

## THE BUSINESS AND ENGINEERING PROBLEM

CTM was approached by a chiller company completing the design of their latest technology chiller using a PMAC motor compressor, direct drive and magnetic bearings which would soon lead the market for efficiency, size, and noise. Their PMAC motor vendor had defined a sine wave filter to remove VSD harmonics from the PMAC motor to increase system efficiency. The chiller company was not able to get their steel inductor suppliers to build a liquid cooled inductor which met their specs for cost, size, and efficiency.

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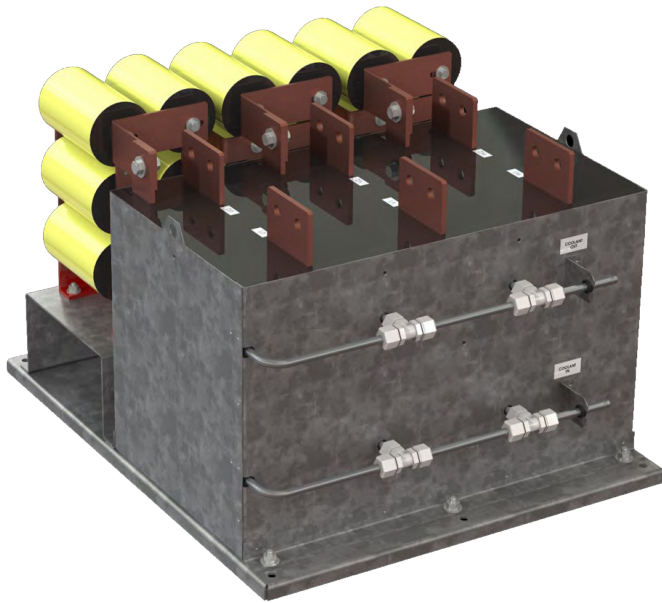
Their new chiller was behind schedule and with each failed silicon steel inductor test it became clear their current supply chain could not solve this high frequency inductor problem. Their new chiller would require a high frequency, high power inductor and filter vendor with liquid cooling experience; their engineering team asked others at an engineering conference where another CTM customer recommended CTM.

## CTM MAGNETICS PROBLEM SOLVING PROCESS

CTM developed and was producing single phase liquid cooled inductors for the US Navy Zumwalt project; their team leveraged this experience to package 3 phase reactor assemblies for commercial markets; this chiller project was a perfect opportunity. The high speed PMAC compressor motor required 400Hz at 525Arms with a whopping 35% total harmonic distortion (THD) from the VSD. The CTM team had just completed reactor designs for a 400A active filter which had a similar harmonic spectrum; their team was confident CTM inductor technology would using direct liquid cooling would be an optimal design. Lastly, the customer requested an entire LC filter assembly; inductors + capacitors + buss work to simplify their assembly.

CTM engineering leveraged their film capacitor vendors expertise and their bussing and packaging experience to develop cost effective, efficient capacitor packaging solutions. CTM delivered an initial sine wave output filter prototype which met the customer specifications; they began designing CTM sine wave output filters into all 4 power levels of their new chillers. The success of the liquid cooled sine wave output filters led the customer to request CTM liquid cooled technology for their input LCL inductors on the active front end (AFE). The chiller VSD now had full liquid cooling for the input and output filters and the VSD; their new chiller efficiency, noise, and size lead the industry.

## THE RESULTS



The market success of a chiller with a PMAC motor, magnetic bearings, liquid cooled VSD, and CTM liquid cooled input and output filters set the bar high. The chiller was small, quiet, efficient, and reliable; competitors would have to respond or lose market share. The Gen 2.0 liquid cooled inductor and filter solutions were consistently improved by CTM engineering and production teams over several years. CTM is now producing Gen 5.0 technology liquid cooled packages which are smaller, more efficient, more reliable, and substantially lower cost. When a VSD or AC drive has a liquid cooled inverter or IGBT stack, CTM GEN 5.0 liquid cooled technology will optimize the VSD cabinet size, noise, efficiency, and reliability.

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