

Commercial Scale, 2-Phase Liquid Immersion Cooling Becomes a Reality

An energy efficient, space-saving 2-Phase liquid immersion cooling FPGA High Performing Computing (HPC) cluster is commercially adapted in Hong Kong. The FPGA computing cluster has a typical heat dissipation of 70kW and achieves an outstanding Power Usage Effectiveness (PUE) of only 1.02 in Hong Kong's hot and humid climate.

The system could be the most energy efficient HPC or mini data center in Hong Kong, if not in Asia. It is more energy efficient than any advanced data center that we already know of in Hong Kong.

For decades, passive two-phase immersion cooling has proven reliable in various military applications like radar, in large traction drives on trains and mining equipment, and even in commercial transformers. However, technical challenges made it difficult to adapt this technology for computing applications. Spurred by the push toward higher energy efficiency, designers have re-examined the technology and introduced refinements that overcome these challenges, simplifying its adoption and allowing extreme power density and unrivaled energy efficiency.

In 2012, a company with a team of innovators started to design and build a FPGA computing cluster where space and energy efficiency were put in mind. In this immersion cooling system, a dielectric fluorochemical liquid ([3M Novec™ 7100 Engineering Fluid](#)) is used as the media to cool and protect the HPC cluster. This fluid exhibit the following properties:

1. Boiling point of 61 deg C;
2. Non-flammable, no flash point;
3. High dielectric constant (excellent electrical insulation);
4. Good compatibility to most electronic materials;
5. Clear in color,
6. Non-toxic;
7. Non ozone depleting chemical (ODC);
8. Low global warming potential;

These factors make this [3M Novec™ 7100 Engineering Fluid](#) a good choice being a cooling media in 2-phase immersion cooling applications. With direct immersion, the system gets rid of heat sinks and fans (space, noise and maintenance). It does not rely on air-conditioning for cooling either.

In the system, primary heat exchange carries out at the interface between the FPGA chip surface and the [3M Novec™ 7100 Engineering Fluid](#). With the low boiling point property, the fluid changes to gaseous state at around 61 deg C and carries heat away in the phase change process. The gaseous state of the chemical is then condensed back to liquid state through secondary heat exchange with a water circulation condenser and heat radiator. The system requires no chilled air. With this design, both primary and secondary heat exchange can be done more efficiently. Eventually reaching a PUE of 1.02.

You can discover more by visiting our 3M's Technology Partner's web site (www.allied-control.com).