

## Ultrapure Fluid Handling Integrated Flow Controller Series



### BPS-iF100

Pump Pressure / Flow: 1.6 bar / 20 l/min

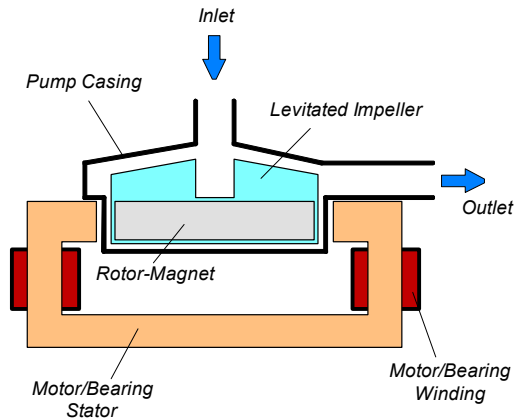
Flow Control Ranges:

4 l/min

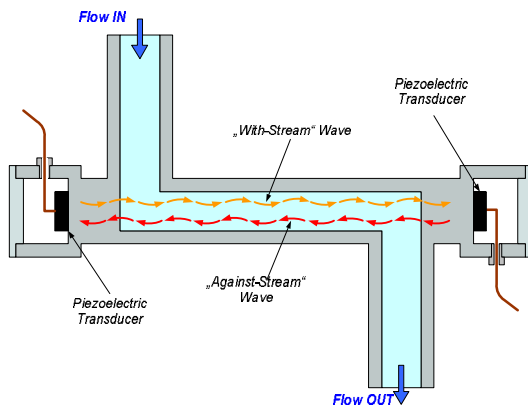
8 l/min

20 l/min

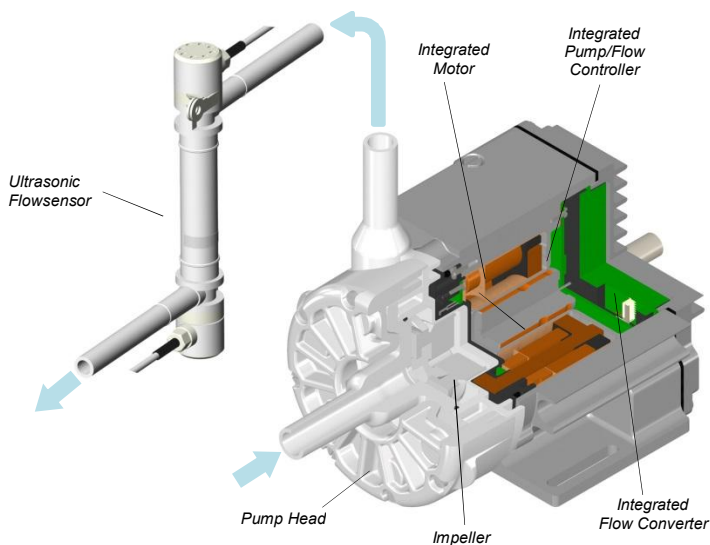
**High Precision. No Bearings. No Contamination!**



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



**Figure 2:** Operating principle ultrasonic flowmeter sensor with Z-shape (same principle with U-shape)



**Figure 3:** Integrated MagLev flow control system with ultrasonic flow sensor.

## INTRODUCTION

With the *BPS-iF100* 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 flow is measured with the proven *LEVIFLOW*® ultrasonic sensor technology not invading into the fluid path (*Figure 2*).

The pump head and flow sensor is fabricated from chemical-resistant high purity fluorocarbon resins. The pump controller, motor and flow converter are integrated into the driver housing (see *Figure 3*). This reduces cabling and setup effort significantly. Fluid flow rate is precisely controlled by electronically regulating the impeller speed without pulsation.

## SYSTEM BENEFITS

- High precision, dynamics and high turndown ratio.
- No dependency on external pressure source.
- Extremely low particle generation due to the absence of mechanically contacting parts.
- Increased equipment uptime with lower maintenance costs by eliminating valves, bearings, rotating seals and costly rebuilds.
- Very low integration costs as no external controller is needed for flow control.
- 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.
- Proven pump and ultrasonic flow measurement technology

## APPLICATIONS

- Semiconductor wet processing (Cleaning, CMP etc.).
- Flip chip and advanced packaging.
- Solar cell production.
- Flat panel display manufacturing.
- Hard-disk fabrication.
- Printer ink handling.
- Pharmaceutical production.
- Plating.
- Circulation in flow batteries.

## BASIC SYSTEM CONFIGURATION

Figure 7 illustrates the interfacing of the integrated flow control system. Various PLC signals allow a simple setup with precisely setting the speed via an analog input. Various digital inputs and outputs allow controlling and monitoring of the system.

A RS485 interface allows communication with a PC in connection with the *Levitronix® Service Software*. Hence parameterization, firmware updates and failure analysis are possible. Furthermore, the user hence is able to optimize the system to various specific situations.

The RS485 can also be used as a fieldbus to implement more intelligent concepts of flow control. The fieldbus also allows control of multiple systems.

## FLOWCONTROL CONCEPT AND MAIN BENEFITS

Figure 5 illustrates the flow control concept with the *BPS-iF100*. 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 (see Figure 5). The speed is precisely controlled with a high resolution over a wide 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 as 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.

## CAPABILITIES OF FLOWCONTROL SYSTEM

The versatility of the *BPS-iF100* 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 (Figure 6).

## ATEX / IECEx SYSTEM CONFIGURATION

An ATEX / IECEx certified driver (OEM model only) together with the pump head allows installation within an Ex Zone 2 area (see Figure 8). An Ex conform solution is needed for the motor cables to leave the Ex area. One option is an ATEX certified cable sealing system as listed in Table 5 (see Pos. 8).

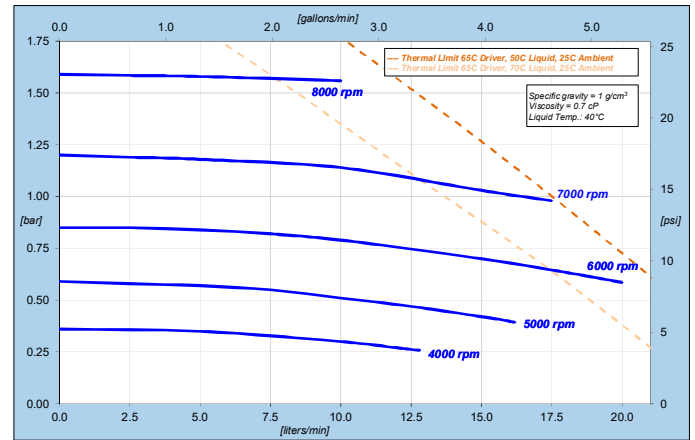


Figure 4: Pressure/flow curves for aqueous liquids (similar to water)

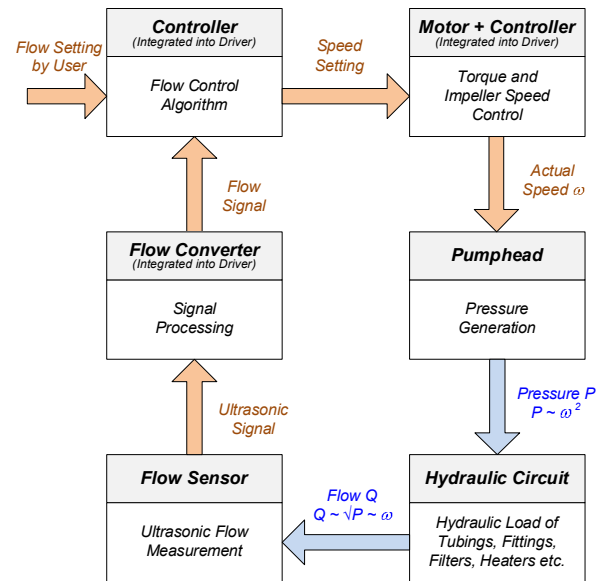


Figure 5: Simplified block schematics of flow control with BPS-iF100

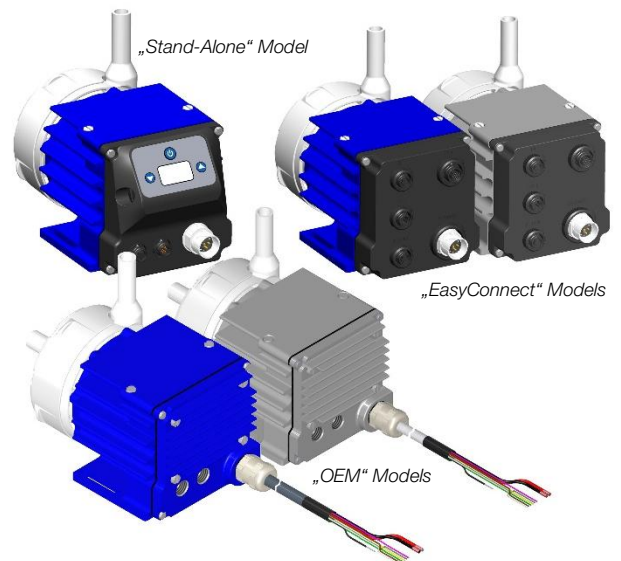


Figure 6: Flow control system models

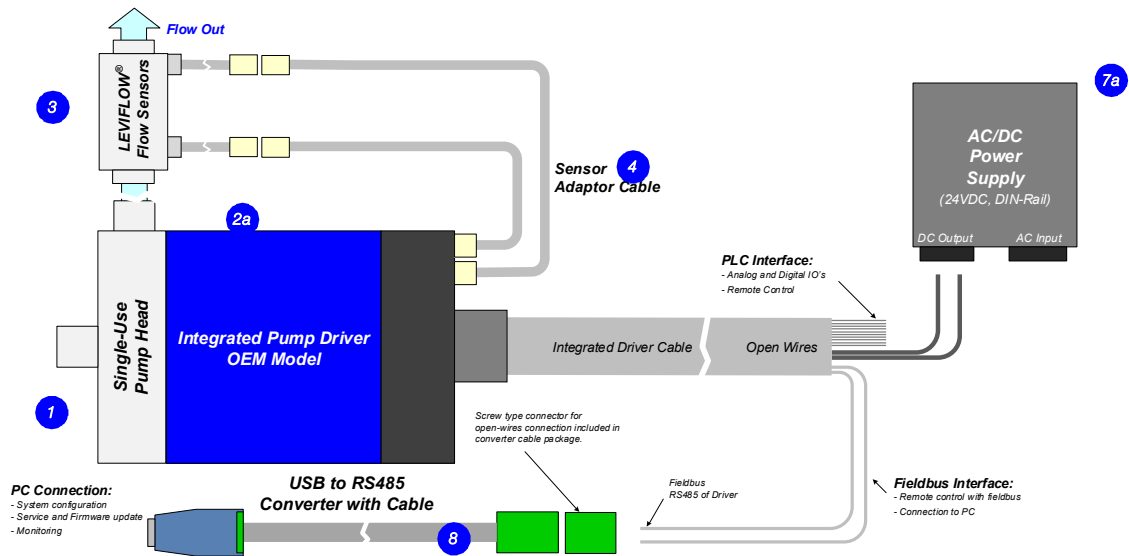


Figure 7: Standard "OEM" system configuration (See section "Order Information" for details to numbered components and other options)

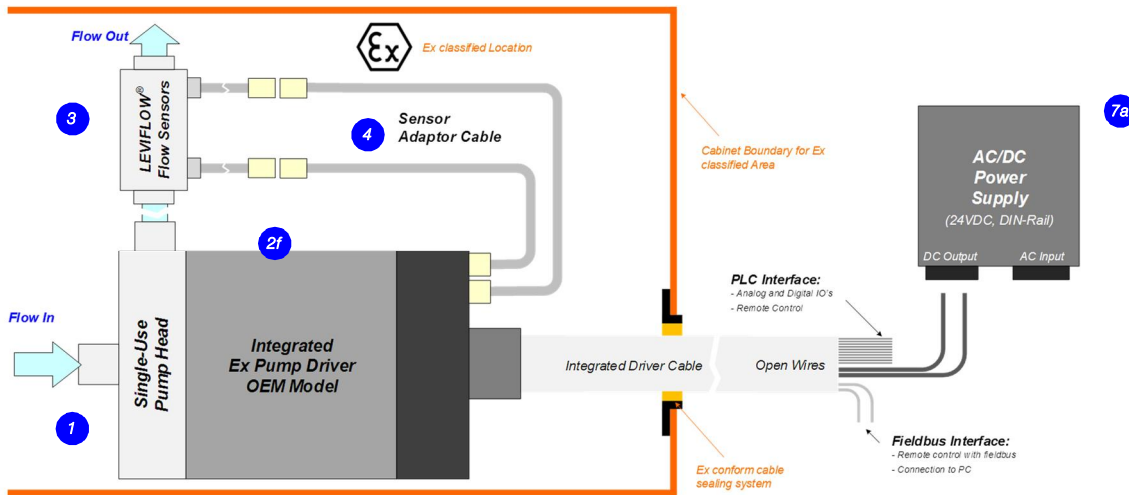
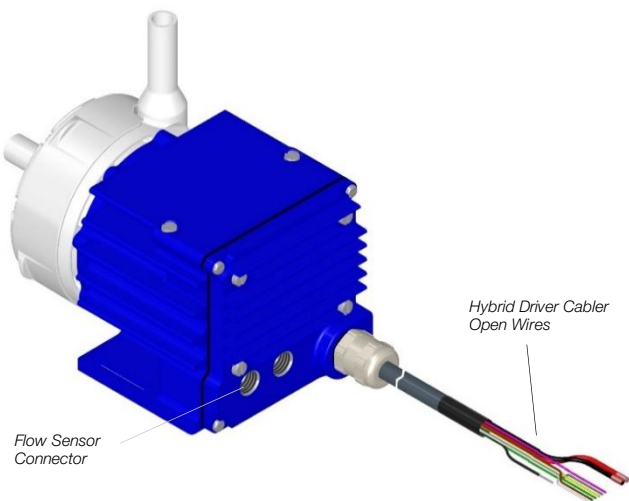


Figure 8: Standard ATEX/IECEx "OEM" system configuration (See section "Order Information" for details to numbered components and other options)



| Wire Name | Description                    | Standard Designation       | Hardware Specification  |
|-----------|--------------------------------|----------------------------|---|
| P+        | + 24 VDC                       | Supply                     | Voltage: 24 VDC<br>P- to be connected to earth  |
| P-        | Power Input Ground / Earth     |                            |   |
| Ain1      | Analog Input 1 (Current Input) | Reference Value (Set Flow) | 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<br>2.2 kΩ input resistance, 5-24V for active input |
| Din2      | Digital Input 2                | Zero Adjust                |   |
| Din_COM   | Common Digital Input           | --                         | --  |
| Aout1     | Analog Output                  | Actual Flow                | 0 – 10V (no galvanic isolation)<br>AGND is reference                                    |
| Dout1     | Digital Output 1               | Status Pump                | Open drain, max. 24V, 100mA   |
| Dout2     | Digital Output 2               | Status Flow Sens.          | Reference ground is AGND  |
| AGND      | Analog Ground                  | --                         | Reference for Aout1, Dout1 and Dout2  |
| RS485+    | RS485 +                        | Field Bus                  | Modbus protocol   |
| RS485-    | RS485 -                        |                            |   |
| NC        | Do not connect                 | --                         | --  |
| NC        | Do not connect                 | --                         | --  |
| Shield    | Shielding                      | Shielding                  | To be connected to earth (see wire No. 2, P-)   |

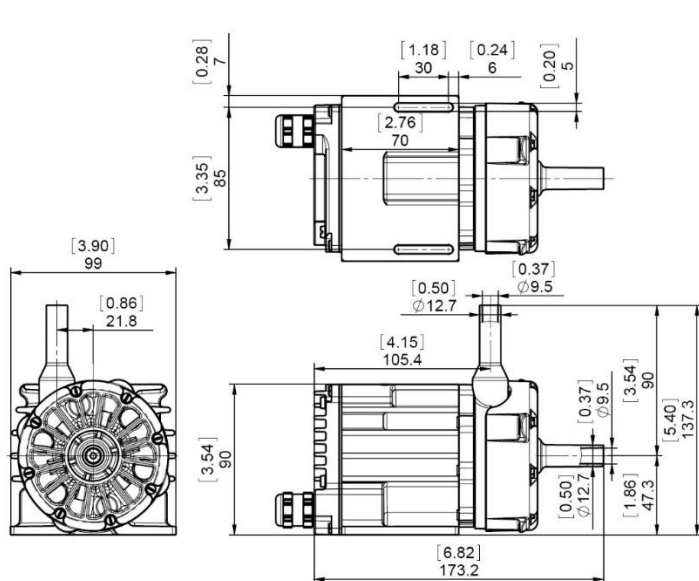
Figure 9: Interface specifications of standard "OEM" model

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



## DIMENSIONS OF MAIN COMPONENTS



Pump Head  
LPP-200.7

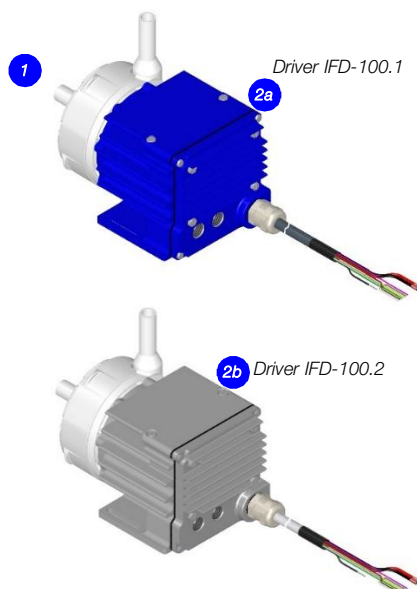
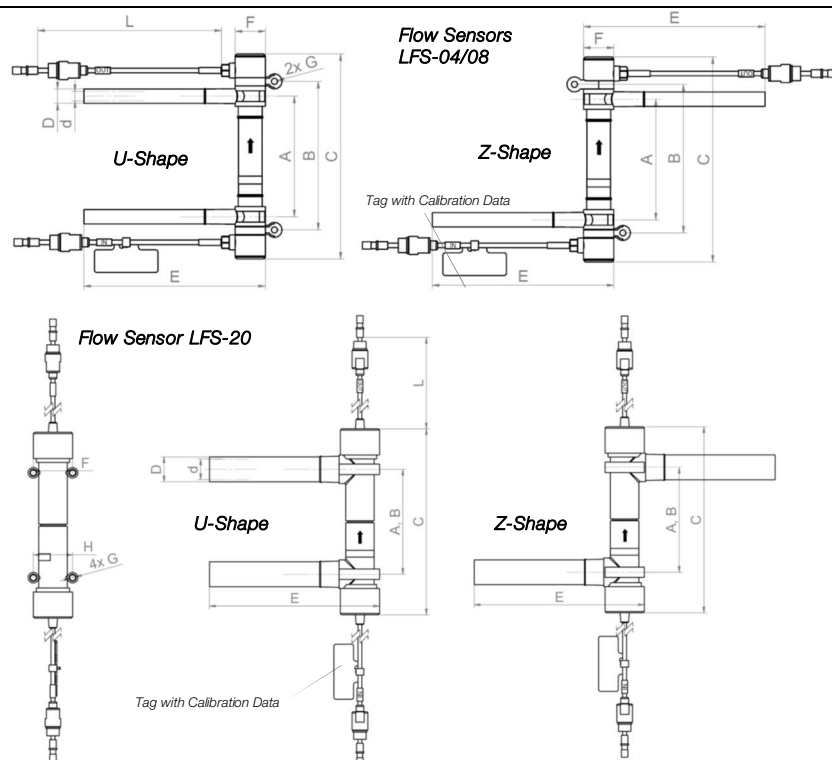


Figure 10: Basic dimensions and description of standard "OEM" model



| Sensor    | LFS-04   | LFS-08   | LFS-20  |
|-----------|----------|----------|---|
| Tube Size | 3/8"     | 3/8"     | 1/2"  |
| A         | 80 ± 1   | 80 ± 1   | 80 ± 1  |
| B         | 98.5 ± 1 | 98.5 ± 1 | 80 ± 1  |
| C         | 136 ± 1  | 136 ± 1  | 136 ± 1   |
| D         | 9.35     | 9.35     | 12.7  |
| d         | 6.33     | 6.33     | 9.5   |
| E         | 120      | 120      | 120   |
| F         | Ø 20     | Ø 20     | Ø 30  |
| G         | Ø 4      | Ø 4      | M4 x 30 (Z-shape)<br>M4 x 31 (U-shape)<br>Max torque = 0.3 Nm |
| H         | --       | --       | 25  |
| L         | 500      | 500      | 500   |

Figure 11: Dimensions of flow sensor (dimensions in [mm])

| Flow Controller Type                                    | BPS-IF100 for 4 l/min  | BPS-IF100 for 8 l/min | BPS-IF100 for 20 l/min |
|---|--|-----------------------|------------------------|
| Characteristics   |  |                       |                        |
| Flow Range [lpm]  | 0 – 4  | 0 – 8                 | 0 – 20                 |
| Sensor Flow Range [l/min]                               | 0 – 0.8  | 0 – 1.7               | 0 – 4.7                |
| Flow Velocity < 1 m/s Accuracy of Read. / Repeatability | ± 0.008 / < 0.004  | ± 0.017 / < 0.009     | ± 0.047 / < 0.024      |
| Sensor Flow Range [l/min]                               | 0.8 – 4  | 1.7 – 8               | 4.7 – 20               |
| Flow Velocity > 1 m/s Accuracy of Read. / Repeatability | ± 1% / < 0.5%  | ± 1% / < 0.5%         | ± 1% / < 0.5%          |
| Response Time: Step from 10 – 90% of full scale.        | < 1s <sup>1</sup>  | < 1s <sup>1</sup>     | < 2s <sup>1</sup>      |
| Fluid Temperature / Ambient Temperature                 | 10 – 70 °C (50 – 158 °F) / 0 – 40 °C (32 – 104 °F)   |                       |                        |
| Max. Fluid Pressure / Sound Speed / Kinematic Viscosity | 0 – 0.5 MPa (0 – 5 bar, 0 – 72.5 psi) / 1000 – 2200 m/s / 0.8 – 40 mm <sup>2</sup> /s (0.8 – 40 cSt) |                       |                        |
| Wet Materials / Enclosure Classification                | PFA for flow sensors and pump head / IP-65 for flow sensor and flow control driver                   |                       |                        |

Table 1: Specifications of flow controller systems BPS-IF100 (All data based on water at 20 °C)

<sup>1</sup>: Values for 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 #  | Flow Sensor   | Flow Control Driver                          | Pump Head | Note  |
|---|--|---|--|-----------|---|
| BPS-iF100.1-04Z or -04U<br>BPS-iF100.1-08Z or -08U<br>BPS-iF100.1-20Z or -20U | 100-908 <b>77</b> or <b>78</b><br>100-909 <b>19</b> or <b>20</b><br>100-909 <b>21</b> or <b>22</b> | LFS-04-Z or -U (4 l/min)<br>LFS-08-Z or -U (8 l/min)<br>LFS-20-Z or -U (20 l/min) | IFD-100.1-50-01<br>(Epoxy Coat., PVC Cable)  | LPP-200.7 | <i>OEM models.</i>  |
| BPS-iF100.2-04Z or 04U<br>BPS-iF100.2-08Z or 08U<br>BPS-iF100.2-20Z or 20U    | 100-908 <b>79</b> or <b>80</b><br>100-909 <b>23</b> or <b>24</b><br>100-909 <b>25</b> or <b>26</b> | LFS-04-Z or -U (4 l/min)<br>LFS-08-Z or -U (8 l/min)<br>LFS-20-Z or -U (20 l/min) | IFD-100.2-50-01<br>(ETFE Coating, FEP Cable) |           | <i>Flow sensor extension cables to be ordered as separate article (see Table 5 Pos. 4). The flow sensors can not be connected to the flow control driver without extension cables.</i>                                      |
| BPS-iF100.4-04Z or -04U<br>BPS-iF100.4-08Z or -08U<br>BPS-iF100.4-20Z or -20U | 100-913 <b>66</b> or <b>67</b><br>100-913 <b>68</b> or <b>69</b><br>100-913 <b>70</b> or <b>71</b> | LFS-04-Z or -U (4 l/min)<br>LFS-08-Z or -U (8 l/min)<br>LFS-20-Z or -U (20 l/min) | IFD-100.8-50-01<br>(ATEX, ETFE Coating)      | LPP-200.7 | <i>OEM models with ATEX/IECEx</i><br><i>Flow sensor extension cables to be ordered as separate article (see Table 5 Pos. 5). The flow sensors can not be connected to the flow control driver without extension cables.</i> |

**Table 2:** Standard flow control system configurations  
(Note: Driver comes delivered with sensor calibration parameters stored in driver if ordered as set.)

| Pos. | Component  | Article Name                                     | Article # | Characteristics   | Value / Feature  |
|------|--|--|-----------|---|--|
| 1    | Pump Head  | LPP-200.7  | 100-90708 | Impeller / Pump Housing<br>Sealing O-Ring<br>In-/Outlet Fittings<br>Max. Flow<br>Max. Diff.-Pressure<br>Max. Viscosity<br>Max. Liquid Temp. | High purity PFA<br>FFPM (FFKM) perfluorelastomer <sup>1</sup><br>½" tube<br>20 liters/min / 5.3 gallons/min<br>1.6 bar / 23.2 psi<br>20 cP<br>70 °C (158 °F)                 |
| 2a   | Integrated Flow Control Driver<br>("OEM" Models) | IFD-100.1-50-01 <sup>1</sup><br>(Epoxy/PVC)      | 100-10079 | Voltage, Power<br>Housing   | 24 VDC ±10%, 100 W<br>Epoxy or ETFE (corrosion resistant) coated Aluminum, waterproofed IP-65 <sup>2</sup>   |
| 2b   |  | IFD-100.2-50-01 <sup>1</sup><br>(ETFE/FEP)       | 100-10080 | Cable<br>Interfaces<br>Standard Firmware  | PVC or FEP jacket, open wires, cable length 5 m<br>PLC, RS485 with Modbus protocol and flow sensor<br>J 1.48   |
| 2c   |  | IFD-100.8-50-01 <sup>1</sup><br>(ETFE/FEP, ATEX) | 100-10152 | Housing<br>Cable<br>ATEX Certification<br>Standard Firmware   | ETFE coated Aluminum, waterproofed IP-65 <sup>2</sup><br>FEP jacket, open wires, cable length 5 m<br>CE II 3G Ex ec h mc IIC T4 Gc / CE II 3D Ex h tc IIC T90°C Dc<br>J 1.48 |

**Table 3:** Specification of standard components  
<sup>1</sup>: If ordered as spare part, calibration parameters of sensor have to be stored with Levitronix® Service Software. <sup>3</sup>: Designed and tested for IP-67.

| Pos.    | Article Name  | Article #       | Shape  | Flow Range   | Fitting | Cable Jacket | Cable Length | Special Feature  | Note  |
|---------|---------------|-----------------|--------|--------------|---------|--------------|--------------|--|---|
| 3a or b | LFS-04-Z or U | 100-30304 or 05 | Z or U | 0 – 4 l/min  | 3/8"    | FEP          | 0.5 m        | All sensors have PVDF male connector cover for IP-65 protection. | Extension/adaptor cables needed to connect sensor to driver (see Table 5 Pos. 5). |
| 3c or d | LFS-08-Z or U | 100-30306 or 07 | Z or U | 0 – 8 l/min  | 3/8"    |              |              |  |   |
| 3e or f | LFS-20-Z or U | 100-30308 or 09 | Z or U | 0 – 20 l/min | 1/2"    |              |              |  |   |

**Table 4:** Standard flow sensors

| Pos. | Component                        | Article Name   | Article #  | Characteristics  | Value / Feature   |
|------|----------------------------------|--|--|--|---|
| 4    | Flow Sensor Extension Cable      | LFE-A.3-05 (0.5 m)<br>LFE-A.3-10 (1 m)<br>LFE-A.3-30 (3 m)<br>LFE-A.3-60 (6 m) | 190-10299<br>190-10300<br>190-10301<br>190-10302 | Cable Jacket and Connector<br>Special Feature  | PVC, PP and PVDF connector covers for IP-65 chemical protection.<br>Flame retardant PVC white (UL VW-1 corresponds to EN-60332-1-2)<br>Note: comes delivered in pairs.  |
| 5    | Impeller Exchange Kit            | IEK-200.4  | 100-90733  | Impeller LPI-200.5 (A)<br>Seal. O-Ring (B)<br>Pump (C) / Motor Screws (D)<br>Exchange Tool IET-1.1 (E) | PFA<br>FFPM (FFKM), 50.52 x 1.78 mm<br>6x M4 x 16 mm / 8x M3 x 40 mm (stainless steel PTFE coated)<br>POM-C   |
| 6    | AC/DC Power Supply               | TSP 180-124 (Traco)  | 100-40018  | Voltage Output / Input<br>Dimensions<br>Certification or Standards                                     | 24 VDC with 120 W / 85 – 132 and 187 – 264 VAC (autoselect)<br>110 x 110 x 54 mm (mountable on DIN rail 35 mm)<br>UL/cUL, CB, Semi F47  |
| 7    | USB to RS485 Adaptor-TR Isolated | YN-485I-TR   | 100-30392  | Structure/Design<br>Purpose  | USB connector (A) with termination resistor and cable with connector pair (B and C) for external RS485 wire connection. Magnetically isolated. Cable length is 2m.<br>Communication over fieldbus of driver with PC |
| 8    | ATEX Cable Sealing System        | ACS-A.1 (Roxtec)   | 100-90292  | Sleeve (A) and Gasket (B)<br>Frame (C)<br>2x Cable Module (D)  | Stainless Steel and EPDM<br>Roxylon (EPDM rubber)<br>Roxylon (EPDM rubber)<br>Note: Lubricant (E) and measurement plates (F) are included.  |

**Table 5:** Specification of accessories

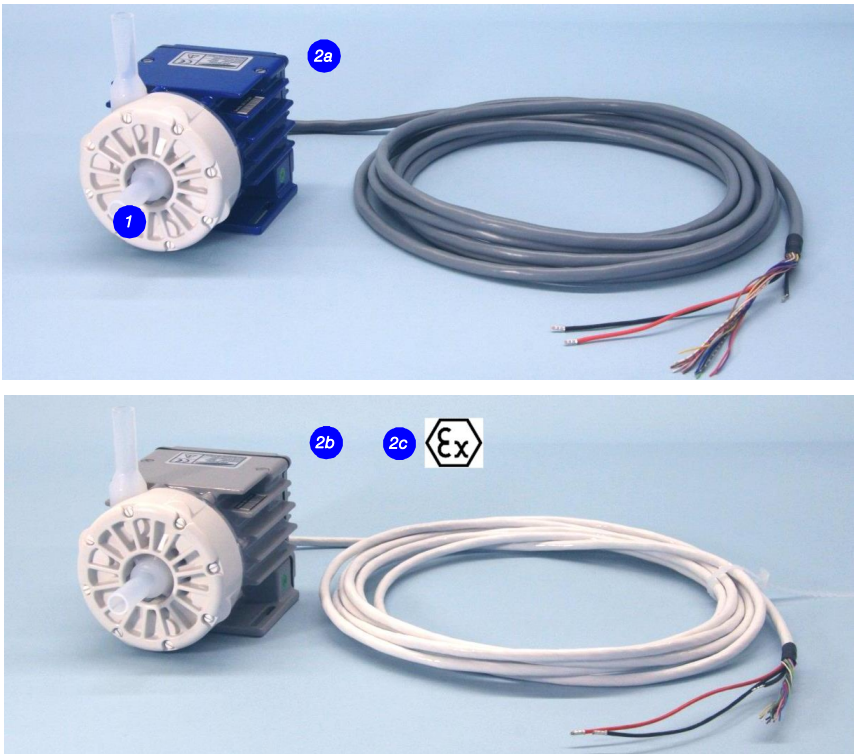


Figure 12: Standard flow control driver and pump head



Figure 13: Standard flow sensors and sensor extension cables



Figure 14: 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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