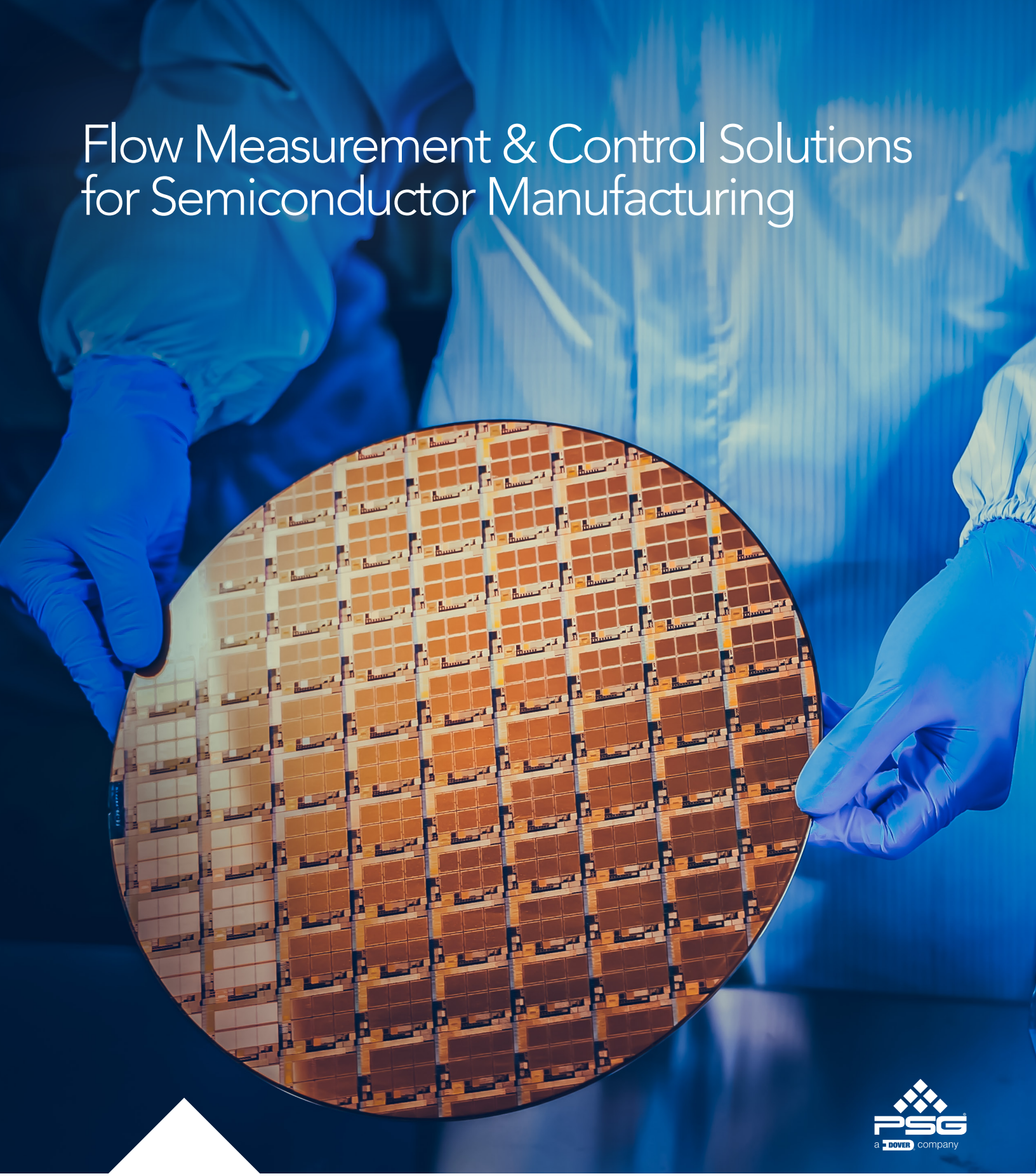
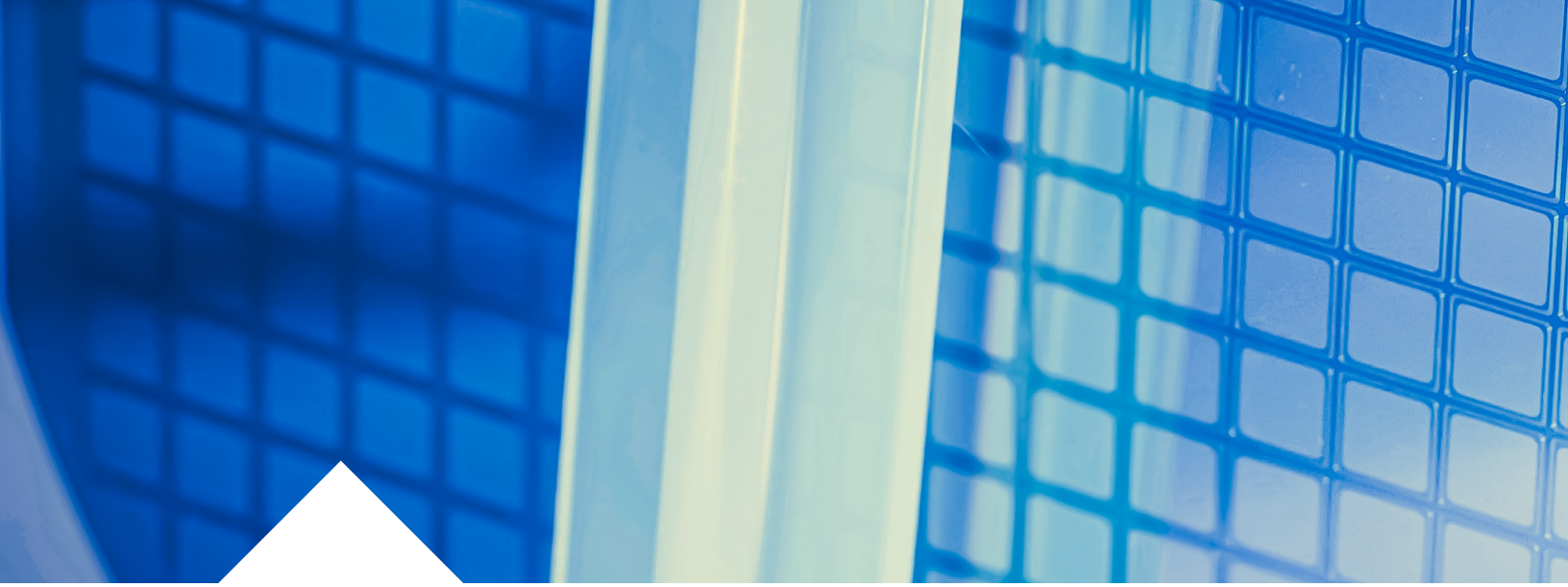
Flow Measurement & Control Solutions for Semiconductor Manufacturing



PSG a DOVER company

MALEMA

Where Innovation Flows



Semiconductor Industry

The semiconductor industry, which impacts nearly every aspect of our lives, is the backbone of modern technology and serves as a foundation for innovative breakthroughs. Almost every industry depends on semiconductor power, including consumer electronics, medical devices, communication infrastructure, automobiles and more.

Semiconductors, which have an electrical conductivity between conductors and insulators, are used to make transistors, diodes and integrated circuits (ICs), the building blocks of a wide range of electronic devices vital to modern life.

As the leading manufacturer of meters, controllers, sensors, electronics and process instrumentation for abrasive slurries, surfactants, and high-purity and corrosive chemicals, Malema™ provides customers with the flow measurement and control solutions that deliver the superior metering accuracy required by the semiconductor industry.

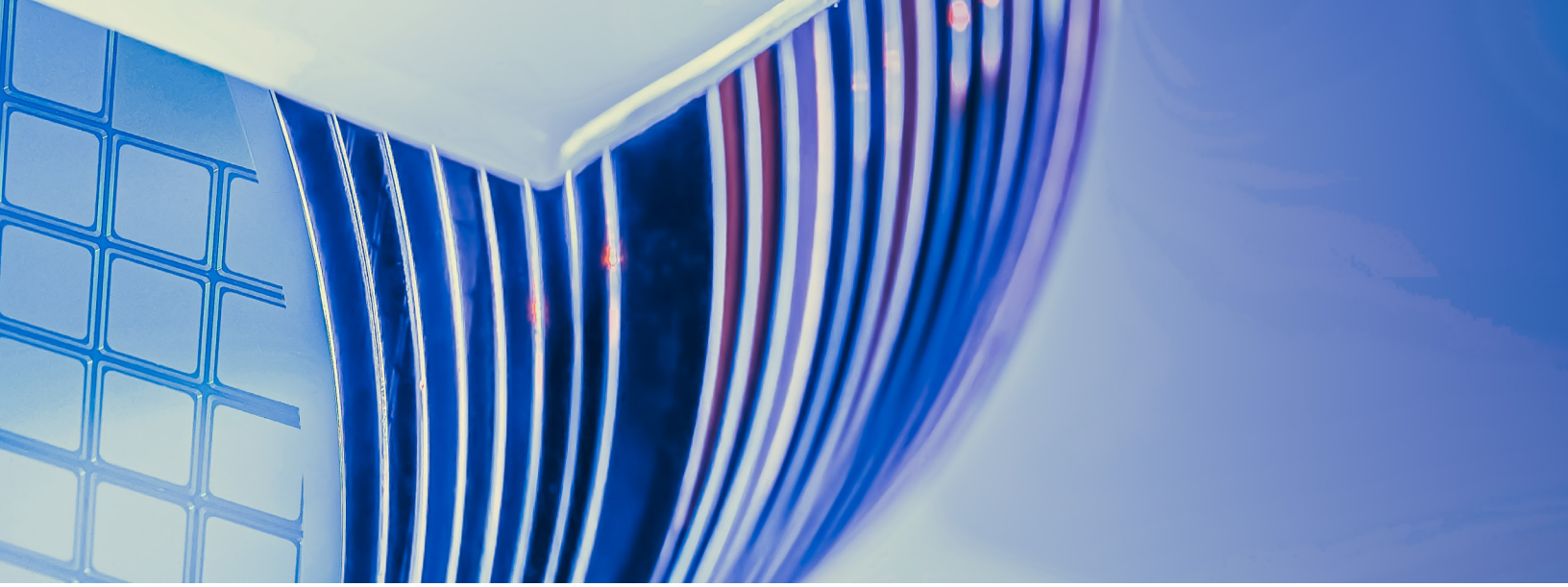
About Malema

Malema engineers flow meters, controllers, flow switches and pressure sensors for the semiconductor industry that are safe, accurate and repeatable, all while maintaining the highest standards for purity and cleanliness.

With decades of experience, several key patents and a full portfolio of flow measurement and control solutions, Malema has built industry-leading relationships with major semiconductor OEMs and manufacturers. Malema engineers have been involved with multiple OEMs, developing customized flow control solutions for global chemical mechanical planarization (CMP) and Wet Bench Tool manufacturers, as well as chip manufacturers. Malema is well known for offering easy installation, simple maintenance, and readily available upgrades and replacements.

Malema Ultrasonic and Coriolis Flow Measurement and Flow Control Solutions are used in applications throughout the semiconductor manufacturing process, including CMP, post CMP cleaning, wet clean, chillers, etch, lithography, pure chemical supply, slurry management, waste-gas scrubber and wastewater treatment.

Malema is proud to offer flow measurement and control solutions that contribute to developing faster, more efficient and innovative electronic devices, shaping the trajectory of global technological progress.



About PSG®

PSG® is the global pump, metering and dispensing-solution expert, enabling the safe and efficient transfer of critical and valuable fluids that require optimal performance and reliability in applications where it matters most.

Additionally, PSG is a leading provider of flow meters designed to reduce waste and downtime while accurately measuring, monitoring and controlling the distribution of fluids.

Headquartered in Downers Grove, IL, USA, PSG is comprised of several world-class brands, including Abaque®, All-Flo™, Almatec®, Blackmer®, Cryo-Mach®, Ebsray®, em-tec®, Griswold®, Hydro™, ipp, Malema™, Mouvex®, Neptune®, PSG® Biotech, Quantex™, Quattroflow®, and Wilden®.

PSG products are manufactured on four continents – North America, Europe and Asia – in state-of-the-art facilities that practice lean manufacturing and are ISO-certified.

PSG is part of the Pumps & Process Solutions segment of Dover Corporation.

Optimizing the Semiconductor Production Process

1 Chemical Mechanical Planarization

Malema PFA Coriolis and Ultrasonic Flow Controllers offer an extremely high level of accuracy to precisely control the heart of the manufacturing process of semiconductor chips while preserving valuable slurry, and post CMP cleaning chemistries and lowering the number of defective wafers. Malema also provides pressure sensors and interlock devices (MIID), a cutting-edge instrument for stopping valve leaks that guards against cross-contamination between DI water and slurry.

- Ultrasonic Flow Meters & Controllers
- Coriolis Flow Meters & Controllers
- MIID (Interlock Device)
- Pressure Sensors

2 Chillers

The presence of liquid flow is indicated by Malema Flow Switches installed along the piping flow path of the chillers. Process safeguards can be activated by programming them to trip an alarm and instantly alert operators when flow stops. Paddlewheel and vortex flow meters are also available from Malema to control flow to and from the chillers.

- Paddlewheel Flow Meter
- Vortex Flow Meter
- Stainless Steel Flow Switches

3 Etch (Dry & Wet)

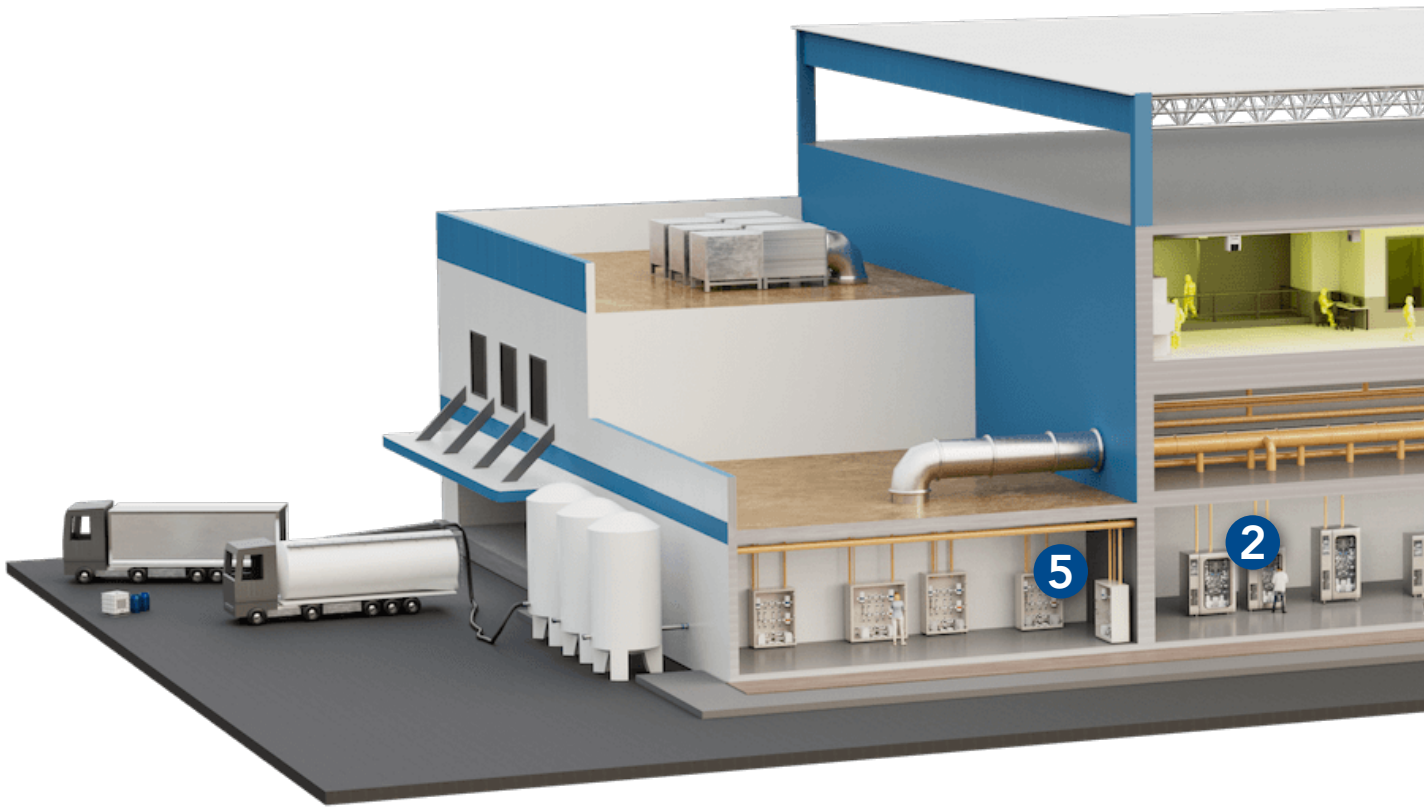
To prevent unnecessary chemical use during the etching process, Malema Ultrasonic Flow Meters and Controllers provide a controlled method of chemical dispensing, while high-purity flow switches composed of PTFE or PFA offer a chemically inert way of monitoring flow while providing resistance to abrasive chemicals.

- High Purity Flow Switches

4 Lithography

For applications involving the dispensing of small-volume photoresists, Malema Ultrasonic Flow Meters with PFA wetted parts offer precise flow measurement.

- Ultrasonic Flow Meter
- Ultrasonic Dispense Verification Meter



5 Pure Chemical Supply

During the pure chemical supply process, the VF-8100 Vortex Flow Meter and the M-2111 Ultrasonic Flow Meter offer precise flow measurement at high flow rates. Every wetted part of these flow meters is made of PFA material, ensuring excellent purity and resistance to corrosion.

- Ultrasonic Flow Meter
- Vortex Flow Meter

6 Slurry Management

For the management of slurry, Malema provides an extensive range of PFA flow and controllers. Every technology offers precise measurement to control usage and ensure accuracy in slurry batch mixing. Measuring foamy liquids, which are present in slurry mixtures, is an additional advantage of the Coriolis flow and controllers.

- Coriolis Flow Meters & Controllers
- Ultrasonic Flow Meters & Controllers
- Vortex Flow Meter

7 Waste-Gas Scrubber

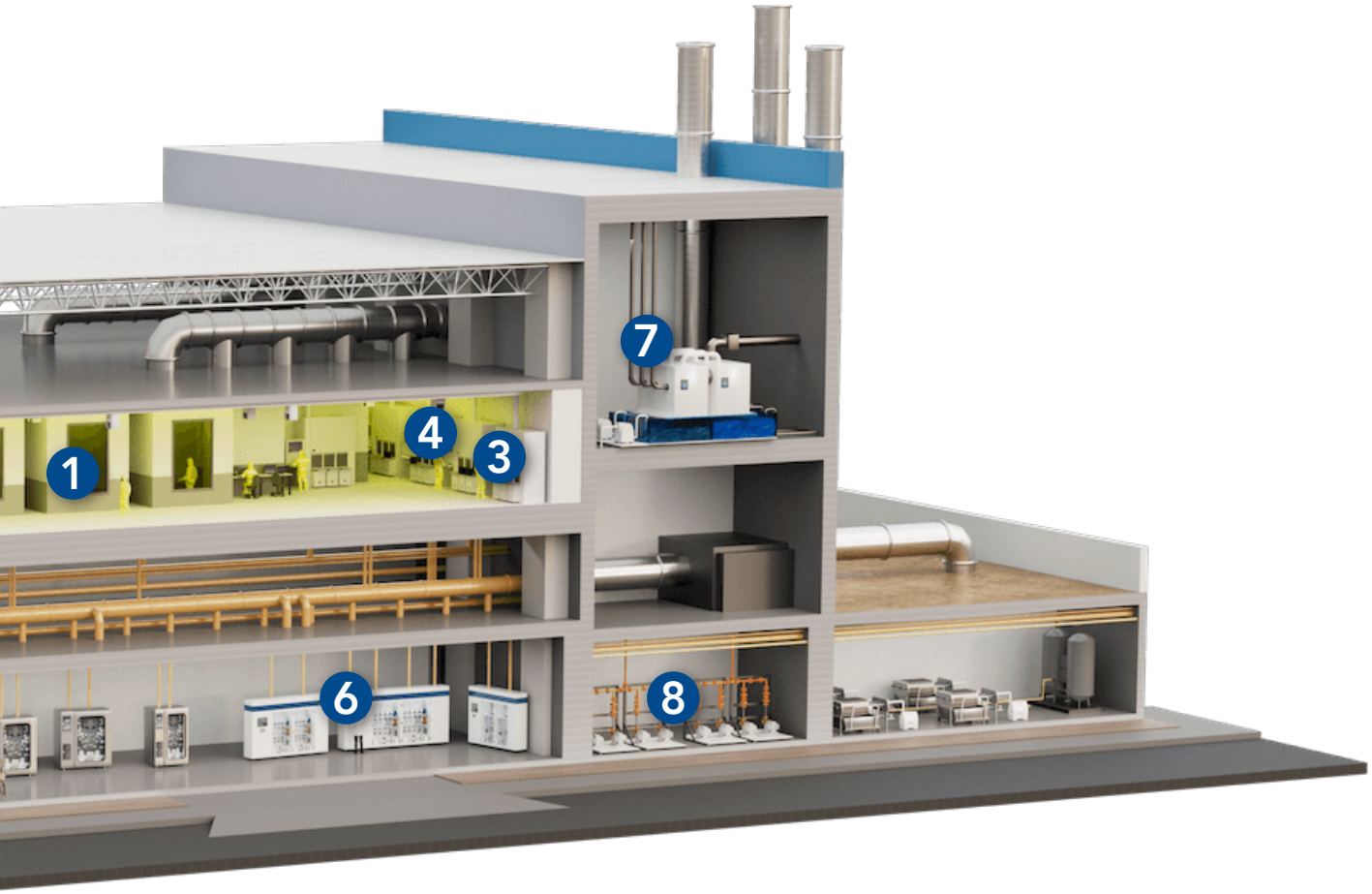
Malema Flow Switches detect and monitor gas flow throughout the waste-gas processing system. ATEX-certified and explosion-proof flow switches are available to monitor potentially explosive gases. These switches are calibrated to trip alarms when no flow is detected.

- Stainless Steel Flow Switches
- Explosion Proof Flow Switches
- Ultrasonic Flow Meter

8 Wastewater Treatment

Malema Flow Switches are installed at various points throughout the wastewater treatment process to detect flow. They can be programmed to trip an alarm in the event that they detect no flow, alerting operators of any issues or blockages in the system.

- Stainless Steel Flow Switches



Coriolis Flow Meters & Controllers

Malema offers flow measurement and control solutions that feature Coriolis technology in both flow meters and flow controllers. One of the main benefits of Coriolis technology is its extreme accuracy of ±1% and its accuracy is unaffected by flow regime or bubbles. Constructed with all-PFA wetted surfaces for use in high-purity semiconductor applications, Malema Coriolis Flow Meters and Controllers measure liquids by providing mass flow rate, total mass and temperature output with extreme accuracy. Malema Coriolis technology provides fluid measurement performance that is independent of fluid properties, eliminating the need to calibrate on different fluids. Additionally, the sensors operate and measure in two-phase flow conditions with gas volumetric void fractions in excess of 30%.

Coriolis Flow Meters

	CPFM-5000 Series Features an integral electronic transmitter, includes sensor and electronics in one compact unit	**CPFM-8800 Series** Designed with separate units for sensor and electronics to allow for remote sensor electronics
Accuracy	±1% of rate (flow rates between 100 – 10% of MRV)* ±1 % of rate Z.O.S. (flow rates below 10% of MRV)*	±1% of rate (flow rates between 100 – 10% of MRV)* ±1 % of rate Z.O.S. (flow rates below 10% of MRV)*
Repeatability	±0.5% of flow reading, down to 10% of full scale*	±0.5% of flow reading, down to 10% of full scale*
Temperature	Ambient: 0 – 50°C | Fluid: 18 – 50°C	Ambient: 0 – 50°C | Fluid: 18 – 50°C
Operating Pressure	80 psig (max.)	80 psig (max.)
Flow Range	50 – 4,000 g/min	50 – 4,000 g/min

**Accuracy and repeatability statement is based on a room temperature DIW calibration.*

Coriolis Flow Controllers

	CMFC-5000 Series Features a pinch valve for slurry applications or a diaphragm valve for chemistries applications	**CMFC-6000 Series** Equipped with an integral pressure sensor, designed for a variety of semiconductor chemistries
Accuracy	±1.5% of set point or ±3 g/min (whichever is larger)*	±1.5% of set point or ±3 g/min (whichever is larger)*
Control Repeatability	±0.5% of set point or ± 0.5 g/min (whichever is larger)*	±0.5% of set point or ± 0.5 g/min (whichever is larger)*
Temperature	Ambient: 0 – 40°C / 30 – 80% RH, without Dew | Fluid: 18 - 50°C	Ambient: 0 – 40°C / 30 – 80% RH, without Dew | Fluid: 18 – 50°C
Operating Pressure	50 psig (max.)	50 psig (max.)
Flow Range	50 – 5,000 g/min**	50 – 5,000 g/min**

**Accuracy and repeatability statement is based on a room temperature DIW calibration.*
***Higher flow ranges are available in 3/8" tubing only.*

Ultrasonic Flow Meters & Controllers

Malema Ultrasonic Flow Meters and Controllers are designed with transit-time ultrasonic technology with the latest digital signal processing (DSP) to determine accurate and precise measurements for use in a wide variety of high-purity liquids, including DI water, harsh chemicals and CMP polishing slurries. Malema Ultrasonic Flow Meters and Controllers feature all wetted parts made of high-purity PFA providing corrosion resistance, and keeping your applications free from ion or particle contamination.

Ultrasonic Flow Meters

	M-3100 Series Non-contact sensor	**M-2700 Series** Sensor with integral electronics	**M-2300 Series** Sensor with integral electronics	**M-2111 Series** Sensor with remote electronics	**M-1500MB Series** Sensor with remote or integral electronics
Sensor Configuration	Clamp-On	U or Z Shaped	Straight Flow Through	U or Z Shaped	Straight Flow Through
Accuracy	±2% of full scale	±1% of flow reading, down to 10% of full scale*	±0.5% of full scale	±1% of flow reading*	±2% of flow reading*
Repeatability	±1% of flow reading, down to 20% of full scale*	±0.5% of flow reading, down to 10% of full scale*	±0.25% of full scale	0.5% of flow reading, down to 10% of full scale*	±1% of flow reading, down to 10% of full scale*
Temperature	Ambient: 0 – 40°C Fluid: 10 – 60°C	Ambient: 0 – 46°C Fluid: 10 – 60°C	Ambient: 0 – 46°C Fluid: 10 – 60°C	Ambient: 0 – 50°C Fluid: 10 – 60°C	Ambient: 0 – 46°C Fluid: 10 – 60°C
Operating Pressure	90 psig (max.)	70 psig (max.)	70 psig (max.)	70 psig (max.)	70 psig (max.)
Flow Range	0 – 20 l/min	0.1 – 20 l/min	3 – 200 l/min	0 – 80 l/min	4 – 600 ml/min

**Accuracy and repeatability statement is based on a room temperature DIW calibration.*

Ultrasonic Flow Controllers

	LFC-7000 Series Integrated controller with pinch valve for slurries or diaphragm valve for chemistries	**LFC-7650 Series** Integrated controller with pressure transducer and diaphragm valve
Accuracy	±1% of set point or ±3 ml/min (whichever is larger)*	±1% of set point or ±3 ml/min (whichever is larger)*
Control Repeatability	±0.5% of set point or ±1.5 ml/min (whichever is larger)*	±1% of set point or ±1 ml/min (whichever is larger)*
Temperature	Ambient: 0 – 40°C (30 – 80% R.H., without Dew) Fluid: 10 – 60°C	Ambient: 0 – 40°C (30 – 80% R.H., without Dew) Fluid: 10 – 60°C
Operating Pressure	50 psig (max.)	50 psig (max.)
Flow Range	5 – 12,000 ml/min** Depending on size of sensor selected	5 – 4,000 ml/min** Depending on size of sensor selected

**Accuracy and repeatability are based on room temperature DIW calibration.*
***The enclosure footprint may be larger for these flow ranges to meet the pressure drop specification. The minimum differential pressure requirements can be higher for these ranges.*

Vortex Flow Meters

An inline flow sensor and electronics are combined into one unit to create the VF-8100 and VF-8200 Vortex Flow Meters. Using ultrasonic sensing technology to measure flow rate, these vortex flow meters are available in multiple sizes and feature no mechanical seals or moving parts. In the semiconductor industry, the VF-8100, with its PFA wetted materials, is an ideal choice for applications requiring corrosion-resistant wetted parts, high purity, and a minimal footprint.

	VF-8100 Vortex Featuring PFA wetted materials	**VF-8200 Vortex** Featuring PPS wetted materials
Accuracy	±2% of full scale	±2% of full scale
Repeatability	Within ±0.5% of full scale	Within ±0.5% of full scale
Temperature	Ambient: 0 – 50°C | Fluid: 0 – 90°C	Ambient: 0 – 50°C | Fluid: 0 – 90°C
Operating Pressure	100 psig (max.)	100 psig (max.)
Flow Range	0.4 – 100 l/min	0.5 – 150 l/min
Sizes	3/8", 1/2", 3/4", 1"	3/8", 1/2", 3/4", 1"

Paddlewheel Flow Meter

The M-10000 Paddlewheel Flow Meter is a compact, easy-to-install flow-sensing device offering improved accuracy by utilizing sophisticated circuitry to foster signal conditioning. This flow meter features a built-in adjustable flow switch and is available in various different materials of construction including PTFE, acetyl copolymer, stainless steel, and more.

	M-10000 Paddlewheel
Accuracy	±5% of full scale*
Repeatability	±0.5%*
Temperature	All electrical components are extended industrial range components rated from -40 – 90°C
Operating Pressure	100 – 300 psig**
Materials of Construction	PTFE, Acetyl Copolymer, Stainless Steel
Flow Range	0.1 – 225 l/min

**Accuracy and repeatability is based on room temperature DIW calibration.*
***Depending on component materials.*

Pressure Relief Valve

With an all-PFA molded body, the M-VF-F Series Pressure Relief Valve is designed for installation on pressurized systems applications involving semiconductors, ultra-pure water and abrasive chemicals. Featuring 1/4" male flare size ports, these high purity pressure relief valves come with bubble tight seal and are factory set for relief pressure.

	M-VF-F Pressure Relief
Set Point Accuracy	±5%
Repeatability	±2.5%
Calibration Range	The product can be set at a cracking pressure in the range of 30 – 90 psi (2.1 – 6.2 bar) with bubble-tight shut off.*
Cracking Pressure	30 – 90 psi (2.1 – 6.2 bar)
Hysteresis	30%
Connection Sizes	1/4" Male Flare

**Consult factory for lower settings.*

Pressure Sensors

Malema Pressure Sensors are designed to meet the requirements of contamination-free wetted parts, providing minimum dead-volume and resistance to corrosive chemicals used in semiconductor and high-purity applications. The MPT-750 Series offers temperature as well as pressure monitoring in a single compact device. These pressure sensors are available in PFA and PTFE, and as a single port or inline flow through design with tube connections or options for flare or pillar type connections.

	MPS-450 Series	MPT-750 Series	KL Series
Measurement Range	0 – 7.5 psig 0 – 30 psig 0 – 100 psig	0 – 30 psig 0 – 100 psig	0 – 50 psig 0 – 75 psig
Accuracy	±1% of full scale	±1% of full scale	±1% of full scale
Allowable Maximum Pressure	Depends on pressure range; typically 2 bar over max pressure	Depends on pressure range; typically 2 bar over max pressure	120 psig
Operating Temperature Range	10 – 70°C	-5 – 70°C (non-phase changing)	10 – 80°C
Operating Humidity Range	25 – 89% RH (no condensation inside sensor)	25 – 89% RH (no condensation inside sensor)	25 – 89% RH (no condensation inside sensor)
Connection Sizes	1/4", 3/8", 1/2", 3/4", 1"	1/4", 3/8", 1/2", 3/4", 1"	1/4", 3/8", 1/2", 3/4", 1"

Flow Switches

Malema adjustable and fixed set point flow switches feature a piston-style working principle and come in single-pole, single-throw (SPST) and single-pole, dual-throw (SPDT) configurations. Designed for the semiconductor industry, Malema has three all PFA flow switches built for use in high-purity applications.

- M-61-F PFA Fixed Set Point Flow Switch with Right Angle Flow
- M-62-F PFA Fixed Set Point Flow Switch with Inline Flow
- M-200-F PFA Adjustable Flow Switch with Right Angle Flow

Model	Set Point Type	Port Size	Flow Range Water	Flow Range Air*	Connection Type	Available Materials
M-61	Fixed	1/4"	20 – 7600 CCM (0.005 – 2 gpm)	0.3 – 55 SLPM	Flare	PFA
		3/8"				
M-62	Fixed	1/4"	20 – 1200 CCM (0.005 – 0.31 gpm)	0.3 – 55 SLPM	Flare	PFA
		3/8"				
M-200F	Adjustable	3/8", 1/2", 3/4"	113 – 38,000 CCM (0.03 – 10 gpm)	28 – 2,800 SLPM	Flare	PFA

**With applications featuring gases, ranges may vary.*

Fixed Set Point Flow Switches

Extreme accuracy is a highlight of Malema Fixed Set Point Flow Switches models. When triggered, the models will be within 10% of the desired set point, all while offering repeatability of 5%.

Malema Fixed Set Point Flow Switch models offer a custom set point calibration option that can be programed at our Malema facility before shipping. Standard pre-calibrated set point ranges on Malema Flow Switches are also available for immediate use and distribution. Options for SPST and SPDT configurations are available. Use the table below for information on sizes, ranges, and available materials for Malema Fixed Set Point Flow Switches.

Model	Port Size	Flow Range Water	Flow Range Air*	Connection Type	Available Materials
M-50	1/8"	1 – 170 CCM (0.0002 – 0.04 gpm)	.05 – 5 SLPM	FNPT	316SS, Acrylic, Anodized Aluminum, Brass, PP, PTFE
	1/4"				
M-55	1/8"	170 – 750 CCM (0.04 – 0.19 gpm)	5 – 25 SLPM	FNPT	316SS, Acrylic, Anodized Aluminum, Brass, PP, PTFE
M-60	1/4"	750 - 1600 CCM (0.19 – 0.42 gpm)	25 – 55 SLPM	FNPT	316SS, Acrylic, Brass, Anodized Aluminum, PP, PTFE, PVC
M-64	3/8"	0.4 – 26 LPM (0.10 – 7 gpm)	28.5 – 1980 SLPM	FNPT	316SS, Brass, PTFE, PVC
	1/2"				
M-701	3/4"	1 – 19 LPM (0.26 – 5 gpm)	–	FNPT	Fiberglass infused PP

**With applications featuring gases, ranges may vary.*

Adjustable Set Point Flow Switches

Adjustable Malema Flow Switches with right angle flow can be configured at the factory with a specific set points, and further adjusted in the field (by turning the adjustment screw) to meet changing requirements. These extremely accurate flow switches provide repeatability of 5%, and have options for SPST or SPDT configurations. Malema applications engineers can help size the proper switch for each customer's exact requirements. Use the table below for information on sizes, ranges, and available materials for Malema Adjustable Set Point Flow Switches.

Model	Port Size	Flow Range Water	Flow Range Air*	Connection Type	Available Materials
M-100	1/8"	1 – 170 CCM (0.0002 – 0.04 gpm)	0.05 – 60 SLPM	FNPT	316SS, Acrylic, Anodized Aluminum, Brass, PP, PTFE
	1/4"				
M-200	3/8"	0.15 – 19 LPM (0.03 – 5 gpm)	28.5 – 1415 SLPM	FNPT	316SS, Acrylic, Anodized Aluminum, Brass, PTFE
	1/2"				
	3/4"	0.75 – 37 LPM (0.19 – 10 gpm)	56.5 – 2830 SLPM		

With applications featuring gases, ranges may vary.

Explosion-Proof Flow Switches

Malema Stainless Steel Explosion-Proof Flow Switches are available in fixed (M-50X and M-60X) and adjustable (M-100X and M-200X) set point models. These extremely sensitive explosion-proof flow switches are engineered to monitor vital sample flow parameters for instrumentation in process control and inert blanket gases. When triggered, the fixed set point models will be within 10% of the desired set point, while all models offer repeatability of 5%.

Malema Explosion-Proof Flow Switches offer custom set point calibration that can be programed at our Malema facility before shipping. Standard pre-calibrated set point ranges on these flow switches are also available for immediate use and distribution. These switches come in SPST or SPDT configurations and are UL listed, ATEX and IECEX certified.

Model	Port Size	Flow Range Water	Flow Range Air*	Connection Type	Available Materials
M-50X	1/8"	1 – 170 CCM (0.0002 – 0.04 gpm)	.05 – 5 SLPM	FNPT	316SS, Hastelloy
	1/4"				
M-60X	1/4"	750 – 1600 CCM (0.19 – 0.42 gpm)	25 – 55 SLPM	FNPT	316SS, Hastelloy
M-100X	1/8"	1 – 200 CCM (0.0002 - 0.05 gpm)	0.02 – 1 SLPM	FNPT	316SS, Hastelloy
	1/8"	3 – 650 CCM (0.0007 – 0.17 gpm)	0.05 – 40 SLPM		
	1/4"	3 – 950 CCM (0.0007 – 0.25 gpm)	0.2 – 60 SLPM		
M-200X	3/8"	0.2 – 40 LPM (0.05 – 11 gpm)	56.5 – 2830 SLPM	FNPT	316SS
	1/2"				
	3/4"				

With applications featuring gases, ranges may vary.

MALEMA

PSG
Malema
1060 S Rogers Circle
Boca Raton, FL 33487
USA
P: +1 (800) 637-6418
psgdover.com/malema

PSG a DOVER company

Where Innovation Flows

BR_SEMICON_52024111

Authorized PSG® Partner: