

THE BUSINESS AND ENGINEERING PROBLEM

Back in 2005 our customer came to us to solve a problem for the US Navy. The program was called the DDG 1000, it was the next generation US Navy Destroyer. The systems and technology aboard the Navy's new destroyer drove the distributed power requirements to 87MW. The Navy would need to set a record for power density in order to convert 87MW on the ship and the inductors represent most of the size and weight of the power converter. The Navy specification for the AC and DC filter inductors also required that 80% of the inductor power losses be transferred to the coolant; this would allow tight packaging density and maintain long term reliability.

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Our customer had been in business for many years doing ship board power conversion and propulsion systems. Since inductors represent such a large portion of power conversion, they had cultivated many specialist inductor vendors over many years to solve difficult designs. Our customer was reluctant to add a new vendor; however, CTM liquid cooled technology was the only solution which met Navy specifications.

CTM MAGNETICS PROBLEM SOLVING PROCESS

Grant MacLennan, the President of CTM Magnetics was determined to solve this customer's problem. While jogging one morning, Grant came up with a concept to take the CTM inductor shape (donut), thermally integrate it with a cooling system, and pump water through the system to maximize thermal transfer and minimize inductor size. One critical part of this process was to develop a high thermal transfer potting system which was also flexible and cost effective.



CTM pitched their concept to the customer who authorized a prototype purchase order and sent CTM into the lab. The CTM team built the units but could not simulate the customer test circuit to confirm thermal performance; CTM tested what they could and waited for the customer. The CTM prototypes met the Navy's packaging specs and the customer later verified they also met thermal circuit specs. Unfortunately, the customer's other vendor was on their fourth revision as they were given a final chance to solve the problem.

The final decision literally came down to the last days of the engineering process and the customer finally notified CTM that their technology was selected. CTM Magnetics won the order for 100% of the inductors for the DC and AC power systems for the DDG 1000 program for the US Navy's next generation Destroyer. Given the benefits of the solutions CTM provided, the customer was willing to take the risk on being sole sourced with patented technology for a high-profile Navy project. CTM delivered on time and met all program requirements for the Navy.

THE RESULTS

CTM built parts for 3 ships in 2010 through 2013; no units have been returned for CTM defects. The first ship, DDG 1000, passed all field trials and was commissioned in 2017 to the Navy fleet in San Diego, she is the USS Zumwalt, her captain is James Kirk. During production, CTM worked on how to cost optimize liquid cooled designs in order to commercialize the technology. CTM landed their first commercial production customer in the chiller market in 2011; one of the largest chiller companies in the world needed liquid cooled inductors and filters for their most advanced chiller technology. Again, only CTM technology was able to meet efficiency and packaging specifications and that was 7 years ago using generation 2.0 commercial inductor technology. Today, CTM is at generation 5.0 commercial inductor and filter technology; much smaller and much lower cost than 7 years ago.

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This project was highly complex because of the military requirements for shock and vibe. This first liquid cooled project was the genesis of an entire commercial liquid cooled product line that has permeated several markets and is highly valued in many markets today for its efficiency, size, cost, and weight. Developing liquid cooled inductor technology for the USS Zumwalt Destroyer was one of the most important engineering events in CTM history.

