

Ultraclean Flow Measurement!



LEVIFLOW[®] Series

LFS-04: 0 – 4 l/min

LFS-08: 0 – 8 l/min

LFS-20: 0 – 20 l/min

LFS-50: 0 – 50 l/min

LFS-80: 0 – 80 l/min

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

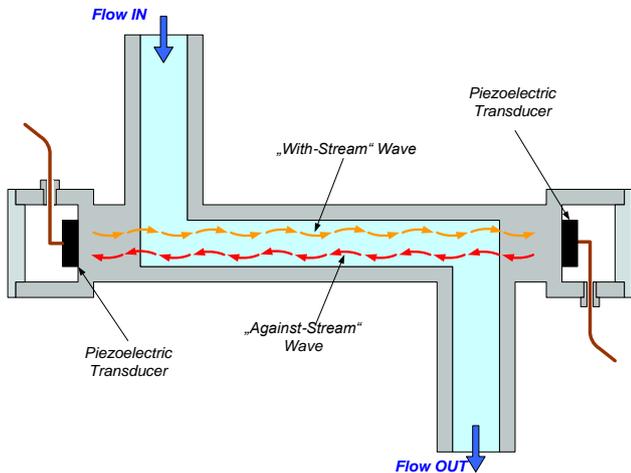


Figure 1: Operating principle ultrasonic flowmeter sensor with Z-shape (same principle with U-shape)

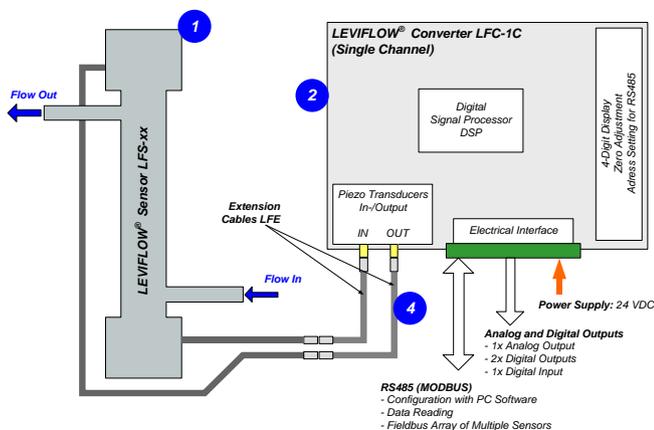


Figure 2: Standard single channel flowmeter configuration

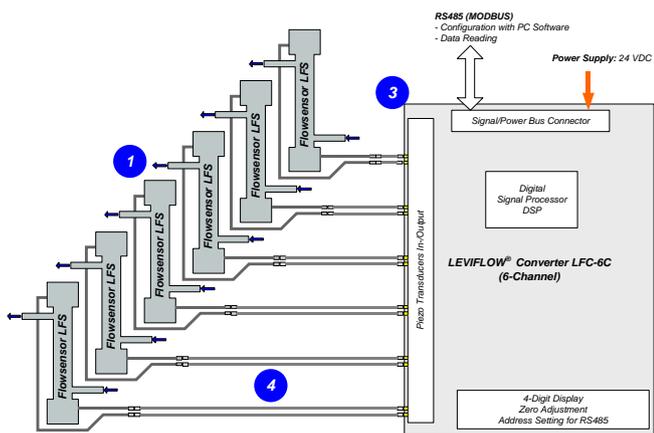


Figure 3: Multi channel configuration (6 channels)

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.

The standard configuration of the LEVIFLOW® flowmeters (Figure 2) consists of a flow sensor and a converter with a digital signal processor (DSP) for processing the sensor signals. Five flow sensor sizes are available to measure flows from the ml/min range up to 80 l/min. 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.

For high volume applications a multi-channel converter (Figure 3) is available, which processes 6 sensors with one single converter. The sensor signals are available over a RS485 two wire bus, hence reducing significantly cabling, space and costs.

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

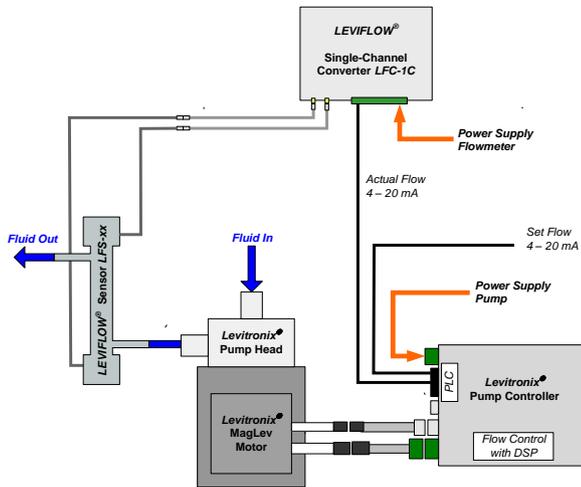


Figure 4: Basic configuration for flow control with Levitronix[®] MagLev Pumpsystems

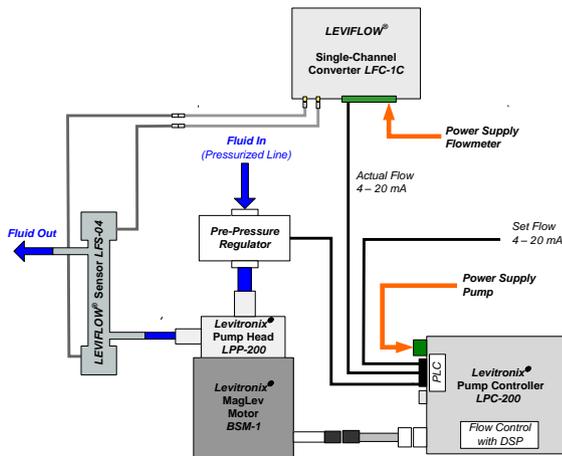


Figure 5: Point-of-use flow control with flowmeter LFS-04 and pump system BPS-200

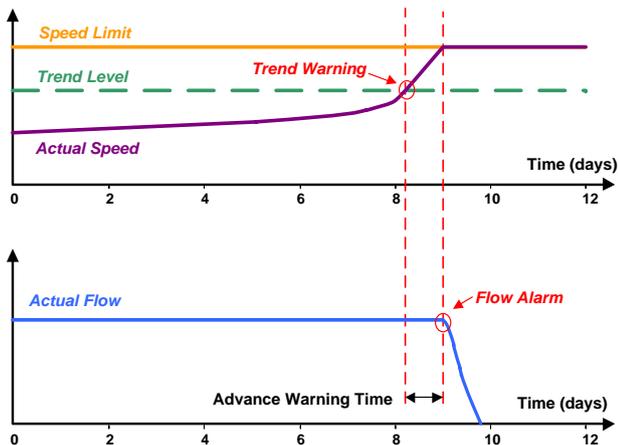


Figure 6: Dynamic Condition Trending (DCT)

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 4). The flow control firmware which comes with the Levitronix[®] pump systems BPS-1, BPS-3, BPS-4, BPS-200, BPS-600 and BPS-2000 electronically regulates the pump speed in order to achieve the desired flow rate. With the current product family, flow control ranges from 30 ml/min up to 80 l/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 5.

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 6).

SYSTEM BENEFITS

- Precise flow control from 30 ml/min up to 80 l/min (lower flows on request)
- 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

SPECIFICATIONS OF SENSORS

Sensor Type		LFS-04	LFS-08	LFS-20	LFS-50	LFS-80
Characteristics						
Flow Range [l/min]		0 – 4	0 – 8	0 – 20	0 – 50	0 – 80
Fitting Tube Size (OD)		¼" or 3/8"	3/8"	1/2"	3/4"	1"
Measurement Path ID in [mm]		4	6	10	15	20
Accuracy Flow Velocity < 1 m/s	Flow Range [lpm]	0 – 0.8	0 – 1.7	0 – 4.7	0 – 10.6	0 – 18.8
	Accuracy [lpm]	± 0.008	± 0 – 0.017	± 0.047	± 0.106	± 0.188
	Repeatability [lpm]	< 0.004	< 0.009	< 0.024	< 0.053	< 0.094
Accuracy Flow Velocity > 1 m/s	Flow Range [lpm]	0.8 – 4	1.7 – 8	4.7 – 20	10.6 – 50	18.8 – 80
	Accuracy of Reading	± 1%	± 1%	± 1%	± 1%	± 1%
	Repeatability of Read.	< 0.5%	< 0.5%	< 0.5%	< 0.5%	< 0.5%
Wetted Surface Area [cm ²]		38.3	59.0 (for 3/8")	61.7	87.5	233.1
Weight [g]		97	95	115	150	180
Pressure Drop Coefficient C $\Delta P = C \times Q^2$, (for water) Q = Flow [l/min], ΔP = Press. Drop [kPa]		1.80 for 3/8" fitting 5.41 for 1/4" fitting	0.88	0.06	0.01	0.003
Fluid Temperature		Normal range: 10 – 90 °C (50 – 194 °F) Maximum Temperature: 160 °C (320 °F) ¹				
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				
Wet Materials		PFA				
Sensor Enclosure Classification		IP-65				
Cable Jacket Material		FEP (PVC on request and at minimum order quantities)				
Standard Cable Length		0.5m with extension cables for length variation (other length on request and at minimum order quantities)				
Electrical Connectors		SMB with protective PVDF cover (male with O-Ring, IP-65 protection)				

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

¹ The flow sensors LFS-04/08/20/50/80 are functionally tested up to 160 °C liquid temperature. However, no lifetime and MTBF data can be given for the high temperature range. Levitronix® rejects warranty for usage at liquid temperatures > 90 °C. For further specific information contact Levitronix®.

SPECIFICATIONS OF CONVERTERS

Characteristics	Single Channel Converter Type LFC-1C	6-Channel Converter Type LFC-6C
Power Supply Current / Start Current	24 VDC ± 10% 150 mA / 4.4 A, 2 ms max.	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)	0 – 50 °C (32 – 122 °F) 30 - 85% R.H. (no condensation)
Enclosure Classification and Material	IP-20 (indoor use), ABS	IP-20 (indoor use), ABS
Interfaces (see Figure 9 and Figure 11 for detailed PIN designation and electrical specification)	- RS485 -> MODBUS protocol -> max. array of 99 chan. - 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	- RS485 -> MODBUS protocol -> max. array of 99 chan. - stacking of max. 16 converters -> 5 ms DSP process/time per channel - 4 Digit Display (flow rate a. 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	Viscosity, Low Cutoff, Dampening constant (filter) Full scale setting, Linearization (15 points) Alarm settings (High and Low Flow Alarm) Volume counter and Volume counter Alarm settings
Weight	130 g	170 g
Dimensions	123 x 75 x 17.5 mm (see Figure 9 for details)	139 x 75 x 17.5 (see Figure 10 for details)
Mounting	DIN rail	DIN rail

Table 2: Specifications of converters

**Levitronix® Ultrasonic Flowmeters
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DIMENSIONS OF SENSORS

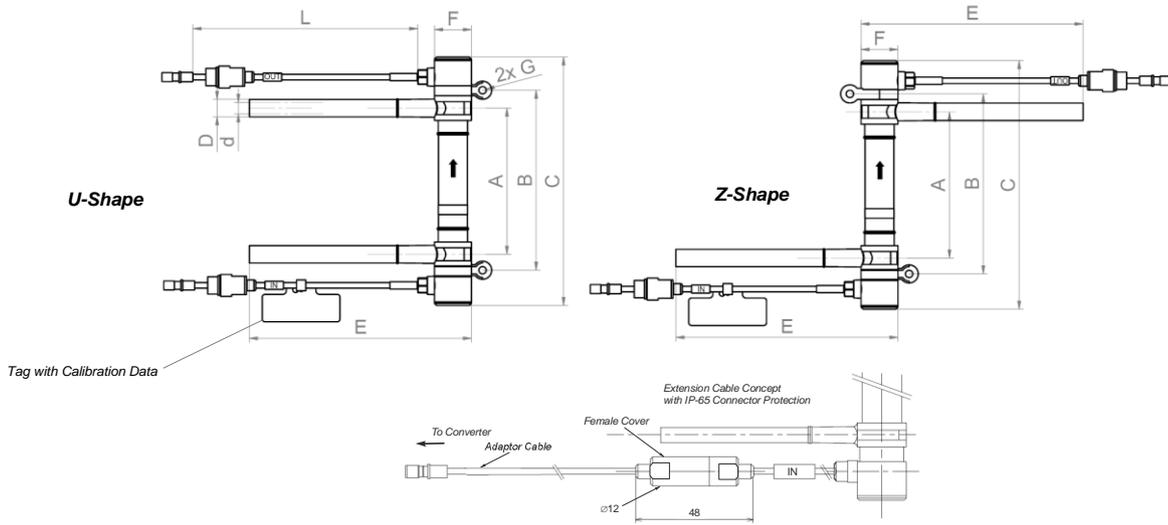


Figure 7: Dimension legend for LFS-04 and LFS-08 sensors -> left: U-shape, right: Z-shape

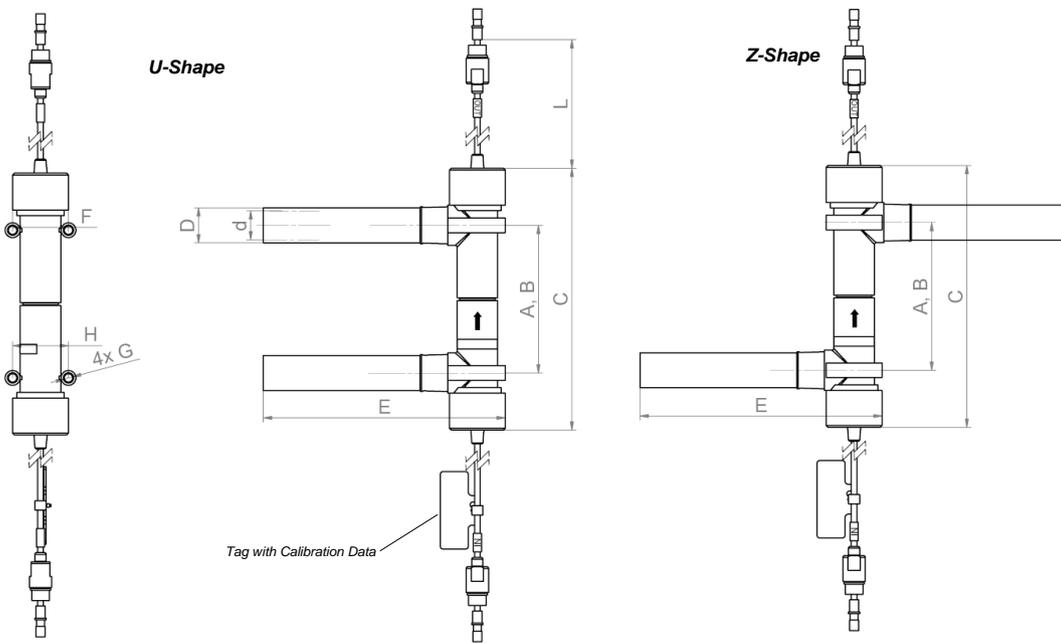
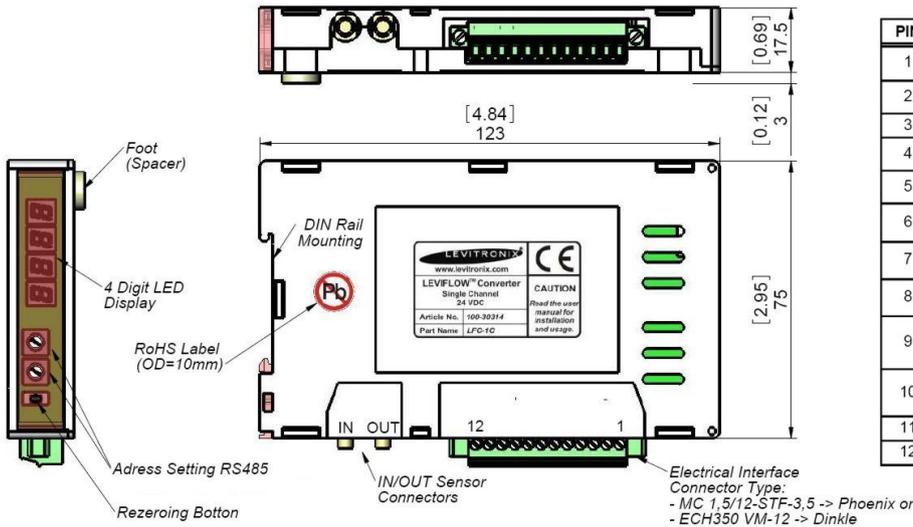


Figure 8: Dimension legend for flow sensors LFS-20, LFS-50 and LFS-80 -> left: U-shape, right: Z-shape

Sensor Type	Tube Size	Dimensions in [mm]									
		A	B	C	D	d	E	F	G	H	L
LFS-04	3/8" 1/4"	80 ±1	98.5 ±1 96 ±1	136 ±1 134 ±1	9.53 6.35	6.33 4.35	120	φ20	φ4	--	500
LFS-08	3/8"	80 ±1	98.5 ±1	136 ±1	9.53	6.33	120	φ20	φ4	--	500
LFS-20	1/2"	80 ±1	80 ±1	136 ±1	12.7	9.5	120	φ30	M4 x 31 for U-shape M4 x 30 for Z-shape	25	500
LFS-50	3/4"	80 ±1	80 ±1	141.8 ±1	19	15.8	130	φ30	M5 x 31 for U-shape M5 x 30 for Z-shape	30	500
LFS-80	1"	80 ±1	80 ±1	148 ±1	25.4	22.2	140	φ30	M4 x 34 for U-shape M4 x 30 for Z-shape	35	500

Table 3: Sensor dimensions

DIMENSIONS OF CONVERTERS



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
5	Analog Out -	(0 - 20 mA configurable) 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

Figure 9: Dimensions and layout of interfaces of single channel converter LFC-1C

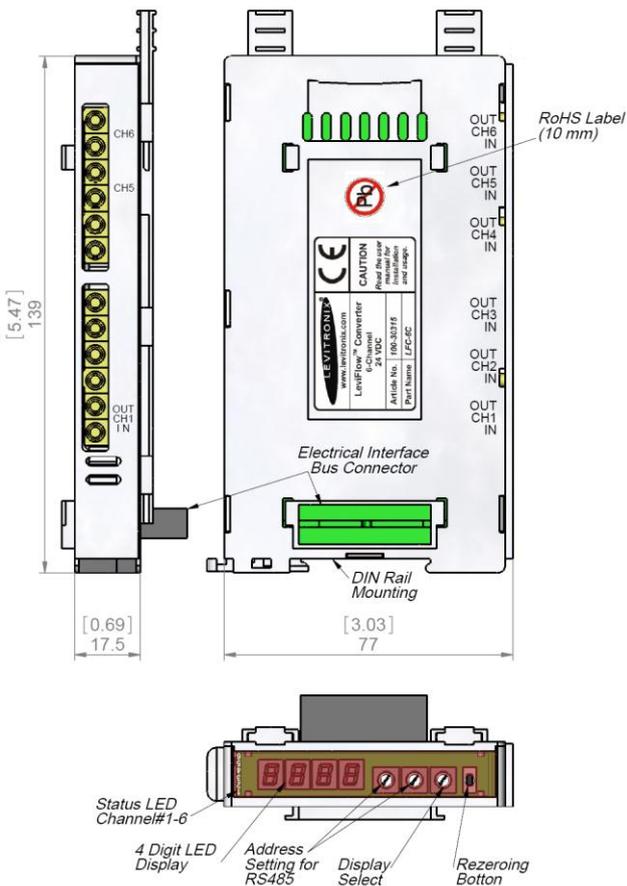


Figure 10: Dimensions 6-channel converter LFC-6C

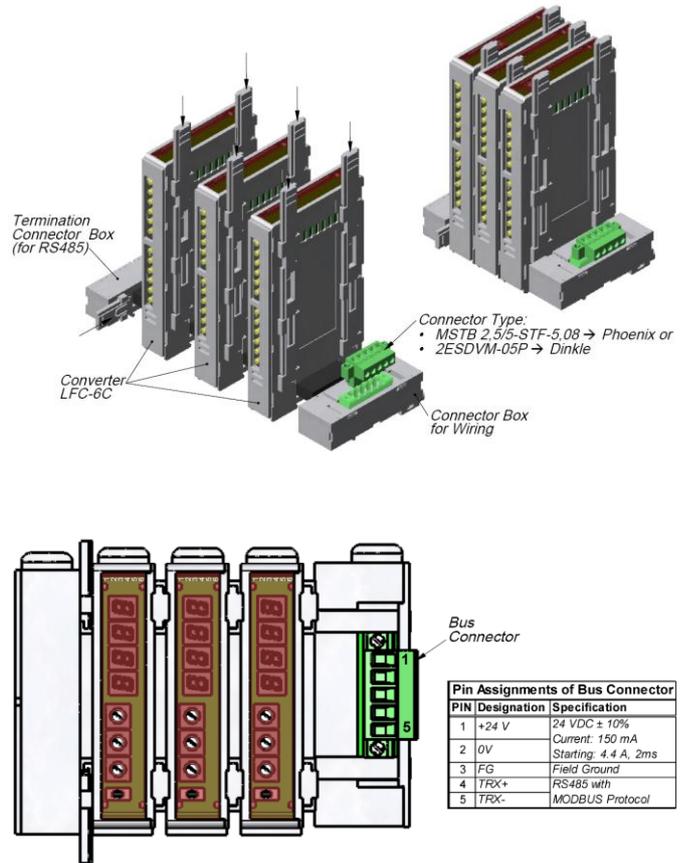


Figure 11: Mounting and stacking concept for converter LFC-6C

PIN	Designation	Specification
1	+24 V	24 VDC ± 10% Current: 150 mA
2	0V	Starting: 4.4 A, 2ms
3	FG	Field Ground
4	TRX+	RS485 with
5	TRX-	MODBUS Protocol

ORDER INFORMATION



Figure 12: LEVIFLOW® flowmeter components

Pos.	Part Name	Part #	Shape	Flow	Fitting	Cable Jacket	Cable Length	Special Feature	Note
1a	LFS-04-Z	100-30304	Z	0 – 4 lpm	3/8"	FEP	0.5 m	PVDF male connector cover	Sensor specific parameter for converter calibration are delivered on a tag attached to the flowsensor.
	LFS-04-U	100-30305	U		3/8"				
	LFS-04-Z-T025	100-30321	Z		1/4"				
	LFS-04-U-T025	100-30322	U		1/4"				
	LFS-08-Z	100-30306	Z		3/8"				
1b	LFS-08-U	100-30307	U	0 – 8 lpm	3/8"				
1c	LFS-20-Z	100-30308	Z	0 – 20 lpm	1/2"				
	LFS-20-U	100-30309	U						
1d	LFS-50-Z	100-30310	Z	0 – 50 lpm	3/4"				
	LFS-50-U	100-30311	U						
1e	LFS-80-Z	100-30312	Z	0 – 80 lpm	1"				
	LFS-80-U	100-30313	U						

Table 4: Standard flow sensor configurations

Pos.	Article Name	Part #	Description	Interfaces
2	LFC-1C	100-30314	Single Channel Converter	Analog Output (4 – 20 mA), 2x Digital Output, 1x Digital Input, RS485 (MODBUS) protocol
3	LFC-6C	100-30315	6-Channel Converter	- RS485 (MODBUS) protocol - Note: Connector box and Termination Box to be ordered as separate article (see Table 6)

Table 5: LEVIFLOW® converters

Pos.	Article Name	Part #	Features	Special Feature / Description
4a	LFE-A.1-10	190-10162	Cable length: 1 m, PVC	- PVDF female connector cover for IP-65 chemical protection - Flame retardant PVC white (UL VW-1 corresponds to EN-60332-1-2)
	LFE-A.1-30	190-10163	Cable length: 3 m, PVC	
	LFE-A.1-60	190-10164	Cable length: 6 m, PVC	
4b	LFE-A.2-10	190-10165	Cable length 1 m, FEP	- PVDF female connector cover for IP-65 chemical protection
	LFE-A.2-30	190-10166	Cable length 3 m, FEP	
	LFE-A.2-60	190-10167	Cable length 6 m, FEP	
5a	Connector Box for LFC-6C	100-30316	COMBICON connector	Is needed for wiring stacks of LFC-6C converters
5b	Termination Box for LFC-6C	100-30317	--	Is needed for termination of RS485 bus
6	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 6: Accessories

Pos.	Part Name	Part #]	Flow Sensor	Flow	Fitting	Cable Jacket	Sensor Cable Length	Converter	Note
7a	LFS-04-Z+LFC-1C	100-90604	LFS-04-Z	0 – 4 lpm	3/8"	FEP	0.5 m	LFC-1C	Converter is delivered with sensor specific calibration parameters. Extension cables to be ordered as separate article with specified length (see Table 6)
	LFS-04-U+LFC-1C	100-90605	LFS-04-U		3/8"				
	LFS-04-Z-T025+LFC-1C	100-90627	LFS-04-Z-T025		1/4"				
	LFS-04-U-T025+LFC-1C	100-90628	LFS-04-U-T025		1/4"				
	LFS-08-Z+LFC-1C	100-90606	LFS-08-Z		3/8"				
7b	LFS-08-U+LFC-1C	100-90607	LFS-08-U	0 – 8 lpm	3/8"				
7c	LFS-20-Z+LFC-1C	100-90608	LFS-20-Z	0 – 20 lpm	1/2"				
	LFS-20-U+LFC-1C	100-90609	LFS-20-U						
7d	LFS-50-Z+LFC-1C	100-90621	LFS-50-Z	0 – 50 lpm	3/4"				
	LFS-50-U+LFC-1C	100-90622	LFS-50-U						
7e	LFS-80-Z+LFC-1C	100-90623	LFS-80-Z	0 – 80 lpm	1"				
	LFS-80-U+LFC-1C	100-90624	LFS-80-U						

Table 7: Flowmeter sets – flowsensor with converters LFC-1C (sets with 6 channel converter LFC-6C on request)

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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