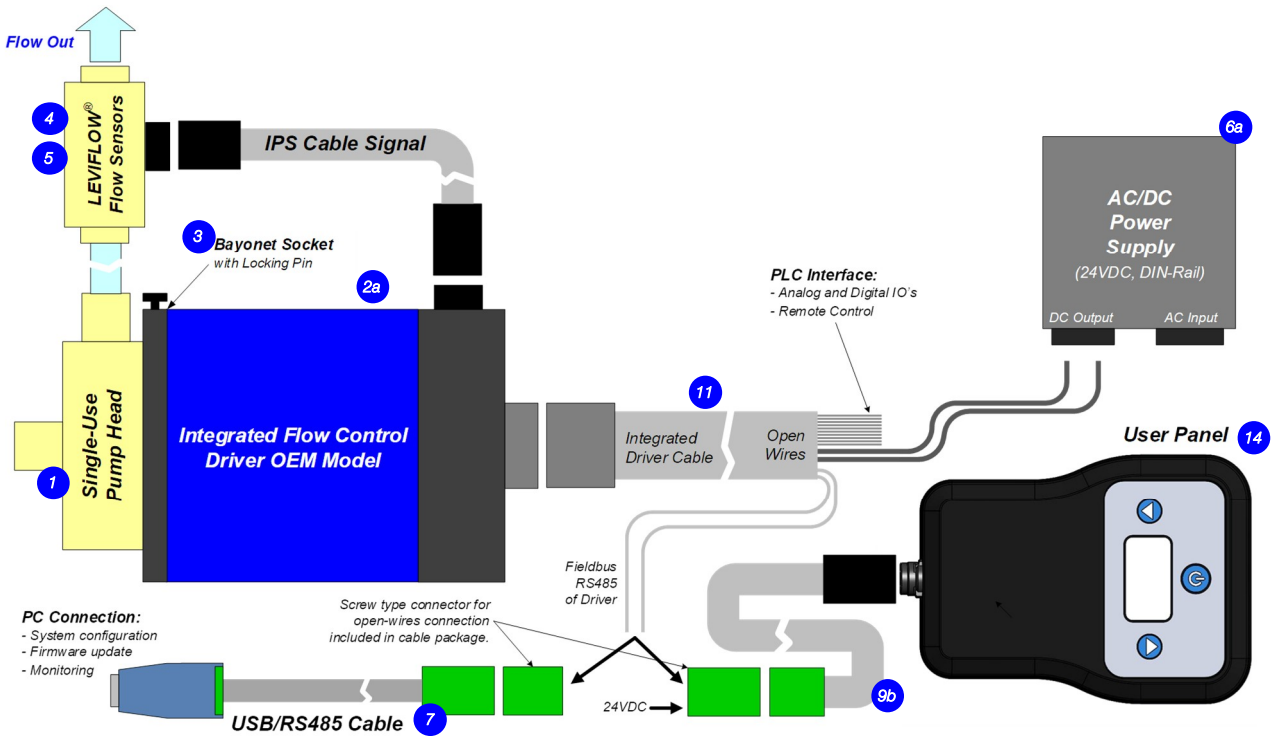
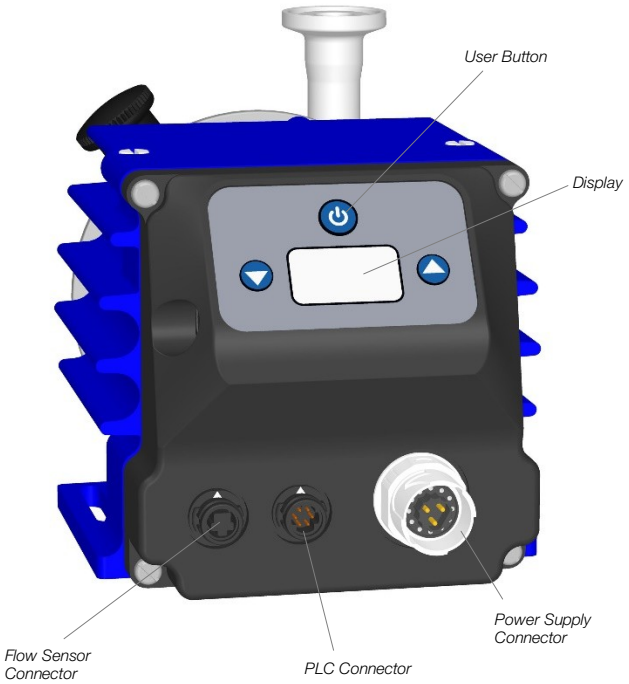


Figure 9: Standard "OEM" system configuration
(See section "Order Information" for details to numbered components and other options)



Interface	PIN Name	Description	Standard Designation	Hardware Specification
Power Supply	P+	+ 24 VDC	Supply	Voltage: 24 VDC Power: 100 W
	P-	Power Input Ground / Earth		
	NC	Not connected.	--	--
PLC 6	Ain	Analog Input (Current Input)	*Reference (Set) Flow or Speed*	Analog current input: 4 – 20 mA (450 Ohm shunt input, no galvanic isolation)
	Ain_GND	Analog In. GND	--	Reference for Ain
	Dout	Digital Output 1	Status	Open drain, max. 24V, 100mA Reference ground is GND
	GND	Analog Ground	--	Reference for Dout
	Din1	Digital Input 1	Enable (Reset)	Galvanic separation with optocoupler 2.2 kΩ input resistance, 5-24V for active input
	Din_COM	Com. Digi. Input	--	Reference for digital input.
Flow Sensor	6 Pins	Flow Sensor	--	Compatible to *LEVIFLOW®* flow sensors of the *LFSC-D* and *LFS-SU* series.
Display and Buttons	--	Display	Flow and Status Display	
	--	Up/Down	Setting Flow	--
	--	On/Off	Enable/Disable	--

Figure 10: *Interface specifications of standard "Stand-Alone" model*

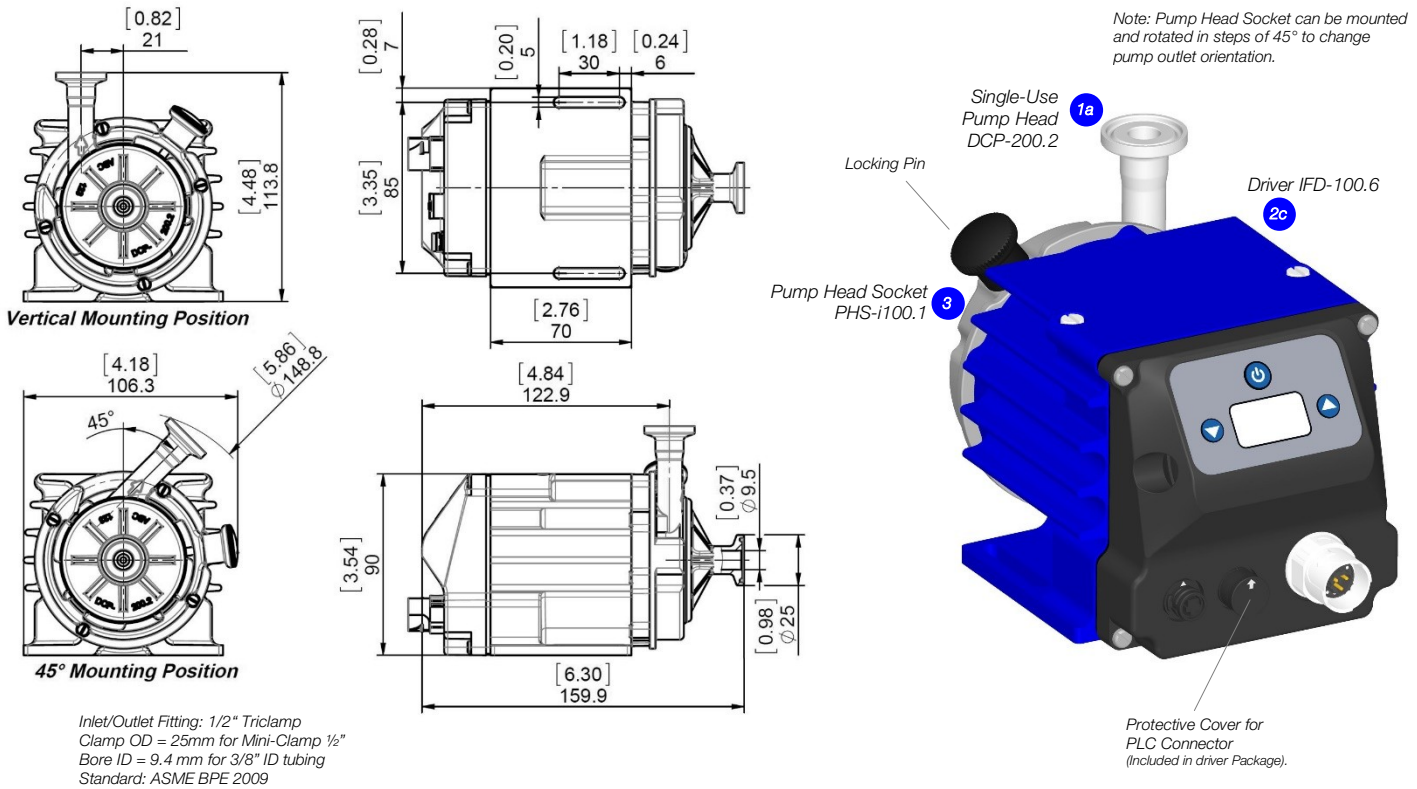
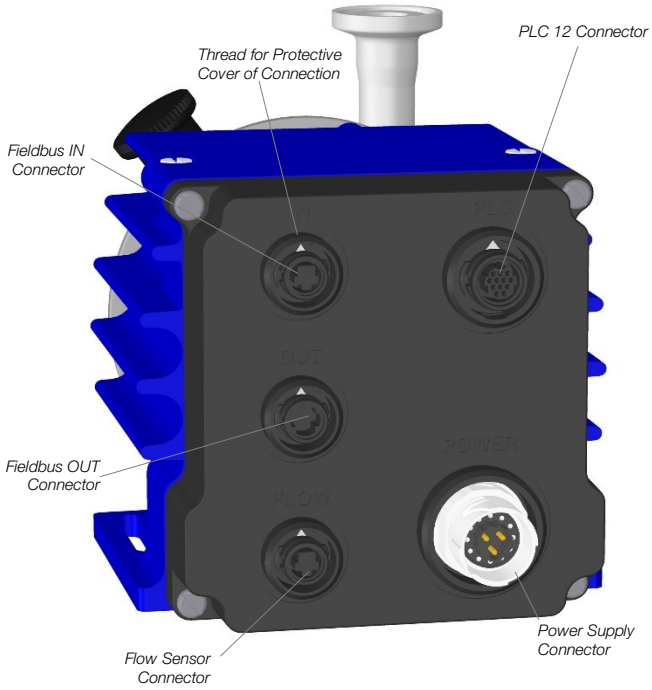


Figure 11: *Basic dimensions and description of standard "Stand-Alone" model*



Connector	PIN Name	Description	Standard Designation	Hardware Specification
Power Supply	P+	+ 24 VDC	Supply	Voltage: 24 VDC Power: 100 W
	P-	Ground / Earth		
	NC	Not connected.	--	--
PLC 12	Dout1	Digital Output 1	Status Pump	Open drain, max. 24V, 100mA Reference ground is GND
	Dout2	Digital Output 2	Status Flow Sensor	
	Din1	Digital Input 1	Enable (Reset)	Galvanic separation with optocoupler 2.2 kΩ input resistance, 5-24V for active input
	Din2	Digital Input 2	Zero Adjust	
	Din_COM	Com. Digi. Input	--	Reference for digital input.
	Ain1	Analog Input 1 (Current Input)	Reference Value (Set Flow/Speed)	Analog current input: 4 – 20 mA (450 Ohm shunt input, no galvanic isolation)
	Ain2	Analog Input 2 (Voltage Input)	Free Configurable	Analog voltage input: 0 – 10V (7.9 kOhm, no galvanic isolation)
	Ain_GND	Analog In. GND	--	Reference for Ain1 and Ain2
	Aout1	Analog Output (Voltage Output)	Actual Flow	0 – 10V (no galvanic isolation) GND is reference
	GND	Analog Ground	--	Reference for Aout1, Dout1, Dout2 and Pout
	Pout	Output +24VDC	Supply Output	For supply of external devices (e.g. sensors). (Current 200mA together with Pout o Fieldbus OUT)
	NC	Not connected.	--	--
Fieldbus OUT	GND	Ground	--	Reference for Pout.
	Pout	Output +24VDC	Supply Output	For supply of external devices (user panels) (Current 200mA together with Pout of PLC 12)
	RS485+	RS485 +	Field Bus	Modbus protocol
	RS485-	RS485 -		
	Internal	Internal Bus	Do not connect	Internal bus needed to connect pumps for serial pumping.
	Internal	Internal Bus	Do not connect	
Fieldbus IN	GND	Ground	--	Connected to PLC12 GND and reference for supply
	NC	Not connected.	--	--
	RS485+	RS485 +	Field Bus	Modbus protocol
	RS485-	RS485 -		
	Internal	Internal Bus	Do not connect	Internal bus needed to connect pumps for serial pumping.
	Internal	Internal Bus	Do not connect	
Flow Sensor	6 Pins	Flow Sensor	--	Compatible to *LEVIFLOW®* flow sensors of the *LFS-SU* series.

Figure 12: *Interface specifications of standard "EasyConnect" model*

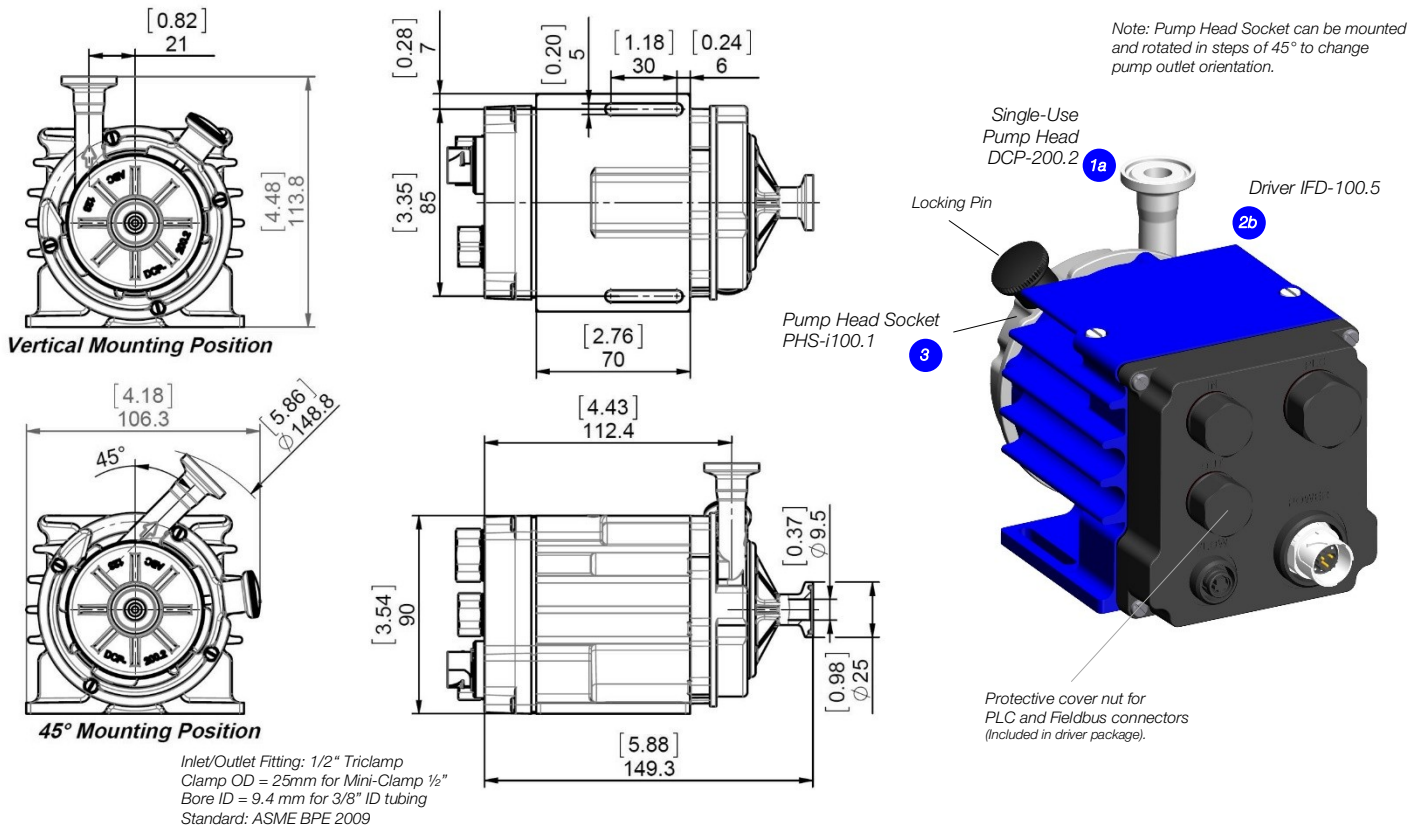
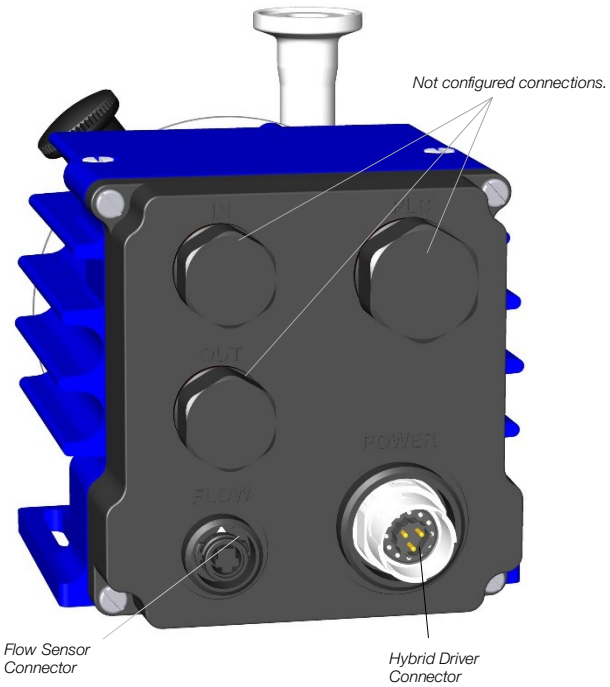


Figure 13: *Basic dimensions and description of standard "EasyConnect" model*



Connector	Designation	Description	Standard Designation	Hardware Specification
Hybrid Driver	P+	+ 24 VDC	Supply	Voltage: 24 VDC P- to be connected to earth
	P-	Power Input Ground / Earth		
	Ain1	Analog Input 1 (Current Input)	Reference Value (Set Flow/Speed)	Analog current input: 4 – 20 mA (450 Ohm shunt input, no galvanic isolation)
	Ain2	Analog Input 2 (Voltage Input)	Free Configurable	Analog voltage input: 0 – 10V (7.9 kOhm, no galvanic isolation)
	Ain_GND	Analog Input Ground	--	Reference for Ain1 and Ain2
	Din1	Digital Input 1	Enable (Reset)	Galvanic separation with optocoupler 2.2 kΩ input resistance, 5-24V for active input
	Din2	Digital Input 2	Zero Adjust	
	Din_COM	Common Digital Input	--	--
	Aout1	Analog Output (Voltage Output)	Actual Speed	0 – 10V (no galvanic isolation) GND is reference
	Dout1	Digital Output 1	Status Pump	Open drain, max. 24V, 100mA Reference ground is GND
	Dout2	Digital Output 2	Status Flow	
	GND	Analog Ground	--	Reference for Aout1, Dout1 and Dout2
	RS485+	RS485 +	Field Bus	Modbus RTU protocol
	RS485-	RS485 -		
	Shield	Shielding	Shielding	To be connected to earth (see wire No. 2, P-)
Flow Sensor	6 Pins	Flow Sensor	--	Compatible to *LEVIFLOW®* flow sensors of the *LFSC-D* and *LFS-SU* series.

Figure 14: *Interface specifications of standard "OEM" model*

Note 1: Power supply wire cross-section is 1.5 mm² and for signal wires 0.14 mm² *Note 2: For more detailed description of interfaces consult user manual*

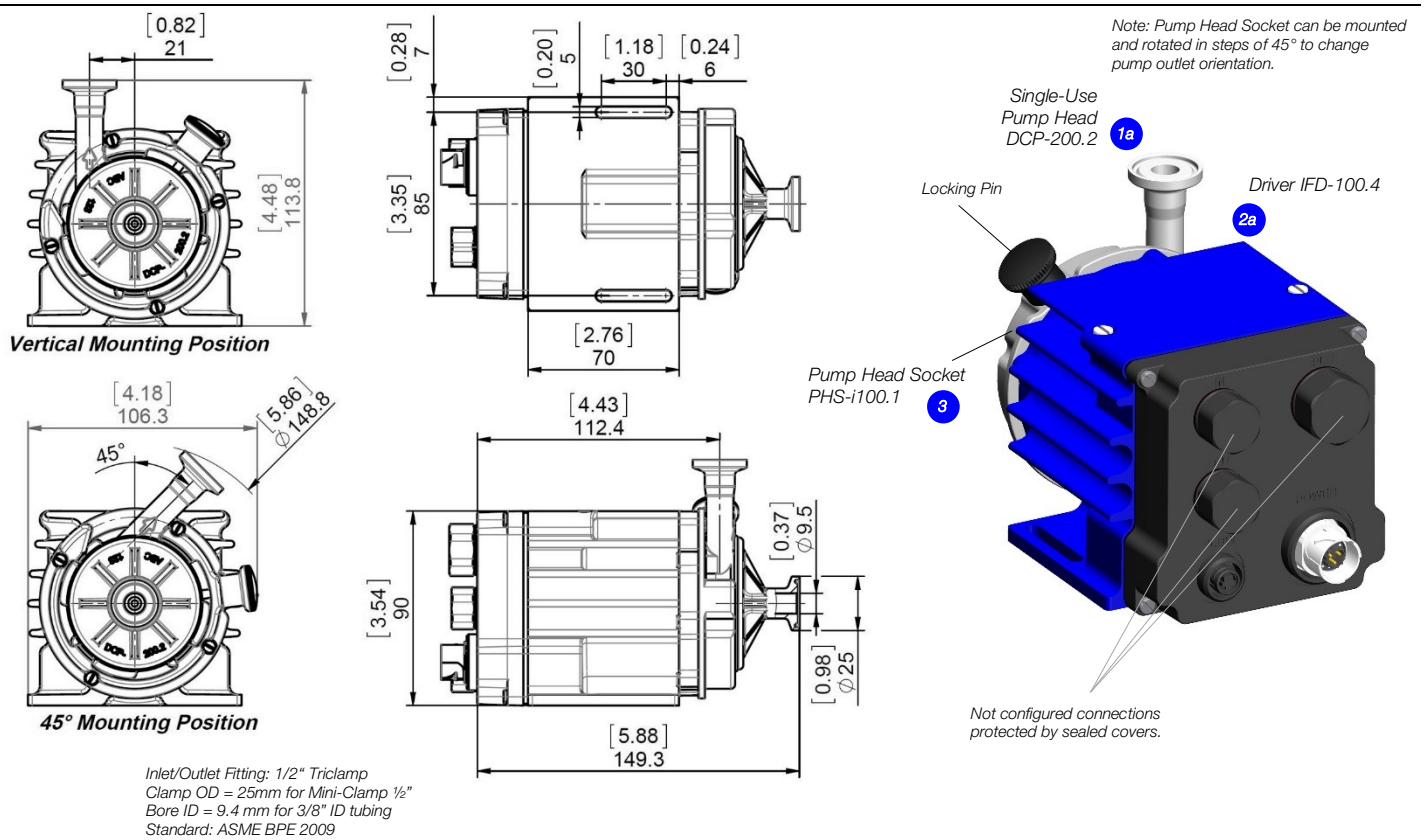


Figure 15: *Basic dimensions and description of standard "OEM" model*

FLOW SENSOR SPECIFICATIONS

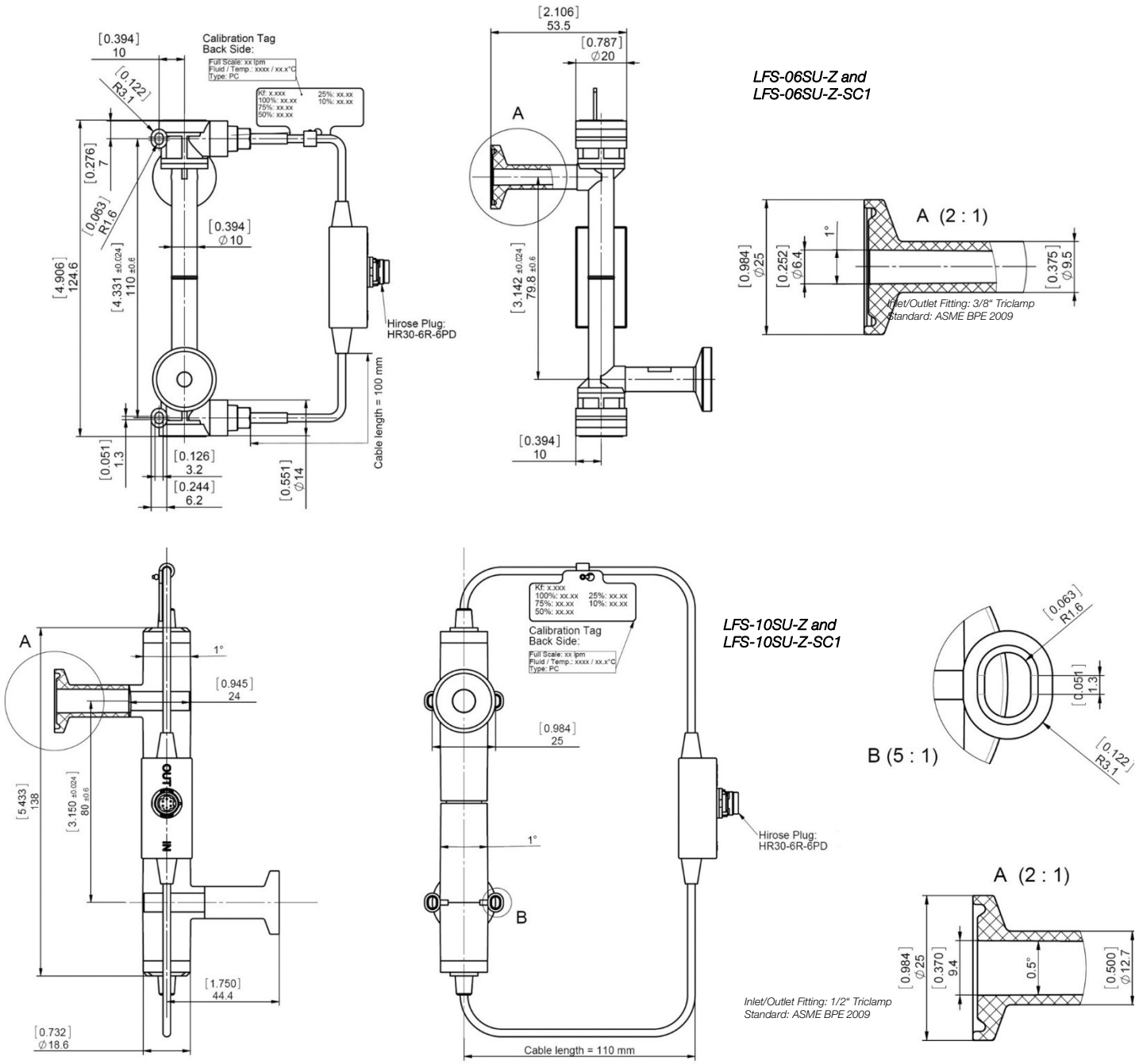


Figure 16: Basic dimensions for LFS-06SU-Z and LFS-10SU-Z single-use flow sensors compatible with IFD-100 flow control drivers

Characteristics \ Flow Controller Type	PuraLev® iF100SU with LFS-06SU	PuraLev® iF100SU with LFS-06SU-SC1	PuraLev® iF100SU with LFS-10SU	PuraLev® iF100SU with LFS-10SU-SC1
Flow Range [lpm]	0 – 8	0 – 8	0 – 20	0 – 20
Accuracy of Reading (at 20°C fluid temperature) Note: Repeatability < Accuracy/2	> 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	> 4.7 l/min: ±1% < 4.7 l/min: ±47 ml/min	> 0.75 l/min: ±1% < 0.75 l/min: ±7.5 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 1: Specifications of flow controller systems PuraLev® iF100SU with LFS-SU single-use flow sensors.
1: Values for to the specific hydraulic circuit optimized flow control parameters. Standard settings are tuned for general flow control stability and may be higher.

ORDER INFORMATION

System Name	Article #	Pump Head Socket	Flow Control Driver	Note
PLD-iF100SU.1	100-91482	PHS-i100.1	IFD-100.4-02	*OEM - Driver, one multi-purpose connector, pump head socket*
PLD-iF100SU.2	100-91483	PHS-i100.1	IFD-100.5-02	*EasyConnect - Driver with interface connectors, pump head socket.*
PLD-iF100SU.3	100-91484	PHS-i100.1	IFD-100.6-02	*Stand-Alone - Driver with integrated user panel, pump head socket.*

Table 2: *Standard driver system configurations*

Pos.	Component	Article Name	Article #	Characteristics	Value / Feature
1a 1b	Single-Use Pump Heads	DCP-200.2 (Triclamp) DCP-200.3 (Barb)	100-90734 100-90792	Impeller / Pump Housing Housing Sealing In-/Outlet Fittings	*Polypropylene (FDA, USP Class VI, BSE/TSE/Animal free)* *Infrared welding* *Triclamp ½" or Barb ½ for tubing with typical ID 3/8""*
1c 1d		DCP-200.2-G25 DCP-200.3-G25 (Gamma Irradiated with Dosage ≥ 25 kGy)	100-91078 100-91122	Max. Flow Max. Diff.-Pressure Max. Viscosity Wet Pump Volume/Surface Max. Liquid Temp. Applicable Sterilization	*21 liters/min / 5.5 gallons/min* *2 bar / 29 psi* *< 20 cP* *24 ml / 150 cm² with Triclamp and 25 ml / 150 cm² with Barb fittings* *60°C / 140°F* *Gamma radiation up to 40kGy*
2a	Integrated Flow Control Driver ("OEM" Model)	IFD-100.4-02	100-10138	Voltage, Power Housing Interfaces Standard Firmware	*24 VDC ±10%, 100 W* *Epoxy coated Aluminum, PP for bottom lid, IP65* [1] *PLC, RS485 with Modbus protocol (see Figure 14 for details) and flow sensor* *J3.48*
2b	Integrated Flow Control ("EasyConnect" Model)	IFD-100.5-02	100-10139	Housing Interfaces Standard Firmware	*Epoxy coated Aluminum, PP for bottom lid, IP65* *2x Fieldbus RS485 with Modbus protocol, PLC, power supply and flow sensor* *J3.48*
2c	Integrated Flow Control ("Stand-Alone" Model)	IFD-100.6-02	100-10140	Housing Interfaces Standard Firmware	*Epoxy coated Aluminum, PP for bottom lid, IP65* *User panel with 3 user buttons, PLC, power supply and flow sensor* *J3.48*
3	Pump Head Socket	PHS-i100.1	100-91053	Mounting Type Material Assembly Screws	*Bayonet type with locking pin* *Anodized Aluminum* *4 pcs M3 x 8 mm (Stainless Steel, INOX A4)*

Table 3: *Specification of standard components*
1: Designed and tested for IP67.

Pos.	Component	Article Name	Article #	Fitting	Wet Material	Note
4a 4b 5a 5b	LEVIFLOW® Single-Use Flow Sensors	LFS-06SU-Z (8 lpm) LFS-06SU-Z-SC1 [1] LFS-10SU-Z (20 lpm) LFS-10SU-Z-SC1 [1]	100-30377 100-30394 100-30397 100-30408	Triclamp 3/8" Triclamp 3/8" Triclamp 1/2" Triclamp 1/2"	*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 4: *Specification of LEVIFLOW® single-use high-precision (1% accuracy of reading) flow sensors compatible with IFD-100 drivers*
Note 1: Extended calibration for wider 1% accuracy range. Note 2: All flow sensors available with gamma irradiation (see LEVIFLOW® product literature for more details).

Pos.	Component	Article Name	Article #	Characteristics	Value / Feature
6a	AC/DC Power Supply	TSP 180-124 (Traco)	100-40018	Voltage Output / Input Basic Dimensions Certification or Standards	*24 VDC with 180 W / 85 – 132 and 187 – 264 VAC (autoselect)* *110 x 110 x 54 mm (mountable on DIN rail 35 mm)* *UL/cUL, CB, Semi F47*
6b	Desktop AC/DC Power Supply	GST160A24-R7B IC915	100-40020	Voltage Output / Input Basic Dimensions Safety Approvals Note	*24VDC, 160W / 85 – 264 VAC, 47-63 Hz* *175 x 72 x 35 mm* *UL60950-1, CSA C22.2, TUV EN60950-1* *Connector for direct connection to power supply of driver with cable length 1.2 m.*
6c	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	*UL, cUL, US, Canada* *CB, Germany, Denmark, Norway, Finland, Belgium, Netherland, Sweden, Austria* *PSE, Japan* *Switzerland* *CE, United Kingdom*
7	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*
8	IPS Cable Power 2 Wires	ICP-2.1-50 (5 m)	190-10370	Cable Material / Wires Connection In / Connection Out Main Purpose	*PVC jacket / 2x 1.5 mm²* *Open wires / Circular Intercontec type to driver* *Connection of power supply to "Stand-Alone" and "EasyConnect" drivers*
9a	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 / Connection Out Main Purpose	*PVC jacket / 6x 0.08 mm² and shielding* *Circular Hirose type / Circular Hirose type* *Fieldbus connection between "EasyConnect" drivers and flow sensor connection.*
9b 9c	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 / Connection Out Main Purpose ICS-1.2 / ICS-1.3	*PVC jacket / 6x 0.08 mm² 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.*
10	IPS Cable Signal 12 Wires	ICS-2.1-50 (5 m)	190-10347	Cable Material / Wires Connection In / Connection 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.*
11	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 / Connection Out Main Purpose	*PVC jacket / 2x 1.5 mm² for supply wired, 13 x 0.14 mm² for signal and shielding wire* *Open wires / Circular hybrid connector for driver connection* *General connection integrated driver connector of to "OEM" driver models.*
12	Fieldbus Termination Connector	FTC-1.1	190-10348	Materials Main Purpose	*PPS for connector housing and FPM for sealing.* *Termination of fieldbus.*
13a 13b	Mounting Kit	LMK-1.2 (for LFS-06SU) LMK-2.2 (for LFS-10SU)	100-91478 100-91479	Material / Structure Main Purpose	*Anodized Aluminium / Locking pin concept* *For mounting of LFS-06SU and LFS-10SU flow sensors.*
14	User Panel	LUI-B.1-01	100-30448	Interface / Housing Rating Standard Firmware	*RS485 / IP65* *A3.00*

Table 5: *Specification accessories*

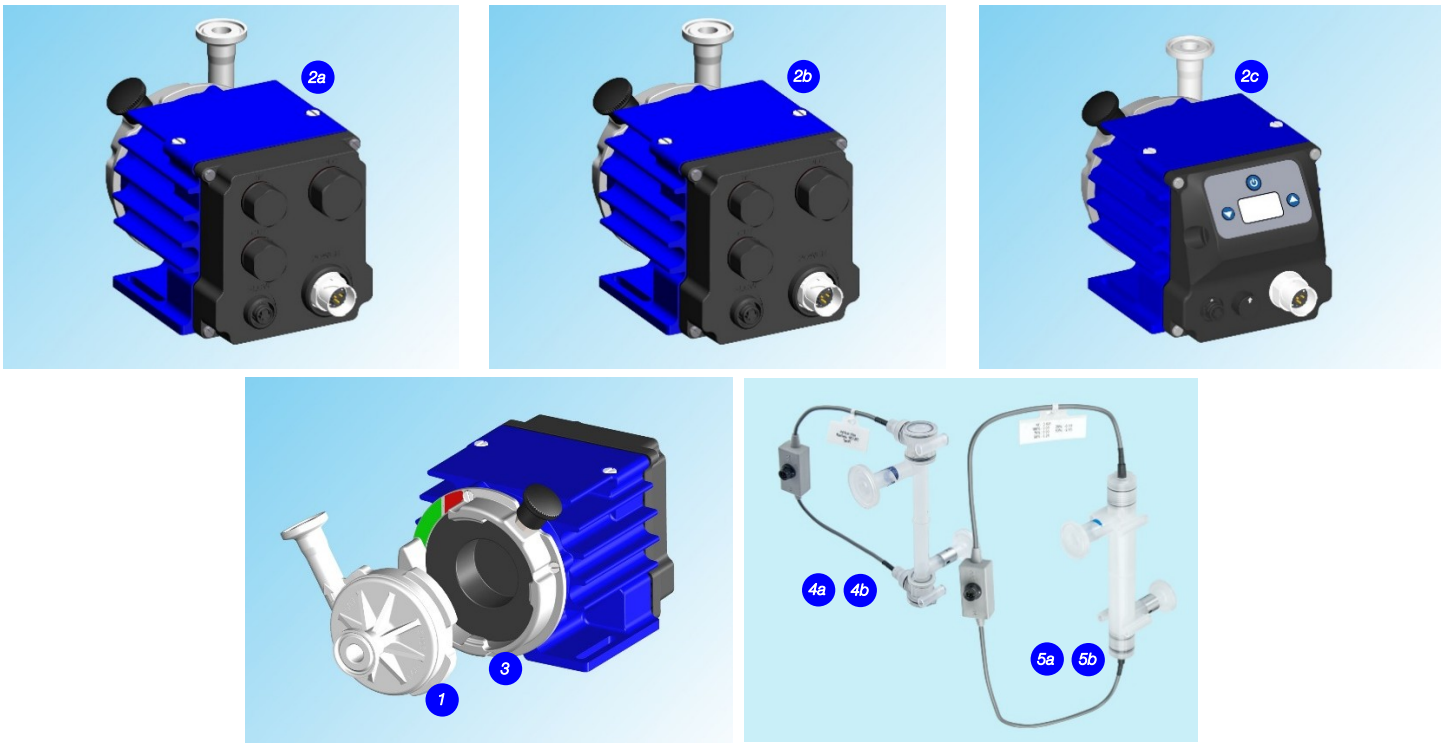


Figure 17: Flow control system with standard main components

Figure 18: General standard accessories

Figure 19: Standard cables and other accessories

LEVITRONIX® THE COMPANY

Levitronix® is the world-wide leader in magnetically levitated bearingless motor technology. *Levitronix®* was the first company to introduce bearingless motor technology to the Semiconductor, Medical and Life Science markets. The company is ISO 9001 certified. Production and quality control facilities are located in Switzerland. In addition, *Levitronix®* is committed to bring other highly innovative products like the *LEVIFLOW®* flowmeter series to the market.

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