Peristaltic Pump Electronics Thermal Design with FloTHERM XT

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IC BLUE the answer comes out of the Blue

WATSON MARLOW Fluid Technology Group

Watson-Marlow Fluid Technology Group produce a range of chemical metering pumps. Their Qdos pumps are specified to replace diaphragm and other designs of metering pump as a result of their precision flow rates and significantly lower maintenance costs when handling abrasive or corrosive fluids. The success of these pumps and their technology makes them the ideal choice for rugged applications.

One such application for Qdos pumps is metering chemical coatings on to seeds, with the pump mounted on the seed planter towed behind a tractor. Seed treatment is now common practice for agriculture and horticulture industries, where the thick fluid coating may contain growth promoters, inert carriers or fertilizers, as well as antimicrobial or antifungal treatments.

The requirement to deploy Qdos pumps externally has introduced some new design complexity. As all Watson-Marlow pumps are mains powered, the mains powered 48V 200W internal Switched Mode Power Supply Unit (SMPSU) had to be replaced by a 12/24V DC input power supply.

The original power supply was constrained by the footprint of the mains SMPSU, with an initial heatsink design intended to ensure that the power supply components would be kept cool enough at the output power and input currents required for a target 90% efficiency, giving a thermal load of 20W. The pump housing is non-optimal for cooling due to its construction of glass-loaded plastic and also contains a brushless DC motor that can vary between 70°C and 90°C surface temperature at a maximum ambient of 40°C. The initial heatsink design looked reasonable, but could not be evaluated without an expensive machined prototype being manufactured.

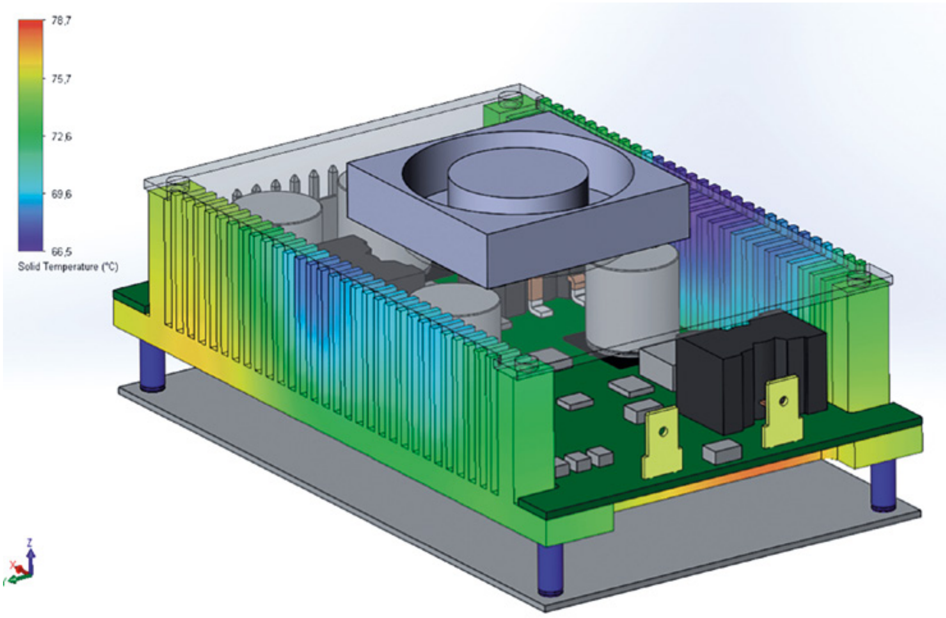

Figure 1. Original Watson-Marlow design as evaluated by IC Blue

Previous experience of FloTHERM, coupled with use of PADS PCB design software suggested that FloTHERM XT for PADS would be the best tool for evaluating heatsink designs.

Working with the Mentor business partner, IC Blue, Watson-Marlow evaluated the original design using FloTHERM XT for

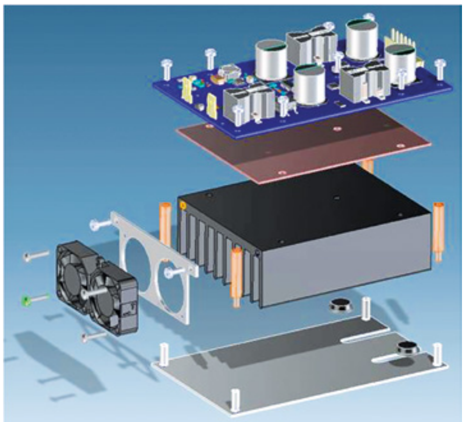

Figure 2. Dual Fan Extruded Heatsink Design showing Complexity of PCB Imported from PADS

PADS, discovering that the heatsink did not work well, with excessive temperatures shown on the components, as well as being prohibitively expensive to machine, requiring a large number of fins.

Based on the success of the evaluation work by IC Blue, Watson-Marlow were able to make a business case to purchase FloTHERM XT for PADS to be used by their own development team. The purchasing decision was used to great effect, enabling a completely redesigned heatsink utilising dual 30mm fans and a standard heatsink extrusion, with the DC power supply meeting the cost and size target, as well as matching the original mains SMPSU, shown in Figure 2.

Throughout this development work, Watson-Marlow were able to take component placement, board design and power data, directly from PADS (Figure 3) into FloTHERM XT in a smooth and efficient manner. As a result, FloTHERM XT simulations were fully synchronized with the PCB layout and circuit design, without thermal risks. Watson-Marlow also use PTC Creo for their mechanical design, and were able to read native Creo geometry directly into FloTHERM XT for PADS, allowing other designs of heatsink to be incorporated directly and used without modification or further simplification.

With this workflow, Watson-Marlow used FloTHERM XT for PADS to undertake many further investigations, re-designing the heatsink to a form that can be cast to save costs over the extruded part. They were also able to optimize air flow paths through the cast heatsink to achieve the equivalent cooling performance of the above dual fan design, but using a single 30mm fan resulting in further cost savings. Two of the many variants studied are shown in Figure 4, indicating how complex the interaction is between the flow exhausting the fan and passing along the heatsink fins.

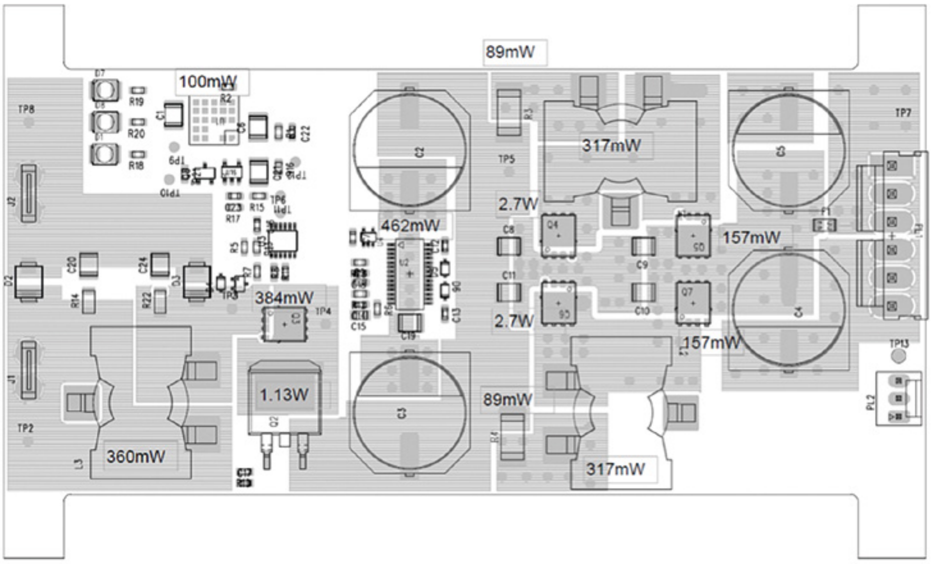

Figure 3. PCB component layout drawing from PADS

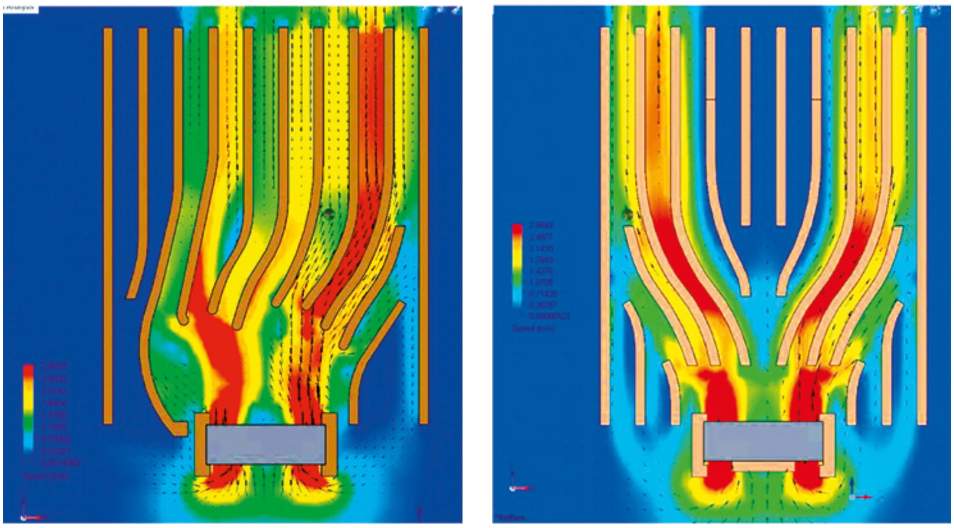

Figure 4. Preliminary Designs of Cast Heatsink Evaluated by Watson Marlow

The success of this project, which has enabled Watson-Marlow to produce an efficient and effectively powered DC dosing pump, has also opened up new markets, for example, in solar powered pumps for remote applications where mains power is not available. Examples of this application are for waste water treatment plants in remote locations or deployed directly into the PLC-BUS for use in factory automation applications.