

# High Concentration Hydrogen Peroxide Gas Delivery System

*Safe, stable, consistent H<sub>2</sub>O<sub>2</sub> gas delivery*

The RASIRC Peroxidizer provides a safe, reliable way to deliver high-concentration hydrogen peroxide gas into ALD, annealing, dry surface preparation and cleaning processes.

## RASIRC Peroxidizer Benefits

- Safely concentrates H<sub>2</sub>O<sub>2</sub> from semiconductor grade 30% weight H<sub>2</sub>O<sub>2</sub>
- Flows H<sub>2</sub>O<sub>2</sub> gas to process at up to 50,000 ppm, depending on flow rate
- Delivers high purity H<sub>2</sub>O<sub>2</sub> without entrained droplets or decomposition
- Delivers low H<sub>2</sub>O to H<sub>2</sub>O<sub>2</sub> ratios

## Benefits for Annealing and ALD

- Allows low temperature processing
- High oxide growth rates
- More reactive to metal-organic precursors
- Useful for *in situ* surface pre-cleaning
- Enables high-density, uniform hydroxylated surfaces
- Reduces number of defects

## Benefits for Surface Preparation and Cleaning

- Delivers stable H<sub>2</sub>O<sub>2</sub> gas at wide range of concentrations to remove films and residues
- Cleans *in situ*, requiring less chemical than wet cleaning
- Oxidizes organic hydrocarbons and metals, enabling their removal
- Removes carbon contamination without damaging the surface

## H<sub>2</sub>O<sub>2</sub> Delivery Challenges

H<sub>2</sub>O<sub>2</sub> presents a multitude of difficulties:

- Users wish to use standard two-component 30% weight H<sub>2</sub>O<sub>2</sub>
- Low volatility
- Easily condenses in the gas stream to form droplets, which can lead to particles on wafer surfaces
- Decomposes to form water and oxygen at elevated temperatures, undermining the use of hot-plate vaporizers
- Generates particles when used with flash vaporizers

## Overcoming Raoult's Law

H<sub>2</sub>O<sub>2</sub> gas has not been used extensively in oxidation, surface preparation and cleaning applications because of the obstacle described by Raoult's Law. When a two-component solution is vaporized, the individual components will do so at different rates. In the case of 30% weight H<sub>2</sub>O<sub>2</sub>, the H<sub>2</sub>O component vaporizes significantly faster than H<sub>2</sub>O<sub>2</sub>. H<sub>2</sub>O dominates the vapor stream, and the H<sub>2</sub>O<sub>2</sub> concentration is too low to be effective for the process.

Bubblers and traditional vaporizers do nothing to counteract the effect of Raoult's Law. If a carrier gas is bubbled through 30% weight H<sub>2</sub>O<sub>2</sub> solution, less than 300 ppm of H<sub>2</sub>O<sub>2</sub> will be delivered along with about 25,000 ppm of H<sub>2</sub>O. For traditional vaporizers, high temperature operation leads to H<sub>2</sub>O<sub>2</sub> decomposition. Lack of temperature control leads to entrained droplets.

For both bubblers and traditional vaporizers, the differential vaporization rate causes



the liquid solution to concentrate and the composition of the process gas to constantly change. This prevents repeatable process control. Process recipes cannot be written around continuously changing mixtures.

The RASIRC Peroxidizer overcomes the issues of Raoult's Law by using a patent-pending *in situ* liquid concentration method. Its unique vaporizer concentrates the liquid 30% weight H<sub>2</sub>O<sub>2</sub> solution to a stable and consistent level that allows up to 50,000 ppm of H<sub>2</sub>O<sub>2</sub> gas to flow to process along with H<sub>2</sub>O at a ratio of four to one.

Carrier Gas (slm)	H <sub>2</sub> O <sub>2</sub> Vapor (ppm)	Total H <sub>2</sub> O <sub>2</sub> and water mass flow (g/min)
5	50,000	1.65
10	40,000	2.47
20	30,000	3.5
30	21,200	3.5

Table 1: Typical maximum H<sub>2</sub>O<sub>2</sub>/H<sub>2</sub>O mass flow output using 31% H<sub>2</sub>O<sub>2</sub> source.

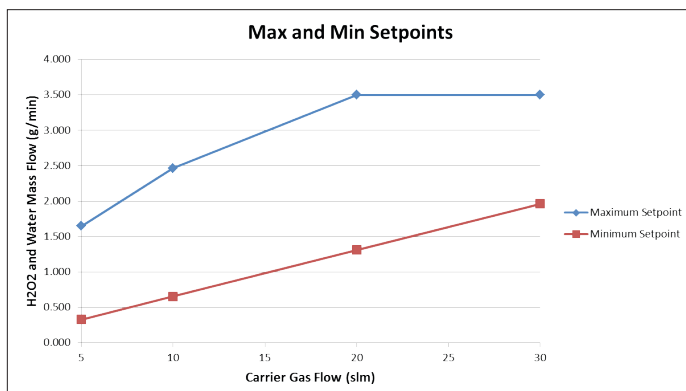
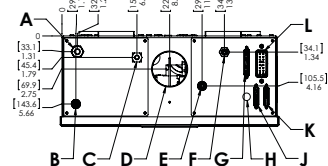
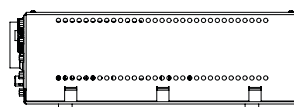
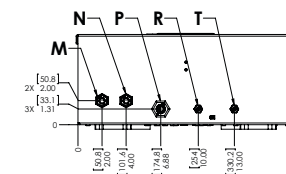


Figure 1 (left): Typical maximum H<sub>2</sub>O<sub>2</sub>/H<sub>2</sub>O mass flow setpoints for a range of carrier gas flow rates. Contact RASIRC if calibration is needed outside this range.





### Chemical Cabinet Bottom View



### Electronics Box Back View

	Description	Size/Type
N	Chilled water outlet	1/4" Male flare, PFA
P	Drain	1/2" Female compression, SS
R	H2O2 Bulk fill inlet	1/4" Female compression, PFA
T	DI Water inlet	1/4" Female compression, PFA
U	Process needle valve (NV1) adjustment port	Flathead slot
AA	J1 AC Power	CPC Type XIII, Male
AB	Power Switch	
AC	J3 Comm Port	USB Type B
AD	J8 RS232 Comm Port	9 Pin D Sub Receptacle
AE	J7 Remote Interface	15 Pin D Sub Receptacle, 4-40 screws
AF	J4 TC Cable	25 Pin D Sub Plug
AG	J5 Valves	25 Pin D Sub Receptacle
AH	J6 Instrumentation Cable	37 Pin D Sub Receptacle
AJ	J2 Heater AC Power Cable	