

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

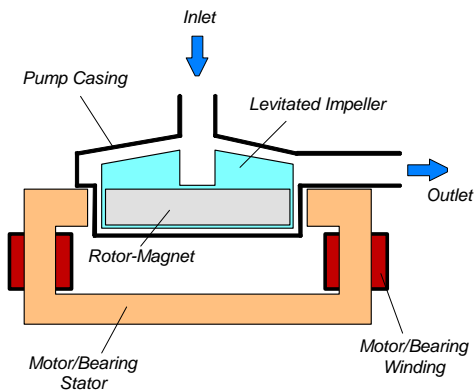


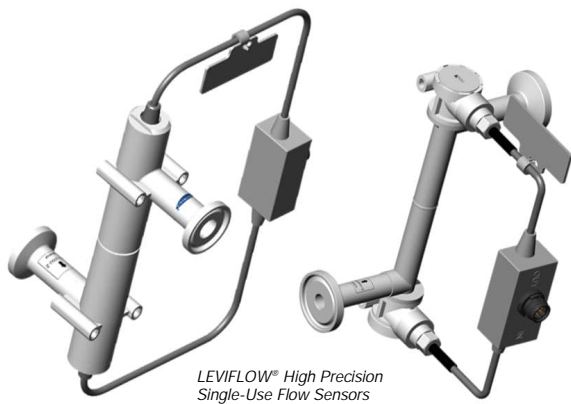
Figure 1: Schematic of the main elements of the MagLev centrifugal pump

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.



LEVIFLOW® High Precision Single-Use Flow Sensors

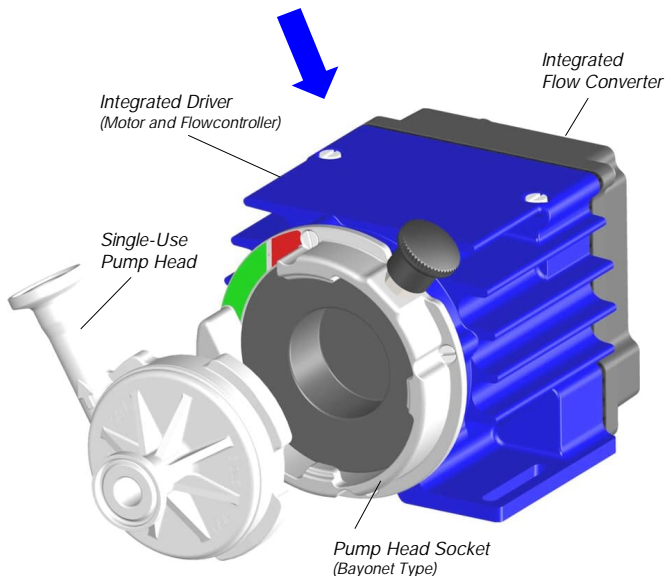


Figure 2: Integrated flow control system with ultrasonic flow sensors

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.

SYSTEM CONFIGURATIONS

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.

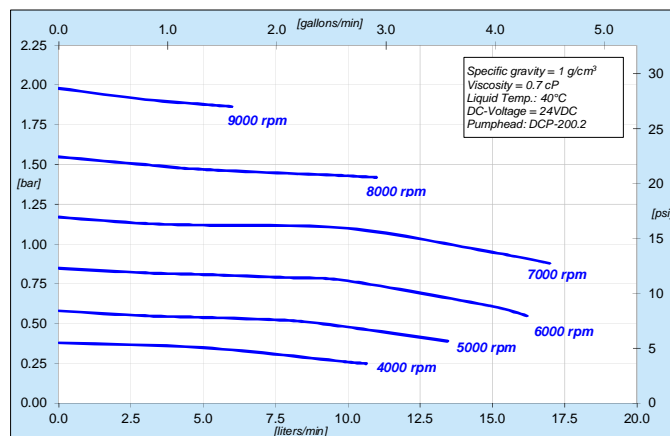


Figure 3: Pressure/flow curves for aqueous liquids (similar to water)

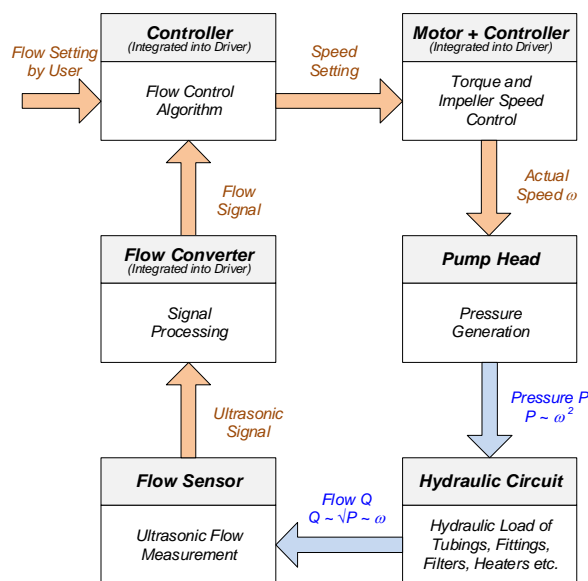


Figure 4: Simplified block schematics of flow control system

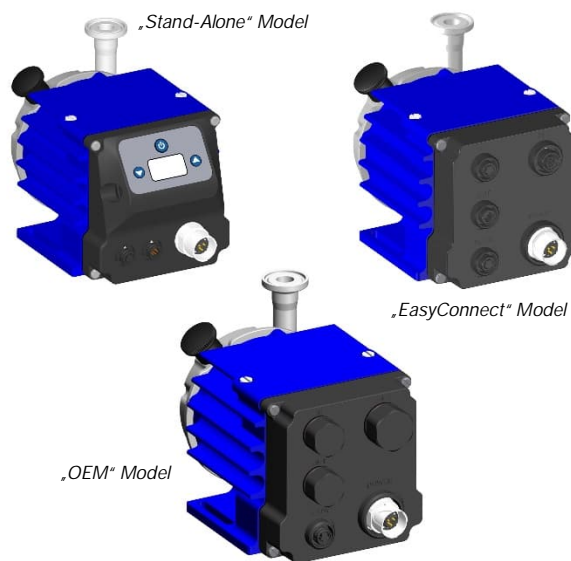


Figure 5: Flow control system models

SYSTEM CONFIGURATIONS

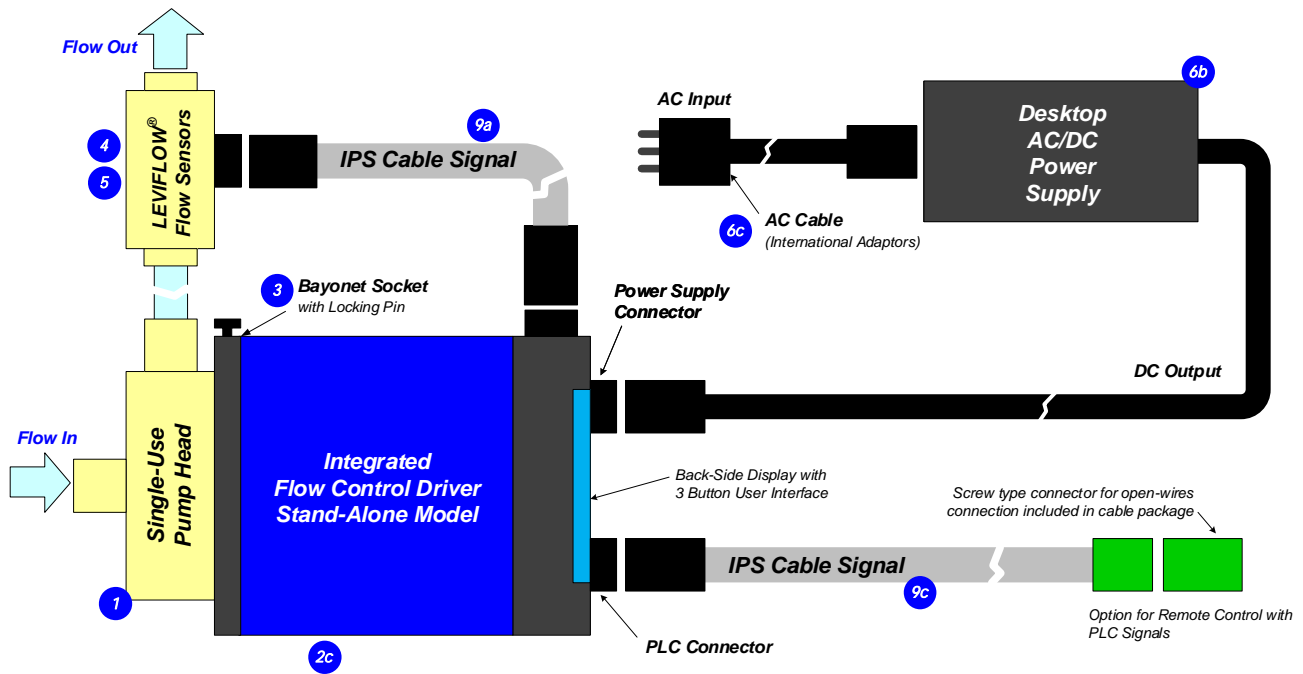


Figure 6: Standard "Stand-Alone" system configuration with main accessories
 (See section "Order Information" for details to numbered components and other options)

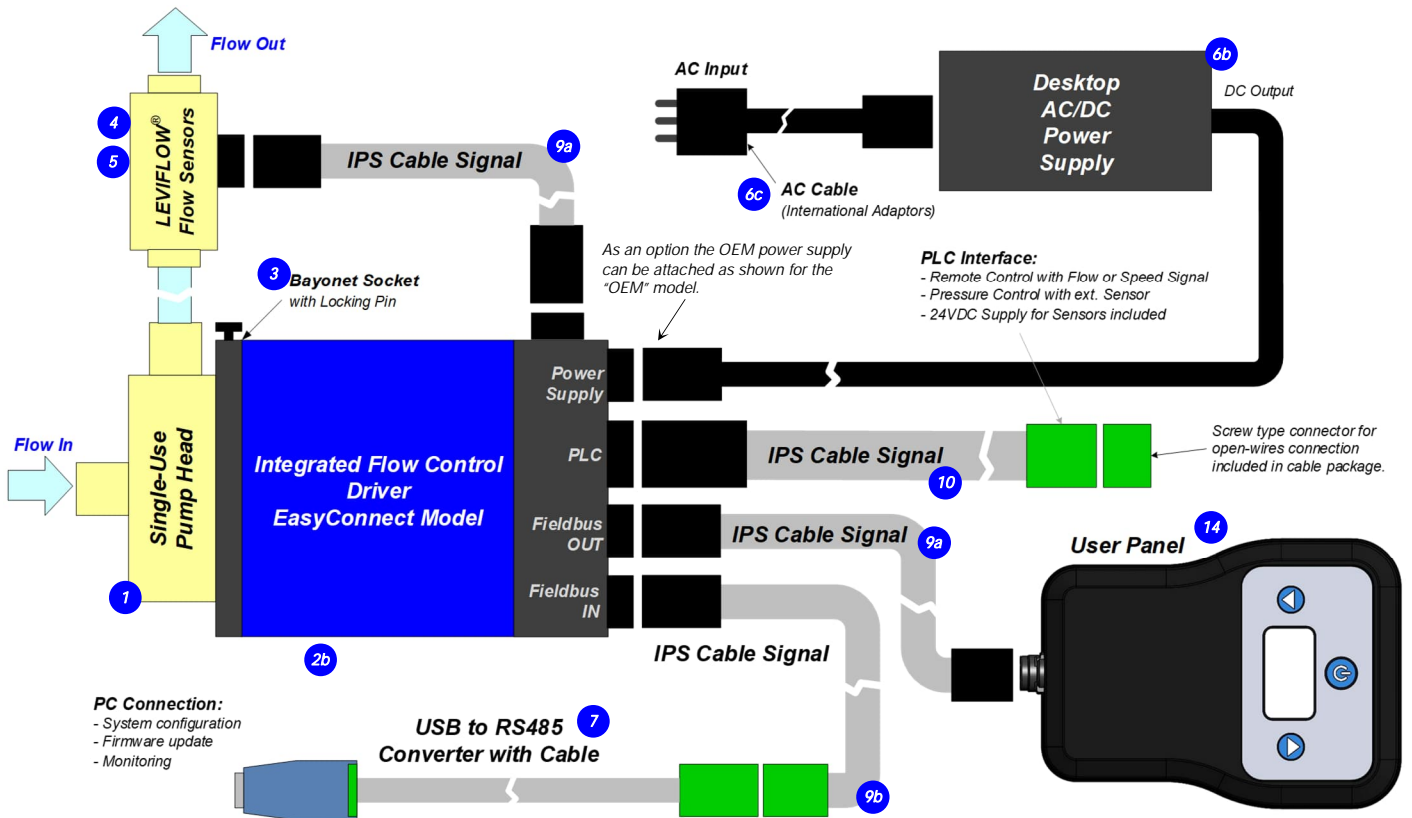


Figure 7: Standard "EasyConnect" system configuration with main accessories
 (See section "Order Information" for details to numbered components and other options)

SYSTEM CONFIGURATIONS

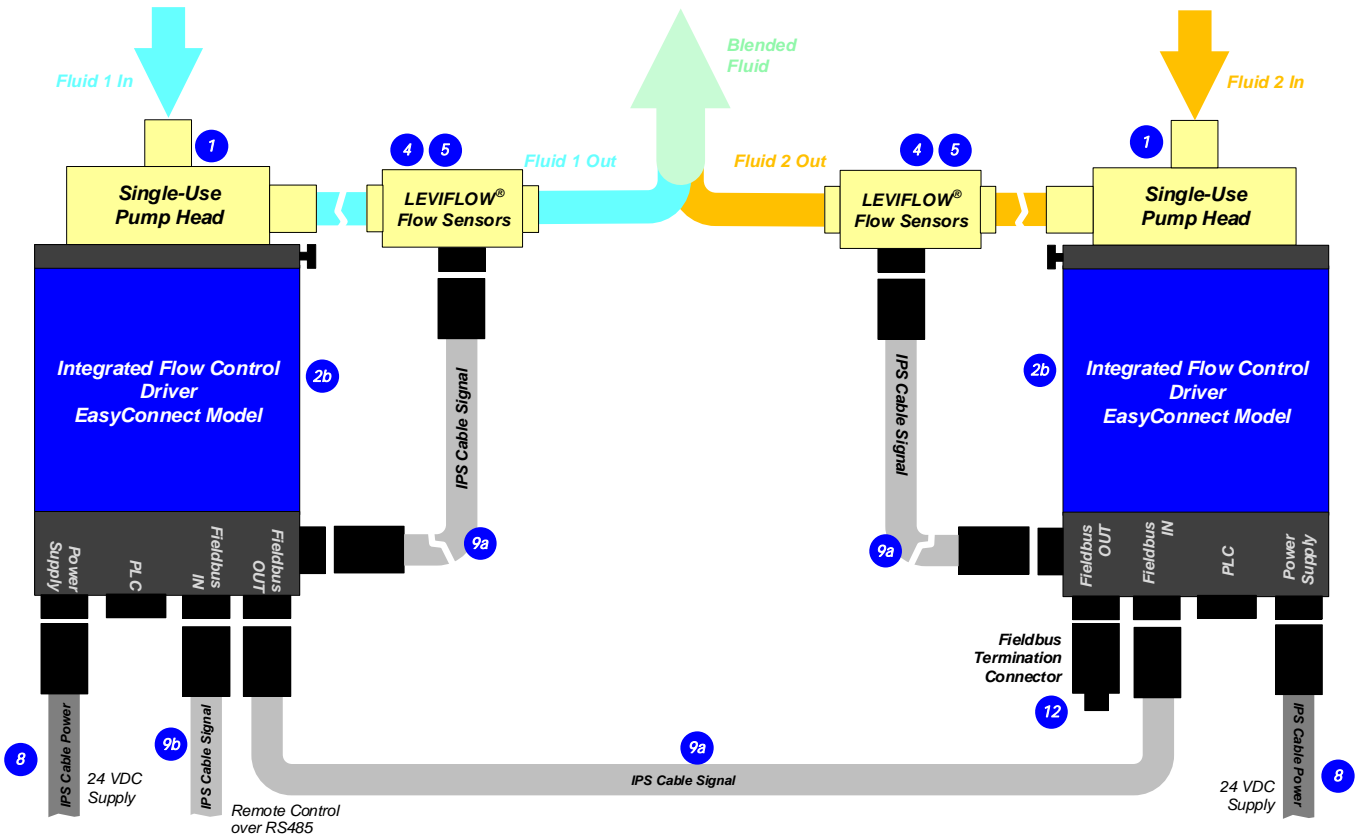


Figure 8: Flowcontrol array configuration with "EasyConnect" models for blending applications
 (See section "Order Information" for details to numbered components and other options)

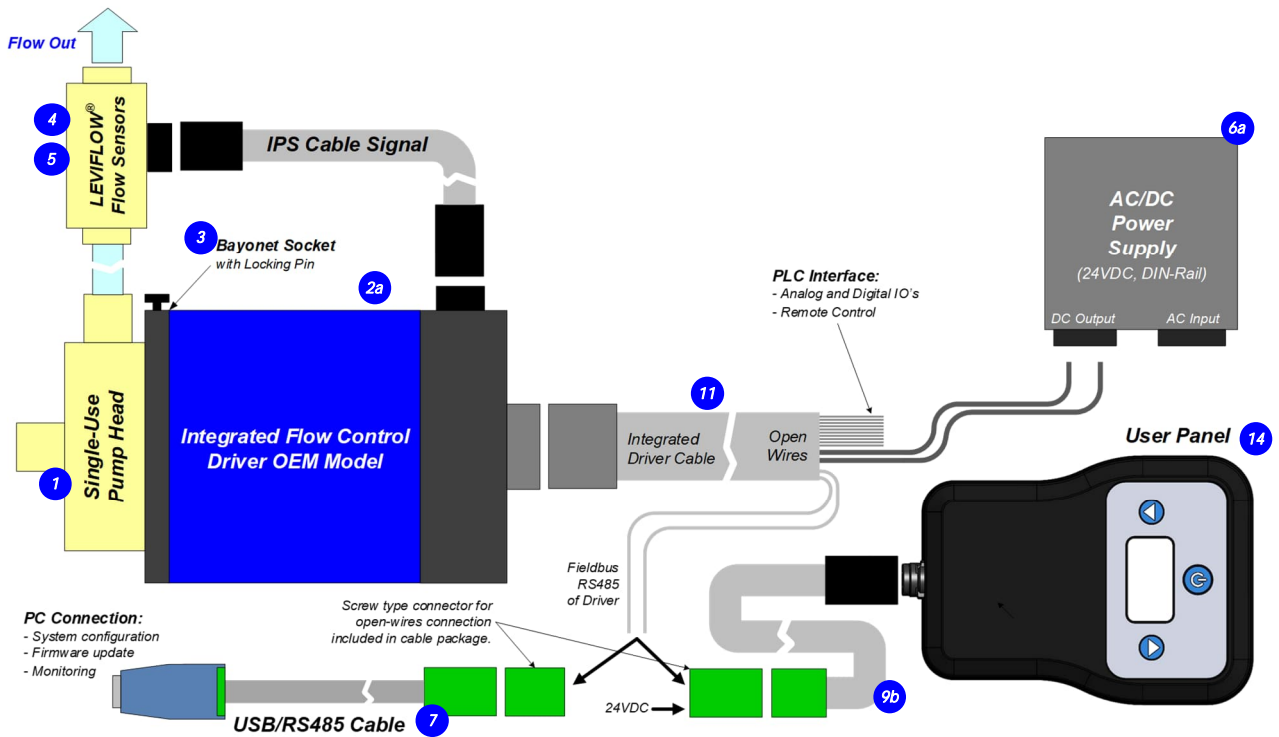
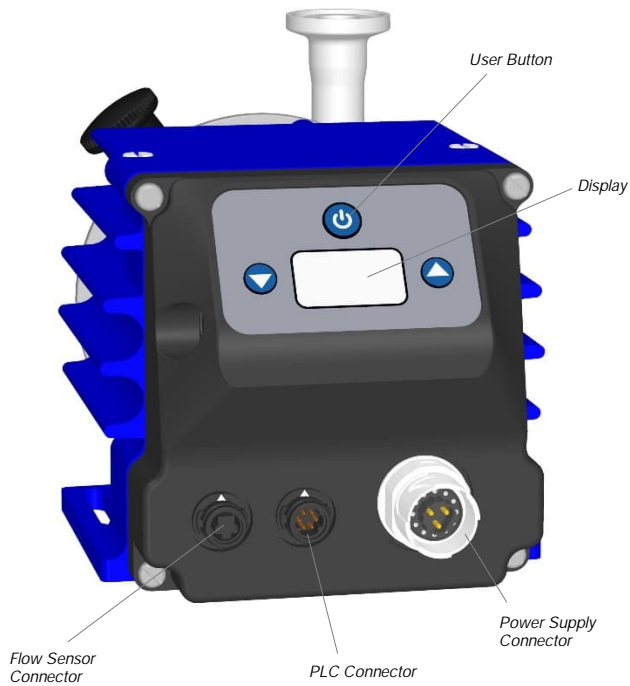


Figure 9: Standard "OEM" system configuration
 (See section "Order Information" for details to numbered components and other options)

MODEL DESCRIPTION – STAND-ALONE



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

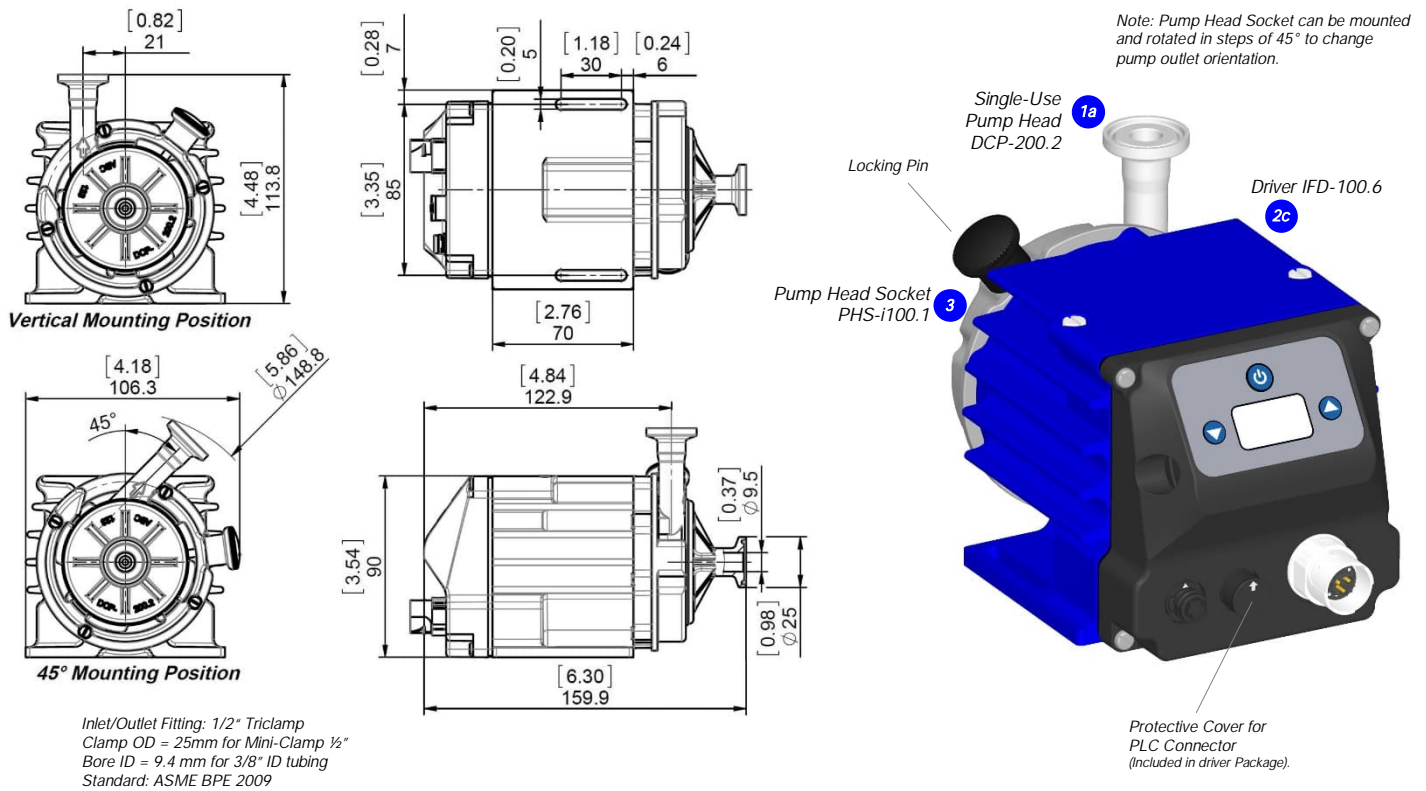
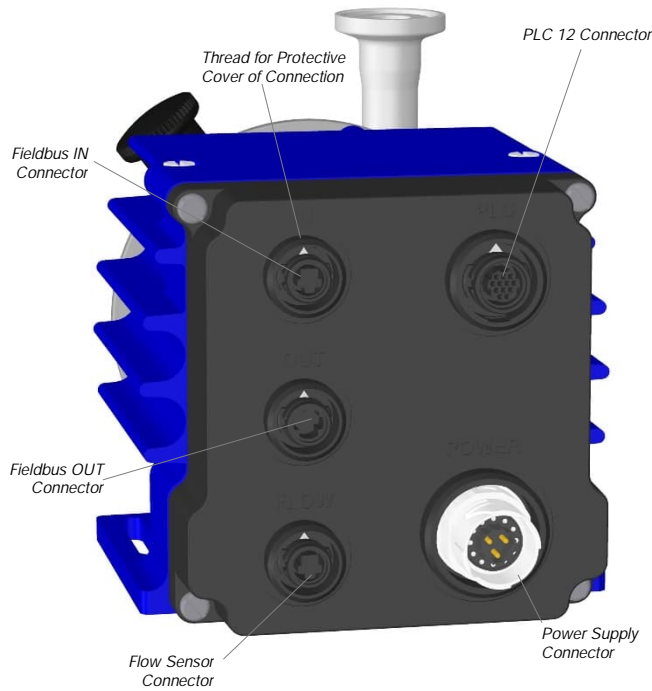


Figure 11: Basic dimensions and description of standard "Stand-Alone" model

MODEL DESCRIPTION – EASYCONNECT



Connector	PIN Name	Description	Standard Designation	Hardware Specification
Power Supply	P+	+ 24 VDC	Supply	Voltage: 24 VDC
	P-	Ground / Earth		Power: 100 W
	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 k Ω 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	
	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 or Fieldbus OUT)	
NC	Not connected.	--	--	
GND	Ground	--	Reference for Pout.	
Fieldbus OUT	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	
GND	Ground	--	Connected to PLC12 GND and reference for supply	
NC	Not connected.	--	--	
Fieldbus IN	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

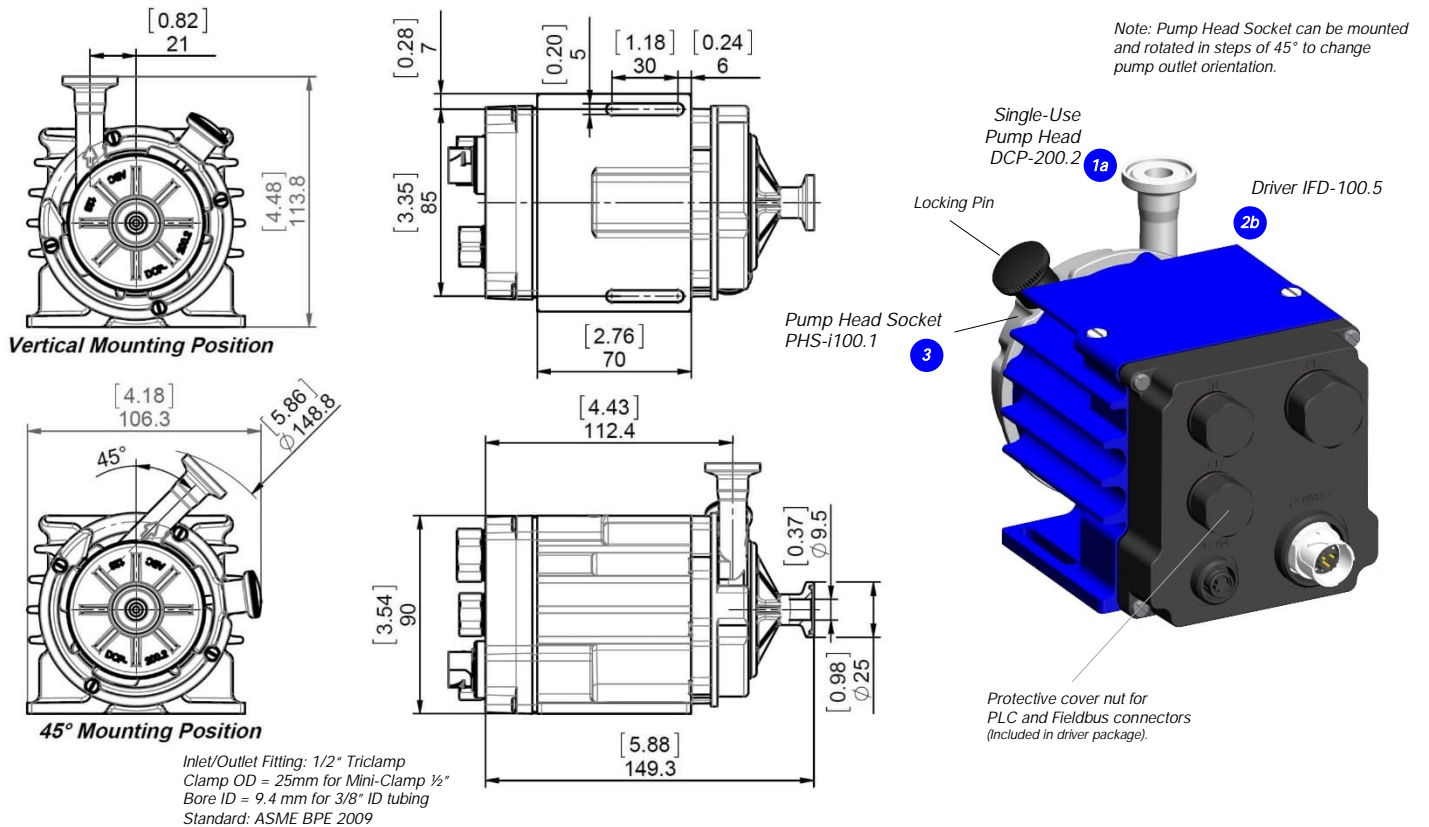
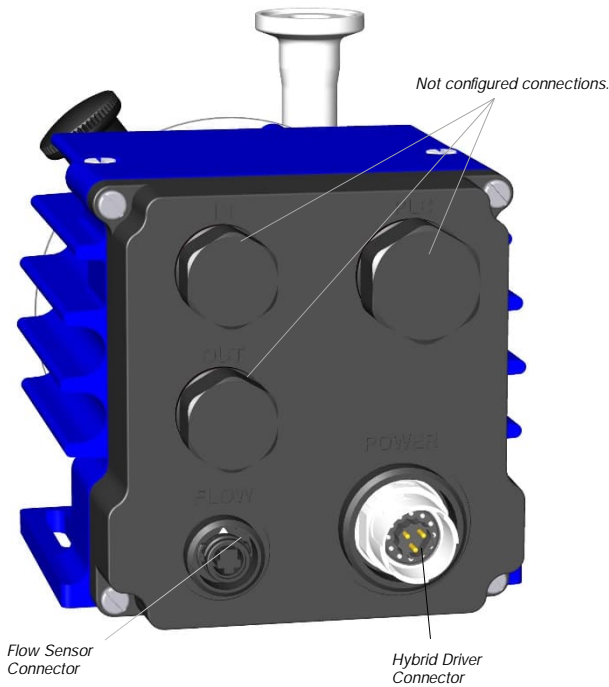


Figure 13: Basic dimensions and description of standard "EasyConnect" model

MODEL DESCRIPTION - OEM



Connector	Designation	Description	Standard Designation	Hardware Specification
P+	+ 24 VDC			
p-	Power Input Ground / Earth	Supply		Voltage: 24 VDC P- to be connected to 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
Din2	Digital Input 2	Zero Adjust		2.2 kΩ input resistance, 5-24V for active input
Hybrid Driver	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
	Dout2	Digital Output 2	Status Flow	Reference ground is GND
	GND	Analog Ground	--	Reference for Aout1, Dout1 and Dout2
	RS485+	RS485 +	Field Bus	Modbus RTU protocol
	RS485-	RS485 -	Field Bus	Modbus RTU protocol
	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

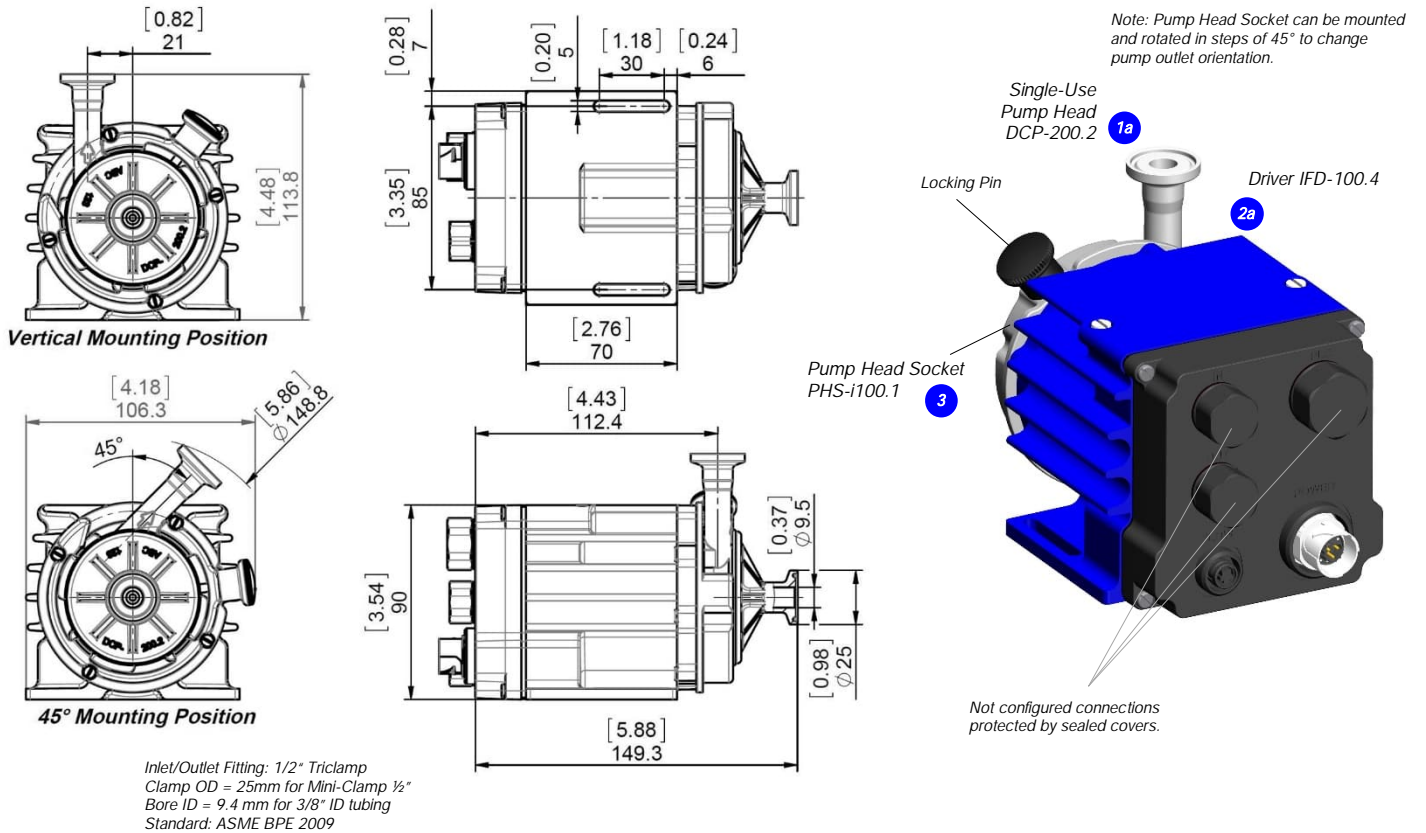


Figure 15: Basic dimensions and description of standard "OEM" model

FLOW SENSOR SPECIFICATIONS

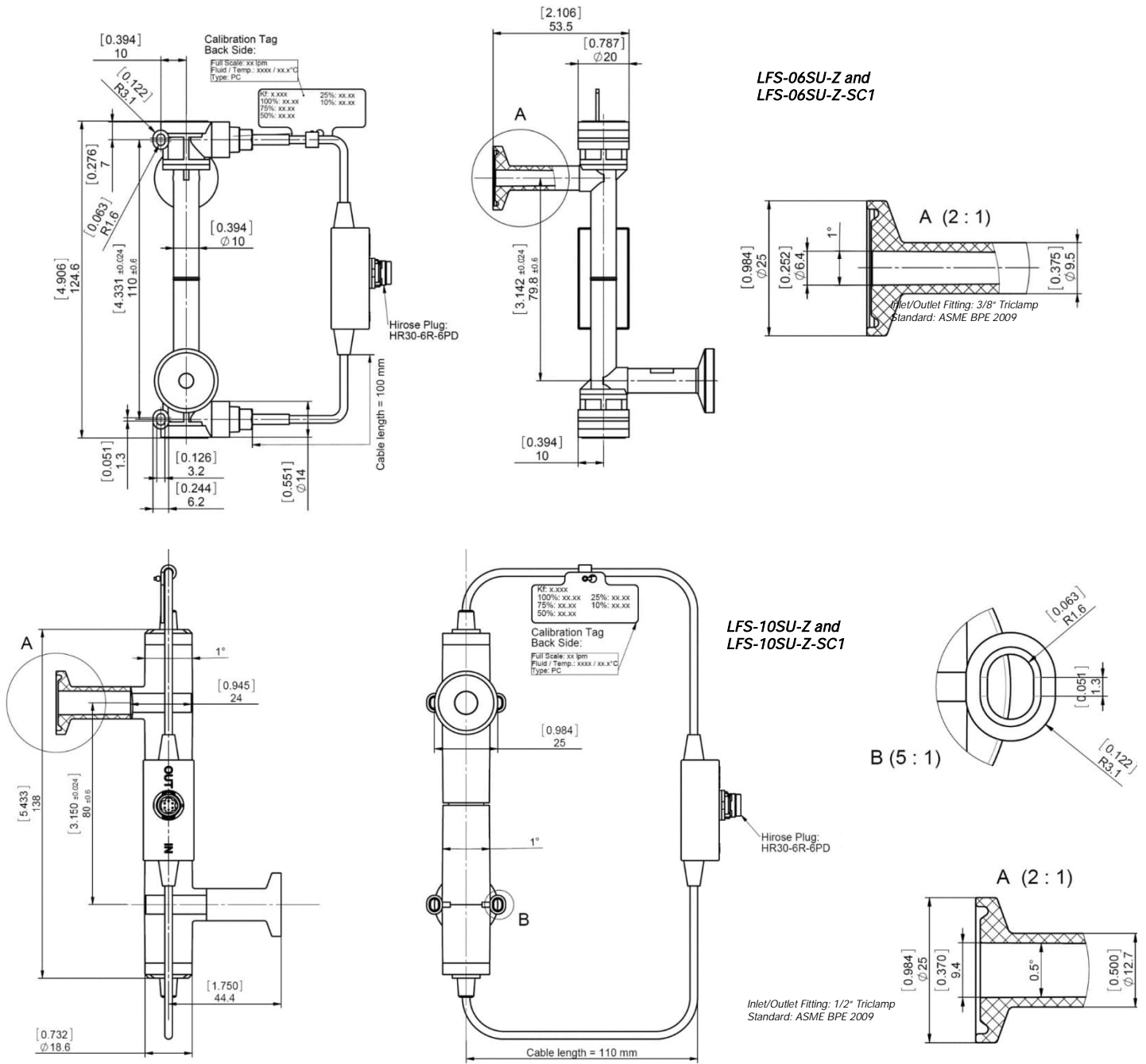


Figure 16: Basic dimensions for LFS-06SU-Z and LFS-10SU-Z single-use flow sensors compatible with IFD-100 flow control drivers

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
Characteristics				
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	Single-Use Pump Heads	DCP-200.2 (Triclamp)	100-90734	Impeller / Pump Housing	Polypropylene (FDA, USP Class VI, BSE/TSE/Animal free)
1b		DCP-200.3 (Barb)	100-90792	Housing Sealing	Infrared welding
1c		DCP-200.2-G25	100-91078	In-/Outlet Fittings	Triclamp ½" or Barb ½" for tubing with typical ID 3/8"
1d		DCP-200.3-G25 (Gamma Irradiated with Dosage ≥ 25 kGy)	100-91122	Max. Flow	21 liters/min / 5.5 gallons/min
				Max. Diff.-Pressure	2 bar / 29 psi
				Max. Viscosity	< 20 cP
				Wet Pump Volume/Surface	24 ml / 150 cm ² with Triclamp and 25 ml / 150 cm ² with Barb fittings
				Max. Liquid Temp.	60°C / 140°F
				Applicable Sterilization	Gamma radiation up to 40kGy
2a	Integrated Flow Control Driver ("OEM" Model)	IFD-100.4-02	100-10138	Voltage, Power	24 VDC ±10%, 100 W
				Housing	Epoxy coated Aluminum, PP for bottom lid, IP65 ¹
				Interfaces	PLC, RS485 with Modbus protocol (see Figure 14 for details) and flow sensor
				Standard Firmware	J3.48
2b	Integrated Flow Control ("EasyConnect" Model)	IFD-100.5-02	100-10139	Housing	Epoxy coated Aluminum, PP for bottom lid, IP65
				Interfaces	2x Fieldbus RS485 with Modbus protocol, PLC, power supply and flow sensor
				Standard Firmware	J3.48
2c	Integrated Flow Control ("Stand-Alone" Model)	IFD-100.6-02	100-10140	Housing	Epoxy coated Aluminum, PP for bottom lid, IP65
				Interfaces	User panel with 3 user buttons, PLC, power supply and flow sensor
				Standard Firmware	J3.48
3	Pump Head Socket	PHS-i100.1	100-91053	Mounting Type	Bayonet type with locking pin
				Material	Anodized Aluminum
				Assembly Screws	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	LEVIFLOW® Single-Use Flow Sensors	LFS-06SU-Z (8 lpm)	100-30377	Triclamp 3/8"	Polypropylene (FDA, USP Class VI, BSE/TSE/Animal free)	See Levitronix® technical brochure of LFS-SU single-use sensor series for more detailed specifications and for other configurations.
4b		LFS-06SU-Z-SC1 ¹	100-30394	Triclamp 3/8"		
5a		LFS-10SU-Z (20 lpm)	100-30397	Triclamp 1/2"		
5b		LFS-10SU-Z-SC1 ¹	100-30408	Triclamp 1/2"		

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	24 VDC with 180 W / 85 – 132 and 187 – 264 VAC (autoselect)
				Basic Dimensions	110 x 110 x 54 mm (mountable on DIN rail 35 mm)
				Certification or Standards	UL/cUL, CB, Semi F47
6b	Desktop AC/DC Power Supply	GST160A24-R7B IC915	100-40020	Voltage Output / Input	24VDC, 160W / 85 – 264 VAC, 47-63 Hz
				Basic Dimensions	175 x 72 x 35 mm
				Safety Approvals	UL60950-1, CSA C22.2, TUV EN60950-1
				Note	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)	190-10331	Approvals and Country	UL, cUL, US, Canada
		AMC-1.2 (2.5m)	190-10332	Approvals and Country	CB, Germany, Denmark, Norway, Finland, Belgium, Netherland, Sweden, Austria
		AMC-1.3 (2.5m)	190-10333	Approvals and Country	PSE, Japan
		AMC-1.4 (2.5m)	190-10334	Approvals and Country	Switzerland
		AMC-1.5 (2.5m)	190-10335	Approvals and Country	CE, United Kingdom
7	USB to RS485 Adaptor-TR Isolated	YN-485I-TR	100-30392	Structure/Design	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	Purpose	
				Cable Material / Wires	PVC jacket / 2x 1.5 mm ²
				Connection In / Connection Out	Open wires / Circular Intercontec type to driver
				Main Purpose	Connection of power supply to "Stand-Alone" and "EasyConnect" drivers
9a	IPS Cable Signal 6 Wires	ICS-1.1-01 (0.1 m)	190-10343	Cable Material / Wires	PVC jacket / 6x 0.08 mm ² and shielding
		ICS-1.1-10 (1 m)	190-10344	Connection In / Connection Out	Circular Hirose type / Circular Hirose type
		ICS-1.1-30 (3 m)	190-10345	Main Purpose	Fieldbus connection between "EasyConnect" drivers and flow sensor connection.
9b	IPS Cable Signal 6 Wires	ICS-1.2-50 (5 m)	190-10346	Cable Material / Wires	PVC jacket / 6x 0.08 mm ² and shielding
9c		ICS-1.3-50 (5 m)	190-10389	Connection In / Connection Out	Connector with screw type plug for open wire connection / Circular Hirose type
				Main Purpose	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	PVC jacket / 12x 0.14 mm ² and shielding
				Connection In / Connection Out	Connector with screw type plug for open wire connection / Circular Hirose type
				Main Purpose	General connection to PLC of "EasyConnect" drivers.
11	IPS Cable Hybrid 15 Wires	ICH-1.1-30 (3 m)	190-10386	Cable Material / Wires	PVC jacket / 2x 1.5 mm ² for supply wired, 13 x 0.14 mm ² for signal and shielding wire
		ICH-1.1-50 (5 m)	190-10341	Connection In / Connection Out	Open wires / Circular hybrid connector for driver connection
				Main Purpose	General connection integrated driver connector of to "OEM" driver models.
12	Fieldbus Termination Connector	FTC-1.1	190-10348	Materials	PPS for connector housing and FPM for sealing.
				Main Purpose	Termination of fieldbus.
13a	Mounting Kit	LMK-1.2 (for LFS-06SU)	100-91478	Material / Structure	Anodized Aluminum / Locking pin concept
13b		LMK-2.2 (for LFS-10SU)	100-91479	Main Purpose	For mounting of LFS-06SU and LFS-10SU flow sensors.
14	User Panel	LUI-B.1-01	100-30448	Interface / Housing Rating	RS485 / IP65
				Standard Firmware	A3.00

Table 5: Specification accessories

ORDER INFORMATION

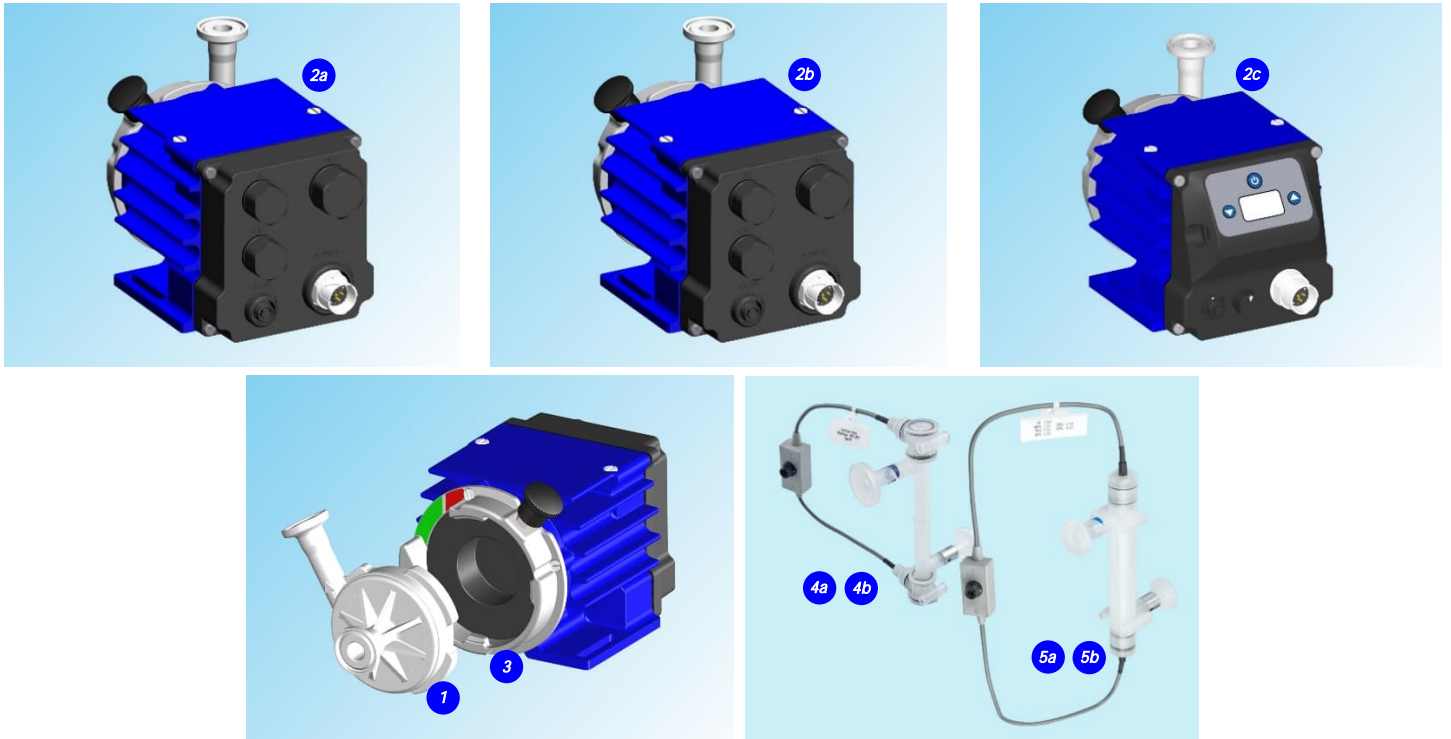


Figure 17: Flow control system with standard main components



Figure 18: General standard accessories



Figure 19: Standard cables and other accessories

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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