

AD-102

High Resolution Bubble Detector



Features

- Bubble detection resolution of 25% of tubing inner diameter.
- Customizable tubing sizes between 3mm to 10mm, with 6mm as standard.
- Non-invasive design eliminates concerns related to sterility & fluid compatibility.
- High noise immunity to EMI/RFI
- On-demand self-test to verify functionality, preventing false positive readings.
- LED indication of sensor wet and dry state visible through housing.
- Compliance with ROHS Directive 2011/65/EU

Key Specifications

- Temperature Range: 5°C to +60°C
- Response Time: < 0.5ms
- Input: 5 ± 0.5VDC
- Output: 5V TTL
- Current Draw: 5mA typical, <10 mA

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AD-102

Compact sensor designed to detect air-in-line (AIL) with an industry leading bubble resolution of 25% tubing inner diameter.

High Resolution Air Bubble Detector (ABD)

In applications like infusion pumps, syringe pumps, hemodialysis or peritoneal dialysis systems, and blood flow monitoring, the accurate detection of bubbles is of utmost importance. TE Connectivity (TE) proudly introduces its cutting-edge AD-102 High-Resolution Air Bubble Detect (ABD) sensor, designed to set a new industry standard with an exceptional bubble resolution of 25% of the tube's inner diameter. This non-invasive device offers continuous monitoring of fluid to detect air bubbles effectively.

Employing advanced ultrasonic technology, the High-Resolution AD-102 sensor is capable of reliably identifying interruptions in liquid flow, regardless of the liquid type. It provides a robust solution for positively confirming the presence of any flow disruption, ensuring the utmost safety and precision in critical medical applications.

Applications

- Hemodialysis
- Infusion Pumps
- Syringe Pumps
- Cardiac Ablation
- Automated Immunoassay Analyzers
- Apheresis/Auto-Transfusion
- Semiconductor
- Blood Processing
- DNA Analysis
- Laboratory
- Pharmaceutical
- Chemical Analysis
- Food Processing
- 3D Printing

AD-102

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Absolute Maximum Ratings ⁽¹⁾

Parameter	Symbol	Min	Typ.	Max	Unit	Notes/Conditions
Supply voltage	VDD	4.5	5.0	5.5	V	Reference to Ground
Mounting screw torque	M _{fix}	-	8.0/1.65	-	Inch-Lbs./Nm	Recommend: #4-40 or M3 screws
Cable bend radius	R _{cable}	12.0			mm	-

Electrical and Performance Characteristics

Parameter	Symbol	Min	Typ.	Max	Unit	Notes/Conditions
Air Bubble Detector						
Signal TTL Output Dry	VTTL-H	4.0	5.0	-	V	-
Signal TTL Output Wet	VTTL-L	-	0.0	1.0	V	-
Self-Test Input	VTIN	4.5	5.0	5.5	V	Self-test on demand input voltage
Self-Test Output (normal)	VTO_NORM	-	0	0.3	V	Under wet condition, indicates normal condition
Self-Test Output (marginal)	VTO_MAR	1.0	1.25	1.5	V	Under wet condition, indicates marginal condition
Self-Test Output (marginal)	VTO_FAIL	2.0	2.5	2.7	V	Under wet condition, indicates failed condition
Operating Current	I	2.0	5.0	10.0	mA	-
Response Time	RT	0.1	0.3	0.5	msec	-
Minimum Detectable Bubble Size	%ID	20	25	25	Diameter (% Tube ID)	Tested at room temperature at 600 mL/min
Minimum Detectable Continuous Air Infusion	CA_RATE	0.4	0.5	-	mL/min	Test per IEC 60601-2-16: 201.12.4.4.105

Environmental Specifications

Parameter	Symbol	Min	Typ.	Max	Unit	Notes/Conditions
Operating temperature	T _o	0	-	+60	°C	Test per IEC 60068-2-14
Operating pressure	P _o	700	-	1060	hPa	-
Ingress protection	IP	-	IP53	-	-	-
Weight	W	-	-	60	g	-
Storage temperature	TSTO	-20	-	+70	°C	Test per IEC 60068-2-2 (Bb)
Storage humidity	HSTO	+20	-	+90	%RH	Test per IEC 60068-2-56 (Cb)
Shock limit	amax	-	-	10	g	Per IEC 60068-2-29 [R10]
ESD	ESD	-15	-	+15	kV	Per IEC 61000-4-2 Home Healthcare
EMC	EMC	-	Compliant	-	-	Per IEC 60601-1-2 Home Healthcare and IEC 61326-1 Industrial (cable length < 3m)

AD-102

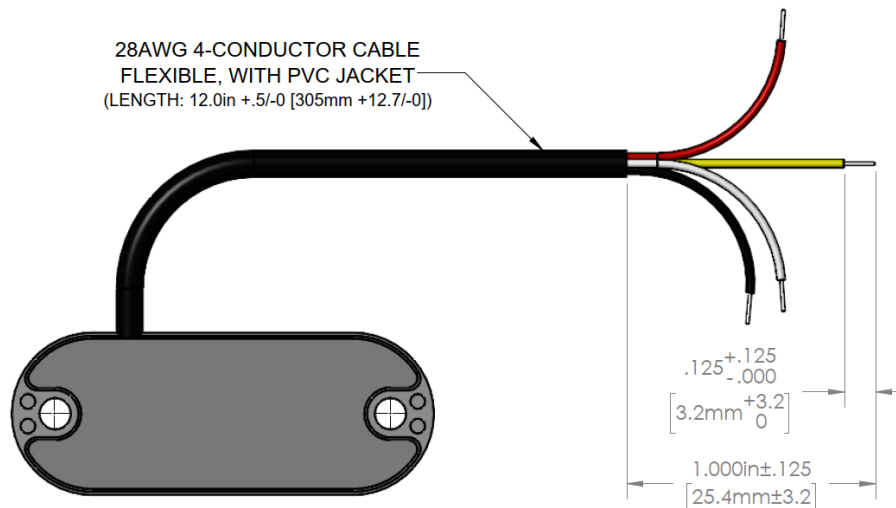
High Resolution Bubble Detector

Compliance Type	Notes/Conditions
RoHS Compliance	Under Review
REACH Compliance	Under Review

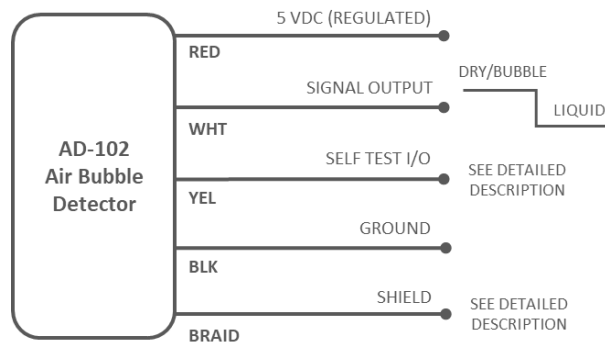
Please refer to TE.com for most up to date information.

Wire Configuration/Description

Wire Color	Function
BLACK	GND
WHITE	OUTPUT
YELLOW	SELF-TEST
RED	REGULATED 5 VDC NOMINAL

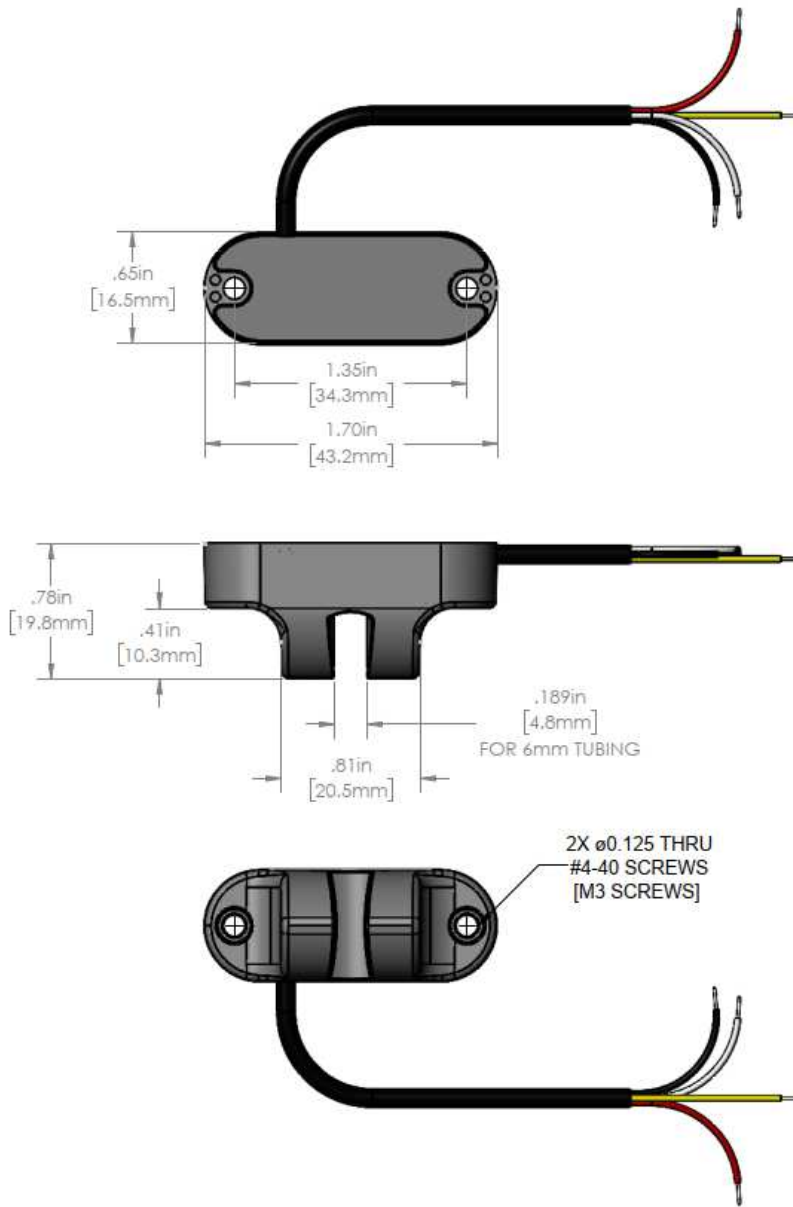


Block Diagram/Schematic



AD-102

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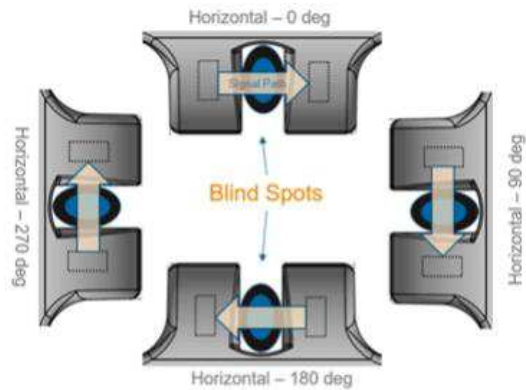
Detailed Description

Tubing: The AD-102 is designed to optimally function with compliant plastic tubing (such as silicon or plasticized PVC) where the inner diameter is equal to or less than half of the outer diameter. The sensor can function with tubing outside of these parameters but functional testing to verify performance limits is recommended.

Orientation: The AD-102 offers high resolution detection of small single bubbles and low continuous air infusion rates. To maximize performance, care should be taken in defining the orientation of the device within the system it is being installed if the tubing is horizontal. Buoyant air bubbles will tend to gravitate into blind spots for the sensor when oriented in the “horizontal 0 degree or horizontal 180 degree” position as shown in the figure below. As a result, sensors installed in those orientations will still be completely functional but may be unable to achieve the full stated bubble/continuous air detection resolution.

AD-102

High Resolution Bubble Detector

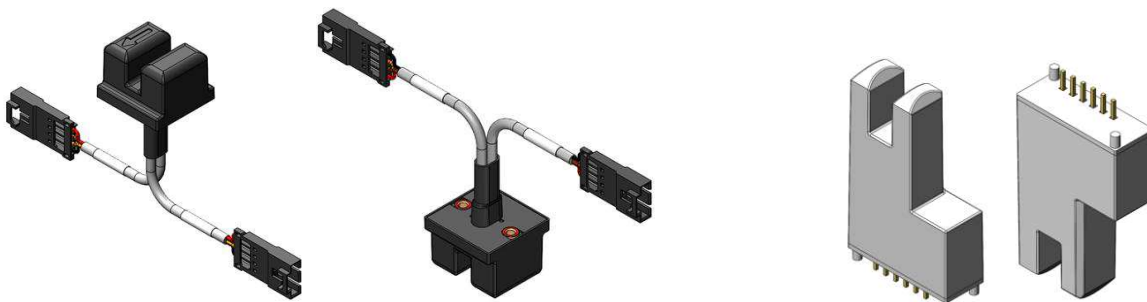


Horizontal Configuration Issue: Gravity causes bubble to "float" into blind spot at 0 and 180 degree. Increases Minimum detectable bubble size

Self-Test: The AD-102 offers some enhanced self-test capability via an input/output self-test line. When used as an input, the sensor works in a traditional self-test on demand mode. A 5V input signal will initiate a self-test operation forcing the signal output to a dry state (TTL High) indicating a self-test pass. If the device fails to indicate TTL High when self-test input is high, this constitutes a self-test failure and corrective/mitigation actions can be taken. Additionally, the self-test line also provides a continuous low-level output which provides continuous indication of the sensor state. With a liquid-filled tube installed, if the sensor is operating in a normal state, the self-test output is 0V. If there is any reduction in sensor performance (which could arise from internal sensor degradation, tube degradation, improper tube insertion, or other external factors), the self-test output will change to 1.25V which indicates a marginal state. In this state, the device is still fully functional, but performance levels have decreased to a point which indicates that some level of degradation has occurred and device failure may soon occur. If performance decreases beyond this point, particularly to a point where the device is not likely to function properly, the self-test output will change to 2.5V indicating that immediate action should be taken.

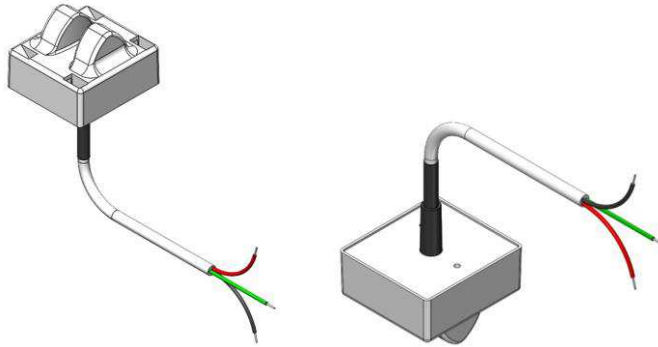
Braided Shield: To ensure full EMC compliance, the braided shield must be connected to either the negative power supply or directly to earth ground.

Customization: The performance capabilities described in this datasheet can also be integrated into other form factors/housing configurations. This may include alternate tubing diameters, different mounting features, and/or geometry modifications to meet space claim requirements. Additionally, interface modifications can be made such as cable connector terminations or thru-hole board mount pins integrated into the housing. Functionally, signal output types can be customized in addition to changes in bubble size detection limits/thresholds. Below are some examples of such customizations.



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Ordering Information

Description	Part Number
AD-102, 6mm	20019846-00

Revision History

Revision Number	Revision Date	Description	Pages Changed
		Initial release	-

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