



THERMORACK

THE ULTIMATE CHILLER FOR PLASMA ETCH



Solid State
COOLING SYSTEMS
Temperature Control...Precisely.

THE ULTIMATE CHILLER FOR PLASMA ETCH

How can we make such a grand statement? Because, after 20 years working in the semiconductor equipment industry, we know the problems caused to a fab by conventional Freon-based chillers: reliability, size, noise, first wafer effect, consistent wafer to wafer and within wafer temperature control and power consumption. And, after 13 years designing and manufacturing our thermoelectric technology-based temperature control products for wet benches and many applications beyond the semiconductor industry, we have created the ThermoRack 1200 Watt chiller especially for poly, metal and trans-ambient oxide etchers.

The ThermoRack rack-mount chiller has a long list of benefits and dynamic precise temperature control, which makes it the best chiller from a technical standpoint. However, what makes it the obvious choice is that the ThermoRack also has the lowest cost of ownership. That's a winning combination.

Major benefits of the ThermoRack chiller include improving wafer to wafer repeatability, reducing energy costs, increasing MTBF, saving fab space, reducing repair costs, and eliminating Freons and their replacement chemicals. ThermoRack can operate in heating or cooling modes, is programmed for Lam Research analog and (single channel, single channel dual output or dual output Master/Slave) Applied Materials CHX plasma etcher interfaces (more interfaces coming soon), and can control process temperatures to $\pm 0.03^\circ\text{C}$ at constant heat loads or to $\pm 0.2^\circ\text{C}$ with a 1000 Watt cycling plasma load (see Figure 1) with up to 62% improved on wafer temperature control demonstrated.

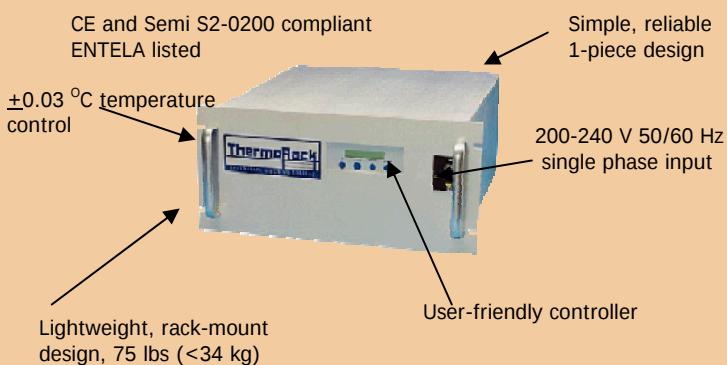
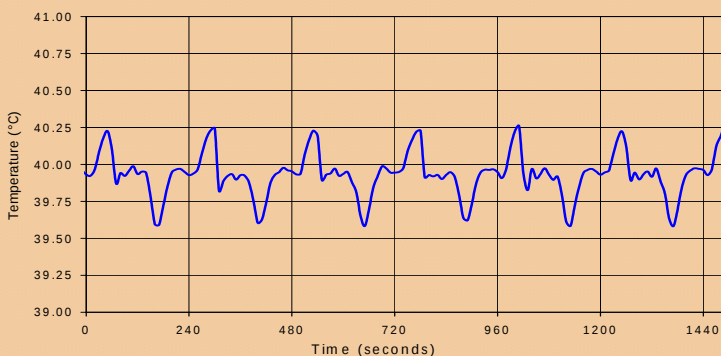


Figure 1. ThermoRack Control w/ Cycling Load
1000 Watt plasma load (2 minutes on/ 2 minutes off)



Every wafer sees the same temperature profile with fast proactive response

PROACTIVE FAST TEMPERATURE RESPONSE

Because electrons are, in essence, providing temperature control in the ThermoRack, the thermoelectric modules inside the ThermoRack's heat exchanger respond nearly instantaneously to the variable voltage power supply's instructions when the load changes. ThermoRack operates in heating or cooling modes and has an easy interface for inputting temperature setpoints. The digital PID temperature controls process temperatures to $\pm 0.03^\circ\text{C}$ at constant heat loads or to $\pm 0.2^\circ\text{C}$ with a 500 Watt cycling load (equivalent to a 1000 W plasma process). See Figure 1.

QUIET OPERATION

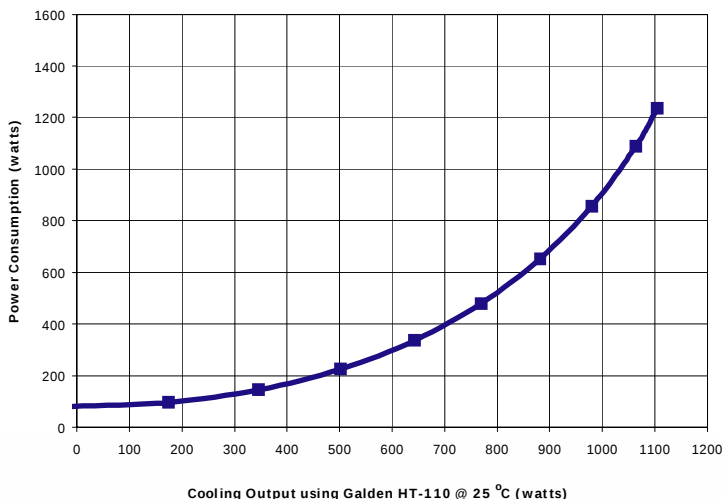
Once you are accustomed to shouting when next to a loud buzzing refrigerant-based chiller, you will be surprised by the quiet operation of the thermoelectric-based ThermoRack. Measuring at only 55 dBA, this chiller is 1/3rd as loud as a Freon-based chiller.

COMPACT AND SPACE-SAVING

With fab space valued at \$2000 per ft^2 , reducing equipment footprint saves money. The ThermoRack is housed in a 19" rack mount enclosure to minimize space. Six chillers can fit in one rack with a footprint of only 5 ft^2 .

Each chiller is 20" deep and 8.72" tall. The units are light, weighing only 75 lbs. A full rack of six compact ThermoRack chillers uses only 1/6th the footprint, 1/8th the volume, and 1/7th the weight of six stand-alone Freon-based chillers for plasma etch applications.

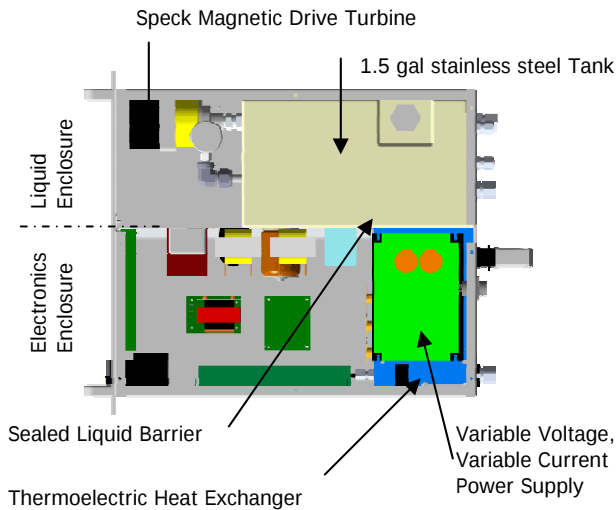
Figure 2. ThermoRack 1200 Power Consumption vs. Cooling Output



SIMPLE AND RELIABLE

Reliability has been built into the ThermoRack by using tested components and a simple, straightforward design. ThermoRack has only two moving parts: the pump and cooling fan. The solid-state thermoelectric modules, which have been utilized widely throughout the world for 50 years in various applications from space probes to home appliances, have lifetimes exceeding 200,000 hours. Based on an analysis of all its components, the ThermoRack has an MTBF greater than 60,000 hours for plasma etch and ash applications. A full two-years parts and labor warranty demonstrates confidence in ThermoRack's reliability.

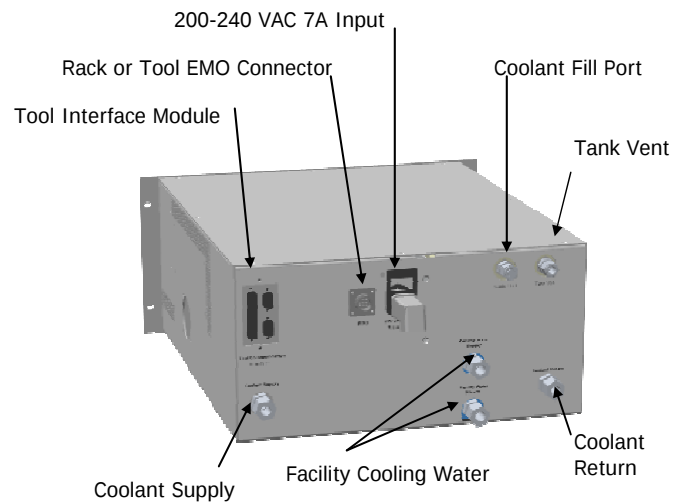
THERMORACK 1200 TOP VIEW



ENERGY-SAVING

(See Figure 2.) The ThermoRack chiller can reduce energy costs up to 93% compared to a Freon-based chiller for plasma etch. The thermoelectric technology at the heart of the ThermoRack is based on electron flow, not refrigerant flow. During chiller operation, the thermoelectric modules in the chiller's heat exchanger are only powered as much as required to meet the temperature setpoints. When not needed or needed only at a low level, the modules are either not powered at all or are only powered to the exact amount required, in contrast to a conventional refrigerant-based chiller, which operates in an "always-on" mode. Those chillers use a heater or hot gas bypass to control temperature, which requires a constant high level of power, regardless of load. ThermoRack saves around 4.2 kW continuously or about \$4375 per year for poly and metal etch processes at \$0.10/kwhr.

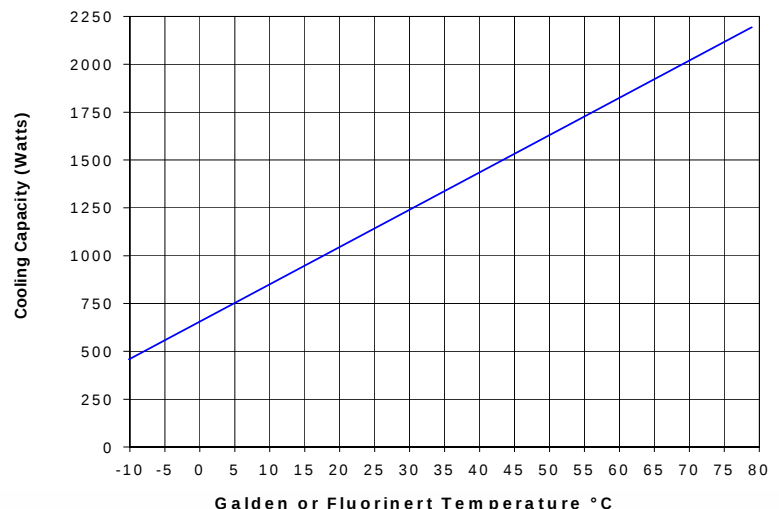
THERMORACK 1200 REAR VIEW



LOWER ENVIRONMENTAL IMPACT

The ThermoRack chiller minimizes environmental impact and helps meet ISO 14001 environmental standards in four ways. First, the ThermoRack uses no Freons or replacement chemicals or chemical refrigerants of any kind. It uses a well-known method of temperature control based on thermoelectric modules. Second, it reduces energy usage and cost by up to 93%. Because the thermoelectric modules are powered up or down by the variable voltage, variable current power supply and PID temperature controller to the exact amount of heating or cooling required to meet a temperature setpoint, the ThermoRack does not run in a full-on mode like a refrigerant-based chiller. Third, the ThermoRack reduces perfluorinated ether emissions because no tank venting is necessary. The tank operates as a surge tank, which remains at ambient temperature, so the coolant in the tank does not heat up. The ThermoRack's coolant loop is completely sealed and does not require venting. Fourth, the ThermoRack requires 60% less PCW and adds 80% less heat to the PCW while reducing the facilities air conditioning load by 85%!

Figure 3. ThermoRack 1200 Cooling Capacity



SPECIFICATIONS

Coolant Type:

Galden HT fluids, Fluorinert FC fluids, and NOVEC 7000 series fluids

Cooling Capacity with 20 °C Facility Water:

1200 Watts @ 25 °C (see Figure 3)

Heating Capacity with 20 °C Facility Water:

2000 Watts @ 25 °C

Set Point Range: -10 to +80 °C

Control Accuracy: ± 0.05 °C at constant load

Coolant Pump:

4 gpm @ 33 psig (15 lpm @ 210 kPa) (see Figure 4)

System Proof Pressure: 100 psig (690 kPa)

Coolant Fluid Connections:

½" (12 mm) Swagelok (316 stainless steel)

Tank Volume: 1.5 gal (6 liter)

Facility Cooling Water Required:

1-2 gpm (4-8 lpm) @ 10 - 35 °C

Facility Cooling Water Connections:

½" (12 mm) Swagelok (316 stainless steel)

Power Required: 200-240 VAC 1 phase 7 amps 50/60 Hz

Circuit Breaker: 15-amp 200-250 VAC 2-pole w/ 30 mA GFCI

Remote EMO: External dry contact

Dimensions:

19 x 8.7 x 24" (EIA-310-C Rack Standard 5U)

(48.3 x 22.1 x 61 cm)

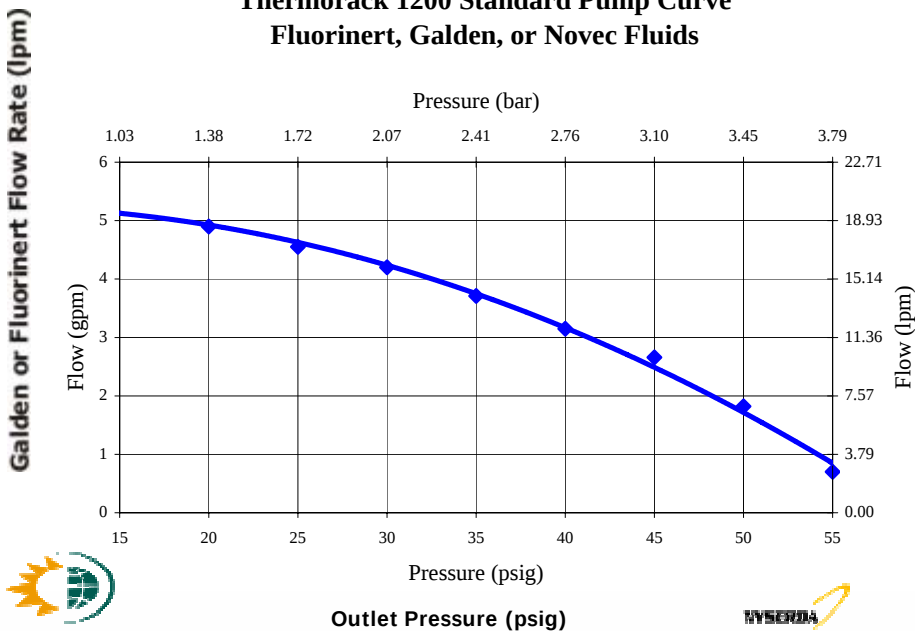
Weight: 75 lbs. (34 kg)

External Tool Interface: Communications interface available for several tool OEM's. Contact factory for details.

Safety: CE Mark, Semi S2-0200, F47 Compliant

Figure 4

Thermorack 1200 Standard Pump Curve
Fluorinert, Galden, or Novec Fluids



New York State Energy Research
and Development Authority

SOLID STATE COOLING SYSTEMS
20 PLEASANT VIEW ROAD
PLEASANT VALLEY, NY, 12569 U.S.A.
PHONE: (845) 635-5500
FAX (845) 635-8081
WWW.SSCOOLING.COM

Contact us directly or one of our reps in your area!

SEMITORR, INC

Representing: **Northwest United States**

Contact: Mike Frank

25749 SW Canyon Creek Rd.

Wiltonville, OR 97070

Tel: (503) 682-7052

Email: mfrank@semitorrinc.com

Representing: **Northern California**

Contact: Lamont Humphrey

Tel: (408) 651-3227

Cell: (408) 425-4633

Email: lamont@semitorrinc.com

Representing: **Southern California**

Contact: Terry Reilly

Tel: (760) 754-2877

Email: treilly@semitorrinc.com

STEVE DUNBRACK AND ASSOCIATES

Representing: **Northern California**

Contact: Steve Dunbrack

San Jose, CA

Tel: (408) 347-1396

Cell: (408) 476-3959

Email: sdunbrack@scbglobal.net

ZENEXUS

Representing: **Texas**

Contact: David Klucsarits

3523 McKinney Ave., #469

Dallas, TX 75204

Tel: (214) 821-0137

Cell: (214) 837-6113

Email: david@zenexus.com

PSE ELECTRONICS VERTRIEBS GMBH

Representing: **Europe**

Contact: Gerd Piller, Robert Piller

Franz Kamerseder Str. 2

D-85598 Baldham, Germany

Tel: 49 81 636-3131

Mobile/Cell: 49 172 766-3595

Email: g.piller@psegbmh.de

Email: ropiller@psegbmh.de