



Malema Sensors M-2300 In-Line Ultrasonic  
Flow Meter

**User Manual**



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## Subject to Technical Changes

Owing to our policy of continuous product development, the illustrations and technical data contained in this document may differ slightly from the current version of the device.

## Legal Manufacturer

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## Certifications/Compliances

CE Compliance via the following testing:

1. EN61000-4-2: Electrostatic Discharge
2. EN61000-4-3: Radiated Immunity (and Radiated Emissions)
3. EN61000-4-4: Electrical Fast Transients
4. EN61000-4-5: Surge - Power Line
5. EN61000-4-6: Conducted Immunity

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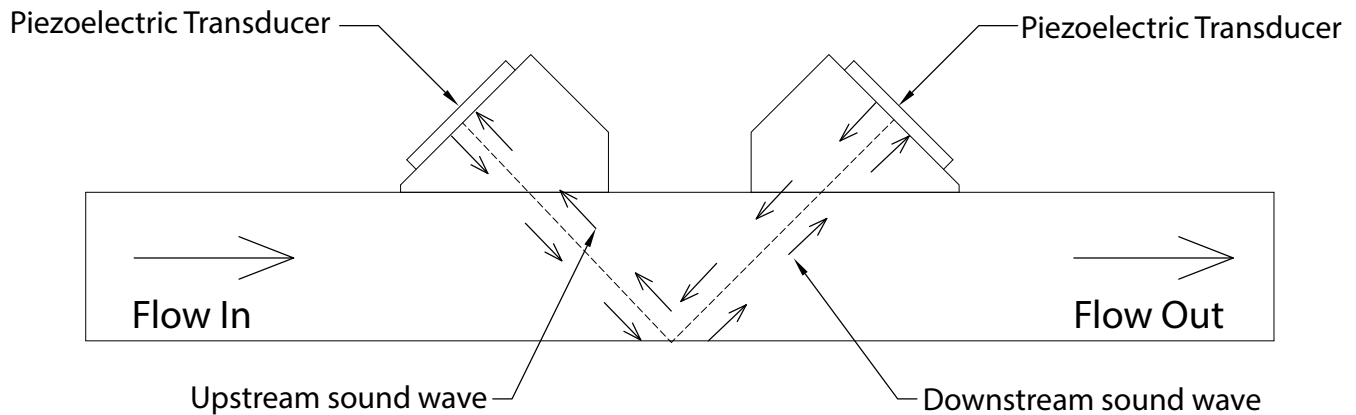
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# 1.00 Introduction

The Malema Sensors M-2300 Ultrasonic Transit Time flow measurement system is one of the most feature rich flow measuring devices in the market. The M-2300 improves efficiency and accuracy in your process. M-2300 is used in semiconductor and bioprocessing applications.

The Malema ultrasonic flow meter is designed to measure the fluid velocity of liquid within closed conduit (pipe). The design eliminates liquid contact to the transducers extending the life of the sensors. The two transducers are designed to sit at an angle to the flow path, functioning as both ultrasonic transmitters and receivers. The flow meter operates by alternately transmitting and receiving a frequency modulated burst of sound energy between the two transducers and measuring the time interval that it takes for the sound to travel between the two transducers. The fluid path is straight, without any intrusions in the flow path, eliminating pressure drops and turbulence caused by a sensor with a bent or partially obstructed flow path. The difference in the time interval measured is directly related to the velocity of the liquid in the pipe and is used to derive the flow rate.



## 1.01 Storage and Handling

### Storage conditions

The Malema Sensors M-2300 is shipped operational and packaged. The sensor must be stored free from moisture, mechanical shock, and vibration. Store the product under packed condition in an anti-static bag. The ambient temperature shall be between 0°C and 46°C and the humidity between 5% and 80% Relative Humidity (R.H.) without condensation.

### Unpacking and Product Inspection

On delivery, check the product for damage. Confirm that the model code on the label matches the specification in the purchase order.

## 2.00 Installation

The following must be considered when selecting the installation location of the flow sensor:

1. Ambient temperature: 0°C to 50°C (32°F to 122°F), protected from direct sunshine.
2. Free from electromagnetic interference. Keep away from such heavy inductive devices as motors, pumps, power-relays and solenoid valves.
3. The location must be protected from water jets or corrosive gases.
4. The location should allow easy access for maintenance.

### 2.01 Mounting of Flow Meter

Consider the following guidelines when selecting and installing Flow Meter for accurate measurement.

1. The Flow Meter should be mounted in an orientation and position in the fluid path to make sure bubble entrapment in the flow tube is avoided.
2. To install on pipe that has an open end, mounting should be at the lower position of pipeline.
3. The arrow on side plate of Flow Meter shows flow direction. Make sure the arrow matches the direction of flow.
4. Flow Meter should be mounted where pressure in the pipe is above atmospheric.
5. A flow control valve is recommended downstream of Flow Meter to prevent formation of bubbles in the liquid. An upstream valve may form bubbles: thus attenuating the ultrasound signal and resulting in measurement noise.
6. A bypass flow line (including bypass valve and shutoff valve) is recommended for easy zero adjustment and maintenance.
7. Take great care to avoid mechanical stress on the inlet and outlet pipes when mounting the Flow meter.

#### CAUTION

To avoid stress on the flow tube/housing interface, follow the precautions below:

- Tube should be held firmly while working on the hose barb fittings during installation.
- There should not be any relative displacement/movement between the tube and the housing at any point in time.

### 2.02 Start Up

Before initial process run, it is important to do preliminary checks of the M-2300 flow meter system to ensure accuracy. Upon start up the M-2300 flow meter must be equilibrated for about 30 minutes. No flow is required during initial 30 minute warm-up. Allow the liquid to flow through the Malema flow meter for about two minutes to equilibrate the system. It is important to "Zero Reset" the flow meter for each process run to ensure accurate flow measurement. Flow measurement is dependent upon the density of the liquid; therefore, the Malema flow meter must be recalibrated for each process run.

#### Preliminary Checks:

1. Make all the necessary electrical connections as per the connection details on Section "3.05 Connector or Mating Cable (Optional) Specification".
2. Ensure that the external power supply input Voltage rating is 24 V DC  $\pm$  10%, Current rating  $\geq$  300 mA.
3. Confirm that the Flow direction arrow on the flow meter points in the same direction as the physical flow direction.

#### Start Up Process:

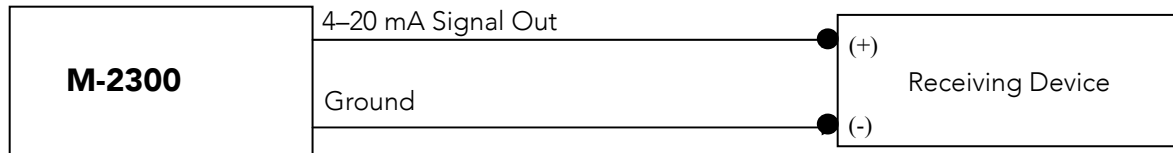
1. Turn on the power.
2. Please allow the instrument to warm up for about 30 minutes
3. Before initiating the Zero Reset, allow liquid to flow at a high flow rate ( $>$  50% of the full scale range) for at least 2 minutes.
4. Shut off the flow and verify that the flow tube is full of stationary liquid without bubbles.
5. Within 20 seconds from the time the flow is shut off, initiate Zero Reset by momentarily pulling up the Remote Zero In wire to 24 V DC (+) (or through the communication interface software, available on request).
6. The flow meter is now ready for making valid measurements.

**NOTE:** To read valid flow rates, Zero Reset needs to be done whenever the measurement fluid physical properties change.

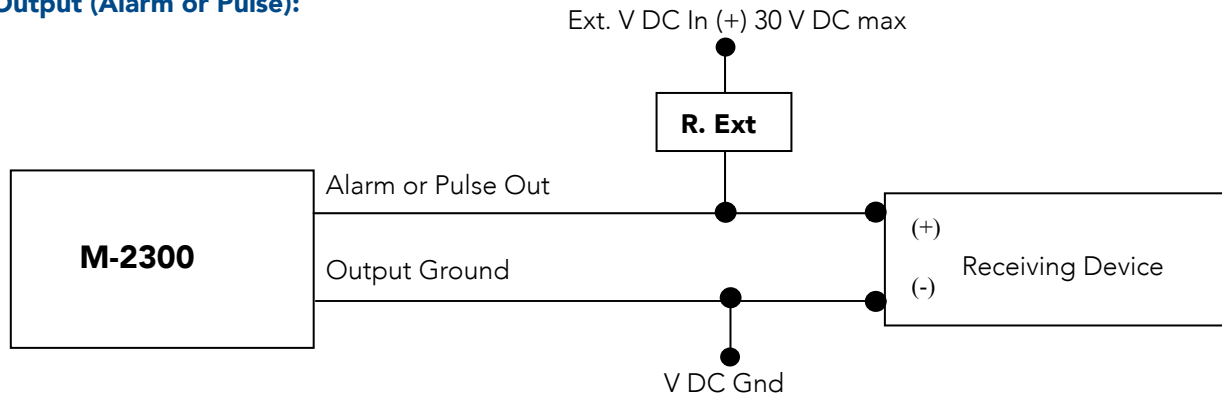
# 2.00 Installation

## 2.03 Electrical Wiring

### 4-20 mA Active Current Output:



### Digital Output (Alarm or Pulse):



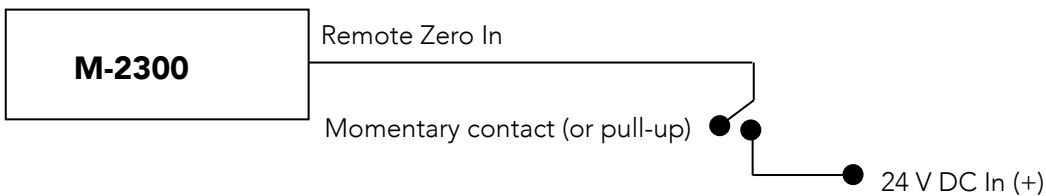
R. Ext is an external resistor.

Choose R. Ext so that the maximum current through the terminal does not exceed 200 mA.

R. Ext can be calculated as follows:

$$R. \text{ Ext (k}\Omega) = \text{Ext. V DC In} / \text{Max. Current (mA)}$$

### Remote Zero In:



# 3.00 Specification

## 3.01 Performance Specification

Table 1: Flow Range and Connecting Tube Size

Full Scale Flow Range (L/min)	Connection Tube Size
3 L/min	1/4"
8 L/min	3/8"
40 L/min	1/2"

Table 2: Accuracy and Repeatability

Accuracy	±1% F.S.
Repeatability	±0.5% F.S.

**NOTE:** Accuracy statement is based on a room temperature DIW calibration. Full Scale refers to values presented in "Table 1: Flow Range and Connecting Tube Size".

# 3.00 Specification

## 3.02 Material Specification

Part name	Material
Tube	PFA (AP-211SH)
Housing	PP
Cable Connector	SS
Screw Plug	PTFE

## 3.03 Operating Specification

Measurable Fluid	Liquids
Fluid Temperature	50° – 140°F (10° – 60°C)
Fluid Pressure	0 – 70 psi
Ambient Temperature	32° – 115°F (0° – 46°C) *
PFA Tube End or others*	
Enclosure Classification	IP65
* Consult Malema for any special requirements	

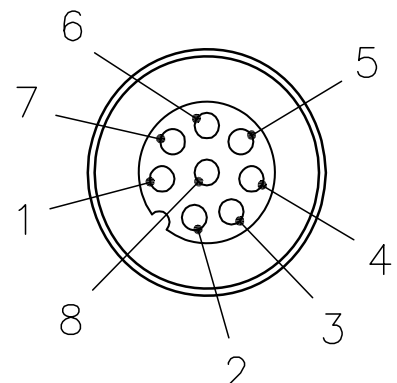
## 3.04 Electrical Specification

Output Options	Analog Output	Current Output: 4-20 mA (Max. Load < 900 ohms) Voltage Output: 0-10 V DC (min. impedance > 10 K)
	Digital Output	Open Collector / Max. 30 V DC, 200 mA max. Configurable for Low flow rate, High flow rate, Totalizer greater than, Totalizer less than, Signal strength less, Positive totalizer pulse *
Digital Input	Zeroing – Momentary pull-up to 24 V DC for activation	
Power Supply	24 V DC ±10%	
Power Consumption	120 mA	
Digital Communication	MODBUS over RS-485	
* Pulse frequency configurable up to 1 kHz; Pulse weight configurable from 0.001 mL		

## 3.05 Connector or Mating Cable (Optional) Specification

Pin #	Wire Color	Function
1	White	Signal Out (4 - 20 mA or 0 - 10 V DC)
2	Brown	Power In (+24 V DC)
3	Green	Remote Zero In *
4	Yellow	Alarm or Pulse Out
5	Gray	RS-485 A, Data -
6	Pink	RS-485 B, Data +
7	Blue	Ground (Power and signal)
8	Red	Not Used
* Momentary pull-up to 24 V DC		
<b>NOTE:</b> Consult factory for other cable and pin out options		

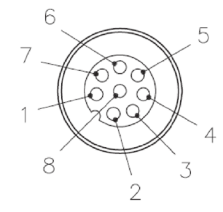
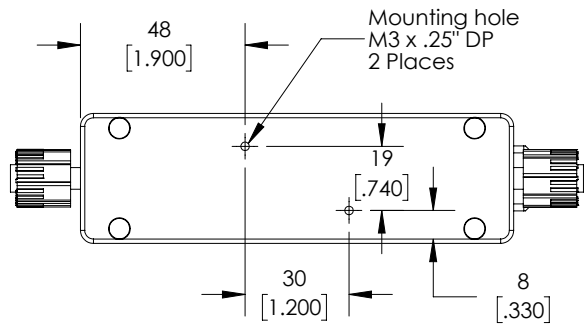
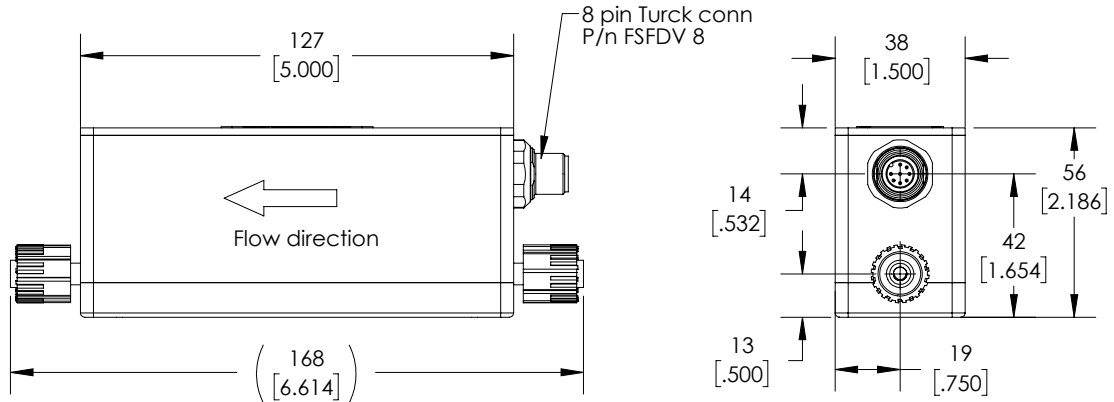
Front View



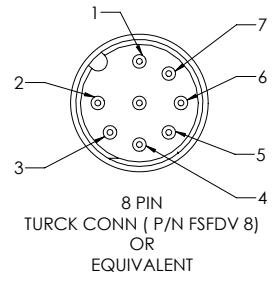
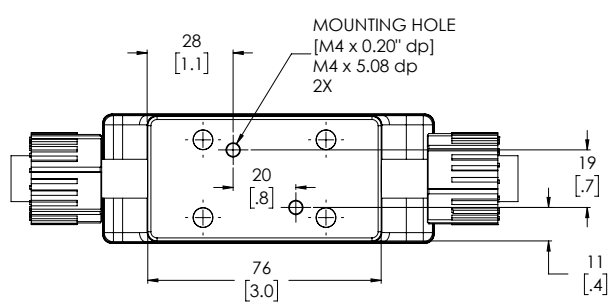
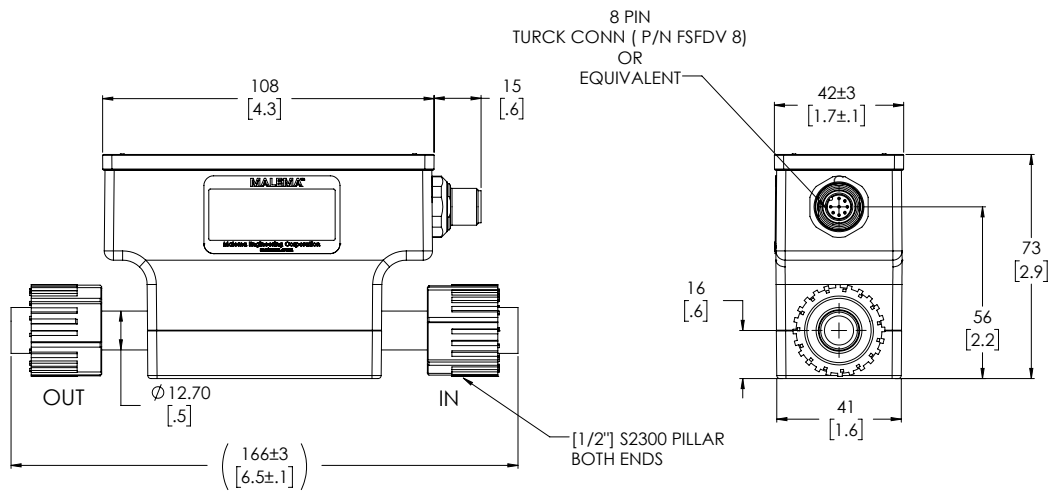


# 4.00 Dimensional Drawing

## 4.01 Ultrasonic Flow Meter 1/4" Pillar

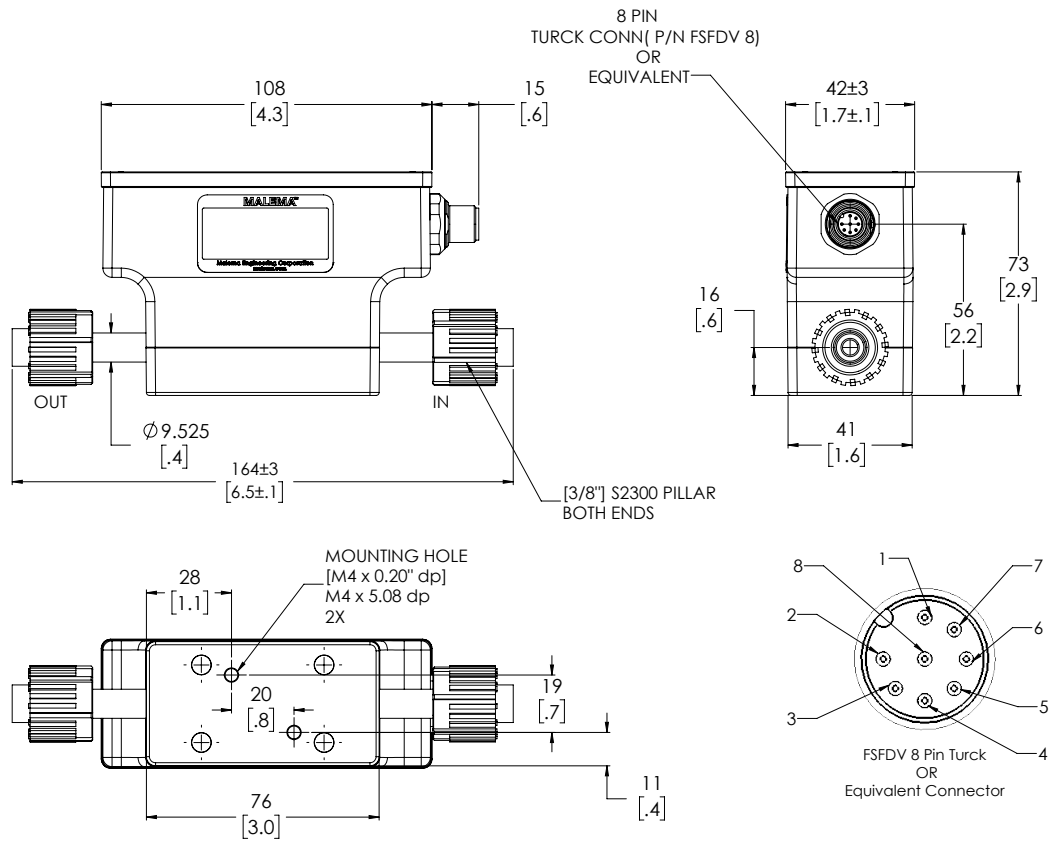


## 4.02 Ultrasonic Flow Meter 1/2" Pillar



# 4.00 Dimensional Drawing

## 4.03 Ultrasonic Flow Meter 3/8" Pillar



# 5.00 Order Information

## 5.01 Electronics

Model Ordering Code														Description	
M-2300	-	*	-	*	*	*	-	*	*	*	*	**	***		
<b>Product</b>	I													M-2300 PFA Flow Meter with Integrated Electronics	
<b>Wetted Parts</b>	F													PFA	
<b>Connection Size (O.D.)</b>	2													1/4" ( Full scale: 3 L/min)	
	3													3/8" ( Full scale: 8 L/min)	
	4													1/2" ( Full scale: 40 L/min)	
	6													3/4" ( Full scale: 80 L/min)*	
	8													1" ( Full scale: 250 L/min)*	
<b>Connection Type</b>	1													Tube Ends	
	2													Female Pillar S300	
	5													Female Flare	
	Z													Custom (consult factory)	
<b>Reserved</b>			-	X											Reserved
					X										Reserved
<b>Analog Output</b>						X									Reserved
		1													1 x Analog 0 - 10 V DC (0 V DC = 0 L/min and 10 V DC = full scale value), 1 x Digital Output- Alarm, 1 x Digital input-remote zero, 1 x RS485
		2													Active 4 - 20 mA (4 mA = 0 L/min and 20 mA = full scale value), 1 x Digital Output- Alarm, 1 x Digital input- remote zero, 1 x RS485
		3													Passive 4 - 20 mA (4 mA = 0 L/min and 20 mA = full scale value), , 1 x Digital Output- Alarm, 1 x Digital input- remote zero, 1 x RS485
		4													1 x Analog 0 - 10 V DC (0 V DC = 0 L/min and 10 V DC = full scale value), 1 x Digital Output- Pulse, 1 x Digital input-remote zero, 1 x RS485
		5													Active 4 - 20 mA (4 mA = 0 L/min and 20 mA = full scale value), 1 x Digital Output- Pulse, 1 x Digital input- remote zero, 1 x RS485
		6													Passive 4 - 20 mA (4 mA = 0 L/min and 20 mA = full scale value), , 1 x Digital Output- Pulse, 1 x Digital input- remote zero, 1 x RS485
			T												8 Pin Turck
		C												8 core cable	

## 5.00 Order Information

### 5.01 Electronics

Model Ordering Code														Description		
M-2300	-	*	-	*	*	*	-	*	*	*	*	*	**	***		
<b>Electrical Cable</b>														<b>00</b>		No cable
														<b>01</b>		1 meter cable (supplied only when Electrical connection C is selected)
														<b>03</b>		3 meter cable (supplied only when Electrical connection C is selected)
														<b>05</b>		5 meter cable (supplied only when Electrical connection C is selected)
														<b>ZZ</b>		Custom (consult factory)
<b>Ordering Extention (Standard and Custom options)</b>														<b>-S01</b>		For Standard Version select this
														<b>-XXX</b>		For any custom options, factory will assign 3 digit unique ID in place of XXX

\* Not Available.

## 6.00 Maintenance

Ultrasonic flow meter requires minimal routine maintenance since it has no moving parts that can be subject to wear and tear. However, it is recommended to periodically inspect the sensor to ensure smooth and reliable operation.

### Connection of Flow Detector

- Check for leakage around pipe connections or liquid penetration into sensor housing.
- Check for any loose nut/s.
- Make sure that the connection ports are leak free.

Check for mechanical stress to Flow tube caused by possible warping of connecting pipes or loose connections caused by heavy pipe vibration.

## 7.00 Warranty

### 7.01 Period of Warranty

Malema Sensors warrants its Products will meet their written specifications when used in accordance with their applicable instructions and within the limits stated in the operating manuals and/or product data sheets for a period of one year from shipment of the Products. Malema Sensors makes no other warranty, expressed or implied. Malema disclaims the warranties of merchantability or fitness for a particular purpose. The express warranty provided herein and the data, specifications and descriptions of Malema Sensors Products appearing in Malema Sensors user manuals may not be altered except by express written agreement signed by an officer of Malema Sensors. Representations, oral or written, which are inconsistent with this warranty or such publications are not authorized and if given, should not be relied upon.

Buyer shall report any claimed defect in writing to Malema Sensors immediately upon discovery and in any event, within the warranty period. If Malema Sensors on receipt of the alleged defective product determines that the defect is due to misuse or modification owing to failure to comply with instructions and/or applicable limits stated in the operating manuals and/or product data sheets or for whatever other reasons (including intentional damage), Malema Sensors shall have the right to impose such repair and other transportation charges as incurred.

## 7.00 Warranty

### 7.02 Repair

Where there are manufacturers' defects, Malema Sensors shall, at its sole option, repair the products and/or equipment or furnish replacement equipment or parts thereof, at the original delivery point. Malema Sensors shall not be liable for costs of removal, reinstallation, or gaining access.

### 7.03 Validity of Warranty

If Buyer or other third parties repair, replace, or adjust equipment or parts without Malema Sensors' prior written approval, Malema Sensors shall be relieved of any further obligation to Buyer under this section with respect to such equipment.

No equipment furnished by Malema Sensors shall be deemed to be defective by reason of normal wear and tear, failure to resist erosive or corrosive action of any fluid or gas (unless otherwise specified in Quotations), Buyer's failure to properly store, install, operate, or maintain the equipment in accordance with good industry practices or specific recommendations of Malema Sensors or in accordance with operating manuals and/or product data sheets limits, or Buyer's failure to provide complete and accurate information to Malema Sensors concerning the operational application of the equipment.

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