Active cooling systems represent a possible solution to the electronics overheating that occurs in wireline downhole tools operating in high temperature oil and gas wells. A Peltier cooler was chosen to maintain the downhole electronics to a tolerable temperature, but its integration into the downhole electronics unit proved to be challenging, because of the space constraints and the proximity of the cooling zone (electronics) to the heat sink (well fluid). The topology optimization approach was therefore chosen to optimize the thermal design of the actively cooled electronics section and the SIMP (Solid Isotropic Material with Penalization) method was implemented in COMSOL Multiphysics. Several optimized designs were obtained for different operating conditions and their sensitivity to the change in the boundary conditions was evaluated. A final design for the electronics unit was selected, according to the topology optimization results and assembly constraints, and compared to the optimized cases.

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