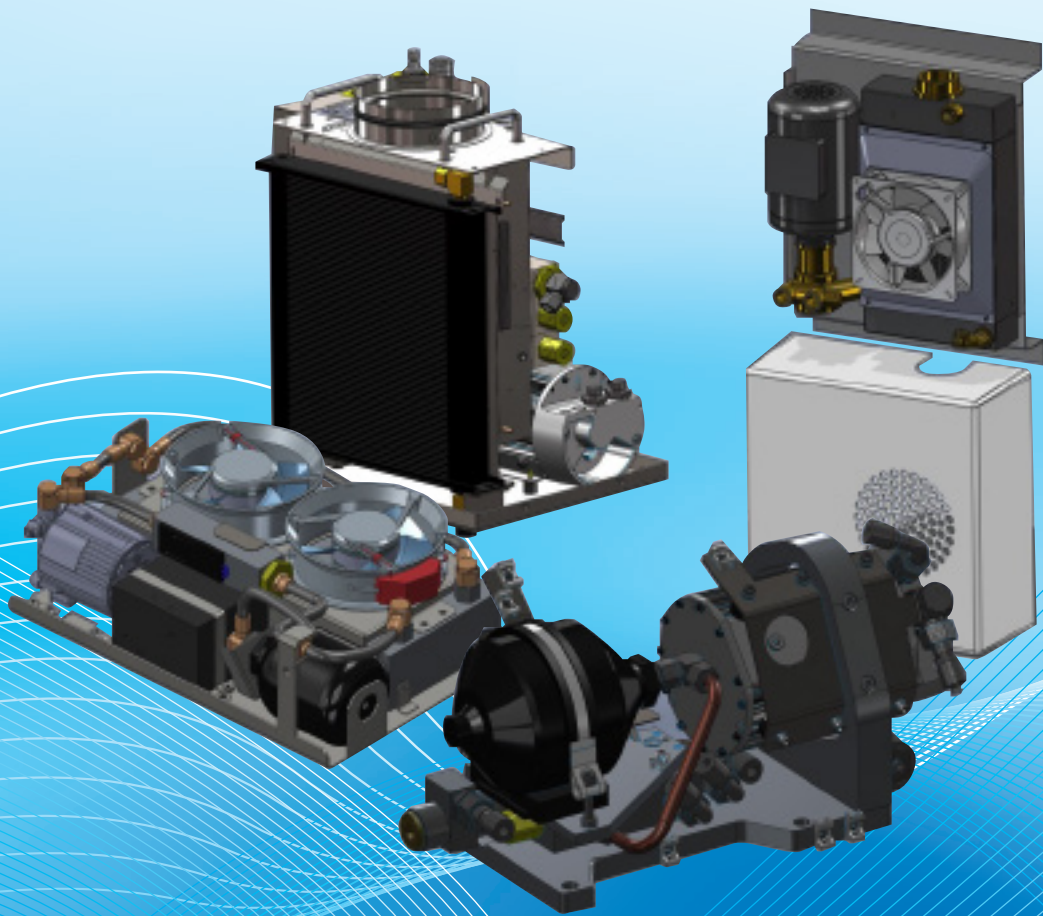




Smart Technology. Delivered.

Liquid Cooling Systems





About Laird

Laird designs and manufactures customized, performance-critical products for advanced electronics and wireless systems. The company is a global market leader in the design and supply of electromagnetic interference (EMI) shielding, thermal management products, specialty metal products, signal integrity components, and wireless antennae solutions, as well as radio frequency (RF) modules and systems. Laird partners with its customers to customize product solutions for applications in many industries including:

- Telecommunications
- Mobile Communications
- Network Equipment
- Automotive
- Industrial Laser
- Analytical
- Aerospace & Defense
- Healthcare
- X-Ray Scanning
- Semiconductor

Laird offers customers unique product solutions, dedication to research and development, as well as a seamless network of manufacturing and customer support facilities across the globe.

A Brief Introduction to Liquid Cooling Systems

Thermal management of electronic components and systems is more challenging than ever. Power densities continue to increase, while product form factors continue to shrink. Engineers must now consider thermal management early on in the product development cycle to make sure sufficient space and power is available to remove heat from their system. Simple thermal management solutions, such as a heat sink fan mechanism, are no longer viable to keep critical systems operating at peak performance. In today's complex operating environment, liquid cooling systems are required to dissipate a large amount of heat in a densely packed electronic environment. Maximum operational life is required to keep system maintenance and repair down time to a minimum. Temperature stabilization has especially become critical, as next generation systems require more precise temperature control.

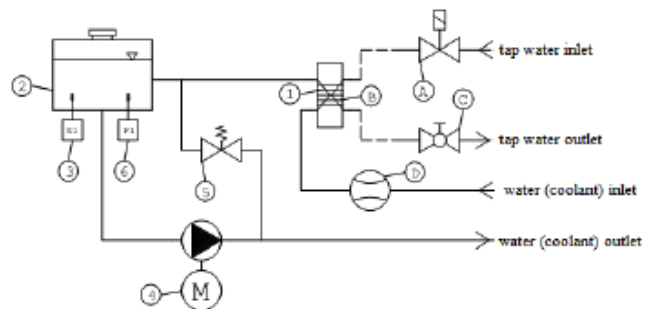
Liquid cooling systems (LCS) are self-contained units that recirculate a coolant to a predefined temperature set point. There are two types of liquid cooling solutions. The first is a liquid heat exchanger system that cools the coolant in a liquid circuit to ambient temperature. This system consists of a pump to circulate coolant, a liquid heat exchanger to dissipate heat, and a liquid circuit to transfer coolant from the heat source to the LCS. The second type is a compressor-based system, or recirculating chiller, that encompasses a compressor system instead of a liquid heat exchanger assembly. It is used to cool the coolant to well below ambient and dissipate heat to the outside environment. Additional features can be included to add temperature control, variable flow control, bypass control, coolant filtration and electronics in order to meet unique attribute requirements. Compatibility of material selection to coolant is also critical in order to minimize corrosion and keep loose oxidized particles from obstructing flow.

Customized Solutions

Since there are many unique attributes that need to be ascertained from each application, often a liquid cooling solution requires a custom configuration to optimize performance and long life operation. The type of coolant used will depend on the desired control temperature. Laird has the know-how to design cooling systems that are compatible with water, water-glycol, transformer oil or various corrosion inhibitors. LCS can also be quite complex and require temperature control of multiple liquid circuits or multiple pressure drop settings in order to accommodate low and high pressure conditions. Laird has experience with both and offers strong engineering design services with a global presence that supports onsite concept generation, thermal modeling, mechanical and electrical design and rapid prototyping. The company also offers validation test services to meet unique compliance standards for each industry, such as UL and MIL-STDs, or a unique standard specific to a medical, industrial or semiconductor account.

Total Thermal Solution Provider

Due to the increasing complexities of thermal management systems, and the constant pressure to reduce product development cycle times, companies are relying on external, specialized thermal management expertise more often. Laird has more than 35 years of experience in the design, manufacture and servicing of liquid cooling systems for various high end markets. While Laird focuses on designing the optimal liquid cooling solution, its customers are free to focus on designing a better end instrument. All products are manufactured in an ISO 9001 and ISO 14001 certified facility and are built to meet the needs of strict process control requirements found in many of the medical, industrial, and semiconductor industries. All parts are procured from strategic suppliers with a proven track record of supplying highly reliable components, and offer strong design support for customization. Laird also offers after sales service support to repair or replace units that have been in the field for more than two decades.



PID Liquid to Liquid System

Benefits of Using Liquid Cooling Systems

LCS are unique to the thermal management market in that they use a coolant to transfer heat. Most engineers are concerned about introducing liquids to their electronics, but if unit is designed and assembled correctly, it becomes a non-issue. LCS have several advantages over conventional air cooled systems.

- **High Heat Pumping Capacity.** Liquid heat exchangers can reduce the thermal resistance of conventional heat sink fan dissipation mechanisms by a factor of 10 or more. This is due to the poor thermal properties of heat transferring in air versus in coolants such as water.
- **High Heat Flux Density.** LCS can remove up to five times the amount of heat per square area over conventional air cooling systems. This becomes advantageous in densely packed electronics with limited space to accommodate an air cooling mechanism.
- **Heat Routing.** Liquid cooling allows the integration of a small heat exchanger to be located at the heat source, which then routes heat away through a liquid circuit. This is advantageous in densely packed electronics where a conventional air cooling system pushes air all around system and potentially adds heat to the system from other hot electronics in close proximity.
- **Rapid Cool Down.** Cool down time is a function of cooling capacity. LCS have larger cooling capacities than conventional heat sink fan mechanisms, which will reduce the time it takes to reach temperature.
- **Lower Noise.** Systems with high heat removal requirements of one kilowatt or higher require much larger fans to generate the air flow needed to dissipate heat. This makes the air cooling system noisier, exposes system to higher vibration and potentially requires a larger system than that of an LCS.

Liquid Cooling Applications

Laird provides robust liquid cooling solutions for many of the high performance applications found in the medical, industrial, and semiconductor markets. Systems are designed to maximize temperature stabilization at above, below, or equal to ambient temperature. Service life expectations can exceed more than 20 years in the field.

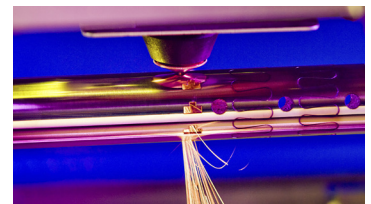
Healthcare Diagnostics & Treatment

- Medical Imaging
- Medical Lasers
- Clinical Diagnostics
- Centrifuges
- Radiation Therapy



Industrial Instrumentation

- Security X-Ray Scanning
- Non-Destructive Test
- Digital Printing
- Electron Microscope
- Industrial Lasers



Semiconductor Fabrication

- Metrology
- Plasma/Wet Etch
- Lithography
- Chemical/Physical Vapor Deposition
- Rapid Thermal Processing

Liquid Heat Exchanger SYSTEMS

Laird offers three (3) types of liquid heat exchanger systems. Standard cooling capacities range from 500 W to 5000 W. However, custom solutions have been designed to remove up to 40 KW of heat. Standard heat transfer configurations are either Liquid-Air or Liquid-Liquid systems. All systems are designed to operate using either water, water with glycol (antifreeze), or oil as a coolant.

WL Series, Water Cooled

Water cooled systems are designed to circulate water or a water glycol (antifreeze) mixture and keep the temperature of the coolant at or near ambient. The WL Series is a re-circulating liquid to air heat exchanger that offers dependable, compact performance by removing large amounts of heat from a liquid circuit. The coolant is re-circulated using a high pressure pump to assure maximum flow rate. Heat from coolant is absorbed by a radiant heat exchanger and dissipated into the ambient environment using a brand name fan.

- Cooling to ambient
- Compact form factor
- High heat pumping capacity
- Long life operation

PART DESCRIPTION	COOLING CAPACITY (WATTS)	MAX PRESSURE DROP (BARS)	PUMP FLOW RATE (LPM)	INPUT VOLTAGE (VAC)	DIMENSIONS (L X W X H) (CM)	WEIGHT (KGS)
WL 500	500	2.5	2.3 @ 4 bar	230	37 x 30 x 15	11
WL 1000	1,000	6.0	4.4 @ 4 bar	230	33 x 29 x 30	17
WL 1500	1,500	6.0	4.0 @ 4 bar	230	48 x 40 x 48	38
WL 2000	2,000	6.7	4.4 @ 4 bar	230	30 x 30 x 50	26
WL 3000	3,000	8.0	6.0 @ 4 bar	230	48 x 40 x 48	38
WL 5000	5,000	7.0	6.5 @ 3 bar	230	48 x 40 x 48	38



Liquid Heat Exchanger SYSTEMS

OL Series, Oil Cooled

Oil cooled systems are designed to circulate transformer oil and are used in applications where the temperature at the heat source exceeds the operational temperature limit of water based coolants. The OL Series is a recirculating liquid to air heat exchanger that offers dependable, compact performance by removing large amounts of heat from a liquid circuit. The coolant is recirculated using a high pressure pump to assure maximum flow rate. Heat from coolant is absorbed by a radiant heat exchanger and dissipated into the ambient environment using brand name fan.

- Cooling to above ambient (where the temperature at the heat source is at or exceeds the limit of conventional coolant operating temperatures)
- High heat pumping capacity
- Compact form factor
- Long life operation

PART DESCRIPTION	COOLING CAPACITY (WATTS)	MAX PRESSURE DROP (BARS)	PUMP FLOW RATE (LPM)	INPUT VOLTAGE (VAC)	DIMENSIONS (L X W X H) (CM)	WEIGHT (KGS)
OL 4503	4,500	9.0	23 @ 3.5 bar	230	75 x 35 x 65	54
OL 15000	15,000	1.75	20 @ 1.0 bar	230	70 x 64 x 98	82



Liquid-Liquid Series

Liquid-Liquid systems use facility water as a hot side heat dissipation mechanism, which increases the cooling capacity while maintaining form factor. WW series systems are designed to operate using water as coolant, while OW Series systems are designed to operate using oil as coolant.

- Cooling to ambient
- High heat pumping capacity in smallest form factor
- Long life operation

PART DESCRIPTION	COOLING CAPACITY (WATTS)	COOLANT TYPE	MAX PRESSURE DROP (BARS)	PUMP FLOW RATE (LPM)	INPUT VOLTAGE (VAC)	DIMENSIONS (L X W X H) (CM)	WEIGHT (KGS)
WW 3001	3,000	Water	6.7	5.4 @ 4 bar	230	45 x 27 x 40	24
WW 5001	5,000	Water	6.5	10 @ 4 bar	230	45 x 30 x 37	24
OW 4002	4,000	Oil	9.0	17 @ 3.5 bar	230	62 x 35 x 55	45



WLK Series, Recirculating Chillers

The WLK Series is a compressor-based recirculating chiller that offers dependable, compact performance by controlling the temperature of water or water with glycol (antifreeze) in a liquid circuit. The coolant is recirculated using a pump with high MTBF. Heat from the coolant is absorbed by a durable, compressor-based system and dissipated to the ambient environment. The unit is regulated with an easy-to-use digital temperature controller with push button interface. The unit is housed inside a durable sheet metal casing. Standard cooling capacities range are available up to 3 KW. However, custom solutions have been designed to remove up to 200 KW of heat.

- Cooling to below ambient
- High heat pumping capacity
- Variable temperature control
- High temperature stability
- CFC free refrigerants
- Long life operation

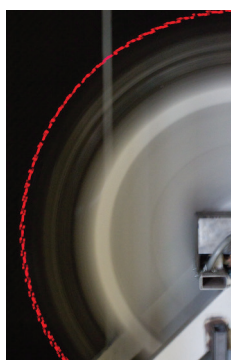
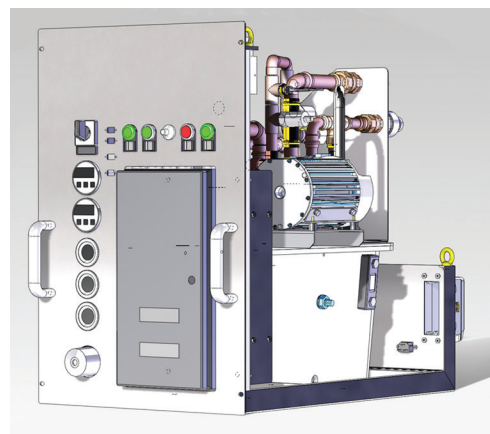
PART DESCRIPTION	COOLING CAPACITY (WATTS)	CONTROL TEMP RANGE (°C)	MAX PRESSURE DROP (BARS)	PUMP FLOW RATE (LPM)	INPUT VOLTAGE (VAC)	DIMENSIONS (L X W X H) (CM)	WEIGHT (KGS)
WLK 21	2,000	5 – 30°C	8.0	6.0 @ 6 bar	230	59 x 61 x 92	115
WLK 31	3,000	5 – 35°C	6.7	6.0 @ 4 bar	230	59 x 61 x 92	115



Liquid Cooling System Turn-key CAPABILITIES

Since there are many unique attributes that need to be ascertained for each application, often the optimal liquid cooling solution ends up requiring a custom configuration. Laird has over 35 years of experience in the design, manufacture and servicing of custom liquid cooling systems for various high end markets. Our engineering team has the know-how to design cooling systems that are compatible with water, water-glycol, transformer oil, or various corrosion inhibitors. LCS can also be quite complex and require the temperature control of multiple liquid circuits or multiple pressure drop settings in order to accommodate low and high pressure conditions. Laird has experience designing both systems, and can integrate many unique attributes into an LCS, such as:

- Cooling capacity (up to 200 KW)
- Variable pump capacity
- Thermal control of multiple liquid circuits
- Coolant filtration
- Variable flow control
- PID temperature control
- High temperature stability
- High Coefficient of Performance
- Durability by hot gas bypass control
- CFC-free refrigerants
- Stainless steel heat exchanger
- High operational temperatures
- Flow monitoring
- Level switching
- Fault signal potential-free
- Maximum pressure limit
- Custom input/output fittings and housing configuration



Laird offers strong engineering services with a global presence that supports onsite concept generation, thermal modeling, flow analysis, mechanical design, electrical design and rapid prototyping. Vertical integration is fundamental to meet the needs of today's fast product development cycles. Laird has invested in sheet metal fabrication, spot welding, tube bending and CNC equipment. Our engineering team also works with world-class suppliers to utilize their expertise in supporting custom designs on pumps, compressor technologies, evaporators and liquid heat exchangers.

Validation test services are also available to support compliance standards for each industry, such as UL/CSA and MIL-STDs. In-house test capabilities exist to support:

- Noise measurement
- Cooling capacity
- Pressure and flow rates
- Electronic drive circuit testing
- Reliability testing
- G-force testing
- High temp oven storage testing
- Temperature cycling
- Continuous operation testing

All products are manufactured in an ISO 9001 and ISO 14001 certified facility and are built to meet the needs of strict process control requirements found in many of the medical, industrial and semiconductor industries. All parts are procured from premium suppliers with a proven history of supplying high reliable components. Laird also offers strong service support to repair or replace parts on units that have been in the field for more than two decades.

Laird provides the knowledge, innovation, and resources to ensure exceptional thermal performance and customer satisfaction. Contact us today for your complete application solutions.

Americas: +1 (919) 597-7300

Europe: +46.31.420530

Asia: +86.755.2714.1166

www.lairdtech.com



THR-BRO-LCS 012115

Any information furnished by Laird and its agents is believed to be accurate and reliable. All specifications are subject to change without notice. Responsibility for the use and application of Laird materials rests with the end user, since Laird and its agents cannot be aware of all potential uses. Laird makes no warranties as to the fitness, merchantability or suitability of any Laird materials or products for any specific or general uses. Laird, Laird Technologies, Inc. or any of its affiliates or agents shall not be liable for incidental or consequential damages of any kind. All Laird products are sold pursuant to the Laird Technologies' Terms and Conditions of sale in effect from time to time, a copy of which will be furnished upon request. © Copyright 2015 Laird Technologies, Inc. All Rights Reserved. Laird, Laird Technologies, the Laird Logo, and other marks are trademarks or registered trademarks of Laird Technologies, Inc. or an affiliate company thereof. Other product or service names may be the property of third parties. Nothing herein provides a license under any Laird or any third party intellectual property rights.