

Ultraclean Flow Measurement! High Accuracy at Low Flow!



LEVIFLOW® Low-Flow Sensor

LFS-008: 0 – 800 ml/min

**Levitronix® Ultrasonic Flowmeters
High Purity Fluid Handling!**

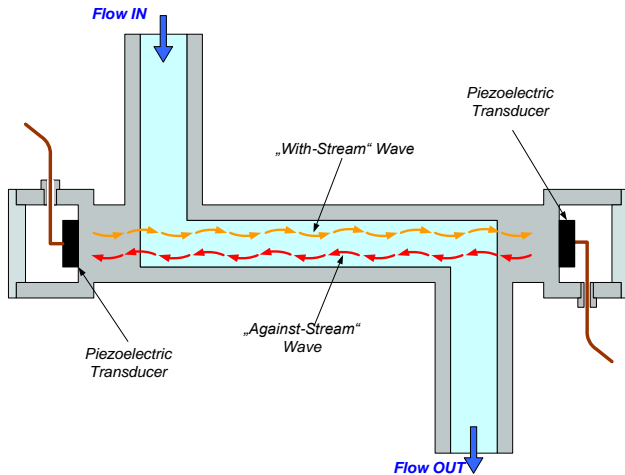


Figure 1: Operating principle ultrasonic flowmeter sensor with Z-shape (same principle with U-shape)

INTRODUCTION

The LEVIFLOW® flowmeter series is designed for non invasive high precision flow measurements of high purity fluids. Figure 1 illustrates the operating principle. Two piezoelectric transducers, mounted at both ends of the measuring path of the fluid stream, generate and receive an ultrasonic wave. The wave going in direction of the flow (with-stream wave) is accelerated and the wave going against (against-stream wave) the flow direction is slowed down. The two waves are processed by a signal converter. The difference of the transmit time of both waves is proportional to the velocity of the fluid.

Levitronix® provides now a sensor especially developed for low flow applications. The LFS-008 flowmeter is able to measure flows from 800 ml/min down to 1 ml/min.

The standard configuration of the LFS-008 flowmeter (Figure 2) consists of a flow sensor and a converter with a digital signal processor (DSP) for processing the sensor signals. Various signals (analog output, digital input and digital output) are provided and can be configured with a PC software. A two wire RS485 bus allows arrays of multiple flowmeters. In addition, the sensor value is shown on a 4-digit display.

SYSTEM BENEFITS

- No contamination due to non-invasive measurement
- High accuracy (1% of reading) and repeatability ($\leq 0.5\%$)
- No moving parts -> no particle generation
- Improved bubble robustness due to DSP technology
- High precision flow control together with Levitronix® MagLev Pumps
- Easy configurable flow sensor parameters (PC software)

APPLICATIONS

- High purity liquid processes in Semiconductor manufacturing
- CMP slurry flow control
- Sterile non-invasive flow measurement in Pharmaceutical manufacturing
- Flow control in combination with Levitronix® MagLev pump systems

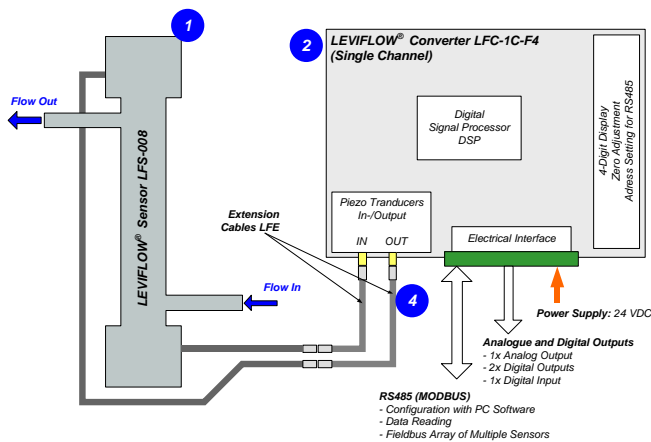


Figure 2: Standard flowmeter configuration for LFS-008

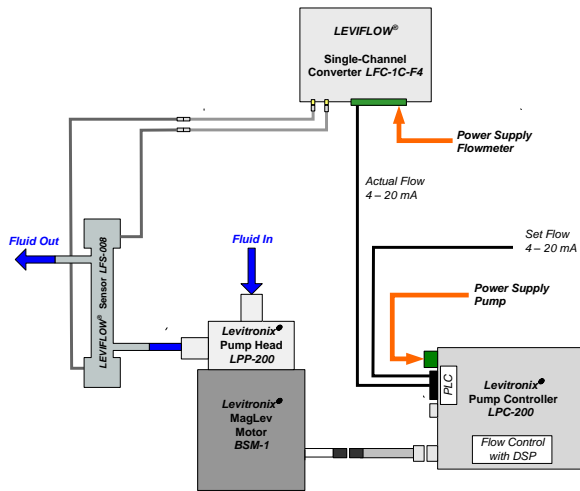


Figure 3: Basic configuration for flow control with Levitronix® MagLev Pumpsystem BPS-200

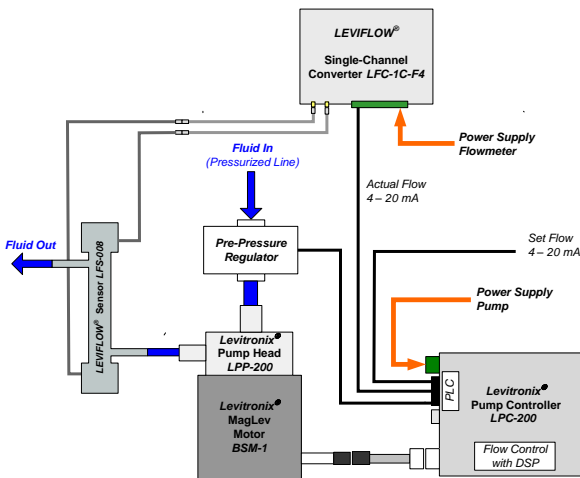


Figure 4: Point-of-use flow control with flowmeter LFS-04 and pump system BPS-200

FLOW CONTROL IN COMBINATION WITH LEVITRONIX MAGLEV PUMP SYSTEMS

Without the need of additional controller hardware, precise ultrapure flow control systems can be realized with LEVIFLOW® flowmeters in combination with Levitronix® MagLev pumps (see Figure 3). The flow control firmware which comes with the Levitronix® pump system BPS-200 regulates the pump speed in order to achieve the desired flow rate. Hence flow control ranges from 1 ml/min up to 800 ml/min can be realized.

To facilitate matters, Levitronix® provides either turnkey solutions for closed-loop flow control or helps to design your own flow control system. Experience has been gained with fluids such as CMP slurries, surface-conditioning chemicals, plating solutions, ultrapure water and solvents. A block-diagram for a typical point of use flow control system with an additional pre-pressure regulator is shown in Figure 4.

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 (Figure 5).

SYSTEM BENEFITS

- Precise flow control from 800 ml/min down to 1 ml/min
- Wide turn-down ratio compared to simple flow controllers
- Alarming capability for flow, speed, current, temperature, line clogging (elimination of catastrophic product loss by elimination of no-flow condition during processing), bubble detection
- Dynamic Condition Trending (DCT) capability (enables failure prediction and scheduling of preventive maintenance or filter exchange)
- Continuous, smooth process flow (stable flow, even with pressure fluctuations on the delivery line!)
- Fully independent from pressure on chemical delivery line (no minimum pressure required!)
- CMP-slurry savings based on reduced slurry flow rate

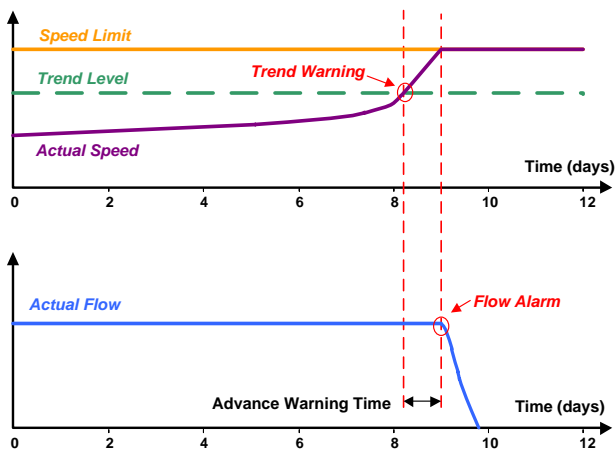


Figure 5: Dynamic Condition Trending (DCT)

SPECIFICATIONS OF SENSOR

Sensor Type		LFS-008
Flow Range [ml/min]		0 – 800
Fitting Tube Size (OD)		1/4"
Measurement Path ID in [mm]		2.5
Accuracy	Flow Range [mlpm]	< 35
	Accuracy of Reading	see Figure 6
Accuracy	Flow Range [lpm]	35 – 800
	Accuracy of Reading	± 1%
Weight [g]		97
Pressure Drop Coefficient $\Delta P = C \times Q^2$, (for water) Q = Flow [l/min], ΔP = Press. Drop [kPa]		16.8

Fluid Temperature	Normal range: 10 – 90 °C (50 – 194 °F)
Ambient Temperature	0 – 60 °C (32 - 140 °F)
Maximum Fluid Pressure	0 – 0.5 MPa (0 – 5 bar, 0 – 72.5 psi)
Kinematic Viscosity	0.8 – 40 mm ² /s (0.8 – 40 cSt)
Sound Speed	1000 – 2200 m/s
Wetted Materials	PFA
Wetted Surface Area	38.3 cm ²
Sensor Enclosure Classification	IP-65
Cable Jacket Material	FEP
Standard Cable Length	0.5 m
Electrical Connectors	SMB with protective PVDF cover (male with O-Ring, IP-65 protection)

Table 1: Specifications of sensor (all data based on water at 20 °C)

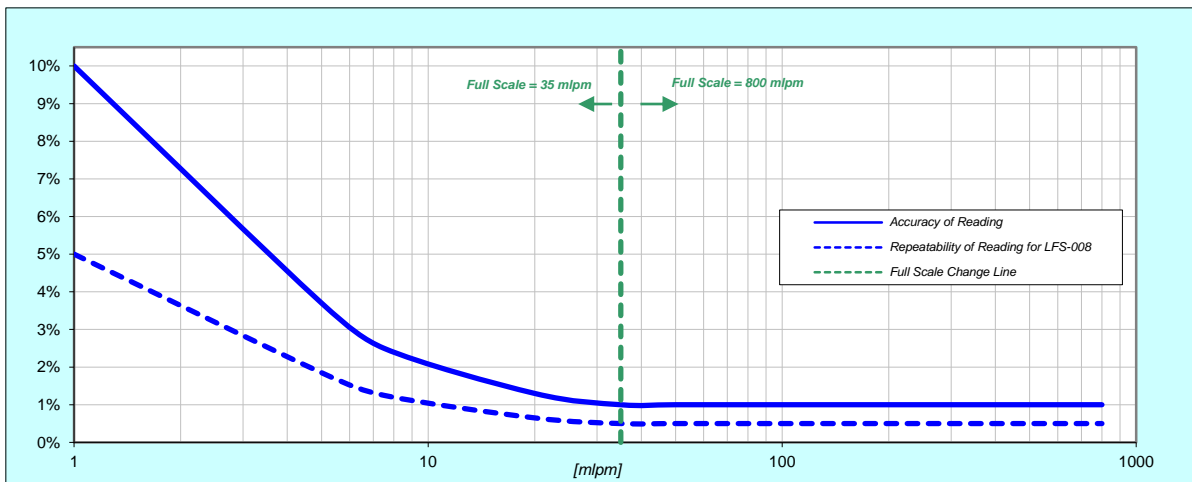


Figure 6: Accuracy and repeatability in % of reading (based on water at 20 °C)

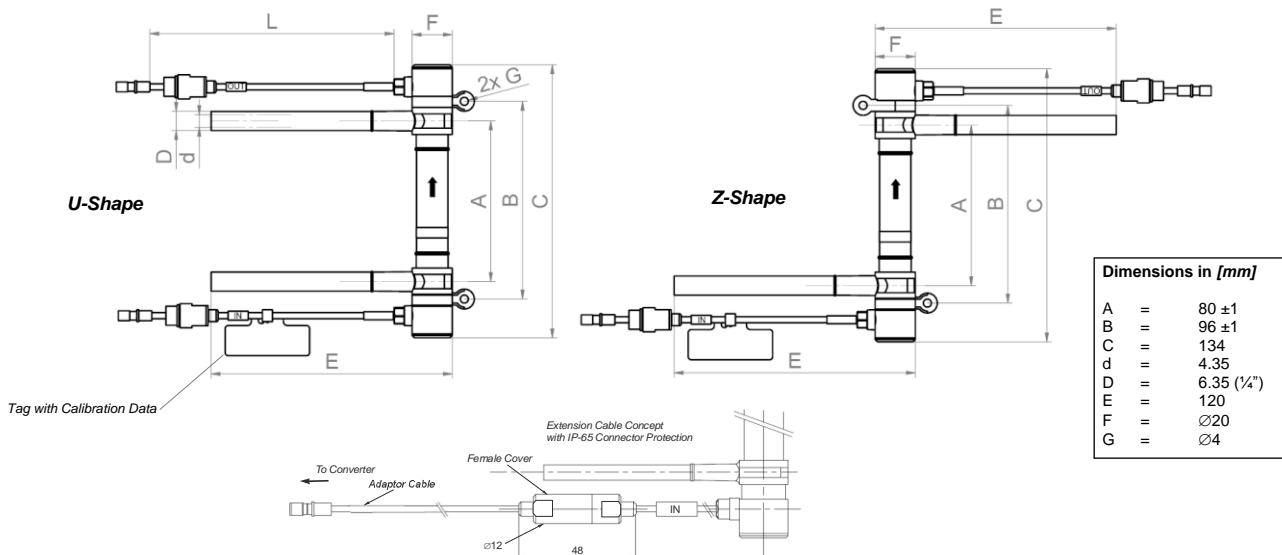


Figure 7: Dimension legend for LFS-008 sensor --> left: U-shape, right: Z-shape

SPECIFICATIONS OF CONVERTER

Characteristics	Single Channel Converter Type LFC-1C-F4
Power Supply Current / Start Current	24 VDC ± 10% 150 mA / 4.4 A, 2 ms max.
Ambient Temp Humidity Range	0 – 50 °C (32 – 122 °F) 30 - 85% R.H. (no condensation)
Enclosure Classification and Material	IP-20 (indoor use), ABS
Interfaces (see Figure 8 for detailed PIN designation and electrical specification)	- RS485 -> MODBUS protocol -> max. array of 99 channels - 1x Analog Output 4 – 20mA (0 – 20mA configurable) - 2x Digital Outputs: Flow Alarm, Measurement Error, Volume Counter Pulse, Volume Counter Alarm, Flow as Frequency or Bubble Detection (default: normally open) - 1x Digital Input: Volume Counter Reset or Zero Adjust - 4 Digit display (flow rate, error codes), re-zero button - Address potentiometers for RS485 address setting
Configuration Parameters (Available and configurable with RS485/USB converter and configuration software)	Viscosity, Low Cutoff, Dampening constant (filter) Full scale setting, Linearization (15 points) Alarm Outputs (High and Low Flow Alarm) Volume counter and Volume counter Alarm settings
Weight	130 g
Dimensions	123 x 75 x 17.5 mm (see Figure 8 for details)
Mounting	DIN rail

Table 2: Specifications of converter

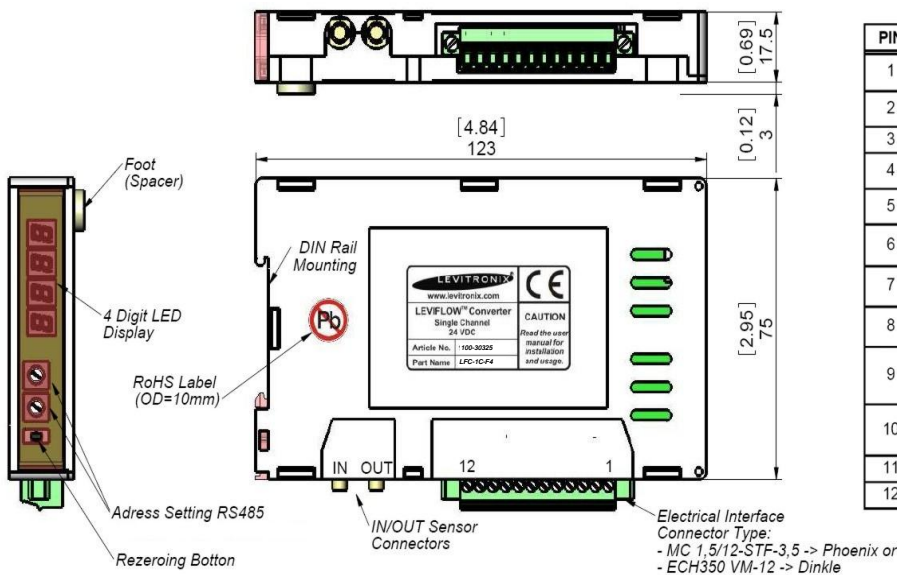


Figure 8: Dimensions and layout of interfaces of single channel converter LFC-1C-F4

PIN	Designation	Specification
1	DC24V+	24 VDC ± 10% Current: 150 mA
2	DC24V-	Starting: 4.4 A, 2ms
3	FG	Field Ground
4	Analog Out +	4 - 20 mA (0 - 20 mA configurable)
5	Analog Out -	Load Resistance < 600 Ohm
6	Digital Out1 +	Max. rating: DC30V, 20mA (open collector)
7	Digital Out2 +	Various configurable options available depending on firmware
8	COM	
9	Digital In+	Various configurable options available depending on firmware
10	Digital In-	No-voltage contact or transistor open collector
11	RS485 +	RS485 with MODBUS
12	RS485 -	Protocol

ORDER INFORMATION



Figure 9: LEVIFLOW™ flowmeter components

Pos.	Part Name	Part #	Shape	Flow	Fitting	Cable Jacket	Cable Length	Special Feature	Note
1a	LFS-008-Z	100-30323	Z	0 – 800 mlpm	¼" (Tube)	FEP	0.5 m	PVDF male connector cover	Sensor specific parameter for converter calibration are delivered on a tag attached to the flowsensor.
1b	LFS-008-U	100-30324	U						

Table 3: Standard flow sensor configurations

Pos.	Article Name	Part #	Description	Interfaces
2	LFC-1C-F4	100-30325	Single Channel Converter	Analog Output (4 – 20 mA), 2x Digital Output, 1x Digital Input, RS485 (MODBUS) protocol

Table 4: LEVIFLOW[®] converter

Pos.	Article Name	Part #	Features	Special Feature / Description
3a	LFE-A.1-10 LFE-A.1-30 LFE-A.1-60	190-10162 190-10163 190-10164	Cable length: 1 m, PVC Cable length: 3 m, PVC Cable length: 6 m, PVC	- PVDF female connector cover for IP-65 chemical protection - Flame retardant PVC white (UL VW-1 corresponds to EN-60332-1-2)
3b	LFE-A.2-10 LFE-A.2-30 LFE-A.2-60	190-10165 190-10166 190-10167	Cable length 1 m, FEP Cable length 3 m, FEP Cable length 6 m, FEP	- PVDF female connector cover for IP-65 chemical protection
4	USB-RS485-WE-5000-BT (RS485 to USB Adaptor)	100-30334	Connections Purpose	Open wire Needed for communication over fieldbus of driver with PC

Table 5: Accessories

Pos.	Part Name	Part #]	Flow Sensor	Flow	Fitting	Cable Jacket	Sensor Cable Length	Converter	Note
5a	LFS-008-Z+LFC-1C-F4	100-90625	LFS-008-Z	0 – 800 mlpm	¼" (Tube)	FEP	0.5 m	LFC-1C-F4	Converter is delivered with sensor specific calibration parameters.
5b	LFS-008-U+LFC-1C-F4	100-90626	LFS-008-U	0 – 800 mlpm	¼" (Tube)				Extension cables to be ordered as separate article with specified length (see Table 5)

Table 6: Flowmeter sets – flowsensor with converter

**Levitronix[®] Ultrasonic Flowmeters
High Purity Fluid Handling!**

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 13485 and 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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