LEVIFLOW® Ultrasonic Technology
Clamp-On Flowmeter D-Series for Flexible Tubing

LFSC-D Clamp-On Flowmeters

LFSC-05D: 1/8x1/4”, 1 l/min

LFSC-08D: 1/4x3/8”, 4 l/min

LFSC-12D: 3/8x9/16”, 20 l/min

LFSC-22D: 3/4x1”, 80 l/min

LFSC-30D: 1x1 3/8”, 160 l/min

Ultraclean Non-Invasive Flow Measurement

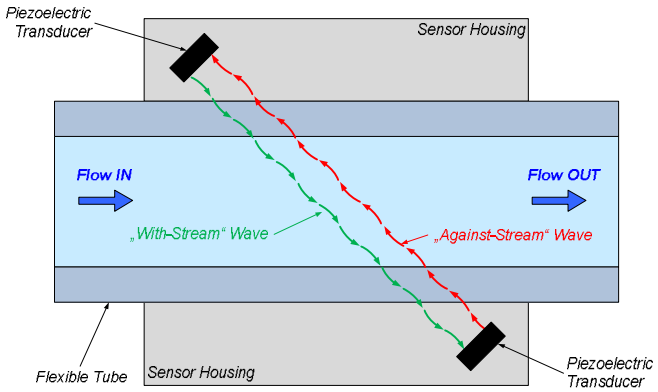


Figure 1: *Operating principle of ultrasonic clamp-on flow sensor (D-series)*

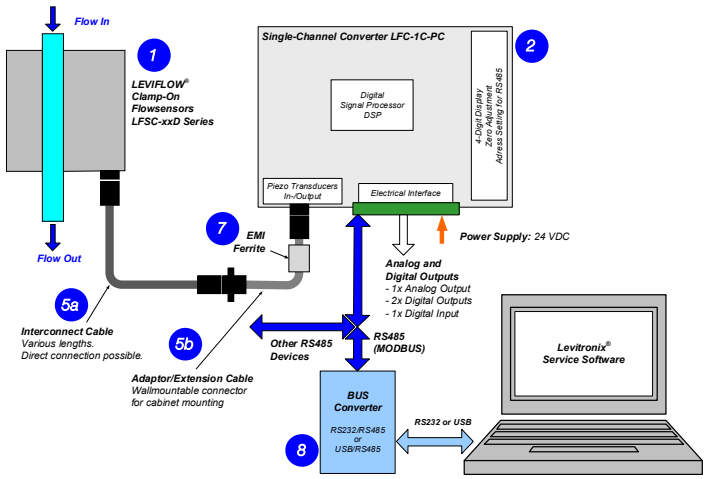


Figure 2: *Single channel system configuration for usage with Levitronix® Service Software (see order info. for article description)*

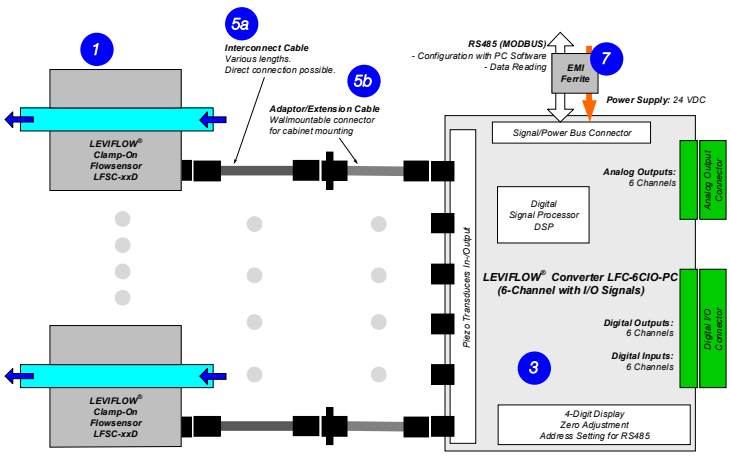


Figure 3: *System configuration for usage with Levitronix® Service Software (see order info. for article description)*

INTRODUCTION

The *LEVIFLOW®* clamp-on flowmeters are designed for non-invasive flow measurements of high purity fluids with flexible tubing. *Figure 1* illustrates the operating principle. Two piezo-electric transducers, mounted in the sensor housing, generate and receive an ultrasonic wave. The wave going in direction of the flow (with-stream wave) is accelerated and the wave going against the flow direction (against-stream wave) is slowed down. The two waves are processed by a signal converter. The difference of the transit time of both waves is proportional to the velocity of the fluid.

The standard configuration of the *LEVIFLOW®* clamp-on flowmeters (*Figure 2*) consists of a flow sensor and a converter with a digital signal processor (DSP) for processing the sensor signals. The clamp on flowmeters can measure a flow up to 80 l/min. Various signals (analog output, digital input/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 debugging, data collection and configuration with a PC the *Levitronix® Service Software* is available at *Levitronix®* together with a USB to RS485 adaptor (see *Figure 3*).

SYSTEM BENEFITS

- No contamination due to non-invasive flow measurement
- No moving parts -> no particle generation
- Low disposable cost (tubing cost only) with reusable sensor
- Improved bubble robustness due to DSP technology
- Flow control together with *Levitronix®* MagLev Pumps
- Easy integration into OEM equipment
- Easy configurable flow sensor parameters (PC software)
- Low pressure loss
- Integrated and configurable totalizer function

APPLICATIONS

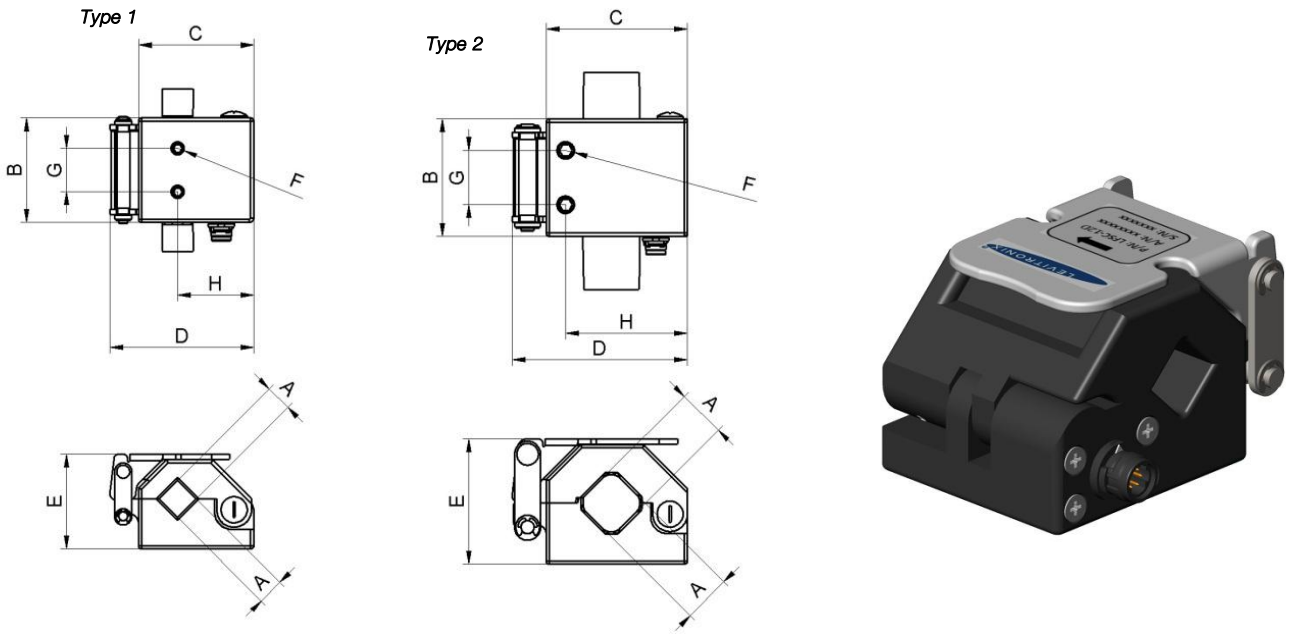
- High purity liquid processes
- Sterile non-invasive flow measurement in Pharmaceutical manufacturing
- Biotech processes
- Flow control in combination with *Levitronix®* MagLev pump systems
- Single-use disposable applications

SENSOR SPECIFICATIONS

Characteristics		LFSC-05D	LFSC-08D	LFSC-12D	LFSC-22D	LFSC-30D
Flow Range [l/min]		0 – 1 l/min	0 – 4 l/min	0 – 20 l/min	0 – 80 l/min	0 – 160 l/min
Accuracy of Reading (Tubing variation not included.)		±5 % for > 25% of FS ±12.5 ml/min for < 25% of FS	±3 % for > 15% of FS ±18 ml/min for < 15% of FS	±3 % for > 15% of FS ±90 ml/min for < 15% of FS	±3 % for > 15% of FS ±360 ml/min for < 15% of FS	±3 % for > 15% of FS ±720 ml/min for < 15% of FS
Weight		212 g	211 g	208 g	327 g	502 g
Maximum Fluid Pressure (max. pressure of tube might limit this value)		6.5 bar	6.5 bar	6.5 bar	4 bar	3 bar
Pressure Drop Coefficient C [2] $\Delta P = C \times Q^2$, (for water), Q = Flow [l/min] ΔP = Press. Drop [kPa = 10 mbar]		4.16 at 20°C 3.77 at 37°C	0.0743 at 20°C 0.0675 at 37°C	0.00725 at 20°C 0.00658 at 37°C	$1.49\ 10^{-4}$ at 20°C $1.34\ 10^{-4}$ at 37°C	$3.9\ 10^{-5}$ at 20°C $3.5\ 10^{-5}$ at 37°C
Usable Flexible Tubing Dimensions	ID	1/8" = 3.2 mm	1/4" = 6.4 mm	3/8" = 9.5mm	3/4" = 19.05 mm	1" = 25.4 mm
	OD	1/4" = 6.4 mm	3/8" = 9.6 mm	9/16" = 14.3mm	1" = 25.4 mm	13/8" = 34.9 mm
	Wall thickness	1/16" = 1.6 mm	1/16" = 1.6 mm	3/32" = 2.4 mm	1/8" = 3.2 mm	3/16" = 4.8 mm
Standard Tube Material		Saint Gobain C-Flex® [1] (374, 072 and 082) and Silicone (Pharma 50, 65 and 80)				
Fluid Temperature		Normal range: 10 – 60 °C (50 – 140 °F)				
Ambient Temperature		0 – 40 °C (32 - 104 °F)				
Kinematic Viscosity		0.7 – 10 mm^2/s (0.7 – 10 cSt)				
Sound Speed		1300 – 1700 m/s (others on request)				
IP Classification		IP-65				
Allowed Cleaning		Wiping with IPA or water				
Electrical Connector		Circular type (IP-67), lock-release mounting				
Cables		Various extension cables available.				

Table 1: *Specifications of flow sensors (all data based on calibration with water at 20 or 37 °C with zeroing after clamping)*

1: C-Flex® is a registered trademark of Saint Gobain Performance Plastics, 2015. All rights reserved. 2: Pressure coefficient based on calculations and accounts for the clamp length only.

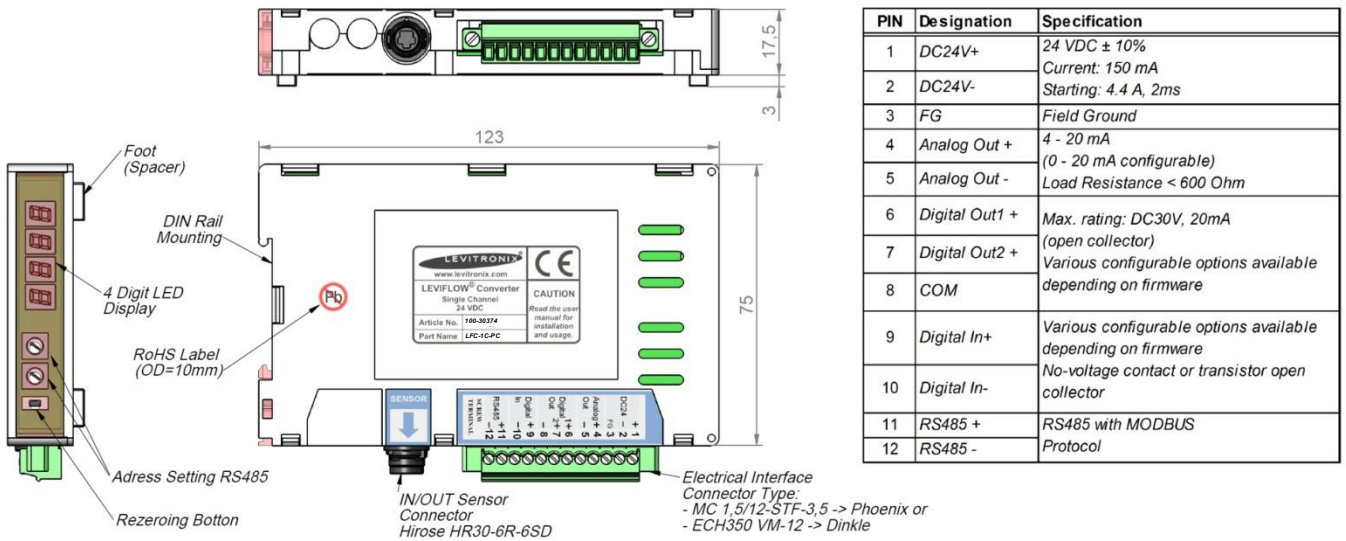


Sensor Type	Type	Dimensions in [mm] A	B	C	D	E	F	G	H
LFSC-05D	2	5.7	48	54	67.2	44.5	M6 x 6	20	35
LFSC-08D	2	8	48	54	67.2	44.5	M6 x 6	20	35
LFSC-12D	1	12	48	54	67.2	44.5	M6 x 6	20	35
LFSC-22D	2	22	54	65	80.7	57.5	M8 x 10	25	56
LFSC-30D	2	29.5	54	85.5	102.1	79.8	M8 x 10	25	30

Figure 4: *Dimensions for LFSC-D clamp-on flow sensors*

Characteristics	Single Channel Converter Type *LFC-1C-PC*
Power Supply Current / Inrush (Start-Up) Current	24 VDC ± 10% 150 mA / 3.8 A during < 210 µs
Ambient Temp Humidity Range	0 – 40 °C (32 – 104 °F) 30 - 85% R.H. (no condensation)
Enclosure Classification and Material	IP-20 (indoor use), ABS
Interfaces (See Figure 5 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 service software)	Viscosity, Low Cutoff, Dampening constant (filter) Full scale setting, Linearization (15 points), Alarm Outputs (High and Low Alarm) Volume Counter Settings
Weight	130 g
Dimensions	123 x 75 x 17.5 mm (see *Figure 5* for details)
Mounting	DIN rail

Table 2: *Specification of converter LFC-1C-PC*



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

Figure 5: *Dimensions and layout of interfaces of single channel converter LFC-1C-PC*

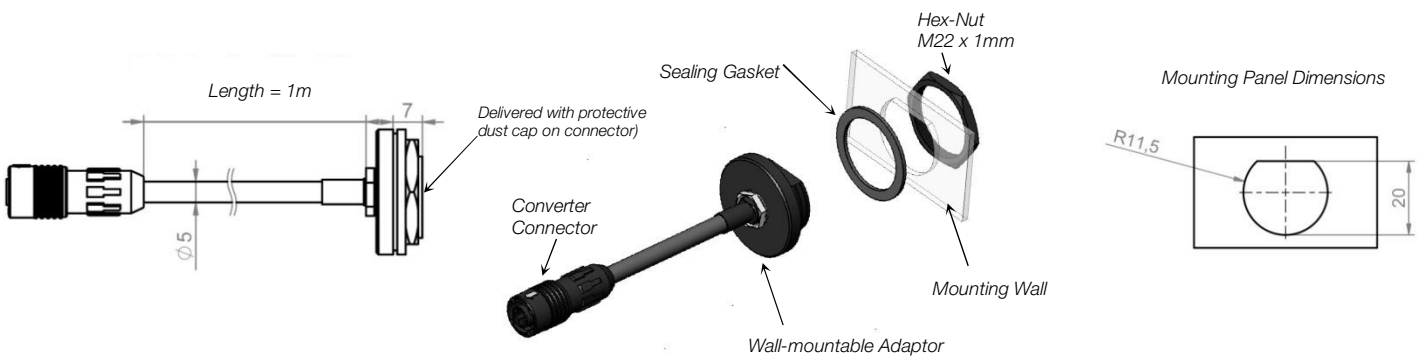


Figure 6: *Dimensions of wall mountable extension cables LFE-C.2*

CONVERTER AND CABLE SPECIFICATIONS

Characteristics	6-Channel Converter Type *LFC-6CIO-PC*
Power Supply / Current / In-Rush (Start) Current	24 VDC ± 10% / 270 mA / Peak 4.9 within 210 µs
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	- RS485 -> MODBUS protocol -> max. array of 99 ch. - Stacking of max. 16 converters -> 5 ms DSP process/time per channel - 4 Digit display (flow rate, error codes), re-zero button - Address potentiometers for RS485 address setting - 6x Analog Outputs: 4 – 20mA (0 – 20mA configurable) - 6x Digital Outputs: Flow Alarm, Measurement Error, Volume Counter Pulse, Volume Counter Alarm, Flow as Frequency or Bubble Detection (default: normally open) - 6x Digital Input: Volume Counter Reset or Zero Adjust
Configuration Parameters (Available and configurable with RS485/USB converter and service software)	- Viscosity - Low Cutoff - Dampening constant (filter) - Full scale setting - Linearization (15 points) - Alarm Outputs (High and Low Alarm) - Volume Counter and Volume Counter Alarm Settings
Weight / Dimensions / Mounting	215 g / 140 x 77.3 x 20.5 mm / DIN rail

Table 3: *Specifications for multi-channel converter LFC-6CIO-PC*

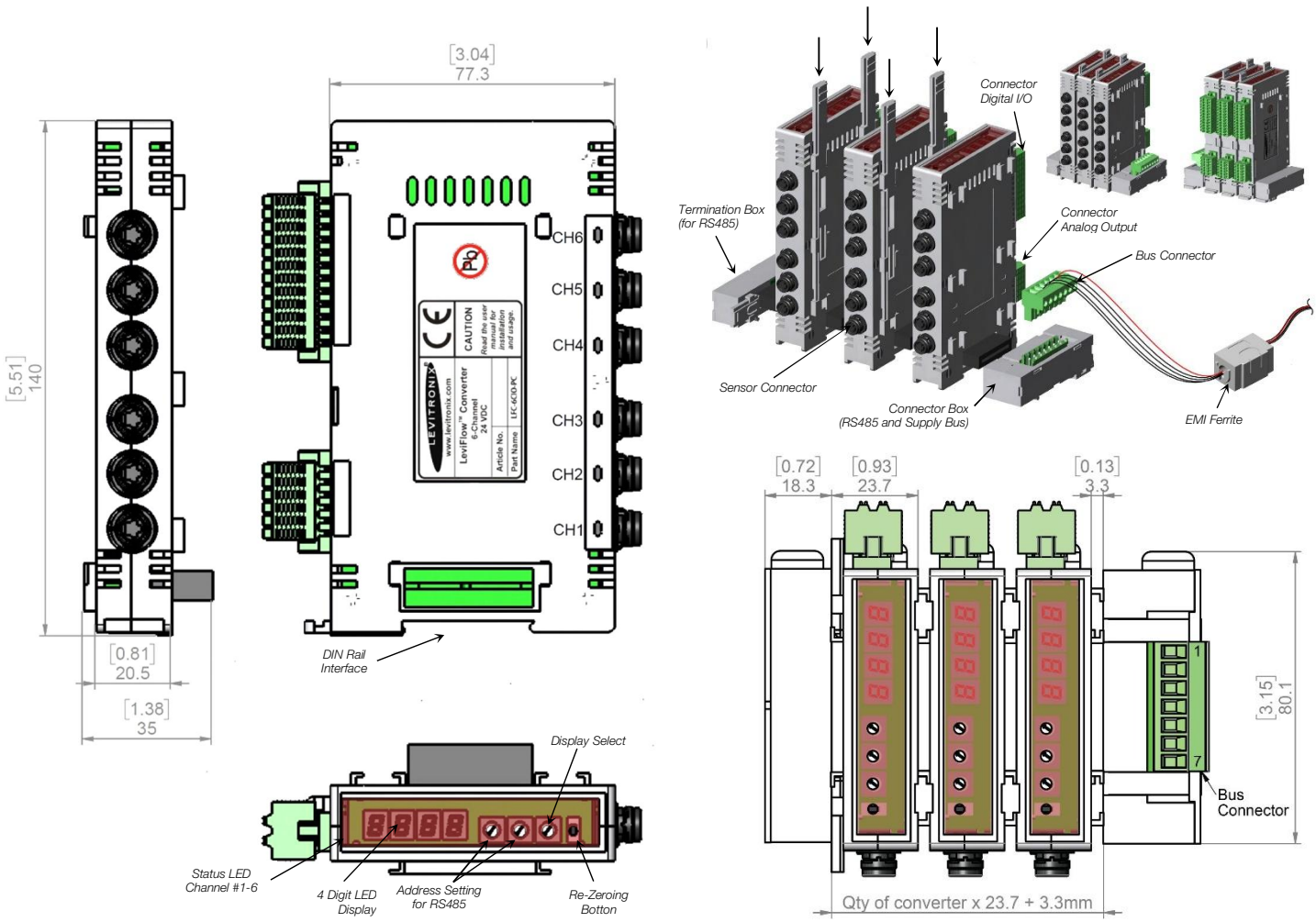


Figure 7: *Dimensions, mounting and stacking concept of LFC-6CIO-PC*

ORDER INFORMATION

Pos.	Part Name	Article #	Tube: ID x OD	Flow Range	Connector	Calibration Set	Note
1a	LFSC-05D-001	100-30407	ID = 1/8"= 3.2 mm OD = 1/4"= 6.4 mm	1 lpm	Circular Hirose	Water @ 20°C and 37°C Silicone and C-Flex®	Default activated calibration set is Silicone at 37°C water temperature. Other parameter sets can be chosen *with Levitronix® Service Software*.
1b	LFSC-08D-001	100-30396	ID = 1/4"= 6.4 mm OD = 3/8"= 9.6 mm	4 lpm			
1c	LFSC-12D-007	100-30390	ID = 3/8"=9.5 mm OD = 9/16"=14.7 mm	20 lpm			
1d	LFSC-22D-005	100-30391	ID = 3/4"=19.05 mm OD = 1"=25.4 mm	80 lpm			
1e	LFSC-30D-001	100-30414	ID = 1"=25.4 mm OD = 13/8"=34.9 mm	160 lpm			

Table 4: *Standard flow sensor configurations (others on request)*

Pos.	Part Name	Article #	Description	Interfaces
2a (A+6)	LFC-1C-PC	100-30374	Single Channel Converter	Analog Output (4 – 20 mA), 2x Digital Output, 1x Digital Input, RS485 (MODBUS) protocol *Note: EMI ferrite (6) for flow sensor cable and signal connector (A) included in converter package.*
3 (A+B)	LFC-6CIO-PC	100-30446	6-Channel Converter with I/O Interfaces (Digital I/O connector A and analog output connector B included)	RS485 (MODBUS) protocol 6 analog outputs (4 – 20 mA), 6 digital inputs, 6 digital outputs Order Bus Conn. (6a) and Termination Box (6b) as separate article (see *Table 6*) *Note 1: EMI ferrite (6) for bus connector to be ordered as separate article (see Table 6). When stacking multiple converters EMI ferrite (6) is needed for every sensor cable (see manual for details).* *Note 2: Firmware Ver08 or higher is needed to run with the LFSC-D family for flexible tubings.*
4 (A-H)	LFC-1C-PC-SK	100-91072	Converter Starter Kit	Flow converter LFC-1C-PC (A) with Ferrite (B), AC/DC desktop supply (C) with international AC mains inserts, sensor cable LFI-C.1-30 (D), converter connection cable LFI-D.1 (E), RS485/USB cable YN-485I-TR (F), USB stick with Levitronix Service Software and product Literature (G).

Table 5: *LEVIFLOW® converter for clamp-on sensor*

Pos.	Part Name	Article #	Features	Special Feature / Description
5a	LFI-C.1-10 LFI-C.1-30 LFI-C.1-60	190-10307 190-10308 190-10309	Cable length: 1 m, PVC Cable length: 3 m, PVC Cable length: 6 m, PVC	Interconnect cable for connection between sensor and converter.
5b	LFE-C.2-10 LFE-C.2-30 LFE-C.2-60	190-10310 190-10311 190-10312	Cable length: 1 m, PVC Cable length: 3 m, PVC Cable length: 6 m, PVC	Extension cable with wall-mountable connector for cabinet mounting. Delivered with protective dust cap on wall-mountable connector side.
6a	Connector Box for LFC-6CIO-PC	100-30447	COMBICON connector	For wiring RS485 and supply of stacks of LFC-6CIO-PC converter.
6b	Termination Box for LFC-6C	100-30317	--	For termination of RS485 bus of LFC-6CIO-PC.
7	LeviFlow Splitting Ferrite	100-30353	EMI filtering of DC supply	For LFC-6CIO-PC supply needed. On flow sensor cables needed in case of stacking of multiple converters.
8	YN-485I-TR, USB to RS485 Adaptor-TR Isolated	100-30392	Structure/Design 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. Included is a space saver cable (D). Communication over fieldbus of converter with PC.

Table 6: *Accessories*

Pos.	Part Name	Part #	Flow Range	Calibration Set	Note
9a	LFSC-05D-001+ LFC-1C-PC	100-91113	0 – 1 lpm	Water @ 20°C and 37°C Silicone and C-Flex®	Extension and interconnect cables to be ordered as separate article with specified length (see *Table 6*). Default activated calibration set is Silicone at 37°C water temperature.
9b	LFSC-08D-001+ LFC-1C-PC	100-91076	0 – 4 lpm		
9c	LFSC-12D-007+ LFC-1C-PC	100-91012	0 – 20 lpm		
9d	LFSC-22D-005 + LFC-1C-PC	100-91013	0 – 80 lpm		
9e	LFSC-30D-001 + LFC-1C-PC	100-91183	0 – 160 lpm		

Table 7: *Standard flowmeter sets – flow sensor with converter*

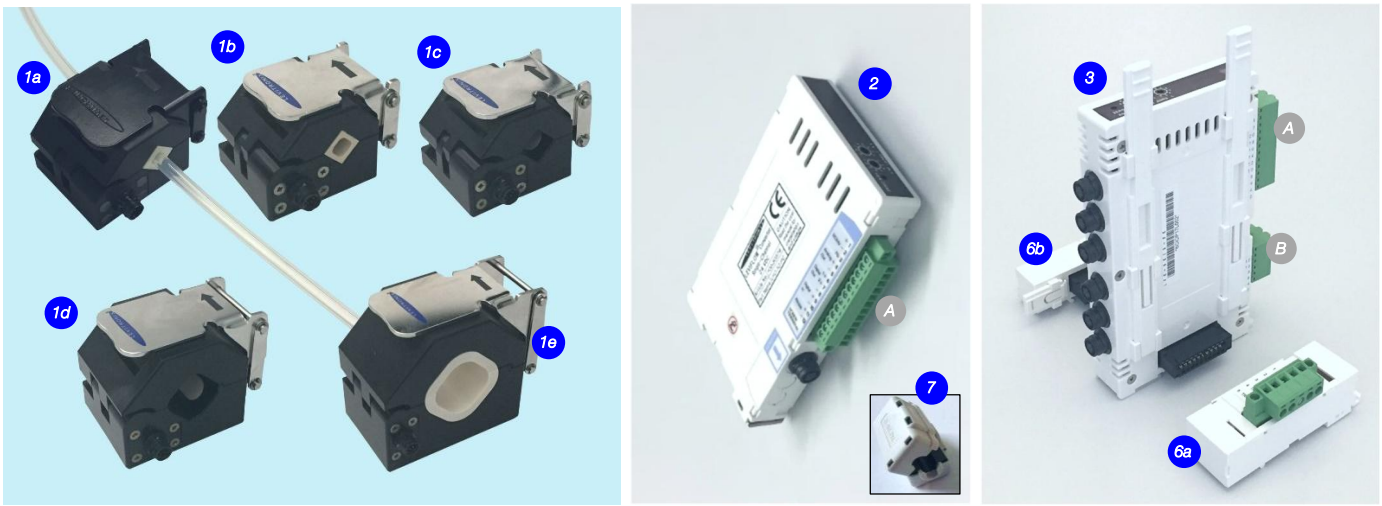


Figure 8: LEVIFLOW® flowmeter components

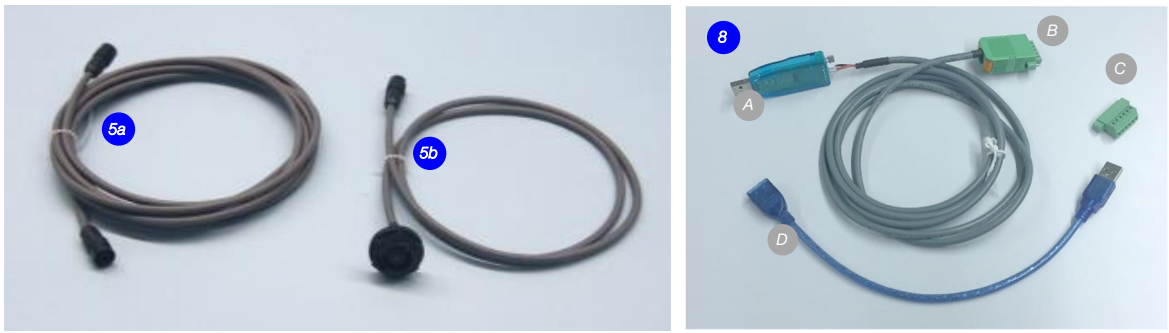


Figure 9: Accessories

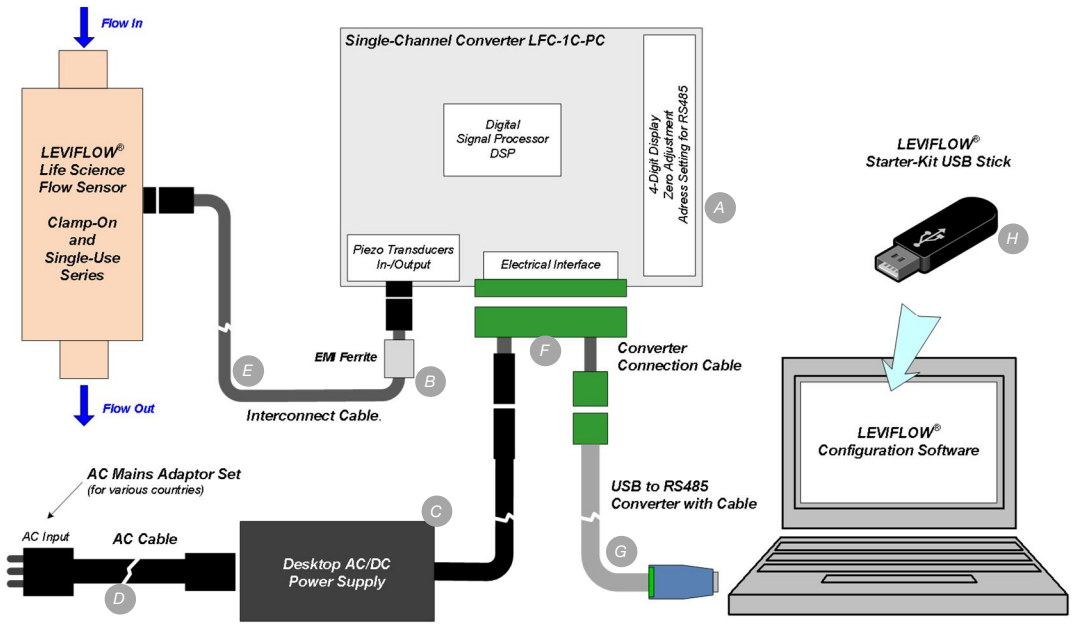


Figure 10: Converter starter kit (see Table 2 Position 4) with components

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 Lifescience 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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