



Model 2800

Turbo-Vaporizer™



A high-performance Direct Liquid Injection (DLI) vaporizer for producing high-purity vapor with minimal thermal decomposition and contaminant generation for Chemical Vapor Deposition (CVD), high quality film formation, and other critical semiconductor and industrial applications.

Is your current vaporizer a constant source of maintenance and operational headaches?

Does your vaporizer generate particles and particle-induced killer defects?

Interested in high quality films and substantially higher rate of deposition?

Interested in multi-liquid vaporization for multi-precursor processes?

THE NEED

International technology roadmaps for creating leading edge device films identify the need to reliably vaporize a liquid or solvent-soluble solid precursor at well-controlled, highly-repeatable delivery rates. Proper handling of these liquid and dissolved-solid precursors is a key technology in the continuing advancement of semiconductors, ferro-electrics and magnetics, superconducting materials, and optical films.

THE SOLUTION

To minimize operational problems the ideal system design would vaporize a liquid just before entry into the CVD chamber. Vaporization should be complete and without entrained-liquid or fogging at the output. To minimize liquid precursor decomposition, the vapor should be created at the

lowest possible temperature and without direct contact between the liquid and a high-temperature metal surface.

In an effort to provide the ideal liquid vaporizing solution, MSP Corporation has collaborated with Brooks Instrument in designing the Model 2800 Turbo-Vaporizer™ for a wide range of scientific and industrial applications. The result is a low-maintenance, high-performance **Universal Vaporizer** that can meet most, if not all, your vaporization needs.

The Model 2800 Turbo-Vaporizer™ solves the problem of advanced liquid-precursor delivery using four innovative technologies: (1) precision mass flow control, (2) fine droplet atomization, (3) indirect heat-transfer isothermal vaporization, and (4) integrated hot-gas filtration.

Precise Mass Delivery of Liquid and Gas—Stable control of the mass of liquid delivered is a key to consistent film formation. Many advanced CVD precursors are so new and expensive that accurate thermal and physical properties have not been determined. Conventional thermal-based liquid flow sensors cannot accurately measure these fluids.

The Model 2800 uses a **Quantim®** liquid mass flow controller from **Brooks Instrument**. The **Coriolis** sensor at the heart of the flow controller measures fluid mass directly, independent of physical properties of the fluid, thus eliminating the need to use conversion factors required for conventional thermal measurements. A precision valve to control low flowrates is integrated into the Quantim®. Brooks calibrates the Quantim® to mass standards traceable to the National Institute of Standards and Technology (NIST). This **NIST-Traceable** calibration ensures mass-flow measurement accuracy that is independent of the precursor used.

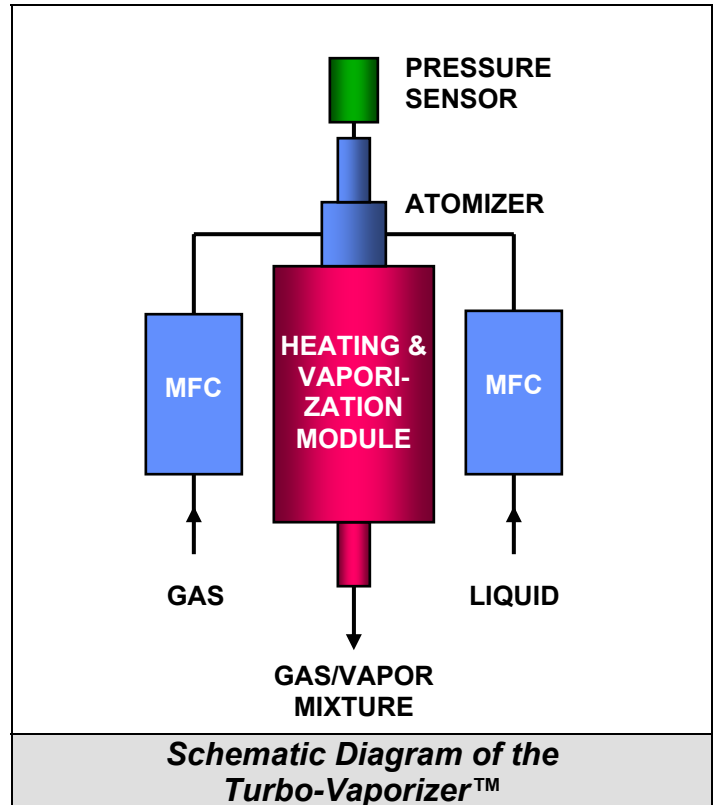


The Model 2800 requires a carrier gas to assist in liquid vaporization. A Brooks thermal gas mass flow controller is provided as part of the integrated system in either an elastomeric or metal sealed design.

Fine Droplet Atomization—The Turbo-Vaporizer™ is a major advancement in delivering delicate precursors used in advanced CVD processes. Heating these precursor liquids to create a vapor using a conventional wetted metal surface can result in thermal breakdown, which leads to fouling, plugging and particle formation. This failure leads to frequent hardware replacement and tool downtime, both of which increase operating costs. A properly designed vaporizer system can

greatly increase overall tool reliability and the effectiveness of your capital investment.

The Model 2800 uses a **fine droplet atomizer** to create very small liquid droplets and greatly increase the surface area available for transferring the heat of vaporization. Heat is transferred indirectly from a heated metal surface through an intervening gas layer and into the droplets. The small droplet size minimizes droplet impact on hot metal surfaces, thereby avoiding material decomposition and surface fouling that may otherwise occur.



Isothermal Heat Exchanger and Integrated Filter—The Model 2800 uses a turbo-mixer and recirculating-gas heat exchanger to efficiently transfer heat from the heated metal surface through the gas to the droplets. The large heat-transfer surface area minimizes the differential temperature required to transfer the heat of vaporization. The large thermal mass and symmetrical design assures stable operation during transients with no hot spots. An integrated, heated, fine-particle filter assures

® **Quantim** is a registered trademark of Brooks Instrument

that the vapor delivered is substantially free of particulate contaminants that could be a source of device defects. The filter is effective in removing particles as small as 2nm in diameter.

INTEGRATED SOLUTION

The Model 2800 is delivered as an integrated solution. All key components are mounted on a frame, insulated and plumbed together. The *Atomization/Vaporization Module* shown on the front cover is a small package that can be mounted close to the inlet of the CVD chamber, which minimizes the need for heat tracing. The module can be supplied as a stand-alone replacement for an existing vaporizer on existing CVD chamber tools or used in OEM applications where the temperature, flow rates and pressure are monitored and controlled via the tool controller.

For stand-alone use, a *Vaporizer Control Module* shown below can be used to control the vaporizer and monitor the temperature and flow.



Vaporizer Control Module

For interfacing to a computer, the *Vaporizer Control and Interface Module* provides all the electronics necessary for controlling the heat exchanger temperature, and liquid and gas flow rates and monitoring the atomizing gas pressure.



Vaporizer Control & Interface Module

FEATURES

The *Model 2800 Turbo-Vaporizer™* uses a patented vaporization technology to produce high purity vapors from liquid sources. Key features include:

- Precision gas and liquid flow control for accurate and stable vapor mass delivery rates
- Patented fine-droplet atomization technology for rapid and complete vaporization of liquid with minimal or no thermal decomposition and residue formation
- Large heat transfer surface allows for high liquid/gas ratios
- High solid to gas heat capacity ratio for excellent transient control
- Internal filter effectively removes particles as small as 2 nm in diameter and insures that the gas/vapor mixture entering the CVD process chamber is substantially free of particulate contaminants
- An exit heater eliminates the potential for any fogging at the vaporizer outlet
- Liquid flow rate: available from 3 g/hr to flow rates of 1000 g/hr and higher (TEOS equivalent)
- Carrier gas flow: available from 50 sccm to 10,000 sccm
- Available for multi-liquid vaporization
- Available for Atomic Layer Depositions (ALD)

APPLICATIONS

- Insulating, high-k, low-k, metallic, barrier and ferroelectric films
- Precision water-vapor generation for semiconductor, fuel cell, instrument calibration, and industrial applications
- Liquid precursors for fiber optic production
- Vaporization for bench top and pilot plant chemistry research

MSP Corporation is proud to have developed the Model 2800 Turbo-Vaporizer™ with **Brooks Instrument** as a development partner. **The Model 2800** features precision liquid and gas flow controllers from this world-leading supplier in the flow measurement and control field.

<p>Brooks Instrument A flow measurement and control technology company providing flow control solutions to the semiconductor and industrial markets</p>	<p>Brooks Instrument 407 West Vine Street Hatfield, PA 19440</p>	<p>Tel. 952 828 3651 wesley.sund@emersonprocess.com www.quantim.com</p>
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SPECIFICATIONS

Specifications are subject to change without notice. The Turbo-Vaporizer is capable of operating over a very wide range of liquid and gas flow rates and can be supplied with the appropriate flow controllers to meet user requirements. Liquid vaporization rates and gas flow rates outside the indicate ranges can be supplied on special order. Contact factory for details.

ATOMIZATION/VAPORIZATION MODULE

Dimensions	14" x 8" x 8" (356mm x 203mm x 203mm)
Weight	14 lb (8 kg)
Fittings	Gas Inlet, 1/4" VCR; Liquid Inlet, 1/8" Swagelok or VCR; Vapor Outlet, 1/4" VCR
Wetted parts	SS 304 & Ni standard (Optional: SS316 & Ni; or Hastelloy & Ni)
Leak integrity	< 1 x 10 ⁻⁹ scc/sec He
Heater power	115/230VAC, 60/50Hz, 100W to 400W depending on liquid flow rate
Carrier gas	Helium (standard); Nitrogen and Argon (optional)
Gas flow rate	Can be configured for flow rates from 50 sccm to 10,000 sccm
Liquid flow range	Can be configured for flow rates from 5 g/hr to 1000 g/hr (TEOS equivalent)
Temperature range	40 to 280 °C
Inlet gas pressure	35 to 80 psig (240 to 540 kPa)

VAPORIZER CONTROL AND INTERFACE MODULE

Dimensions	17" x 5.5"x12" (432mmx140mmx305mm)
Power	115/230VAC, 60/50 Hz, 140W
Display	LCD (4x40)
Analog inputs	Type J Thermocouple
Serial	RS-485

LIQUID MASS FLOW CONTROLLER

Mass Sensor Technology	Coriolis
Flow Rates	Available from 5 g/hr to 1000 grams/hr
Process Wetted Components	Process Wetted: 316L, 316L VAR, High Alloy Ferritic Stainless 17-7PH and Ni-Cr Braze Process Seals: Nickel and Viton, Buna, Kalrez or EPDM

GAS MASS FLOW CONTROLLER

Mass Sensor Technology	Thermal
Flow Rates	Available from 5 sccm to 10,000 sccm
Carrier Gas	Helium, Nitrogen, Argon
Process Wetted Components	Wetted Parts - Standard: Stainless Steel with Viton®; Optional: Kalrez® or Buna-N



*Innovative technology and products
for the semiconductor industry*

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