Bubble Detection Sensor

Preliminary Data Sheet

IM-21LQ000BD

FEATURES

- Disposable, compact design
- Fast response to bubbles
- Low power
- High accuracy – low probability of missed bubbles
- Interface to existing control modules

APPLICATIONS

- Chemical Processing Equipment
- Pharmaceutical Instruments
- Food Processing
- Biotech analysis
- Air bubble, air-in-line, and end-of-sample sensing

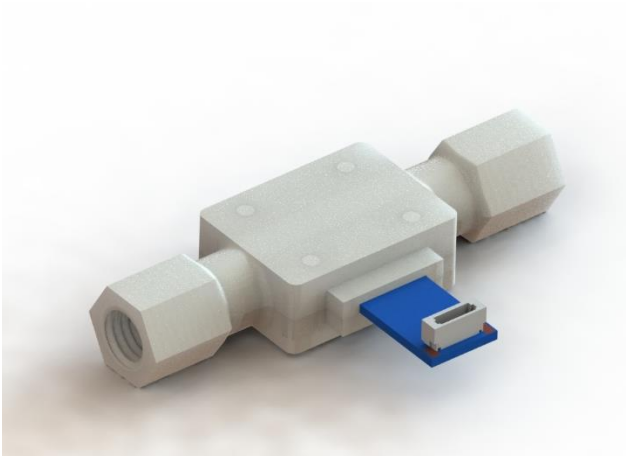

Fig 1. Sensor component

GENERAL DESCRIPTION

Instrumems flow sensing technology uses a revolutionary MEMS nanowire, which can be used as an air bubble detector. It is used to detect air or gas bubbles in plastic tubes filled with liquid and is intended to prevent air infusions. The sensor has an extremely low thermal mass, which gives the sensor a fast response time, low power consumption, and high accuracy.

Many of the variables affecting the accuracy of amplitude during continuous wave ultrasound are also eliminated. The sensor is in contact with the liquid delivering the lowest number of "missed" bubbles. The sensor is capable of measuring bubbles >50% tube diameter.

The sensor comes in a single-use format with an external electronics module. The electronics module connects to data acquisition systems as inputs to the overall control system.

Rev. A

Document Feedback

260 State St, Los Altos, CA 94022 U.S.A.

Technical Support **www.instrumems.com**

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REVISION HISTORY

04/2022 – Revision Pr A: Initial version

ORDERING GUIDE

Part number	Description
IM-21LQ000BD-1	Disposable bubble sensor
IM-21LQ000BD-2	Electronics module for disposable bubble sensor

SPECIFICATIONS

T_F = 10-50°C, T_A = 25°C, unless otherwise noted. T_A is the ambient temperature of the IM-21LQ000BD and reference circuit; T_F is the temperature of the fluid being measured.

Table 3. Fluidic Specifications and Connections

Parameter	Value	Unit
Wetted materials	UV cured SLA resin, epoxy-based adhesive	
Fluid connector ports (fittings)	UNF ¼"- 28 flat bottom	
Compatible fluid	Any non-corrosive liquid	
Recommended tubing ID	5	mm
Operating fluid temperature	10 – 50	°C
Pressure Drop	TBD	Pa
Temperature Increase at Output	<0.14°C @1ml/min	

Table 4. Mechanical specifications

Parameter	Value	Unit
Dimensions	49 x 29 x 9	mm
Inner diameter	5	mm
Tubing outer diameter	¼	in
Inner Channel Diameter	0.8	mm
Operating pressure	3	bar
Burst Pressure	5	bar

Table 5. Electronics specifications

Parameter	Value	Unit
Supply Voltage	5 – 15	V
Maximum Power consumption	15	mW
Digital Output	Open drain (Active Low)	
Pull up resistor (recommended min)	10k	Ω
Logic High	3.3 - 32	V
Logic Low	0 - 3.3	V
Operating temperature	10 – 50	°C
Response time	200	ns
Operation indicator	Blue LED indicates bubbles	
Analog output	0 – 3.3	V

Table 6. Absolute Maximum rating

Parameter	MIN	MAX	Unit
Sensor module			
Storage temperature	-20	+70	°C
ESD – human body model		±500	V
ESD- charge device model		±1000	V
Electronics module			
Supply Voltage	-0.3	+15	V
Digital I/O Voltage	-0.3	+40	V
Analog I/O Voltage	-0.3	+3.3V	V
Storage temperature	0	+70	°C
ESD – human body model		±8000	V
ESD – charge device model		±3000	V

Stresses at or above those listed under Absolute Maximum Ratings may cause permanent damage to the product. This is a stress rating only; functional operation of the product at these or any other conditions above those indicated in the operational section of this specification is not implied. Operation beyond the maximum operating conditions for extended periods may affect product reliability.

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

PIN ASSIGNMENTS AND THE PHYSICAL FORM FACTOR OF THE SENSOR

PIN ASSIGNMENTS

Fig 2. Pin configuration on the IM-21LQ000BD-2 module side of the 5-pin connector

Table 7. Pin Function Descriptions

Pin No.	Type	Description
1	INPUT/OUTPUT	Sensor 4-wire sensing (V_{sense})
2	INPUT/OUTPUT	Sensor 4-wire force (V_{force})
3	INPUT/OUTPUT	Sensor 4-wire force (V_{force})
4	INPUT/OUTPUT	Sensor 4-wire sensing (V_{sense})
5	RESERVED	

DRAWING AND DIMENSIONS OF SENSOR

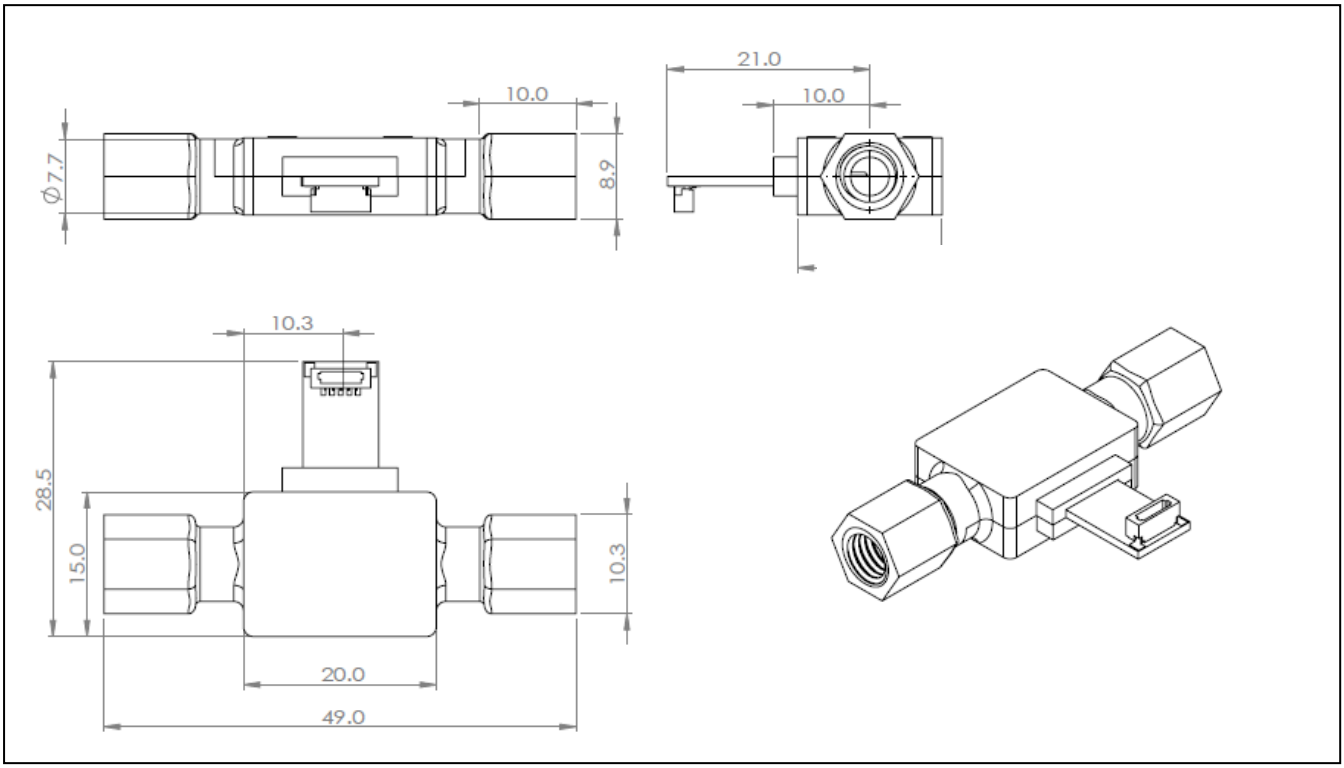

Fig 3. 3-view drawing and the dimensions of the sensor component. All dimensions in [mm]

SIMPLIFIED REFERENCE DESIGN SCHEMATIC

Fig. 4 shows the simplified schematic of the measurement circuit used for the flow sensor characterization.

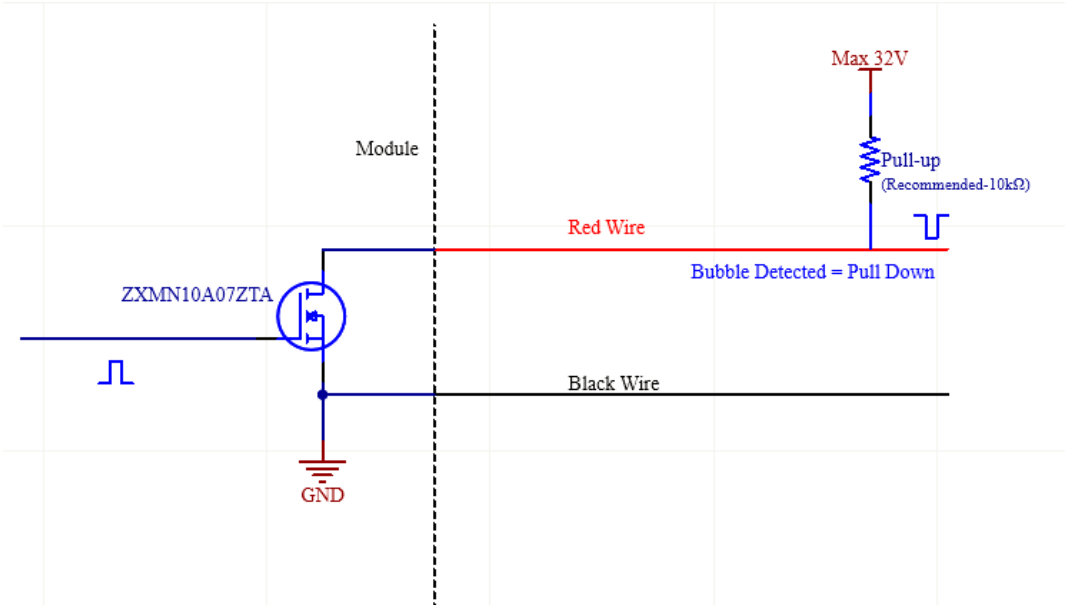

Fig 4. Simplified Schematic of Reference Measurement Circuit

Calibration – Initial

I. Power on the board with a supply voltage between 5 and 15 Volts. Ensure the Green LED turns ON.
II. Connect the Module to the sensor PCB using the sensor cable.
III. Connect an oscilloscope between the Analog Out pin & Ground
IV. Start liquid flow through the sensor
V. Turn the potentiometer (Clockwise to increase, anti-clockwise to reduce) to adjust the analog output level until it reaches 2.3 – 2.5 Volts. This potentiometer adjusts the wire temperature, which in turn can be used to change the output level.
- The threshold for bubble detection is set to 2.0 Volts. Every time the analog voltage falls below 2.0 volts, the digital output will change to LOW. By adjusting the output to 2.3Volts, we configure the system to signal an output whenever the analog output falls by 0.3 Volts.
- Typical dips in voltage for larger bubbles (bubbles that occupy the entire diameter of the tube) are around 0.5-1 Volts but will decrease with bubble size.
- Note that this output voltage will vary with flow and fluid temperature. It is recommended that the output is adjusted when the system is in flow, such that the threshold is kept at 0.3-0.5 volts below steady-state operating conditions.

Calibration – Temperature

Repeat the above calibration process for every time the fluid temperature changes more than +/- 2 degrees from the temperature during initial calibration.