



EcoFlow AC Controller

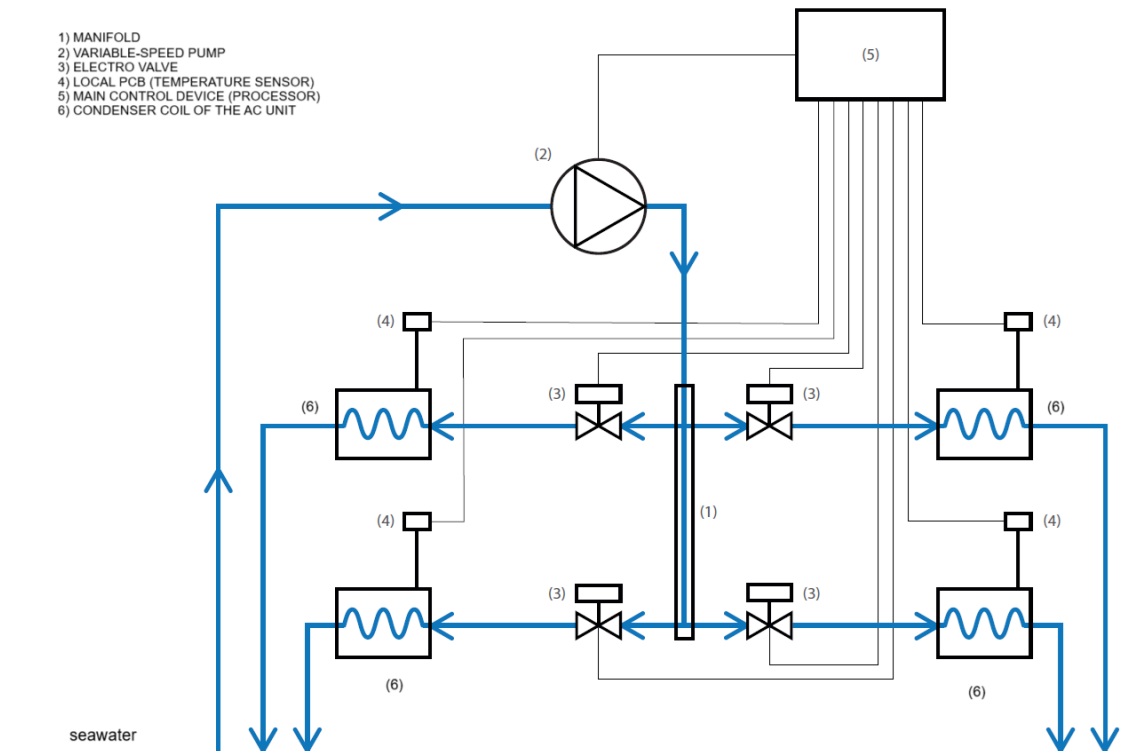
Why the EcoFlow AC Controller Represents Design Excellence

The EcoFlow AC Controller is a transformative solution for marine air conditioning systems, designed with a strong focus on energy efficiency, optimized performance, and sustainability. This innovative controller showcases exceptional design by targeting and resolving critical inefficiencies found in conventional marine air conditioning systems. It adopts a comprehensive system-wide approach, encompassing heat exchange, water distribution, and maintenance.

Design Innovation

Marine air conditioning systems generally require a substantial amount of energy to pump seawater through heat exchangers. These exchangers transfer heat from the internal spaces of the vessel to the seawater.

The EcoFlow AC Controller revolutionizes this process by using a variable-speed pump and processor-controlled electro valves to optimize water flow, significantly reducing energy consumption.



Hydraulic and electrical diagram

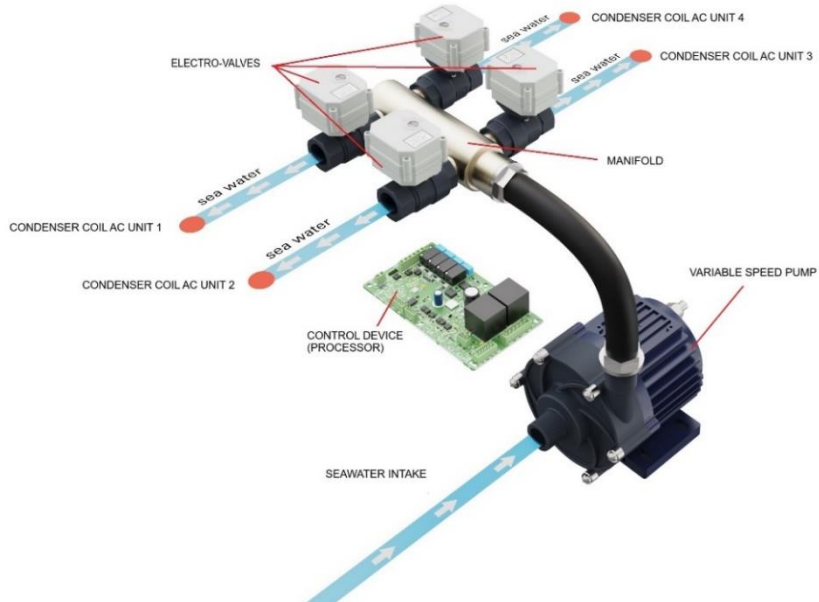


Image of the System

1. Optimized Water Distribution:

Traditional systems waste energy by maintaining a constant water flow across all air conditioning units, even when some units are inactive. The EcoFlow AC Controller uses a manifold with multiple outlets and electro valves to direct water flow only to active heat exchangers, automatically closing valves for inactive units. This precision in water management ensures that energy is used only when needed.



Cu-Ni Manifold with Electro Valves



2. **Variable-Speed Pump Efficiency:**

At the heart of the system is a magnetic BLDC variable-speed pump, which adjusts water flow to match the demand from operating air conditioning units. By delivering seawater at the optimal rate for each unit's heat exchanger, the system maximizes heat transfer efficiency while minimizing unnecessary power consumption. This dynamic flow adjustment is key to achieving superior energy efficiency, particularly in marine environments where resources must be managed carefully.



Magnetic BLDC variable-speed pump

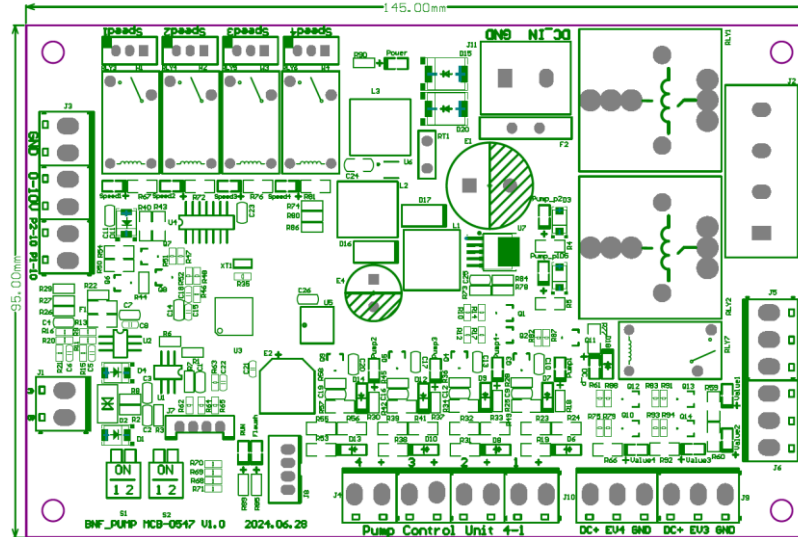
3. **Intelligent Processor Control:**

A local processor connected to temperature sensors in each onboard environment provides real-time data on cooling needs. When an air conditioning unit is activated, the central processor opens the corresponding electro valve, allowing fluid to flow through the heat exchanger. This ensures precise control of cooling resources, reduces average power consumption, and enhances longevity through optimized and efficient operation.





Main control device (central processor)



4. Redundancy and Reliability:

The system includes the option for dual variable-speed pumps, providing redundancy to ensure reliable performance. In the event of a pump malfunction, the processor immediately switches to the backup pump. Furthermore, the system alternates between pumps during normal operation to evenly distribute wear, reducing the risk of maintenance issues and prolonging pump life.





Maintenance and Sustainability

The EcoFlow AC Controller not only excels in day-to-day performance but also in maintenance efficiency. To minimize system downtime and reduce environmental impact, the controller includes a maintenance mode that enables cleaning without the use of harsh chemicals.

1. **Easy Maintenance with High-Flow Mode:**

The system's processor can switch all electro valves to the open position, allowing seawater to circulate through the entire system at maximum flow. This high-flow mode efficiently flushes out sediments and debris from the heat exchangers, making routine cleaning straightforward and environmentally friendly. The use of high-pressure water flow rather than chemical agents reduces the potential for marine pollution.

2. **Durable and Sustainable Materials:**

The EcoFlow AC Controller is built using marine-grade plastic and Cupronickel, materials selected for their resistance to corrosion and extreme marine conditions. These materials ensure the system's durability, reducing the need for frequent replacements and contributing to long-term waste reduction. By extending the system's operational life, we minimize the environmental impact associated with disposal and manufacturing over its lifecycle.

Environmental Impact Statement

The EcoFlow AC Controller represents not only technical excellence but also a commitment to environmental impact. By improving energy efficiency and reducing the need for harmful chemicals, it aligns with the growing demand for eco-friendly solutions in marine technology.

1. **Energy Efficiency:**

The system's intelligent water distribution and use of variable-speed pumps optimize energy efficiency by ensuring that water flows only to active air conditioning units and circulates at the correct rate. The EcoFlow AC Controller can reduce the pumps' energy consumption by an average of 50%, significantly decreasing the energy footprint of marine vessels equipped with the system. This contributes to lower carbon emissions and promotes a more sustainable marine environment.

In the video, we used as an example an air conditioning system composed of four self-contained air conditioners (SDC08V12 Blue-Airco), each with a capacity of 8,000 BTU/h and operating at 12V DC, along with a magnetic brushless pump (007001PUMOP12V Blue-Airco) that operates at variable speed on 12V DC. When



all the AC units are turned on, the pump runs at full speed with a power consumption of 160W. If one AC unit is switched off, the pump reduces its speed and power consumption by 40W. Eventually, if only one AC unit is running, the pump's consumption will drop to 40W, thanks to the EcoFlow AC Controller. This is a significant improvement compared to traditional systems, which keep the pump running at full speed regardless of how many AC units are operating. In the case of an air conditioning system with four AC units (18,000 BTU/h) connected in parallel on the same pump and equipped with the EcoFlow AC Controller, the pump's power consumption will vary between 100W when only one AC unit is running, and 400W when all units are running. This setup allows for energy savings of up to 300W compared to traditional systems where the pump runs at full speed regardless of the number of AC units in operation.

AC units working	Pump consumption [W] with EcoFlow AC Controller	Pump consumption [W] with traditional system	Energy saving [W]	Energy saving [%]
1 x AC unit 8.000 BTU/h	40	160	120	75
2 x AC units 8.000 BTU/h	80	160	80	50
3 x AC units 8.000 BTU/h	120	160	40	25
4 x AC units 8.000 BTU/h	160	160	0	0
1 x AC unit 18.000 BTU/h	100	400	300	75
2 x AC units 18.000 BTU/h	200	400	200	50
3 x AC units 18.000 BTU/h	300	400	100	25
4 x AC units 18.000 BTU/h	400	400	0	0

Thanks to the EcoFlow AC Controller, average seasonal energy savings can reach around 50%. This estimate accounts for variations in cooling needs between day and night, different usage of spaces (such as day areas versus night areas), and fluctuations in thermal loads due to weather conditions and local climate. For example, when the AC units in day areas are turned off overnight, the seawater flow is reduced accordingly, which leads to lower power consumption by the pumps.

2. **Chemical-Free Maintenance:**

The high-flow cleaning mode eliminates the need for harsh chemicals that could otherwise harm marine ecosystems. By facilitating easy cleaning with just water, the EcoFlow AC Controller promotes a cleaner and safer marine environment.

3. **Long-Lasting Construction:**

Constructed with robust, marine-grade materials, the EcoFlow AC Controller is designed to withstand the harsh conditions of the sea, reducing the need for frequent replacements. This focus on durability minimizes waste and the environmental impact of manufacturing and disposal. The welding of the manifold is done using hydrogen,



which is produced on-site. This has significantly improved the working environment for employees and eliminated common health and safety issues associated with brazing. Additionally, it results in higher quality welding due to the more concentrated heat and electronically controlled flame. The climate impact is negligible because the hydrogen is produced locally at the workstations from distilled water, eliminating the need for conventional energy sources such as propane and acetylene, as well as removing the need for truck transportation of gas bottles.

Conclusion

The EcoFlow AC Controller represents a pinnacle of design excellence, demonstrated by its innovative approach to energy efficiency, intelligent water management, and environmental sustainability.

By optimizing heat exchange and reducing energy consumption, the system offers a powerful solution to a common challenge in marine air conditioning systems.

Its ease of maintenance and eco-friendly features further reinforce its position as a progressive product, designed for both performance and sustainability.

With these design innovations, the EcoFlow AC Controller represents a significant step forward in marine technology.