DuraMassFlow CIFM-88 Series PFA Coriolis Industrial 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

Support Email Address

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1.00 Introduction

1.01 Safety Precautions

⚠ **Warning:** Read and understand this user's guide before operating the equipment.

⚠ **Warning:** Use caution when using hazardous chemicals or materials. Personnel operating the equipment need to know of any hazardous chemicals or materials that may be present when using the equipment. Use general hazardous information to communicate to personnel. This includes Safety Data Sheets, labels or signs.

⚠ **Warning:** Follow lockout/tagout procedures. To prevent injury, when servicing equipment, use your company lockout/tagout procedures to isolate electrical, mechanical, chemical, thermal or any other potential energy and protect workers from the potential risk.
Flush the flow path (pumps, piping, tubing) with water prior to disconnecting any plumbing.

1.02 Overview

The Malema DuraMassFlow PFA Coriolis Industrial Flow Meter (CIFM) 88 Series leverages the Coriolis principle to simultaneously measure mass flow, density, and temperature with exceptional precision. The CIFM-88 Series Flow Meters are designed for use in harsh industrial environments. The DuraMassFlow flow meter also features a built-in 4-line local LCD for displaying, flow rate, totalized flow, temperature, or density, and outputs these parameters through analog 4-20mA, frequency outputs as well as Modbus communication over RS-485.

1.03 Transport and Storage Guidelines for Flow Meters

Note: It is recommended to follow the transportation and storage guidelines to ensure operational efficiency of the CIFM-88 Series.

Transport Guidelines

- Adhere to Packaging Guidelines: Follow all transport-related instructions indicated on the packaging.
- Unpacking Protocol: To prevent damage, do not unpack the flow meter until it has arrived at the installation site.
- Maintain Protective Materials: Do not remove any protective materials, such as stickers or covers on process connections, during transport.

1.00 Introduction

1.03 Transport and Storage Guidelines for Flow Meters

Storage Recommendations

⚠ **Warning:** Risk of Damage from Humidity

- Shield from Moisture: Protect the flow meter from rain and humidity.
- Humidity Control: Ensure that relative humidity does not exceed 95%.

⚠ **Warning:** Risk of Mechanical Wear

- Secure Storage Location: Store the flow meter in an area that is protected from mechanical influences.
- Temperature Compliance: Adhere to the specified storage temperature limits outlined in the Operating Conditions.
- Avoid Direct Sunlight: Protect the flow meter from direct sunlight to prevent overheating.
- Humidity Protection: Again, ensure protection from rain and excessive humidity.
- Maintain Protective Materials: Keep all protective stickers or covers on process connections intact or reapply them as needed.
- Preparation for Storage: Prior to storing a previously used flow meter, completely drain all fluids from the measuring tube.

1.04 Key Advantages

Corrosion Resistance: The wetted parts of the CIFM-88 are constructed from PFA (Perfluoroalkoxy), renowned for their superior corrosion resistance, far surpassing traditional metal Coriolis flow meters. This makes the CIFM-88 particularly well-suited for applications involving aggressive chemicals or harsh environments where metal meters would deteriorate over time.

Dual PFA Tube Measuring System: Engineered with an innovative dual PFA tube measuring system, the CIFM-88 significantly mitigates noise and enhances accuracy and operational stability, even under varying conditions. Traditional single-tube configurations are more susceptible to external interferences

1.05 Features

- Fluid measurement performance is independent of fluid properties, eliminating the need to calibrate on different fluids.
- Accuracy is unaffected by flow regime (e.g., laminar or turbulent flow) or variations in flow velocity profile.
- Sensors can operate and measure fluids in two-phase flow conditions with gas volumetric void fractions up to 30%.

1.06 Applications

- Highly corrosive chemicals
- Slurries or solutions containing solid contents
- Pure water or ultra-high purity chemicals
- Fluids with varying density or viscosity

2.00 Operating Principle

The CIFM-88 Series Sensor comprises two measuring tubes, a drive coil, and two sensors positioned on either side of the drive coil attached to each of the measuring tubes. When the meter is energized, the drive coil induces vibrations in the measuring tubes, causing them to oscillate and generate a sine wave. This sine wave is captured by the sensors. As liquid flows through the measuring tubes, the Coriolis effect induces a phase shift in the sine wave, detected by the sensors. The magnitude of this phase shift is directly proportional to the mass flow rate. Additionally, density measurement is achieved by analyzing the frequency of vibration, while temperature measurement is obtained using an integrated temperature sensor.

3.00 Installation

The following must be considered when selecting the installation location of the CIFM-88 Series Coriolis Industrial Flow Meter.

- **Cavitation Prevention:** Avoid installing the flow meter in locations prone to cavitation, such as directly downstream of control valves.
- **Distance from Electrical Equipment:** Position the flow meter away from motors, transformers, and other electronic transmitters to minimize interference.
- **Pump Installation Protocol:** Do not install the flow meter immediately after rotary or gear pumps, as fluctuations in pressure may disrupt the resonance frequency of the CIFM-88 measuring tubes.
- **Back-to-Back Sensor Installations:** For configurations requiring two identical sensors installed back-to-back, please consult the Malema sales organization for a customized design.
- **Downpipe Installations:** When possible, avoid placing the CIFM-88 at the end of a pipe or a pipe that turns downward in a 45 to 90 degree angle. This can cause flow measurement deviations.
- **Magnetic Compass Considerations:** Position the CIFM-88 away from magnetic compasses, as it may cause compass deviations.
- **Minimize Shock and Vibration:** Install the flow meter in a manner that minimizes exposure to shock and vibration.
- **Facilitate Zero-Point Setting:** Utilize closing valves and a bypass line to facilitate the zero-point setting of the flow meter.
- **Fluid Measurement Precautions:** For applications involving fluids, avoid installing the flow meter at the highest point of the piping system, as gas bubbles may form and lead to increased measurement uncertainties.
- **Avoid Free Pipe Outlets:** Do not install the flow meter immediately before a free pipe outlet in a downpipe.
- **Idle Sensor Precautions:** Avoid allowing the sensor to remain idle during measurements, particularly in filling applications where it is installed before an air gap. To mitigate this, consider installing a restriction in the open downpipe or using an orifice gauge with a diameter smaller than the nominal pipe width.
- **Pressure Testing Assurance:** Each device undergoes pressure testing prior to delivery to ensure reliability and performance

3.01 Plumbing Connection

The DuraMassFlow CIFM-88 Series is available with two process connection types for the Inlet and Outlet ports. The process connection types are orderable in pillar or flare connectors.

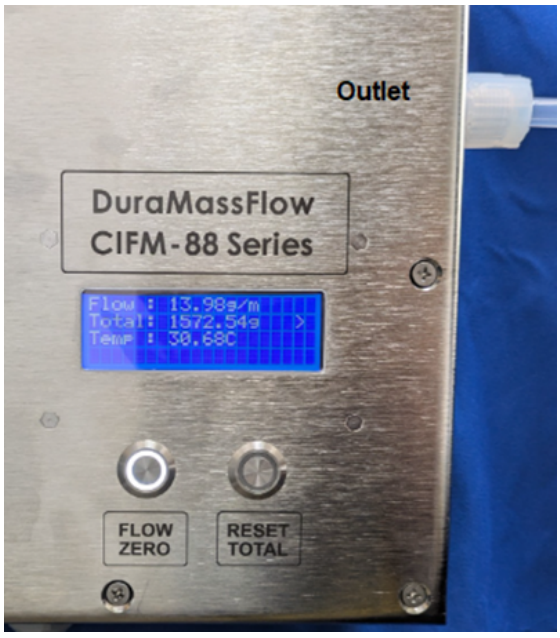


Figure 3-1: Outlet connector for the DuraMassFlow CIFM-88

Attach and tighten pillar connections to the inlet and outlet of flow meter. Typical sizes are 3/8″ and 1/2″.

3.00 Installation

3.02 Electrical Connections

1. Communication and power/signal connectors are located at the bottom.
2. Connect the Power/signal cable, twist the connector clockwise to lock connector, turn counterclockwise to the release.

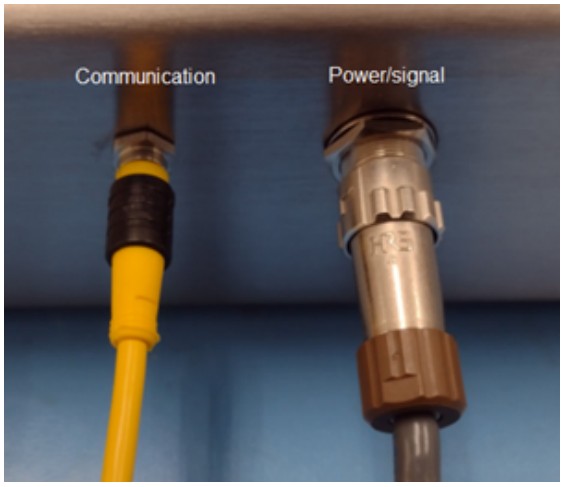


Figure 3-2: The Communication and Power/signal connection ports for the DuraMass

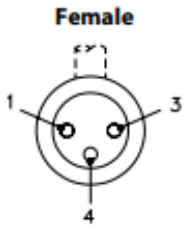
3. Make sure the rubber boot is pressed towards the connector to lock the cable.

Figure 3-3: Unlocked boot

Figure 3-4: Locked boot

4. The GUI communication setting for RS-485.
    - Bits per second:115.2 kbps
    - Data bits: 8
    - Parity: None
    - Stop bits: 1
    - Flow control: None

5. RS-485 output connector



Pin	Color	Signal
1	Brown	B(+)
3	Blue	A(-)
4	Black	Gnd

Figure 3-5: RS 485 output connector and pin configuration

3.00 Installation

3.02 Electrical Connections

6. Turn power ON to the flow meter (i.e. the electronics) after priming to ensure the sensor is filled with liquid. The Flow zero and Reset totalizer LED's will blink during initialization. When initialization is complete, the Flow meter will remain ON.

Figure 3-6: Initialization Screen

7. After initialization the display should display Flow, Total, Temp, Density (if enabled).

Note: Allow 30 minutes for the sensor and transmitter to warm-up.

Figure 3-7: Display Screen with Flow, Temp, and Density

3.03 PC Software/GUI Communication

1. Make sure the converter is installed on the PC by checking its COM port in Device Manager. If there is a yellow exclamation mark on the device in Device Manager, install the proper driver from the device manufacturer.
2. Copy the PSG Dover Malema software GUI (an .exe executable file) to a folder on the local drive. The software GUI is available for download.
3. Double-click the .exe to open the GUI. A COM port should appear in the upper-right box.

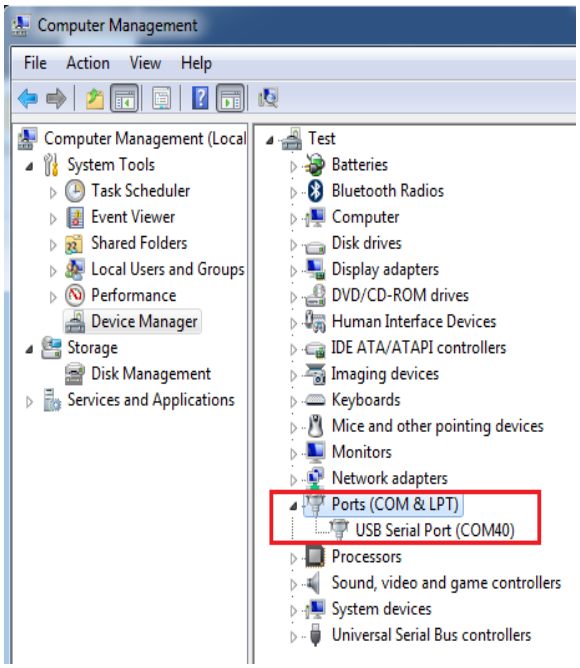


Figure 3-8: PC Software/GUI Interface

4. Double-click the COM port to connect to the flow meter. If the connection is successful, the Main GUI window will appear.

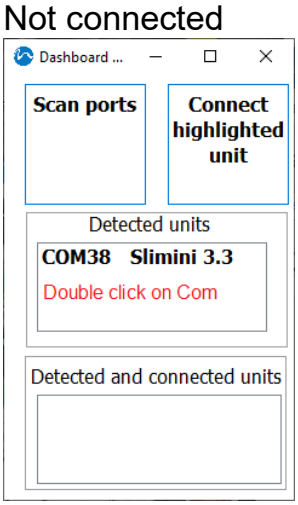


Figure 3-9: GUI COM Port Display when Not Connected

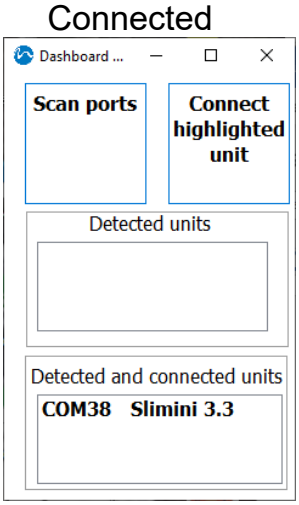


Figure 3-10: GUI COM Port Display when Connected

3.00 Installation

3.03 PC Software/GUI Communication

5. Main GUI window.

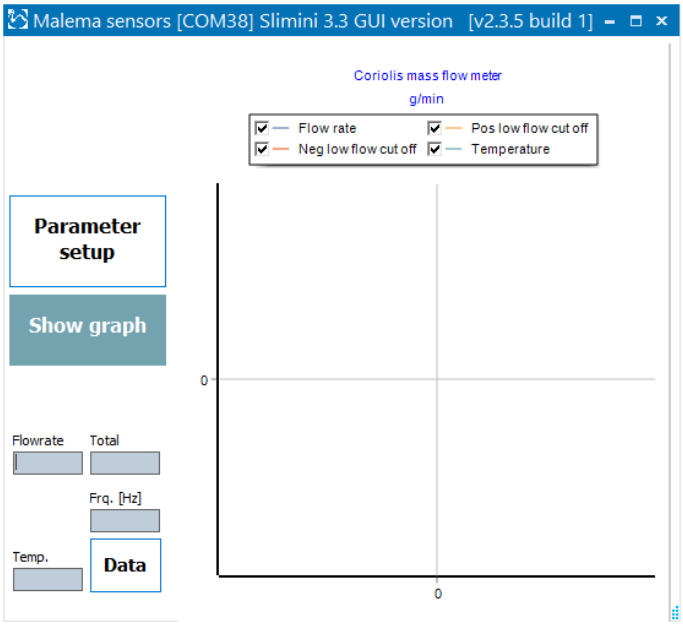


Figure 3-11: Main GUI Window

6. Click the "Data" button to start monitoring the flow rate.

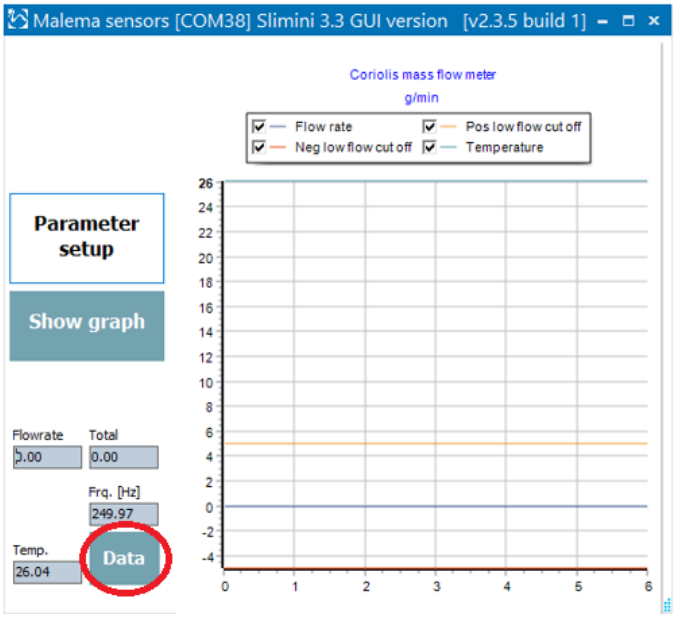


Figure 3-12: Main GUI with Graph of Flow

7. MODBUS COMMUNICATION
   - An external adapter is needed for communication for Modbus – USOPTL4.
   - Connect pin 7 (RS485 + Modbus) of the User I/O cable to the TDB+ terminal of your RS-485 module.
   - Connect pin 8 (RS485 GND Mod) of the User I/O cable to the GND terminal of your RS-485 module.
   - Connect pin 9 (RS485 - Modbus) of the User I/O cable to the TDA- terminal of your RS-485 module.
   - Recommend the 2 terminal wires (TDB+, TDA-) are twisted pair.
8. Modbus communication must be activated in the Factory GUI for Modbus operation.
9. For Modbus operation, Refer to Section 6.00 Appendix Coriolis Meter - Serial MODBUS Version 1.0G.

3.00 Installation

3.04 Zero Calibration

To prevent systematic deviations in flow rate measurements, it is recommended to perform a zero-point adjustment prior to initiating measuring operations.

1. Warm-Up Period: Allow the flow meter to warm up for 30 minutes powered on with fluid present in the flow tube. Fluid during warm up can be static during warm up.
2. Purge all air in the sensor and the hoses by running the pump at a high flow rate (ex. 50% of flow range).
3. Turn off the pump and close all valves, if possible, to ensure no actual flow.

Note: Whenever the measured flow rate is below a "low-flow threshold" (typically 2% of flow range) the Coriolis Meter will perform zero-flow calibrations automatically, if Autozero is enabled. Autozero is enabled by default.

Note: Fluid flowing through the sensor (or air pockets in the sensor) while performing a zero flow calibration will result in an inaccurate zero setting and therefore, inaccurate flow rate readings. Make sure there is no fluid flow in the sensor during zeroing.

If the application does not permit closing an upstream or downstream valve to obtain an accurate zero flow calibration, there may be a possibility that fluid may flow even though its value is below the factory preset low flow cutoff. In such situations, an incorrect zero-flow value can result, and it may be desirable to disable the "autozero" feature. Zero flow calibration updates may be required in the field if an application's fluid varies significantly with temperature

4. Perform a zero calibration by pressing the "zero cal" button on the electronics or clicking the "Re-zero the unit" button in the left side of the GUI (shown below). Zero calibration may also be performed remotely by momentarily touching the pink wire (pin 3) to +24 V DC (pin 1).
   a. Zero the meter from GUI

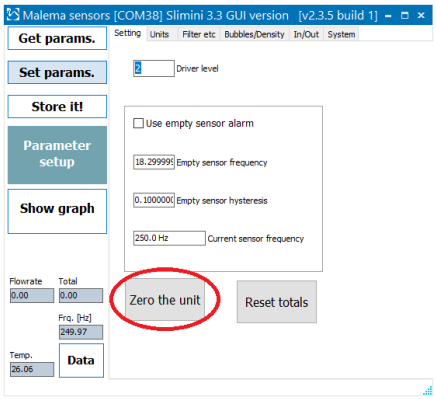


Figure 3-13: GUI Interface for Zero Calibration

   b. Zero the meter from transmitter front panel button.

- Press the "Flow Zero" button.

Figure 3-14: Rezero button on the front of the DuraMassFlow CIFM-88

3.00 Installation

3.04 Zero Calibration

- Press the "Zero Meter" button again to re-zero flow meter.
- Flow zero LED starts to blink when zeroing, stops blinking when complete.
- Display show "…Zeroing…"

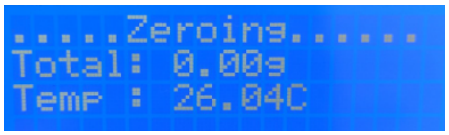


Figure 3-15: The Display during the Zeroing process

- Press the "Reset Total" button.
- Press the "Reset Total" button again to reset totalizer.

Figure 3-16: The Reset Totalizer Button on the front of the DuraMassFlow CIFM-88

- Display show "…Clearing Totals…"

c. Zero meter using digital input terminal (if option is available).
- Set digital input 2 to "Force auto zero on 1 to 0 transition".
- Connect ground to DIO IN 2-
- Momentarily connect +24 V DC to DIO IN2+

d. Zero the meter through Modbus.
- Refer to Section 6.00 Appendix Coriolis Meter - Serial MODBUS Version 1.0G.

5. This zero-calibration procedure will take 10 seconds to complete.

3.05 Error Mode

1. When an ERROR occurs during normal operation, display shall report Severe error has occurred with an error code indicating the type of failure that has been detected.
2. Flow Zero LED shall go off, Reset Total LED shall stay on while in this error mode.
3. If an Error Code occurs contact Malema.TechnicalSupport@psgdover.com.

Figure 3-17: Error Message on the Main Display

3.00 Installation

3.06 Transmitter Connector Pin-Out

Transmitter Connector Pin-Out

Table 3-1: Signal Configurations

		Modbus	2 Analog Outputs
Pin #	**Color**	**Signal name**	**Signal name**
1	Red	+24 V DC	+24 V DC
2	Black	+24 V DC GND	+24 V DC GND
3	Pink	DIO IN2+	DIO GND
4	Gray	DIO OUT1	DIO OUT1
5	Blue	DIO IN2-	CL1 GND
6	White	DIO GND	CL1+
7	Red/White	RS485 + Modbus	RS485 + Modbus
8	White/Black	RS485 GND Mod	RS485 GND Mod
9	Yellow	RS485 - Modbus	RS485 - Modbus
10	Brown	Alarm *OC	Alarm *OC
11	Green	CL GND	CL GND
12	Violet	CL0+	CL0+

***OC** – Open collector

Analog Outputs: The analog output signal can be set for Mass, Volumetric, Density, or Temperature.

Analog output CL0 is normally set for 4-20 mA , Mass flowrate

LED Status Lookup Table

Table 3-1: LED Status

Meaning	Left	Right
Power up: Initialization	Blink	Blink
Normal operation	ON	OFF
Forced auto zeroing	Blink	OFF
Cable error or other	OFF	ON

3.00 Installation

3.06 Transmitter Connector Pin-Out

Setup Digital Inputs/Outputs

Digital outputs 1 and 2 can be set individually as open collector as shown below.

Click "Set params." to activate any changes then click "Store it" to save to non-volatile memory".

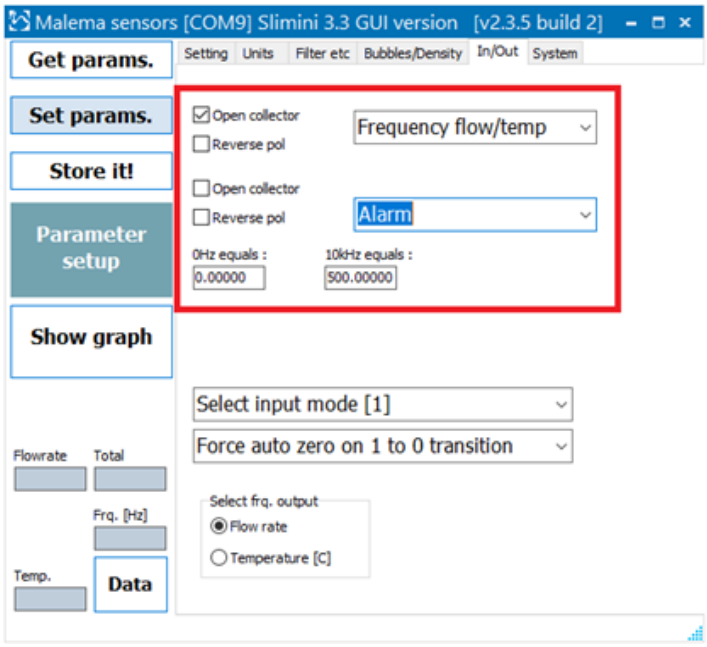


Figure 3-18: Selecting Digital Outputs 1 and 2 for Frequency and Alarm Settings

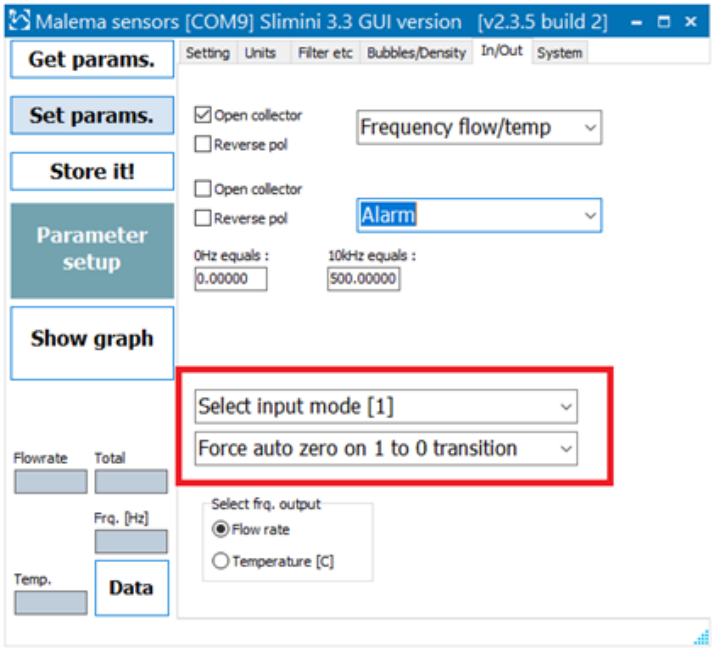


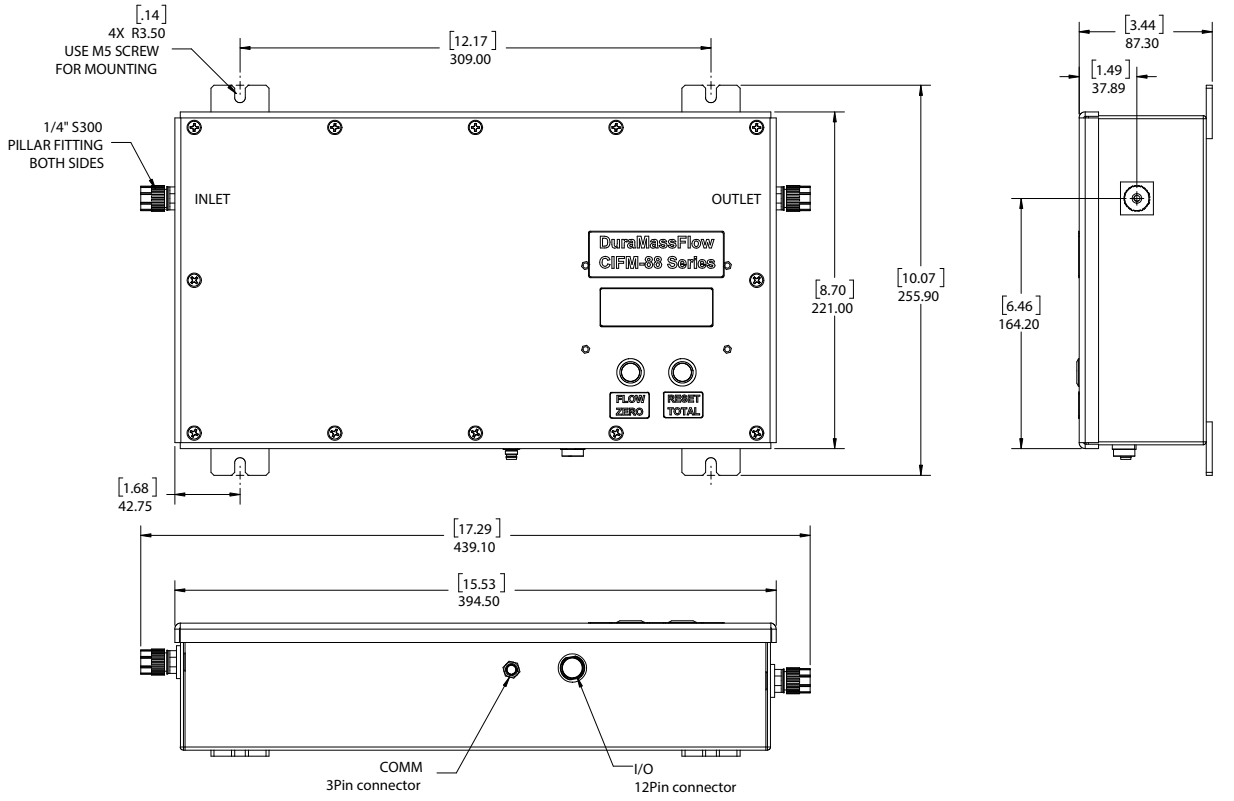
Figure 3-19: Selecting Digital inputs 1 and 2 or Input Mode and Force Auto Zero

Product Specification and part numbers

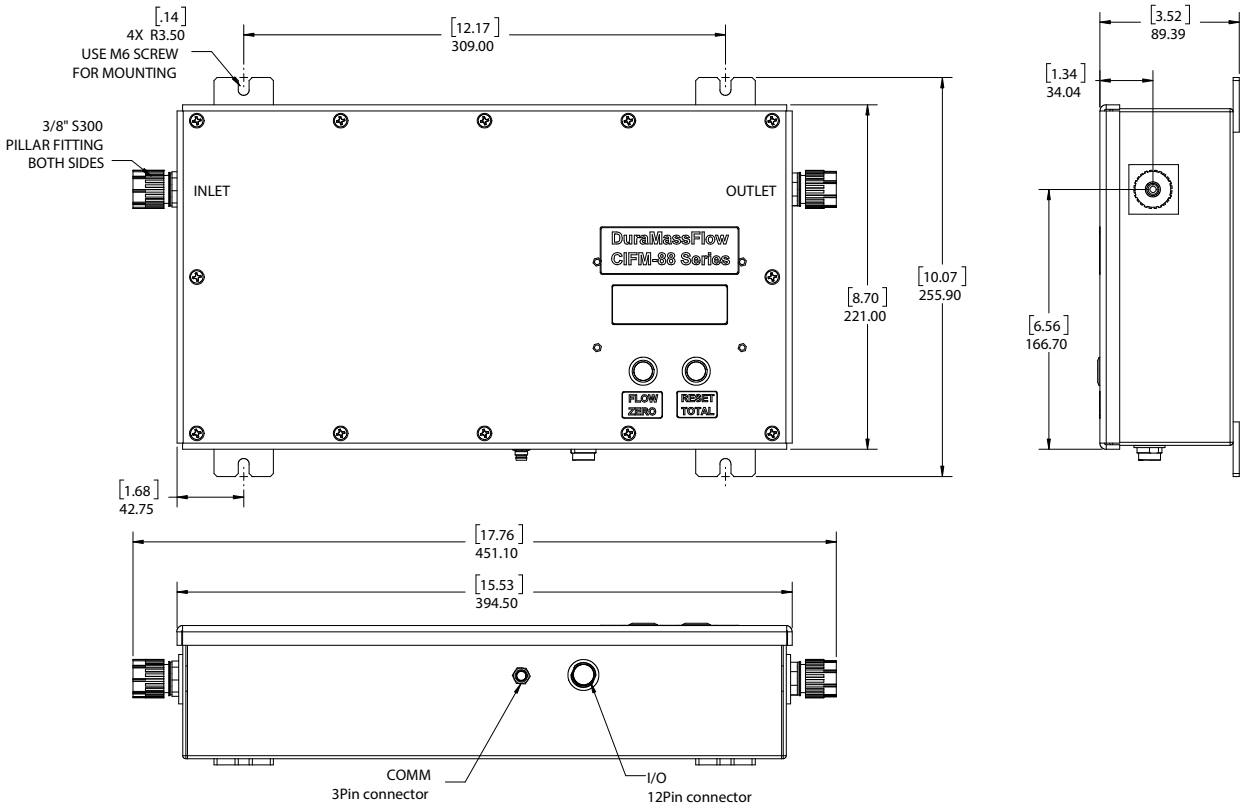
4.00 Dimensional Drawing

For Reference Only

Model CIFM-88 with 1/4" fluid connection



Model CIFM-88 with 3/8" fluid connection



5.00 Ordering Information

Model Ordering Code											Description
CIFM-	**8803-***	*	*	*	*	**	*	*	*	-***	
Range Code	8803-1										PFA Sensor; 15-1,500 g/min
	8803-2										PFA Sensor; 40-4,000 g/min
Display		D									With Local LCD Display
Process Connection			2								1/4"
			3								3/8"
Process Connection Type				P							Pillar (S 300)- Male
				F							Flare - Male
Output					1						1x 4-20mA for mass or volume flow (4mA =0 g/min, 20mA= Max Flow for the corresponding size range); 1 X DI, 1 X DO, 1 x RS 485 Modbus
					2						1 x 4-20mA mass flow or volume flow (4mA =0 g/min, 20mA= Max Flow for the corresponding size range); 1 x 4-20mA for density (0.8 to 1.4 g/ml). 1 X DI, 1 X DO, 1 x RS 485 Modbus
Mounting Orientation						HL					Horizontal (Flow Left to Right)
						HR					Horizontal (Flow Right to Left)
						VB					Vertical (Flow Bottom to Top)
Measurement Version							0				Mass only version
							1				Mass and Density version
I/O cable								0			Cable not included
								3			3 meter cable included with supply
Factory Reserved									X		Reserved
Unique ID										-S01	Standard Supply
										-XXX	Custom (Factory will assign unique 3 digit extension)

6.00 Appendix Coriolis Meter - Serial MODBUS Version 1.0G

6.01 Technical data

Interface		
Bit rate RS485 [kbps] Index	19.2, 4.8, 9.6, 38.4, 57.6, 115.2 0 1 2 3 4 5	8 databits, 1 stopbit, even parity
Bit rate RS232 over USB [kbps]	115.2, 8 databits, 1 stopbit, no parity	
Protocol	MODBUS RTU or ASCII	
Maximum systems on one bus. RS485 only	256 including the client (master)	
Address range	MODBUS: 1..247	
Transmission protocol	Half duplex, asynchronous	
Bus access	Server (slave)	
Cable and terminals	RS485: Screened twisted pair, push'n lock terminals USB: Mini B connector, screened.	
Distances	RS485: Up to ~4000ft (1.2km), depending on the bit rate and cable quality.	

6.02 Technical Specification

RS485: Meets or exceeds TIA/EIA RS-485.

For correct operation of MODBUS in half duplex in single or multipoint communication, it is recommended that terminating resistor is added to both the far ends of the line.

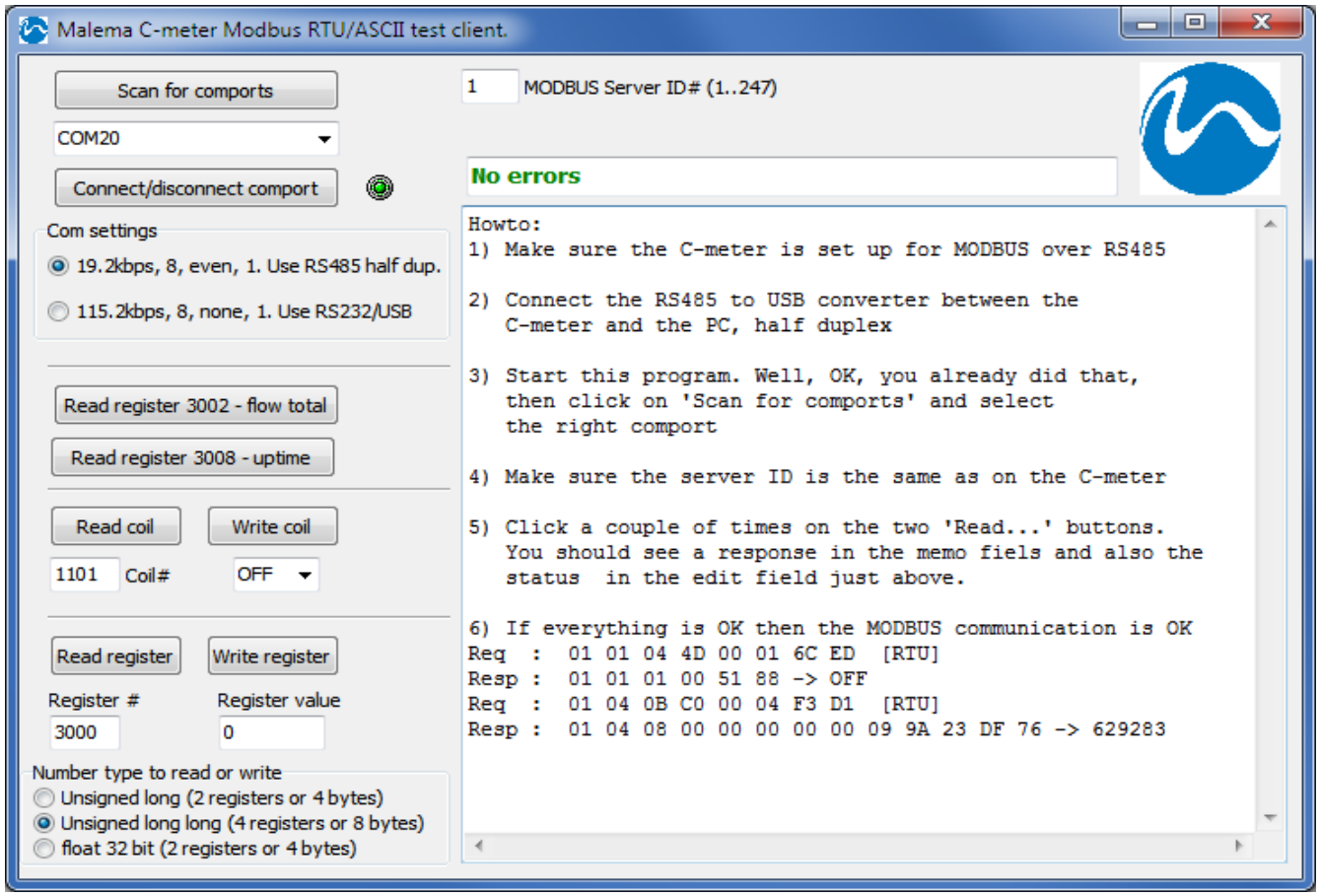
6.03 Default Settings

Slave address	1. Range 1..247. Always answer to address 0x7F
Protocol	RTU
Bit rate	19.2 kbps (Index = 0)
Parity	Even
Data format	Big endian
Transmission delay	3.5T
Stop bits	1

6.00 Appendix Coriolis Meter - Serial MODBUS Version 1.0G

6.04 Getting started with the MODBUS communication

- Connect the RS485 interface in half duplex mode.
- Connect a RS485 to USB converter between the meter and a PC.
- Power up the Coriolis meter and wait till the meter is in normal mode – green LED on, red LED off.
- Open the PC program ModbusTester_2.exe and select the comport number assigned to the RS485 to USB converter.



- Click on 'Connect/disconnect comport' and observe the green "LED" turns on.
- Click on one of the 'Read...' buttons and observe the request and response packets in the text window.

The first set of request/response was 'Read coil', coil # 1101 (test coil).

The second set was 'Read register 3008' (uptime in ms). NOTE: to interpret the recieved data packet, change the number type to 'Unsigned long long'.

The Modbustester program can be used to alter a few parameters if needed. See the description of each coil and holding registers.

6.00 Appendix Coriolis Meter - Serial MODBUS Version 1.0G

6.05 MODBUS protocol

Note: The Coriolis mass flow meter/ flow controller uses protocol addresses. This means the register address listed is the actual number required in the MODBUS command.

Addressing

The used MODBUS protocol registers are addressed and divided into functional equivalent groups:

Coil registers:	1000/11000	Read/Write
Input registers:	3000 /43000	Read only
Holding registers:	5000/35000	Read/Write single register sets
Holding registers:	6000 /Not used	Read/Write multiple register sets

Each group may be divided into smaller logical groups,

Multi-words are transmitted using big endian, most significant word first and most significant byte first.

Floating point is in IEEE754 format.

Overview of supported functions

Function code	**Name**	**Access to**
Hex / Dec		
01 / 01	Read single coil	Status, Flow/No flow,
03 / 03	Read holding register	Parameters
04 / 04	Read input register	Flow rates, totals, status
05 / 05	Write single coil	Zero meter, reset totalizers, auto zero on/off,
06 / 06	Write single register	
08 / 08	Diagnostics	TBD
10 / 16	Write multiple registers	Totalizer compare, zero offset, parameters, digital set point

Coil registers

Read / Write. Function code 0x01. ONLY read one coil at a time.

PDU Register address (dec)	**Description**	**Settings**		
1000/11000	Zero meter	Write	ON	Start to zero the meter
		Write	OFF	No effect
		Read	ON	Meter is in forced zeroing state OR flow rate is above low flow cut off settings
		Read	OFF	Meter is zeroed

6.00 Appendix Coriolis Meter - Serial MODBUS Version 1.0G

6.05 MODBUS protocol

Coil registers

PDU Register address (dec)	Description	Settings		
1001/11001	Reset totals Resets: - mass and volume totals - flow time - avg. flow rate - etc.	Write	ON	Reset all totals
		Write	OFF	No effect
		Read	ON	Totals are at zero
		Read	OFF	One or more totals are not zero
1002/11002	Start / stop measuring	Write	ON	Start measuring
		Write	OFF	Stop measuring
		Read	ON	Measuring is ON
		Read	OFF	Measuring is OFF
1003/11003	Auto zero	Write	ON	Set Auto zero to ON
		Write	OFF	Set Auto zero to OFF
		Read	ON	Auto zero is ON
		Read	OFF	Auto zero is OFF
1004/11004	Store current setting and parameters in non-volatile RAM.	Write	ON	Store parameters
		Write	OFF	No effect
		Read	OFF	Always reads OFF
1005/11005	Activate digital output 2 to signal when the preset Totalizer value is reached.	Write	ON	Digital output 2 will indicate when preset Totalizer value has been reached
		Write	OFF	Digital output 2 function will be disabled
		Read	ON	Digital output 2 function is enabled
		Read	OFF	Digital output 2 function is disabled
1006/11006	Use flow control	Write	ON	Use the flow controller functions
		Write	OFF	Do not use the flow controller functions
		Read	ON	Flow controller is active
		Read	OFF	Flow controller is inactive
1007/11007	Close valve when totalizer value is reached	Write	ON	The valve will close as soon the totalizer value has been reached. Flow control will be disabled and must be reactivated again. Use PDU register address 1006.
		Write	OFF	The valve will not close when totalizer value has been reached.
		Read	ON	Active on totalizer value
		Read	OFF	Inactive on totalizer value

6.00 Appendix Coriolis Meter - Serial MODBUS Version 1.0G

6.05 MODBUS protocol

Coil registers

PDU Register address (dec)	Description	Settings		
1008/11008	Select flow controller set point source	Write	ON	Analog input is selected
		Write	OFF	Digital set point is selected. See holding register 5018
		Read	ON	Indicates analog set point is the source
		Read	OFF	Indicates digital set point is the source
1009/11009	Use 4-20mA input range. (The 4-20mA or 0-10V input is on the same pins)	Write	ON	Use 4-20mA input as 0 to 100% flow control set point
		Write	OFF	Use 0-10V input as 0 to 100% set point
		Read	ON	Indicates 4-20mA set point
		Read	OFF	Indicates 0-10V set point
1010/11010	0V (4mA) stops the motor	Write	ON	If 0% analog flow rate set point is detected, the valve motor will stop in it's current position. Flow controller is disabled
		Write	OFF	Normal flow controller function
		Read	ON	The valve motor will stop when 0% flow rate is detected
		Read	OFF	Normal flow controller function
1011/11011	Open the valve to 100% flow rate	Write	ON	The valve will open up 100%. Use flow control is disabled. Write ON to coil 1006 to enable again.
		Write	OFF	No effect
1012/11012	Close the valve to 0% flow rate	Write	ON	The valve will close to 0%. Use flow control is disabled. Write ON to coil 1006 to enable again.
		Write	OFF	No effect
1013[2]/11013	Reset frequency and then zero the transmitter	Write	OFF	No effect
		Write	ON	The current sensor frequency is reset to the stored frequency in sensor memory.
		Read	OFF	Always OFF
1014/11014	Empty sensor	Read	ON	The sensor is empty
1100/11100	Restart meter	Write	ON	Restarts the Coriolis flow meter
		Write	OFF	No effect
1101/11101	Test	Write/ Read		Can be used to test communication
1199/11199	Terminate MODBUS session	Write	ON	If MODBUS is using RS232 over USB, this command will terminate the MODBUS session and return to normal PC control mode. If using RS485, this command will have no effect.

[2]Coils 1013 and up to coil 1100 are implemented in firmware versions 2.0.15 and 3.3.7.

6.00 Appendix Coriolis Meter - Serial MODBUS Version 1.0G

6.05 MODBUS protocol

Input registers

PDU Register address (dec)	Description and setting	Type	# of registers
3000/43000	**Mass** Flow rate [selected units][4]	Float	2
3002/43002	**Mass** Flow total [selected unit]	Float	2
3004/43004	**Vol.** Flow rate [selected units]	Float	2
3006/43006	**Vol.** Flow total [selected unit]	Float	2
3008/53008	ms since power up / restart	Unsigned long	4
3012/43012	Flow time in ms	Unsigned long	4
3016/43016	Status word LEFT SENSOR ERROR 0x00000001 RIGHT SENSOR ERROR 0x00000002 ZEROFLOWCOND 0x00000008 LR GAIN ERROR 0x00000010 SENSOR CABLE ERROR 0x00000200 DRIVER CABLE ERROR 0x00000400 BUBBLES DETECTED 0x00001000 FLOW CTRL ERROR 0x00002000 POSITION ENCODER ERR 0x00010000 MOTOR ERROR 0x00020000 LEAK DETECTED 0x00040000 SENSOR DISCONNECTED 0X20000000 Some bits are only internal status bits, and therefore omitted here.	Unsigned long	2
3018/43018	Read general I/O pins. Reserved	Unsigned long	2
3020/43020	Read density	Float	2
3022/43022	Read temperature	Float	2
3028[5]/43028	Read L/R phase shift	Double	4
3032/43032	Read extended status word EMPTY_SENSORFLAG 0x00000001 NEGFLOWRATEWARNING 0x00000002	Unsigned long	2

Example: Read mass flow total from register 3002 (0x0BBA) on server #1:

RTU: 01 04 0B BA 00 02 52 0A

ASCII: ':01040BBA000234 crlf'

Response from server:

RTU: 01 04 04 00 00 00 00 FB 84

ASCII: ':01040400000000F7 crlf'

[4]Selected units (g,kg, lb, ccm, liters etc. and s,min, h etc) as configured in the transmitter, Can currently only be changed using the GUI and not via MODBUS.

[5]Input registers from 3024 and above is implemented in firmware versions 2.0.15 and 3.3.7.

6.00 Appendix Coriolis Meter - Serial MODBUS Version 1.0G

6.05 MODBUS protocol

Holding registers

Read / Write. Function codes 0x03 or 0x04 for read, 0x10 for write. One register set at a time.

PDU Register address (dec)	Description and setting	Type	# of registers
5000/35000	Totalizer compare value	Float	2
5002/35002	Filter time constant (RC time constant) [ms]	Unsigned long	2
5004/35004	Positive low flow cutoff value	Float	2
5006/35005	Negative low flow cutoff value	Float	2
5008/35008	Number of samples between calculations	Unsigned long	2
5010/35010	Zero offset	Float	2
5012/35012	Density	Float	2
5014/35014	Bit rate index. See technical data for index#	Unsigned long	2
5016/35016	Server ID. 1..247	Unsigned long	2
5018/35018	Digital set point	Float	2
5020/35020	Set Dir. Gen. I/O bits. Reserved	Unsigned long	2
5022/35020	Set Gen. I/O bits. Reserved	Unsigned long	2
6000/36000	Other parameters.	Mixed	TBD

Example: Write 500.0 (0x43FA0000) to register 5000 (0x1388) on server #1:

RTU: 01 10 13 88 00 02 04 43 FA 00 00 16 EC

ASCII: ':0110138800020443FA000011 crlf'

Response from server:

RTU: 01 10 13 88 00 02 C5 66

ASCII: ':01101388000252 crlf'

Note: When writing to the holding registers, the values are not automatically saved to the non-volatile RAM. Use coil register 1004 to store the parameters in the non-volatile RAM.

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.

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