Electronics manufacturer sought to validate novel liquid cooling concept for electronic control units to be used in future mobility concepts and other sectors

Summary

Profile type	Company's country	POD reference
Technology request	**Germany**	**TRDE20230116006**
Profile status	**Type of partnership**	**Targeted countries**
PUBLISHED	**Research and development cooperation agreement**	**• World**
Contact Person	**Term of validity**	**Last update**
Johannes BÖHMER	**16 Jan 2023** **16 Jan 2024**	**16 Jan 2023**

General Information

Short summary

A German automotive supplier seeks manufacturers of electronics to validate a novel liquid cooling concept for electronic control units. The protype answers the growing demand for heat dissipation due to electrification and autonomous driving functions. Advantages are reduced weight (-35%), less space (-50%) and improved cooling (+10%). Partners are sought to test the prototype (TRL5) to bring it to market maturity and possibly act as a sales partner.

Full description

Electrification, driving assistance systems and autonomous driving functions increase the number of electronic control units (ECUs) and computing power in current and future mobility concepts. This causes more need for electrical power and thus more waste heat produced, which must be removed from the ECUs' housings to ensure their safe operation. 1250 W are predicted until 2025.
From an electrical power of approx. 150 W, only liquid-cooled systems can provide sufficient cooling capacity for cooling of the ECU. However, with the power losses to be expected future ECUs, it is foreseeable that current liquid cooling systems and their cold plates will reach the limits of their performance. In addition to the processors for autonomous driving functions, the power electronics of battery-electric vehicles also require cooling. This cooling task can also usually only be solved with liquid cooling.

A large German automotive supplier (Aluminum, steel and plastic) and a global tech company (software and system integration) have co-developed a cooling concept that not only meets the required cooling conditions, but also minimizes the weight and installation space of the cooling unit. The newly developed optimized coldplate is based on multi-channel flat tubes (Micro Multi Port, MMP) made of 3000 series aluminum (e.g. EN AW 3102). Thanks to their low wall thicknesses, the large number of extremely small chambers and the resulting very high internal surface area, as well as the good thermal conductivity of 160 to 200 W/mK versus approx. 130 W/mK for die-cast materials, they can dissipate high heat quantities in a short time.

For a prototype of the novel liquid cooling system, an MMP (Fig. 1) with external dimensions of 60 mm x 3 mm, a wall thickness of 0.35 mm and 29 chambers was used. This geometry is well suited for the use of water/glycol as a cooling medium. The MMP and the actual cold plate are connected by soldering (Fig. 2). The planar metallic contact ensures the best possible heat conduction. The choice of a suitable solder allows soldering to air atmosphere. The coldplate, in turn, is in good thermal contact with the components to be cooled on the PCB of the ECU. To compensate for manufacturing of the electronic components, thermal paste is usually applied between the cold plate and the components. The new concept allowed the amount of necessary thermal paste to be reduced to a minimum. This is extremely important because the thermal conductivity of the thermal pastes is a factor of 40 lower than that of the aluminum alloys used. The coldplates of the prototype are supplied with coolant by an external, on-board coolant circuit. The coolant is fed into one coolant connection at the housing of the electronic control unit and from there transported from there through the MMPs to a second coolant connection, where it leaves the housing again. The coolant can then be cooled down again via a chiller.

The cooling performance of the prototype was characterized using thermal simulations. The coldplate ensures that the components do not heat up above their specified operating temperature. The cooling performance is improved by up to 10 percent compared to conventional heat sinks. In addition weight can be reduced by around 35 percent compared with conventional die-cast solutions, equal to approximately one kilogram. In addition the compact design, especially of the MMPs, offers opportunities to minimize the required installation space. Compared with die casting solutions, the MMP-based coldplate requires a maximum of 10 mm in the Z-direction, which corresponds to a saving of around 50 percent.

Advantages and innovations

• The coldplate serves the need for liquid cooling of electronic control units in current and future mobility concepts (improvement of +10%)
• The required cooling capacity can be ensured at a significantly reduced weight, namely about 35 % savings, compared to a conventional die-cast solution.
• It enables savings in installation space in the Z-direction due to the flat design of the MMPs used (-50%).
• In addition to the coolant used for the prototype (water/glycol), the use of MMPs also opens up the possibility of using refrigerant from the air conditioning system and thus another significant leap in heat dissipation performance.

Technical specification or expertise sought

The industrial partner should be from the fields of power electronics, ideally related to the mobility sector (electro mobility, autonomous driving, etc.).

In addition to the automotive sector, the following fields are relevant: New Mobility, Railways, Ships, Aerospace, Chemicals, Energy Supply, Power Grids, Charging Technologies (electric vehicles), Telecommunications, Data Centers, Drive Technology, High Performance Electronics, Medical Technology, Defense, IT Hardware, Server Parks.

In general, cooperation partners are sought where heat generation is an issue (heat generation and its effect on electronics and respective cooling technologies).

Stage of development

Available for demonstration

Sustainable Development goals

- **Goal 9: Industry, Innovation and Infrastructure**
- **Goal 7: Affordable and Clean Energy**
- **Goal 11: Sustainable Cities and Communities**

IPR Status

IPR granted

Partner Sought

Expected role of the partner

Role of the partner would be to validate and test the prototype, identify possible problems and help to further improve the solution so that it meets market demands. Agreements to jointly sell the product are possible.

Type of partnership

Research and development cooperation agreement

Type and size of the partner

- **Big company**
- **SME 11-49**
- **SME 50 - 249**
- **SME <=10**

Dissemination

Technology keywords

- **02009014 - Automotive electrical and electronics**
- **001001015 - Semiconductors**
- **04002008 - Cooling technologies**
- **001001004 - Electronic engineering**

Market keywords

- **06002003 - Power grid and distribution**
- **03003 - Power Supplies**
- **03002 - Batteries**
- **007004008 - Automobile parts**
- **03001009 - Other electronics related (including keyboards)**

Targeted countries

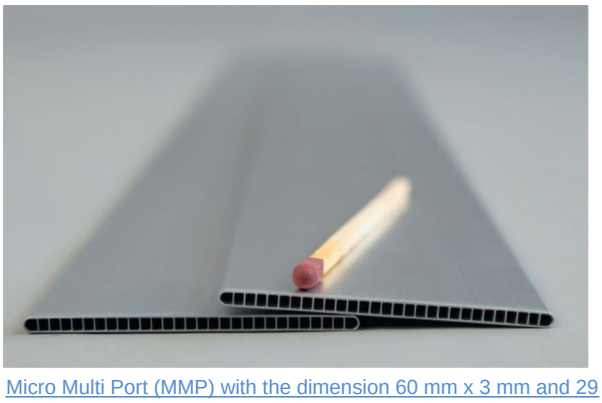
- **World**

Sector groups involved

- **Aerospace and Defence**
- **Energy-Intensive Industries**
- **Digital**
- **Electronics**
- **Mobility - Transport - Automotive**

Media

Images



Micro Multi Port (MMP) with the dimension 60 mm x 3 mm and 29 chambers

General view of the prototype

Detailed view of the connection technology of the prototype