fischer elektronik

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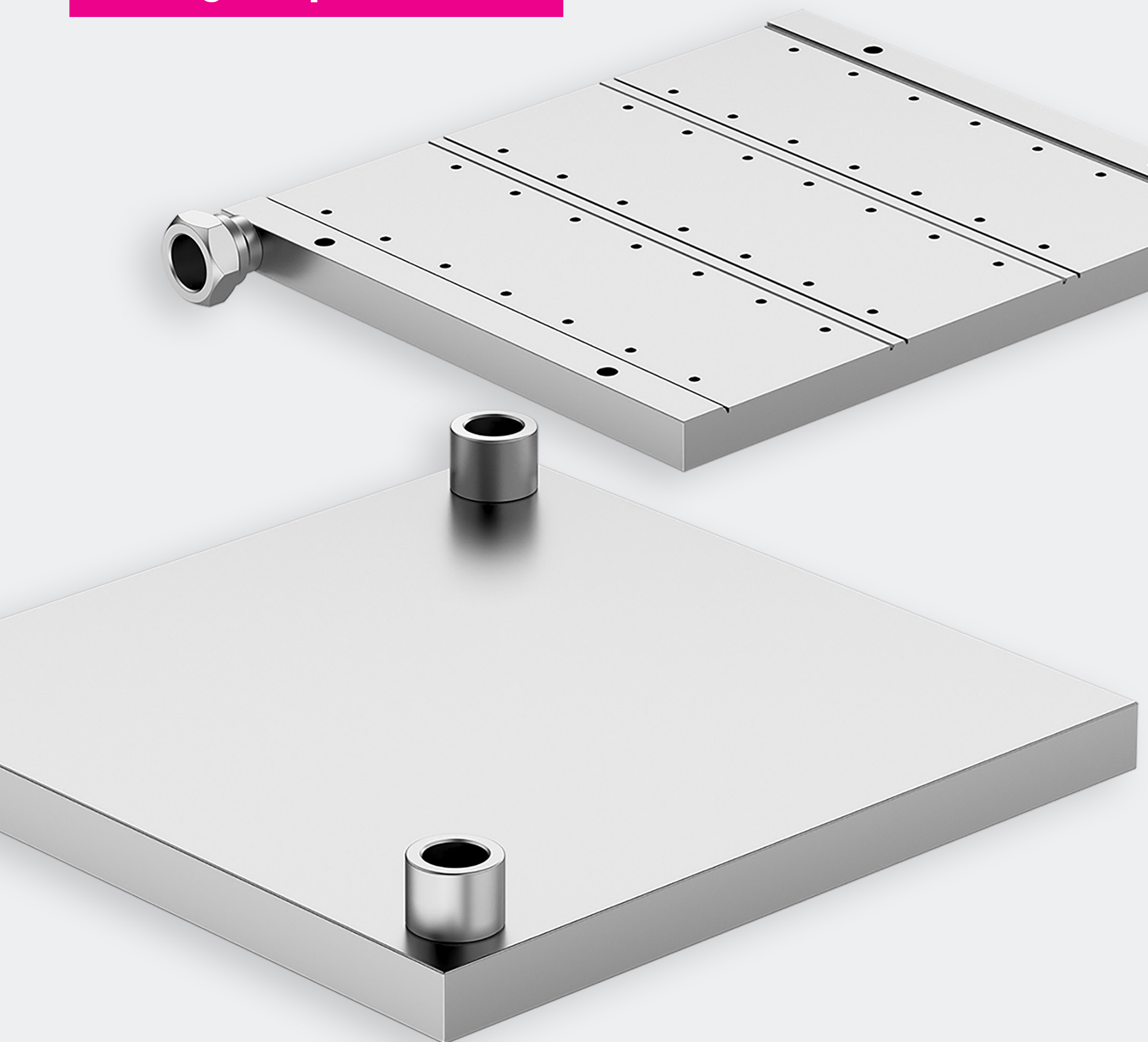
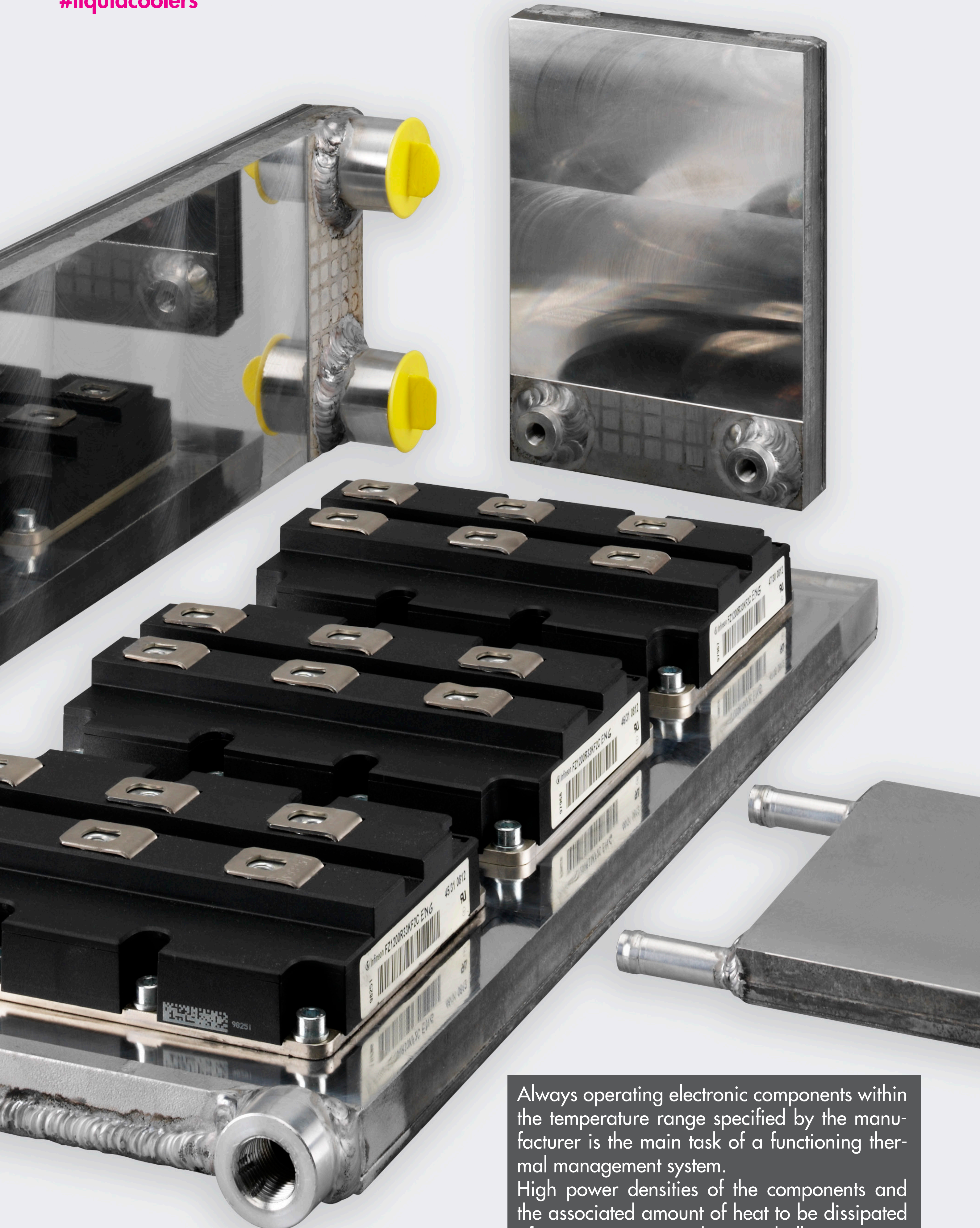
Increased Performance Through Liquid Coolers



#liquidcoolers



Always operating electronic components within the temperature range specified by the manufacturer is the main task of a functioning thermal management system.
High power densities of the components and the associated amount of heat to be dissipated often present users with great challenges.

In the field of power electronics, efficient heat dissipation of the power components used is particularly sought after and necessary. The preservation of the component properties as well as the guarantee of the component service life makes the aforementioned thermal management indispensable. For this purpose, Fischer Elektronik develops and produces various effective heat dissipation concepts which function in accordance with the physical principles of natural or forced convection, but which can also be carried out with the aid of fluids.

The power loss of power semiconductors is analogous to that of other electrical components and can sometimes be significantly higher. The energy supplied is not one hundred per cent converted, but losses occur which are directly converted into heat and thus have a significant influence on the expected service life of the component.

Uncontrolled temperature stress must be diverted from the component as quickly as possible as otherwise malfunctions of the component or even complete destruction of the functional assembly can be expected. Effective heat dissipation components from Fischer Elektronik, in the form of passive, active or fluid-cooled solutions, provide a remedy and are outstanding in terms of service life extension.

Liquid Coolers

The use of high-performance fluid heat sinks from Fischer Elektronik is definitely worth considering for a number of applications in the field of power electronics. In terms of heat dissipation, fluid-cooled solutions clearly stand out from other cooling concepts, although the overall package of „electronics and water" is still viewed critically by many users.

However, this impression is completely unfounded as the compatibility of electronics and water is no longer an issue due to the high quality of workmanship.

← Illustration 1: High-performance fluid heat sinks with a flow-optimised heat exchange structure ensure reliable cooling of high-performance IGBT modules.

Special procedures for leak testing, types of coupling systems as well as the tested safety of the hose systems are reliable state-of-the-art technology. In addition to the significantly higher heat capacity of water as a cooling medium compared to air, another advantage is the very compact design on the component to be cooled.

The implementation of different fluid heat sinks is historically characterised by different variants available on the market and is also partly determined by environmental conditions The first fluid heat sinks were simple, perforated plates made of aluminium or copper, into the holes of which hose nozzles were screwed or welded. The next development step was to draw or press copper tubes into aluminium base plates, which is still the dominant system of fluid heat sinks on the market today under the name „Cold Plate".

Innovative Variants

Today, innovative fluid-cooled concepts are designed and implemented even more effectively through special heat exchange structures. Various fluid heat sinks, in different widths and lengths as well as types of construction, are offered on the market by Fischer Elektronik as I-flow or U-flow variants.

These, including the coolant connections and the internal three-dimensional heat exchange structure, are made entirely of aluminium. The internal structure of the fluid heat sink, consisting of a solid component mounting plate and lateral edge profiles, is connected in a heat-conducting manner to the internal, offset relative to each other fin structure.

The heat transport thus takes place from the component to be cooled into the materially strong base plate, from there into the internal fin structure from which the heat is transferred to the fluid flowing through. The very efficient heat exchange structure also leads to a homogeneous (planar) flow through the fluid heat sink with minimal flow losses.

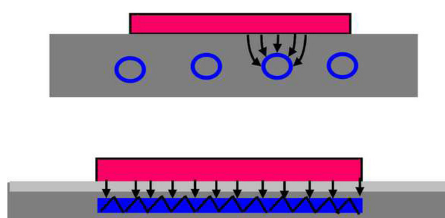


Illustration 2: The close-meshed heat exchange structure, which is connected to all sides and offset from each other, ensures a full-surface flow through the fluid heat sink.

Structure of the Heatsinks

The base plate, which is intended for component mounting, is milled accurately flat with very good evenness and roughness and ensures free placement of the components without being restricted by any possibly interfering pipelines. Due to the aluminium materials used, the cooling medium must be mixed with water and corrosion inhibitors (coolant protection agents) to prevent pitting corrosion. A 50/50 water / glycol mixture is recommended for the application. However, the hose systems to be used must be resistant to antifreeze, for example made of EPDM (ethylene-propylene-diene rubber).

New types of fluid heat sinks are also available for the field of heat dissipation of electronic components with high power losses on the circuit board. The fluid heat sinks of the FLKU 10 series are used on the circuit board, are made entirely of stainless steel and are manufactured using the 3D metal printing process.

The structure of the fluid heat sink contains two separate cooling circuits, that is, one cooling circuit per mounting side. The internal heat exchange geometry is optimised using artificial intelligence and also ensures minimised flow pressure losses.

Illustration 3: Efficient and very compact fluid heat sinks from 3D metal printing help the user to safely and quickly cool down high-performance components on the circuit board.

Due to the stainless steel material used, there is no demand whatsoever on the cooling medium water, that is, this can be used in its pure form without any corrosion protection inhibitors. Pressed-in solder pins are optionally available for mounting the fluid heat sink on the circuit board. This means that the fluid heat sink can also be handled like an electronic component and be soldered onto the circuit board.

When fixed and put into operation, this type of fluid heat sink allows large amounts of heat to be dissipated in a small space. The fluid heat sinks of the FLKU 10 series are particularly useful for cooling power transistors in TO or SIP multi-watt cases.

Also integrated in the manufactured fluid heat sink is a specially adapted groove geometry, in which so-called snap-in transistor retaining springs of the THFU series fix the power transistors for simple and safe assembly with high contact pressure. The semiconductor mounting surfaces on both sides are finely ground and have very good flatness. The fluid heat sinks allow a maximum operating pressure of 3 bar during use. In addition to the standard designs, individual design options, materials and properties can be realised in accordance with customer-specific requirements.

With and Without Air

High-performance heat sinks for free convection are popular and not only used in the field of power electronics. Basically, these concepts differ from classic extruded heat sinks in their structure and geometric dimensions as high-performance heat sinks were specially designed and developed for heat dissipation of greater power losses.

Different types of production offer a wide range of designs and properties and are available with a solid or hollow fin, depending on the application. The flatness specifications sometimes specified by component manufacturers for the required component mounting surfaces, for example < 0.02 mm for large IGBT modules, can be achieved by subsequent CNC machining. Innovative CNC-controlled machines with the corresponding milling tools, adapted according to the surface quality, offer excellent solutions for semiconductor mounting surfaces with special quality in terms of flatness and roughness.

Another possibility for cooling power electronics is provided by the product group of high-performance fan units. Fischer Elektronik offers different product versions depending on the performance class. A special feature of the product range of high-performance fan units are the so-called lamella fan units.

The mechanical construction of the lamella units consists of a tube made up of individual parts. The web plates in the inner air duct are fitted with a honeycomb heat exchange structure and solid aluminium blocks are joined together to form mounting plates. The resulting overall construction is now hard soldered in a further special work step and thus optimally connected mechanically as well as thermally. The heat absorbed by the mounting panels is transferred to the honeycomb structure via the web panels and finally released to the air flowing through.

Illustration 4: Compact heat exchanging surfaces result in an extremely effective honeycomb structure which often provides very good heat distribution within the unit.

In total, this manufacturing process leads to a significantly denser and thus larger heat exchange surface. The required pressure build-up of the fan motor to effectively convey the air through the compact honeycomb structure is provided by powerful diagonal fans. With these fan types the air is also drawn in axially but is discharged diagonally, whereby the conical fan impeller and housing shape compresses the drawn-in air more, resulting in a higher pressure build-up in addition to the higher air volume.

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