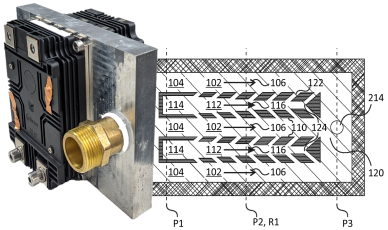
Cold Plate With Improved Cooling Fluid Distribution

Ever more powerful power electronics, as required e.g. for electromobility or the harvesting of renewable energies, require ever stronger cooling solutions. This invention provides a novel cold-plate design which improves the distribution of the cooling fluid inside the cold plate so as to provide a stronger and more spatially uniform cooling effect across the surface of the cold plate.



IP RIGHTS
EP, US, CN pending; priority year 2022

Stronger and more uniform cooling than standard designs

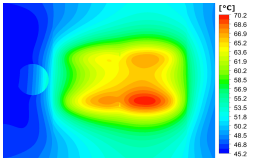
Due to its interconnected channel structure, the invention allows for operating active components at a lower temperature than other cold-plate designs. Alternatively, components with a higher thermal power loss can be operated on a given area, providing an advantage especially for space- and/or weight-critical applications, e.g. within electromobility.

01 Strongly decreased thermal resistance and maximum temperature compared to parallel channels

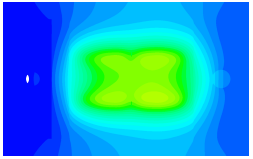
02 Significantly smaller pressure drop than NACA-profile-shaped pins for a similar thermal resistance

03 Targeted channel design ensures spatially uniform cooling effect

04 Tested in simulations and prototype measurements



For a standard cold-plate design with straight parallel channels, the parts of the cold plate in contact with hot spots of active components heat up significantly more strongly compared to surrounding areas.



For a cold plate according to the invention, thanks to more targeted mixing of the cooling fluid, the temperature increase caused by the same thermal power loss is both weaker and more evenly distributed.

REFERENCES:

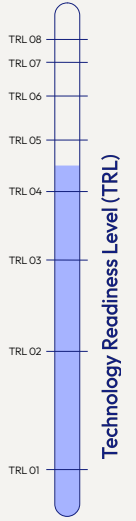
Patent appl. EP4358130A1

CHALLENGE

To function efficiently, cold plates must fulfill several potentially mutually counteracting requirements: The flow rate of the cooling fluid must be high enough to provide sufficient heat capacity overall and the mixing strong enough for the heat to be absorbed throughout the fluid instead of only in segments close to the cold plate's inner surfaces. Ideally, the cooling effect should also be uniform across the plate and the pressure drop should not be too large, in order not to overstrain the driving pump.

INNOVATION

The present invention unites these requirements by means of a targeted design featuring two different types of alternating flow channels. Along the channels, there are several connections by means of which cooling fluid is directed from each second channel to the adjacent channels of the other type (see schematic on the left). Moreover, the channels directing the cooling fluid to their neighbors also taper towards the end. This ensures a far stronger mixing of cooling fluid than parallel straight channels, at a significantly smaller pressure drop than designs fitted with pins or NACA profiles.



01 Basic principles observed · **02** Technology concept formulated · **03** Experimental proof of concept · **04** Technology validated in lab · **05** Technology validated in relevant environment · **06** Technology demonstrated in relevant environment · **07** System prototype demonstrated in operational environment · **08** System complete and qualified

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