LIQUOZON® $HeliO_3$ Gas Module (shown at left), Wet Module (shown at right)

LIQUOZON® $HeliO_3$

MODULAR DISSOLVED OZONE DELIVERY SYSTEM

The LIQUOZON® $HeliO_3$ is specially designed for solar applications such as cleaning, surface conditioning and oxide growth. The ozonated water delivery system is a powerful source for wet processing with ozone and/or chemical mixtures such as acids with ozone.

The system is comprised of at least two modules: a self-contained stand-alone Gas Module and a Wet Module that integrates in the customer's TOOL. Several combinations including closed loop control and special safety features are available.

The LIQUOZON $HeliO_3$ is designed to operate in either single pass or recirculation mode. Recirculation mode reduces chemical and water consumption saving on cost and water use.

As a part of the production-proven family of LIQUOZON systems, the LIQUOZON $HeliO_3$ series is based on the same highly reliable ozone generating and contacting technology. Ozone is an environmentally friendly alternative to many process chemicals in the solar industry. It has a high redox potential, can be generated at the point-of-use, and is easily converted back to oxygen. Cost of purchase, storage and disposal of many chemicals can thus be reduced considerably.

Features & Benefits

Modular Design Optimized for Solar Applications

- Ozonated water flow up to 60 lpm, higher flow rates possible in bypass mode
- Closed loop controlled ozone concentration at the point-of-use
- Typical ramp up of ozone to 25 ppm within 15 min for 220 L bath in recirculation mode
- Applicable for process chemistry such as HF and HCl with up to 10 wt%

System Integration and Operation

- Small, compact Wet Module for an easy tool integration
- Optimized foot print of Gas Module for positioning next to the tool
- Simple operation either remotely or from the Gas Module
- All required controls are integrated into the system
- Multiple bath capability with two Wet Modules in parallel

Clean, Safe Alternative to Conventional Chemical Processing

- High redox potential of ozone
- Green chemical easily converted back to oxygen
- Ozone can be generated at point-of-use

Low Cost of Ownership

- Reduced chemical consumption and disposal costs
- Lower DIW consumption by recirculation mode
- Low O_2, CDA, cooling water consumption

Proven Reliability

- Industry leading ozone generating technology
- MTBF > 20,000 hours

Plasma & Reactive Gas Solutions

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The LIQUOZON® Family

In addition to the LIQUOZON HeliO_3 system, the production-proven family of LIQUOZON ozonated water delivery systems includes LIQUOZON Smart, LIQUOZON Single, LIQUOZON PrimO_3 and LIQUOZON Stream.

The LIQUOZON Single is the most compact single pass system available, especially designed for single wafer application supplying up to 95 ppm at 2 L/min, the maximum flow rate is 20 L/min at 30 ppm. The LIQUOZON PrimO_3 is a compact, low cost-of-ownership system with a performance range from 115 ppm dissolved ozone at 2 L/min to 30 ppm at 60 L/min. The LIQUOZON Stream is the most powerful system in the family with a performance of 25 ppm at 140 L/min.

Also included in MKS's Ozone product portfolio is the field-proven SEMOZON® ozone generation technology, proprietary MKS designed contactors for unsurpassed dissolving efficiency of ozone gas in water, state-of-the-art controls and an ozone destruct unit for safe re-conversion of residual ozone gas to oxygen. LIQUOZON systems for the semiconductor industry are enclosed in a vented cabinet and are CE and S2 compliant.

LIQUOZON® HeliO_3 System

The LIQUOZON HeliO_3 delivers dissolved ozone at flow rates of up to 60 L/min. The accuracy of the DIO_3 concentration is ensured by a closed loop control. The unit is designed as a modular system which provides all required interfaces and controls in the Gas Module and offers easy integration of the Wet Module into the wet processing tool. It is possible to operate the system either in single pass mode or in recirculation mode.

For industrial applications it is recommended that the system be operated in the recirculation mode as this reduces consumption of water and energy for the ozone production. The process liquid is circulating between the LIQUOZON HeliO_3 Wet Module and the process application while the LIQUOZON compensates the losses of ozone caused by ozone consumption, out-gassing and ozone decay. The circulating process liquid can contain HF and HCl with concentration up to 10 wt% which may offer additional options for the wet process such as cleaning, etching, drying and surface conditioning.

Performance—Concentration and Flow

The specified maximum ozone-in-water concentration at the outlet of the LIQUOZON HeliO_3 is shown in the Performance Single-Path Operation graph. The specifications refer to standard conditions see notes on table "performance summary and facility requirements".

One of the main characteristics of the LIQUOZON HeliO_3 is the amount of dissolved ozone added to the DI-Water, as shown in the Ozone Production Recirculation Operation graph. The resulting performance depends both on the specific tool configuration and the process recipe. Therefore the performance data for the recirculation are typical values. It is assumed the LIQUOZON HeliO_3 is connected to a typical batch type bath and a volume of 220 L is circulated with a temperature of 20°C. The internal closed loop control allows a fast and precise adjustment of the dissolved O_3 output concentration at the point-of-use. The LIQUOZON HeliO_3 is designed to deliver a constant O_3-in-water concentration in pass through mode with low pressure drop. According to the performance requirements different types of LIQUOZON HeliO_3 can be chosen.

System Flow and Configuration

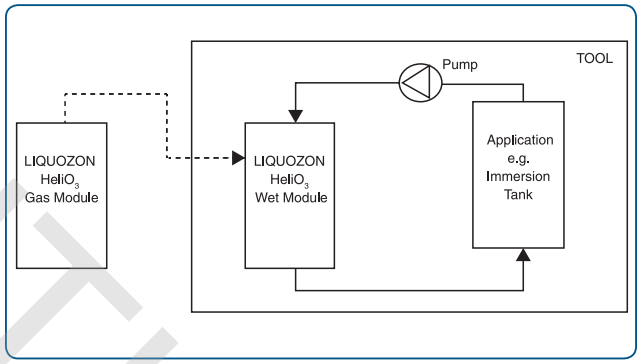
LIQUOZON HeliO_3 has a modular design with a basic configuration and several options.

The ozone gas is produced by the integrated MKS SEMOZON ozone generator through partial conversion of oxygen O_2 into O_3. Different ozone gas sources, including the highly reliable SEMOZON AX8407 series which produces ozone from oxygen by dielectric barrier discharge, can be chosen based on the performance requirements. The transfer of O_3 from the gas phase into the deionized water is accomplished by special MKS designed ozone contactors. The accuracy of the DIO_3 concentration is ensured by a closed loop control.

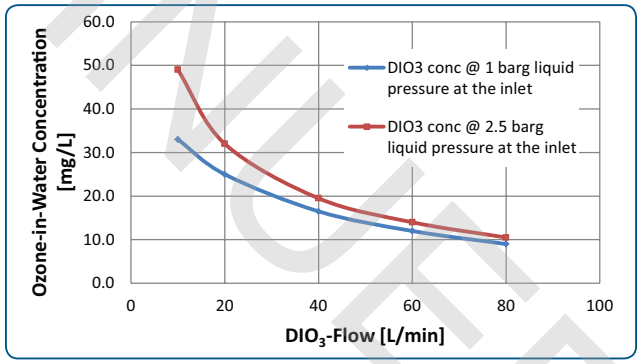
The system is compatible with acids. Liquid wetted surfaces are PFA, PTFE and FFKM. Gas wetted surfaces are 316L stainless steel, PFA and PTFE.

The system is configurable in several options e.g.:

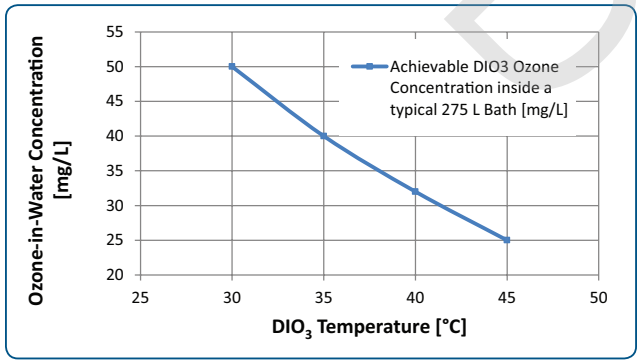
- Performance of the ozone gas generator
- Number of wet applications



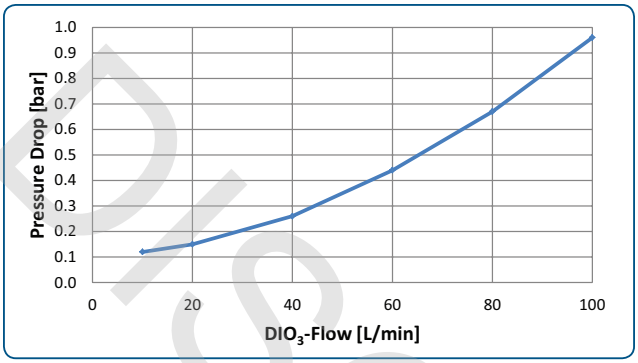
Set Up Schematic



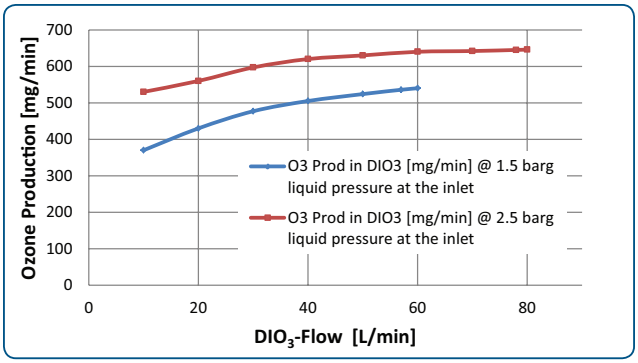
Performance Single-Path Operation DI-Water at Nominal Conditions



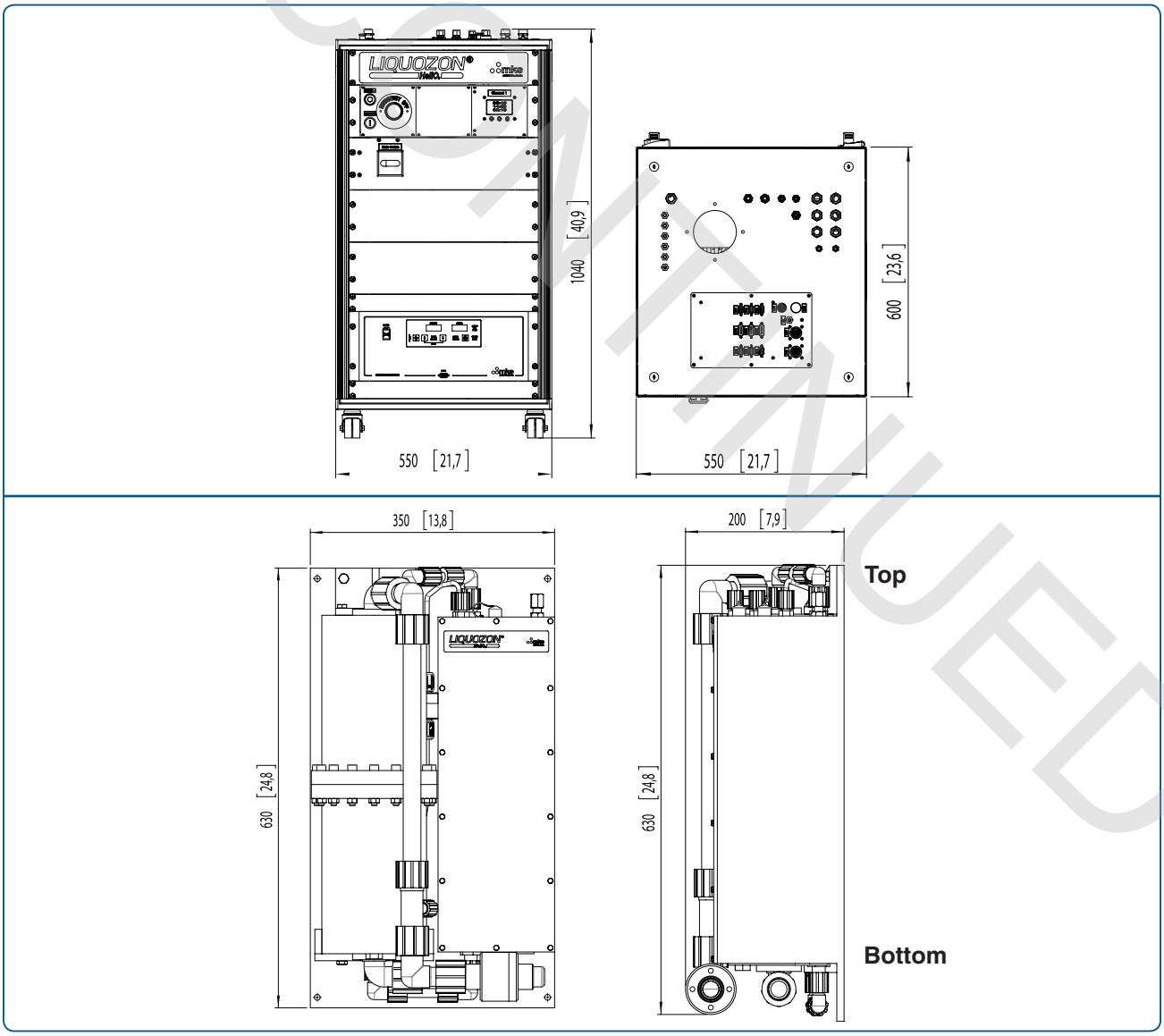
Achievable DIO_3 Ozone Concentration (inside a typical 275 L Bath Recirculation) Conditions: 50% Generator Power (4-Cell), 1.15 bar_g DIO_3 Inlet Pressure, pH=3.3



Pressure Drop of Wet Module



Ozone Production - The amount of dissolved ozone added to "refresh" the DI-Water (Recirculation Mode with 25 ppm Inlet Concentration)



Dimensional Drawings — Gas Module (top) and Wet Module (bottom)

Note: Unless otherwise specified, dimensions are nominal values in millimeters (inches referenced).

Specifications and Ordering Information

Performance Summary			
LIQUOZON HeliO$_3$			
Gas Module	PN 12-14100-01300-2M00		
Wet Module	PN 12-21A-1000A-0000		
Ozone Generator	AX8407LS-D-01		
	DIO$_3$ Flow	**Inlet Pressure 1.0 bar$_g$**	**Inlet Pressure 2.5 bar$_g$**
Achievable Dissolved Ozone Concentration in Single Path Operation DI-Water*	10 L/min 20 L/min 40 L/min 60 L/min	33 ppm 25 ppm 16.5 ppm 12 ppm	49 ppm 32 ppm 19.5 ppm 14 ppm
Plumbing Materials	Liquid wetted surfaces: PFA, PTFE, FFKM Gas wetted surfaces: 316L stainless steel, PFA, PTFE		
Communication	Binary in/out (dry contacts), RS232, RS485, USB		
Compliance	CE, SEMI S2-0302, SEMI F47		
Gas Module Dimensions			
Material	Coated steel		
Cabinet Size (W x H x D)	550 x 950 x 600 mm		
Overall Height	1040 mm		
Weight	Approx. 120 kg		
Wet Module Dimensions			
Material	PP		
Size (W x H x D)	350 x 200 x 630 mm		
Weight	Approx. 15 kg		

Facility Requirements	
Oxygen (O_2 Feed Gas)	
Purity	≥ Grade 4.0 (purity ≥ 99.99%), dew point < -40°C
Pressure	4.5 – 7.6 bar$_g$ (0.45 – 0.76 MPa$_g$, 65 – 110 psi$_g$)
Standard Flow Rate	≤ 8 slm, typ. 4.8 slm, according to SEMI E12 (0°C / 1.01325 bar)
Carbon Dioxide (CO_2 Dopant Gas)	
Purity	≥ Grade 4.5 (purity ≥ 99.995%), dew point ≤ 40°C
Pressure	5.0 - 7.6 bar$_g$ (0.50 - 0.76 MPa$_g$, 73 - 110 psi$_g$)
Standard Flow Rate	≤ 0.3 slm, typ. 0.2 slm, according to SEMI E12 (0°C / 1.01325 bar)
Compressed Dry Air (CDA)	
Purity	Filtrated (free of oils & particles)
Pressure	5.2 - 8.2 bar$_g$ (0.52 - 0.82 MPa$_g$, 75 - 119 psi$_g$)
Standard Flow Rate	≤ 10 slm, typ. 2 slm, according to SEMI E12 (0°C / 1.01325 bar)
Nitrogen (N_2 Dopant Gas)	
Purity	≥ Grade 4.0 (purity ≥ 99.99%), dew point < -40°C
Pressure	4.5 – 7.6 bar$_g$ (0.45 – 0.76 MPa$_g$, 65 – 110 psi$_g$)
Standard Flow Rate	≤ 0.8 sccm, typ. 0.5 sccm, according to SEMI E12 (0°C / 1.01325 bar)
Wet Module – Process Liquid IN – supplied from TOOL	Deionized ozonized water with HF and HCl up to 10 wt% each, free of silicon wafer fragments
Pressure	0.5 - 2.5 bar$_g$ (0.05 - 0.25 MPa$_g$, 7 - 36 psi$_g$)
Temperature	15 - 50°C
Flow Rate	Max. 60 L/min
Cooling Water	
Quality and Purity	Demineralized, filtrated (≤ 20 µm)
pH-value	7.0 - 8.0
Resistivity (Conductivity)	50 - 3000 kΩ*cm (20 - 0.33 µS/cm)
Temperature	17 - 23°C, rated 20°C
Pressure	Max. 5.0 bar$_g$ (0.5 MPa$_g$, 73 psi$_g$)
Differential Pressure	≥ 2.0 bar (0.2 MPa, 29 psi)
Flow Rate	Typ. 3.8 L/min
Gas Module Power Supply	
Class of Protection	IP 40
Current Type	AC
Phases	3/N/PE~
Frequency	50 - 60 Hz
Voltage	400 V ± 10%
RMS Full Load Phase Current	Max. 3.8 A
Collective True Power	1980 W
Collective Apparent Power	2000 VA

NOTES:
- Achievable Dissolved Ozone Concentration in DI Water and Process Liquid respectively depending on DIO$_3$ flow
- All values for nominal conditions 20°C, half life time of dissolved ozone >12 min, operating pressure at the outlet of the system as mentioned.

Ordering Information

Please contact your local MKS sales office for price and availability information.

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