LIQUIDLENS™ UPW POLISHING SYSTEM

Superior cleanliness, TOC reduction, thermal stability and process performance for all UPW applications

superior cleanliness,
process stability,
optimal optical properties

Overview

The LiquidLens™ UPW polishing system provides a one-box solution to deliver "specification-grade" UPW for the most demanding process applications.

The system reduces:

- Total Organic Contamination (TOC) levels
- Anion/ion levels
- Silica levels
- Particle counts
- Dissolved gas concentrations
- Temperature fluctuations
- Pressure fluctuations
- Process variations

Ensures Consistent UPW Purity, Regardless of Facility Variances*

The LiquidLens system provides consistent, repeatable delivery of high-quality UPW. The system automatically compensates for normal, geographical and seasonal changes that typically contribute to variations in typical facility UPW contamination levels. The LiquidLens system works constantly, and automatically to prevent process upsets caused by organic contamination, temperature fluctuations, and other process variations and upsets. TheLiquidLens system protects your process as it ensures scanner-to-scanner and fab-to-fab, consistent UPW point-of-use quality.

Reduces TOC, Anion/Ion, Silica, Particles and Dissolved Gas

The LiquidLens system uses integrated UV lamps to dramatically reduce TOC levels. Degassers remove dissolved gases, and the system's ion exchangers provide excellent anion/ion reduction; most metals are reduced to below detection levels. Optional silica purifiers are available to effectively remove dissolved and colloidal silica which act as defect-causing particles and nucleation sites for other particles.

Ultra-stable Pressure and Temperature Control

Entegris' proprietary system controls are integrated with our advanced flow controllers and Levitronix® pumps to provide ultra-stable UPW pressure/flow delivery to the point-of-use.*

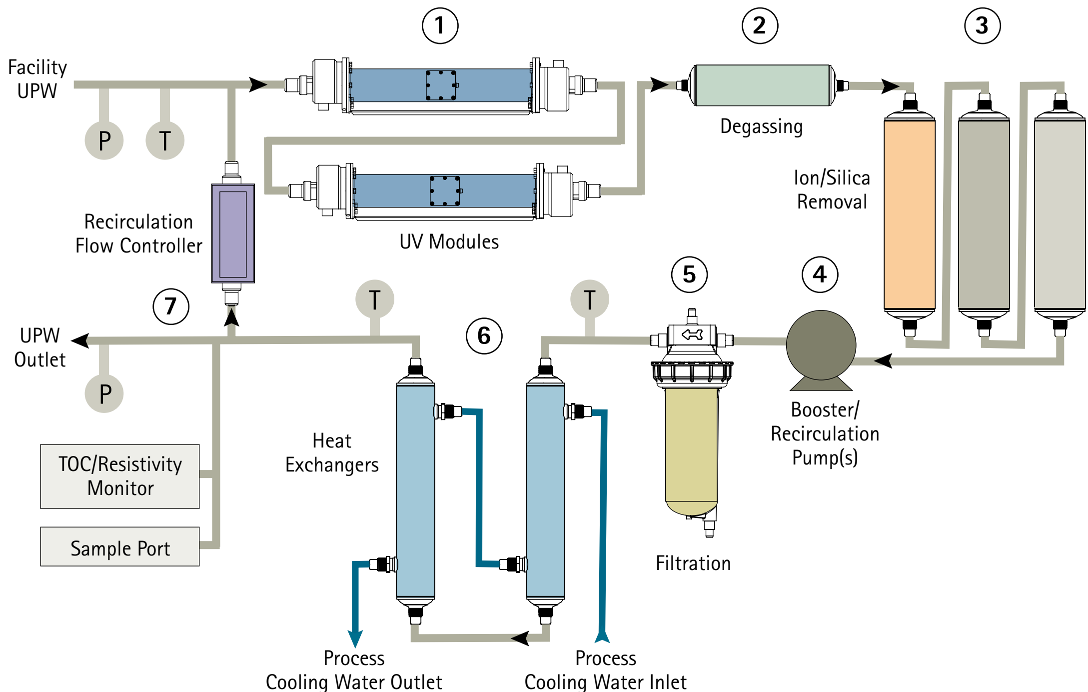
Closed-loop temperature control is used to deliver ultra-stable, thermally-controlled UPW as demanded for each and every exposure under a stepper lens. This ensures a consistent UPW refractive index to enable the creation of critical lines and features.

** See specification tables.*

Operating Principle

The UPW system is a stand-alone system designed to further polish facility UPW. The typical flow path (system dependent) is as follows:

1. UPW flows into the main cabinet and through two UV lamp housings,
2. Then to one or more degassers,
3. Then through a series of purifiers,
4. Then through two recirculation pumps to adjust the UPW pressure,
5. Then through a filter,
6. Then through one or more heat exchangers to deliver UPW at a programmed temperature,
7. Then to the outlet OR through the back pressure throttling/recirculation loop.



UPW Quality Monitoring

A TOC monitor is installed in the fluid path and connected to a Programmable Logic Controller (PLC) to provide real-time TOC monitoring.

An optional resistivity meter measures outlet UPW resistivity.

Sample ports are provided to sample both the inlet and outlet UPW.

UPW Outlet Pressure Control

The system contains an internal boost pump(s), recirculation flow controller and optional pressure damping device which are used to automatically control inlet pressure variations and maintain a stable outlet pressure.

UPW Outlet Temperature Control

An active temperature control system ensures constant UPW outlet temperature. The temperature control system regulates the Process Cooling Water (PCW) flow rate to maintain constant process UPW outlet temperature in response to varying UPW inlet temperature and flow rate loads.

Features and Benefits

Features	Benefits
"One-box" design	Excellent UPW process performance provided in a one-box solution — reduces fab space requirements, simplifies plumbing and utility setup, and ensures simple, reliable, dependable and repeatable setup and operation
UV lamps optimized for TOC reduction	Excellent TOC reduction to ensure pure processing
Integrated degassers	Protects process by dramatically reducing defect-causing ultra-fine dissolved bubbles
Multiple anion/ion purifiers	Excellent anion/ion reduction, with most metals reduced to below detection limits
Silica purifiers	Optional purifiers remove fine dissolved silica and colloidal silica, dramatically reducing defect-causing particles and nucleation sites for other particles
In-line Chemlock® filter housing	Rapid filter changeout with ultimate compatibility with a variety of Entegris filters to protect the process from defect-causing particles
Multiple pumps and flow controllers	Provides excellent outlet pressure, regardless of inlet pressure variations
Closed-loop temperature control	Closed-loop temperature control delivers highly precise outlet temperature control to ensure a constant refractive index of the UPW at the exposure point, as required to enable consistent, ultra-fine line/component exposure, for each and every exposure

Entegris UPW Systems and Products

Entegris offers a variety of systems to meet a broad range of customer needs:

	Entegris LiquidLens Systems		
Customer Requirement	**LLD2**	**LLT2**	**LLG4**
TOC reduction	–	–	YES
Metals removal	–	–	YES
Silica removal	–	–	optional
Degassing	YES	–	YES
Temperature control	YES	YES	YES
Filtration	YES	YES	YES
Pressure boost	YES	YES	YES
Pressure control	YES	YES	YES
Data logging	YES	YES	YES

Specifications

	Parameters	Units	LLD2 Value	LLT2 Value	LLG4 Value
UPW Inlet Specifications	Maximum flow rate requirements (for scanner cleaning cycles):	L/min	>8	>8	>8
	Pressure range[1]:	kPa	100 to 500	100 to 500	100 to 500
	Temperature range:	°C	17–26	17–26	17–26
	Temperature stability:	Max – min = °C/hr	2.5	2.5	2.5
	Temperature stability:	Max – min = °C/5 min	0.5	0.5	0.5
	Resistivity:	Mohm-cm	N/A	N/A	>17.7
	Total Oxidizable Carbon (TOC)[2]:	ppb	N/A	N/A	<3
	Particle performance:	Accumulative counts/ml @ ≥50 nm	<10	<10	<10
	Bacteria:	CFU/liter	N/A	N/A	<5
	Dissolved oxygen:	ppb	<1000	N/A	<1000
	Dissolved nitrogen:	ppm	<18	N/A	<18
	Total silica (as SiO_2):	ppb	N/A	N/A	<2 with Selective Ion Purifier option
	Total metal ions:	ppt	N/A	N/A	<2500 Total
	Anions:	ppt	N/A	N/A	
	Critical metals (Cu, Ni, K, Na, Fe):	ppt	N/A	N/A	
	Other metals:	ppt	N/A	N/A	
UPW Outlet Specifications	Flow rate:	L/min	1–8	1–8	1–8
	Pressure (maximum):	kPa	550	550	550
	Pressure (minimum):	kPa	350	350	350
	Pressure dampening:	% dampening to inlet pressure step changes greater than 40 kPa	>75	>75	>75
	Average temperature[3]:	°C	17–24	17–24	17–24
	Temperature stability:	Max – min = °C/hr	0.5	0.5	0.5
	Temperature stability:	Max – min = °C/5 min	0.1	0.1	0.1
	Resistivity:	Mohm-cm	N/A	N/A	>18.2
	Total Oxidizable Carbon (TOC):	ppb	N/A	N/A	<1
	Total silica (as SiO_2):	ppb	N/A	N/A	<1
	Particle performance:	Accumulative counts/ml @ ≥50 nm	<1	<1	<1

[1] Outlet pressure damping capability is limited for low inlet pressures (below 250 kPa) .

[2] Assumes TOC species in the UPW supply are able to be oxidized by 185 nm UV light.

[3] Consult Entegris for the consumption values per the target application. Actual PCW consumption is dependent on incoming fluid temperatures and PCW consumption is typically in the range of 3 – 6 L/min.

Specifications

	Parameters	Units	LLD2 Value	LLT2 Value	LLG4 Value
UPW Outlet Specifications (continued)	Bacteria:	CFU/liter	N/A	N/A	<1
	Total metal ions:	ppt	N/A	N/A	<25
	Anions:	ppt	N/A	N/A	<50
	Critical metals (Cu, Ni, K, Na, Fe):	ppt	N/A	N/A	<5
	Other metals:	ppt	N/A	N/A	<10
	Dissolved oxygen:	ppb	<1000	N/A	<1000
	Dissolved nitrogen[4]:	ppm	<15	N/A	<15
PCW Specifications	Flow rate:	L/min	<20	<20	<20
	Minimum PCW pressure difference In/Out:	kPa	200	200	200
	Inlet pressure range:	kPa	200–550	200–550	200–550
	Outlet pressure range:	kPa	0–200	0–200	0–200
	Inlet pressure stability:	kPa/5 sec	<90	<90	<90
	Inlet temperature range:	°C	10–18	10–18	10–18
	Temperature stability:	Max–min = °C/hr	2.5	2.5	2.5
	Temperature stability:	Max–min = °C/5 min	0.5	0.5	0.5
	Dissolved nitrogen:	ppm	<12	<12	<12
	Dissolved oxygen:	ppm	<8	<8	<8
	PH[5]:	N/A	>8	>8	>8
	Maximum heat load:	WATTS	<2000	<2000	<2000
Utility Specifications	**Gas**				
	Nitrogen, pressure:	MPa	0.45 ±0.24	N/A	0.45 ±0.24
	Nitrogen, flow rate:	SLPM	3 ±0.5	N/A	3 ±0.5
	CDA, pressure:	MPa	0.78 ±0.22	0.78 ±0.22	0.78 ±0.22
	CDA, flow rate[6]:	SLPM	326	140	326
	Vacuum:	mmHg	N/A	N/A	<160
	Electrical				
	Voltage[7]:	VAC	230	230	230
	Current[8]:	FLA	<25	<25	<25
	Frequency:	Hz	50/60	50/60	50/60
	Phase:	N/A	Single	Single	Single

[4] *DN <3 ppm with Extra Degassing Option.*

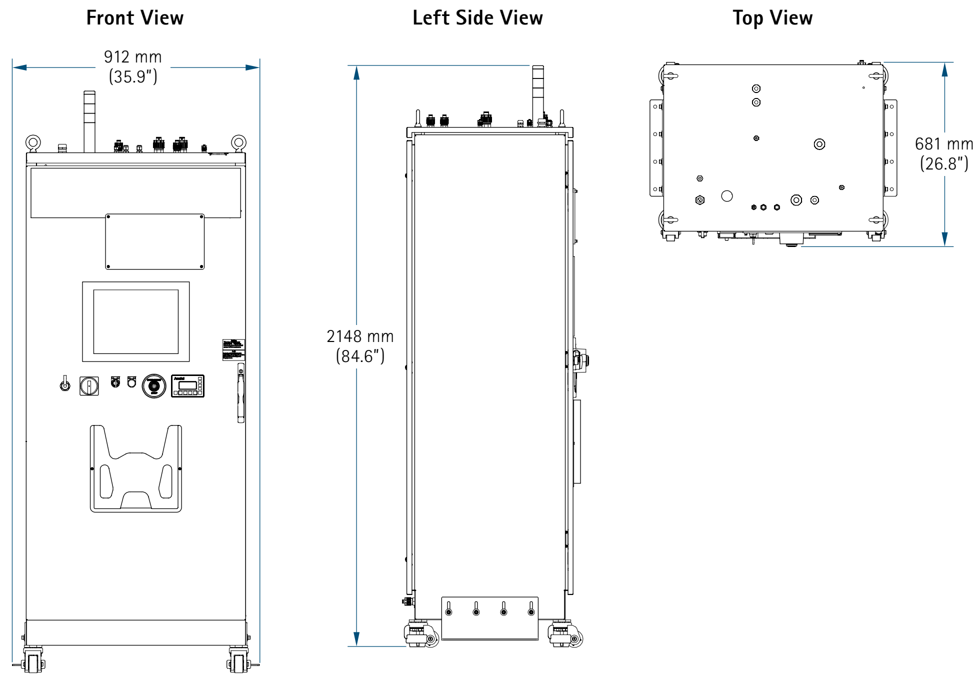
[5] *For systems equipped with an all-PFA heat exchanger through which small molecular gas species may permeate. Permeation by certain gas species may affect UPW resistivity. Care must be exercised in selecting the appropriate PCW chemistry. For example, chemistries containing small molecular gas species such as CO_2 may permeate from PCW and decrease UPW resistivity.* ***Increasing pH above 8 will reduce the risk of CO_2 permeation.***

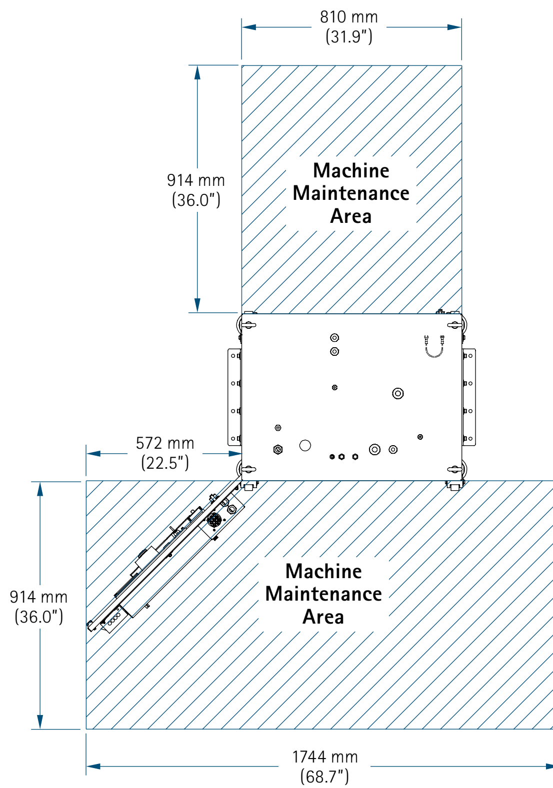
[6] *140-SLPM for systems with customer supplied vacuum connection.*

[7] *Also available in 200 and 208.*

[8] *FLA will depend on final configuration.*

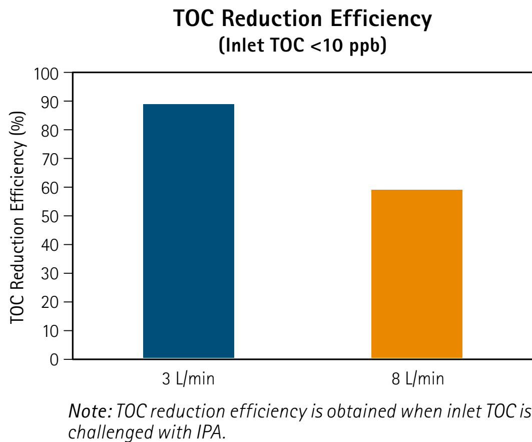
Dimensions





TOC Reduction

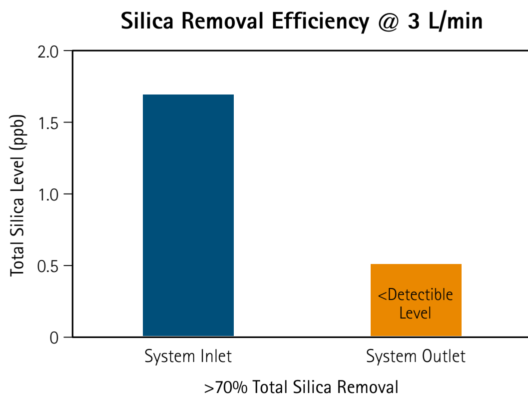
Organic contaminants can absorb light energy during an exposure sequence, causing exposure variations and defects in the photolithographic process. Organic contaminants can also deposit on optics causing lens haze and lens performance impairment. The LiquidLens system provides excellent TOC removal.



Note: TOC reduction efficiency is obtained when inlet TOC is challenged with IPA.

Silica Removal with Silica Purifier Option

High levels of silica in UPW, as dissolved silica or as colloidal silica, acts as defect-causing particles, nucleation sites for other particles, or sources of wafer water spots. The LiquidLens system provides excellent silica reduction results, as shown below:



>70% Total Silica Removal

Anion/Ion Reduction

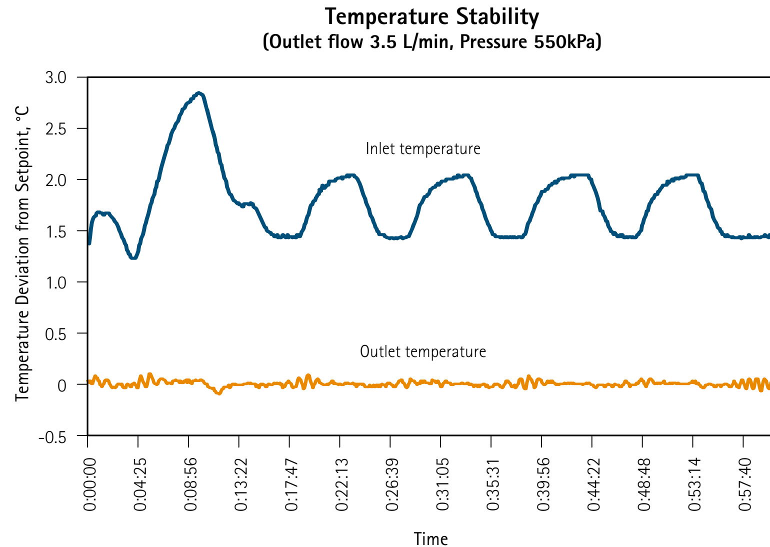
Ion exchangers reduce most metals to below detection level, including calcium, potassium, sodium and other typical, high-risk components of facility inlet UPW. A performance example is provided below, at flow rate of 3 L/min.:

	Detection Limit ppt (pg/ml)	Inlet	Outlet
Aluminum (Al)	1.0	9	*
Antimony (Sb)	0.2	*	*
Arsenic (As)	2.0	*	*
Barium (Ba)	0.5	1.5	*
Bismuth (Bi)	0.2	*	*
Boron (B)	10	57.5	*
Cadmium (Cd)	0.5	*	*
Calcium (Ca)	2.0	480	*
Chromium (Cr)	1.0	*	*
Cobalt (Co)	0.5	*	*
Copper (Cu)	1.0	*	*
Gallium (Ga)	0.5	*	*
Germanium (Ge)	1.0	*	*
Iron (Fe)	2.0	16	*
Lead (Pb)	0.2	*	*
Lithium (Li)	0.2	*	*
Magnesium (Mg)	1.0	49	*
Manganese (Mn)	0.5	1.7	*
Mercury (Hg)	5.0	*	*
Molybdenum (Mo)	0.5	*	*
Nickel (Ni)	2.0	*	*
Potassium (K)	5.0	400	*
Silver (Ag)	0.5	*	*
Sodium (Na)	2.0	200	*
Strontium (Sr)	0.2	14	*
Tin (Sn)	0.5	*	*
Titanium (Ti)	0.5	3.6	*
Tungsten (W)	1.0	*	*
Vanadium (V)	0.2	*	*
Zinc (Zn)	2.0	48	*

**Below detectible limit*

Output Temperature Stability

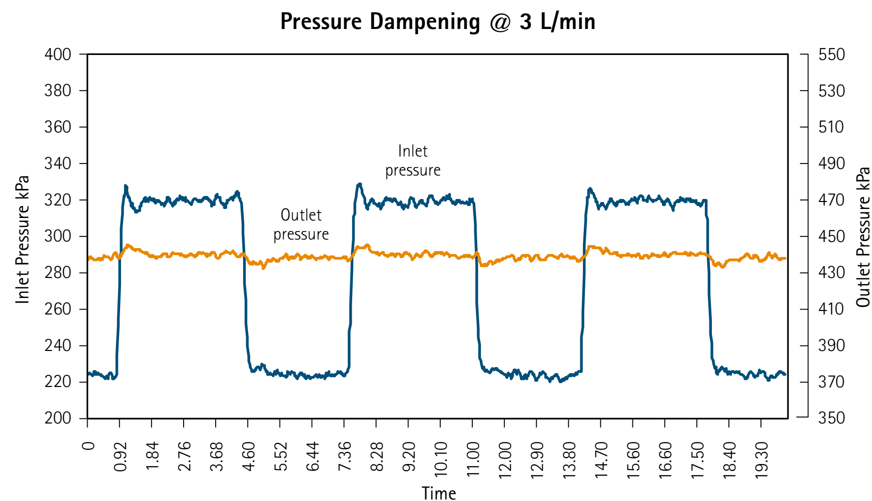
The LiquidLens system provides excellent stabilization of outlet temperature through the use of patented pHasor X heat exchange technology. An example of typical temperature outlet stabilization performance is shown in the example below:



The LiquidLens system delivers stable outlet temperature despite wide fluctuations in inlet temperature.

Output Pressure Stability

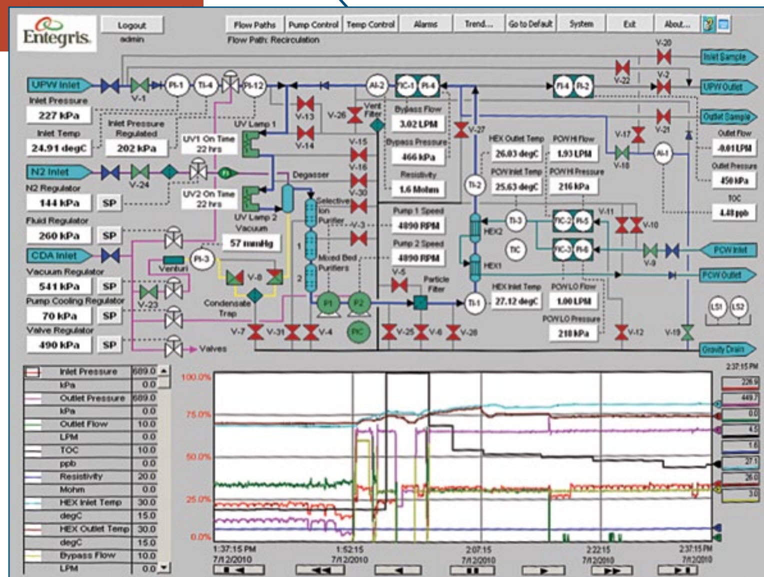
The LiquidLens system provides excellent stabilization of outlet pressure by minimizing pressure disturbances with closed-loop pressure control. An example of typical stabilization performance is shown below:



The LiquidLens system delivers stable outlet pressure despite wide fluctuations in inlet pressure.

Advanced, Automated, Hands-Off Process Control

The LiquidLens system includes automated controls software to allow rapid setup and ultimate control of all process variables. Once set, the system operates automatically to control to set parameters, making any required adjustments with no operator intervention. Remote monitoring capabilities are included in all LiquidLens systems. Process monitoring and data logging are integral to the on-board, advanced automated control system.



Certifications

CE Machinery Directive certification for certain models. All systems are designed to meet SEMI S2 & S8.

For More Information

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