

# Two-Phase Cooling Solution

## Thermosiphons



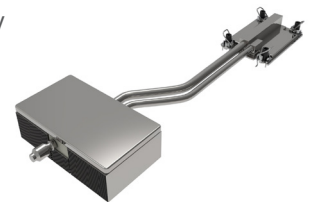
Thermosiphons are passive, two-phase cooling system that require the condenser to be elevated above the evaporator relying on gravity to circulate a dielectric fluid rather than a capillary wick structure often used in heat pipes and other heat transport devices. As with all passive two-phase cooling systems, the liquid and vapor exist within the self-contained envelope and contain no pumps or other moving parts.

### Types of Thermosiphons

#### Direct Contact Loop Thermosiphon

Direct Contact Loop Thermosiphon assemblies transport heat from source to air. They transport heat away from thermal loads to remote condensers, where high density fin stacks dissipate heat to the ambient. Bent liquid and vapor tubes carry the working fluid to and from the remote condenser with airside fins.

**Industries and Applications:** Enterprise (Servers and Networking), Renewable Energy (Solar and Wind Inverters) and Industrial (Power Electronics)



#### 2D Thermosiphon Fin

2D Thermosiphon Fins are individual fins enhanced with Thermosiphon technology. Used to replace standard fins to increase effective surface area for heat dissipation, Thermosiphons are embedded into each fin to increase the fin efficiency and overall performance. These fins can be combined with extruded or cast bases/chassis that may be further enhanced using heat pipes or vapor chambers.

**Industries and Applications:** Enterprise (Telecom 5G Radios), Renewable Energy (Solar and Wind Inverters) and Industrial (Power Electronics)

#### 3D Direct Contact Loop Thermosiphon

3D Direct Contact Loop Thermosiphons dissipate heat from one or more heat sources mounted directly to the base of the Thermosiphon. They feature vapor supply and liquid return passages in the base and the fins as well as manifolds that spread heat through the full 3D volume, maximizing performance by creating a fully isothermal structure.

**Industries and Applications:** Enterprise (Telecom 5G Radios), Renewable Energy (Solar and Wind Inverters) and Industrial (Power Electronics)



#### Air-to-Air Loop Thermosiphon

Air-to-Air Loop Thermosiphon type Heat Exchangers leverage the heat transport capacity of a two-phase system to collect heat from hot internal airflow within a cabinet passing it through the evaporator (E) and dissipate heat into the cooler external airflow passing through the condenser (C) outside of the cabinet or enclosure.

**Industries and Applications:** Industrial / Medical (Power Electronics Cabinets) and Enterprise (Telecom Base Stations)

## Key Features and Benefits of Thermosiphons

Thermosiphons are a form of **Extreme Air Cooling** that extend air cooling performance beyond what is possible with heat pipe or vapor chamber enhanced thermal solutions. If you're looking to delay the transition to direct liquid or immersion cooling, Thermosiphons are a cost-effective option for any application where orientation with respect to gravity is known and fixed.

- Provides isothermal cooling for singular or multiple heat sources
- Ideal for transporting heat over longer distances
- Reduced air side pressure drop (forced convection architectural advantages)
- Increased power density, thermal performance, and heat exchanger efficiency
- Eliminates reliability concerns due to freezing in low temperature operation and storage
- Eliminates risk of short circuits in case of leaks

Thermosiphons may be a good alternative in place of heat pipes with remote heat exchange for CPU and GPU cooling, air-to-air heat exchangers, heat pipe heat exchangers, folded-fin counter flow heat exchangers, and bulky extruded or bonded fin heat sinks.

## Thermosiphons - Industry and Application Fit

| Industry >>                         | Enterprise (Server/ Networking) |     |            | Enterprise (5G Telecom Infrastructure) |              | Medical / Industrial |           |
|-------------------------------------|---------------------------------|-----|------------|--|--------------|----------------------|-----------|
|                                     | CPU                             | GPU | ASIC/ FPGA | RRU                                    | Base Station | Component            | Enclosure |
| Direct Contact Loop Thermosiphon    | ●                               | ●   | ●          | ●                                      | ●            | ●                    | ●         |
| 2D Thermosiphon Fin                 | ●                               | ●   | ●          | ●                                      | ●            | ●                    | ●         |
| 3D Direct Contact Loop Thermosiphon | ●                               | ●   | ●          | ●                                      | ●            | ●                    | ●         |
| Air-to-Air Loop Thermosiphon        | ●                               | ●   | ●          | ●                                      | ●            | ●                    | ●         |

● = Excellent compatability, ● = Limited compatability

## Have questions? We're ready to help!

If you are ready to improve or retrofit your cooling solutions or are looking to tackle new challenges for the next generation, start by contacting Boyd Corporation to learn more about two phase solutions, customizations, and other possibilities for better optimized cooling. To receive more information regarding Thermosiphons, please visit us at [www.boydcorp.com](http://www.boydcorp.com).