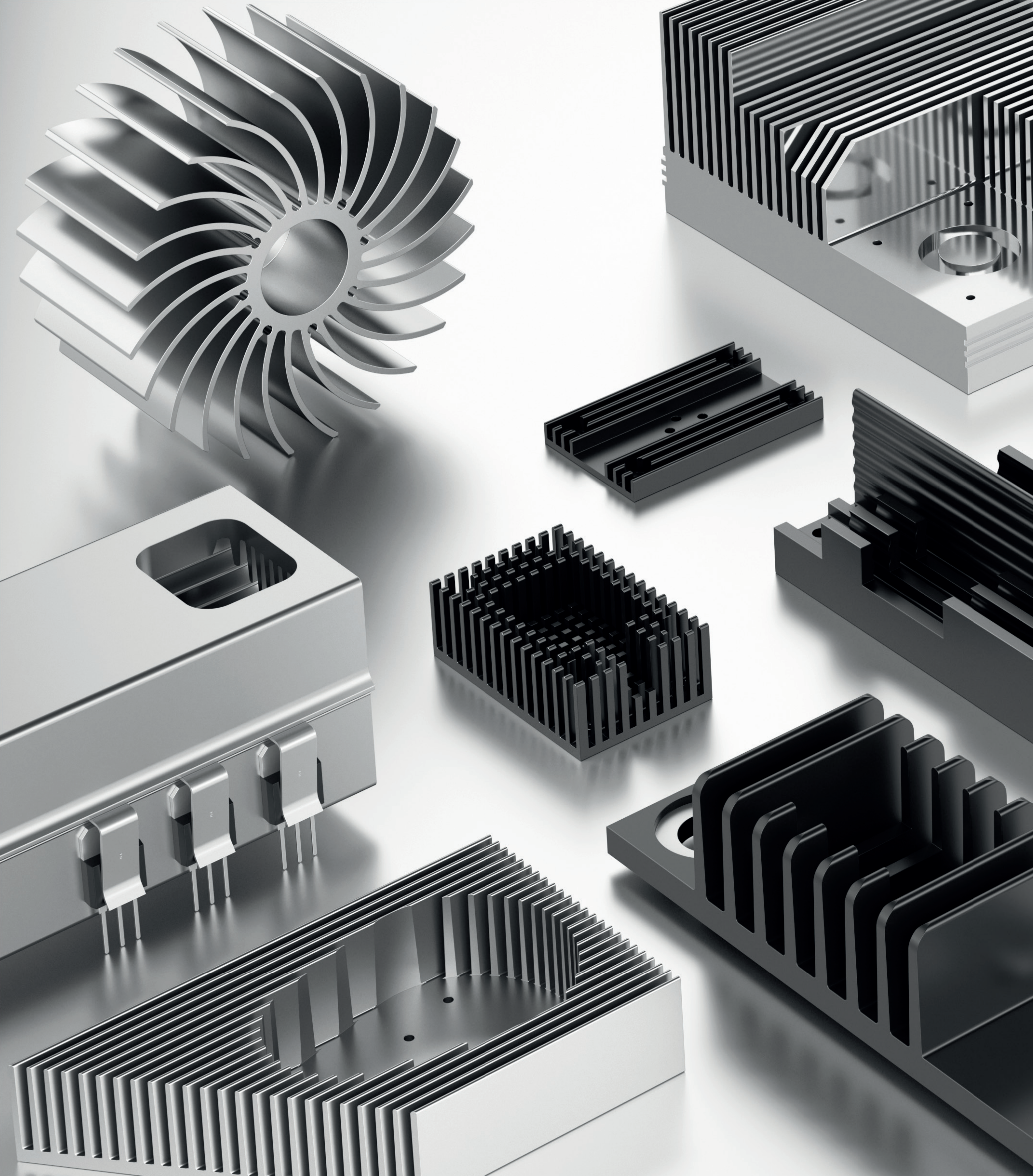
to cool to protect to connect

The Right Heat Dissipation Concept for Every Performance Class



Today's rapid development of electrical components, with steadily increasing power densities at lower packing densities, requires a dynamic and efficient approach to the selection of suitable heat dissipation concepts which are adapted to the requirements for ensuring the function of the semiconductor.

#Heatdissipationconcept

In specialist literature, the term thermal management is defined as the use of various temperature monitoring and cooling methods, such as natural and forced convection, within a system based on electronic components. The main objective of effective thermal management is to keep the temperatures of the electronic components and the interior of the enclosure within a functional range. The physical processes in the semiconductor layer generate power losses which are converted into heat losses. A current-carrying conductor, semiconductor, generates a type of waste heat due to the electrical resistance resulting from collisions of electrons and atoms when switching binary states. Frequency-related charge displacements increase the energy consumption and thus generate the waste heat already mentioned. Safe operation of the semiconductor can therefore only be guaranteed if its temperature balance is maintained and it is operated within a temperature range specified by the manufacturer. Statistical results of investigations on faulty electronic components show that more than 70% of the faults can be traced back to thermal relationships. In electronic systems the failure rate is still a good 55% due to thermally induced processes. Assuming a component temperature of 75°C, a temperature increase to 140°C can be expected to increase the failure rate by a factor of 8. This brief insight into the physical relationships shows very clearly that effective thermal management of electronic components is essential..

Passive Heat Dissipation Possibilities

Extruded aluminium heat sinks are very often used to dissipate heat from electronic components by means of free convection. As a basic definition, a cooling body, also called a heat sink, can be understood as a finned surface or a surface-enlarging component. The larger the heat-transferring surface, the better the heat transfer from a solid body to the surrounding fluid. On the basis of this, when developing heat sinks the aim is always to achieve the largest possible heat exchange surface. When designing the heat sink, however, physical conditions must be taken into account in addition to the technical restrictions of extrusion. When designing the heat sink for free convection, it is particularly important to note that the heat exchange surface cannot be increased arbitrarily. Depending on the heat sink geometry and temperature fields, individual fins and surfaces can have a negative influence on each other. The buoyancy behaviour and boundary layer considerations should be checked using a thermal simulation in advance of each application. With the right choice of heat sink tailored to the application, extruded heat sinks provide efficient heat dissipation options for both smaller and larger power losses and offer an optimal ratio of price, performance, weight and volume. In addition, extruded heat sinks can be machined and surface coated very well and as desired.

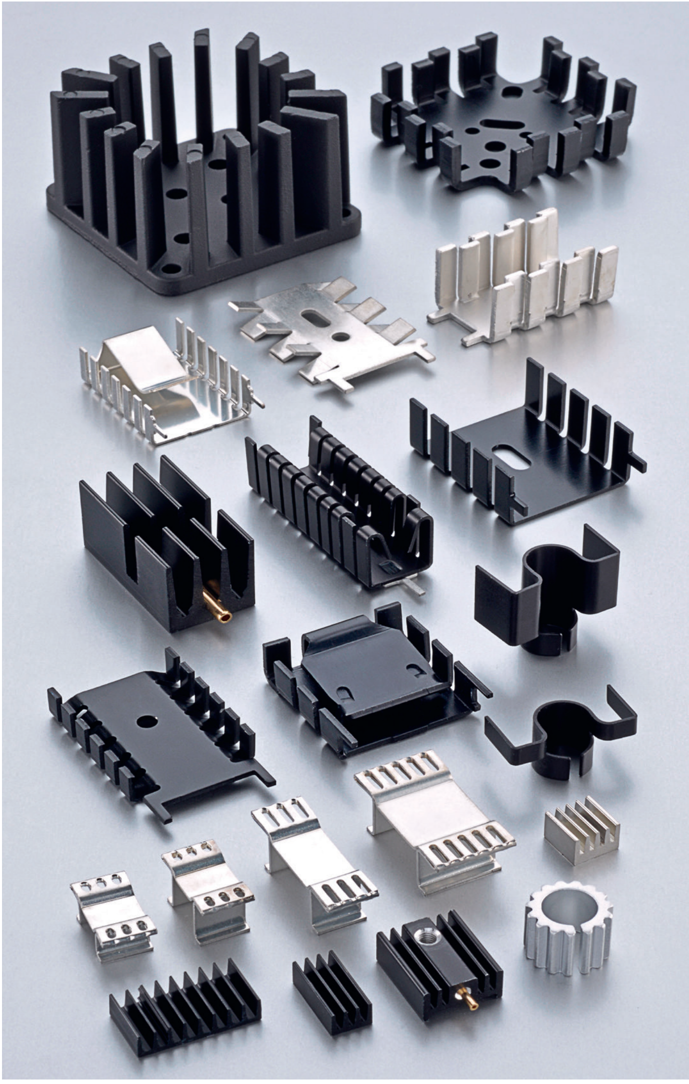


Illustration 1:
Effective heat dissipation options with numerous properties are provided by board-level heat sinks through the best possible heat dissipation directly on the circuit board.

Also for smaller power losses, such as, for example, for direct heat dissipation from electronic components on the circuit board, heat sinks can also be found in many applications and are now indispensable. The group of so-called „board-level" heat sinks (Illustration 1) is made up of various types of manufactured heat sinks. In addition to the classic small-format extruded heat sinks, for example, as SMD (surface mounted devices) heat sinks, press cut heat sinks made of aluminium or copper sheet are also used. Especially for the design of the heat dissipation on the circuit board, optimised and compact forms of the heat sink are preferred and demanded by the customer. Finger-shaped heat sinks provide a particularly effective heat sink design consisting of a base plate from which fins, vanes or pins protrude. These straight, curved, angled or otherwise offset „fingers" result in the preferred compactness and ensure the best possible heat dissipation and surface area per volume. A subgroup of the finger heat sinks are the clip-on heat sinks. These have special holding geometries with integrated spring clips to securely and permanently fix the electronic component to the heat sink with good thermal conductivity. In addition to the fastener-free plug-in, solderable fastening pins are provided for vertical and horizontal circuit board mounting in accordance with the RoHS directives. As an integral part of the clip-on heat sink, these mounting methods are of great importance, especially for cost-effective installation. Aluminium or copper strips are punched and bent into the desired shape and are an inexpensive solution for low cooling capacities. Special features of the mounting options as an integral part of the heat sink, as well as the component / heat sink unit on the circuit board, provide significant labour savings when assembling the circuit board and even enable automated assembly (tape & reel) without additional assembly costs.

Active Heat Dissipation Possibilities

Heat dissipation concepts for electronic parts and components receive an enormous increase in efficiency through the use of fan-assisted designs, the so-called fan units (Illustration 2). The design and geometry of the heat exchange surfaces of the fan units are matched to the corresponding fan motor and its specific characteristics in terms of air volume and air pressure and are also particularly suitable for the heat dissipation of larger power losses. Fan units are also based on convective heat transfer, but in contrast to free convection, depending on the design, a strong air movement is generated by various fan motors and directed through a heat exchange structure. Working on the principle of increasing the surface area, the physical properties of the various fan unit concepts, such as specific thermal conductivity, weight and size, volume and price per unit of heat dissipated, must also be taken into account. Different fan unit configurations for thermal management and for solving the problem of heat dissipation can now be found in all areas of industrial power electronics. The aluminium base bodies of the units as a closed heat exchange structure in conjunction with axial, radial and diagonal fan motors offer efficient solutions for the heat dissipation of electronic components in power electronics.

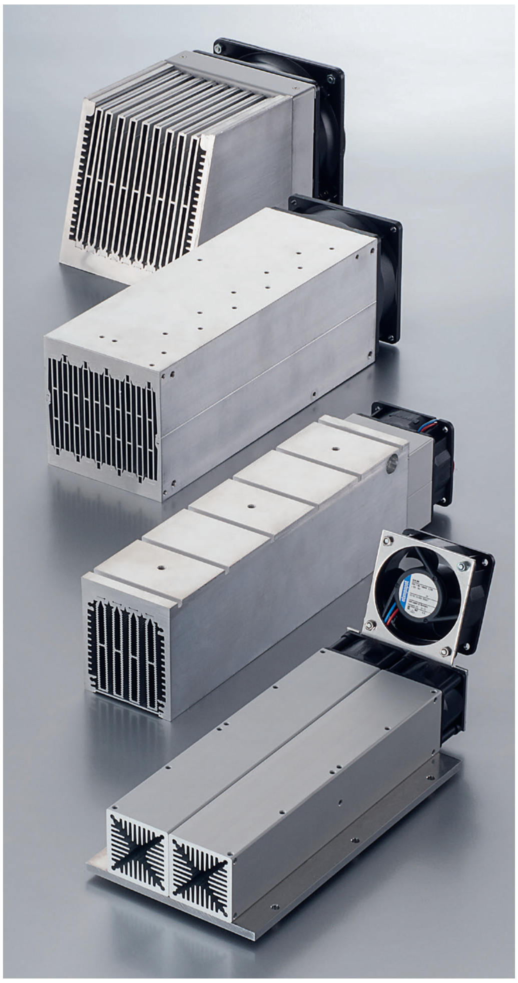


Illustration 2:
Active concepts for cooling electronic components offer significantly higher heat dissipation, especially in power electronics.

The rapid product developments in the field of power electronics have led to constantly increasing power densities in semiconductor components. For applications in which no fan units can be used, for example, due to the installation volume, the weight or the noise development of the fan, the use of liquids as a cooling medium offers a suitable cooling concept. The specific heat capacity of water is approx. 4 times higher than that of air. With liquid cooling, heat is dissipated directly and immediately at the electronic component which is mounted on a cooling element through which liquid flows. The efficiency of such concepts is physically and thermally very good as well as very effective. In comparison to the systems already described, the heat dissipation of liquid cooling clearly stands out. The high heat dissipation capacity of water results in thermal resistances of <0.003K/W, compared to air cooling of approx. 0.01K/W. In addition to the technical thermal considerations, the use of liquid heat sinks has other advantages for the user. The very compact design does not require any large heat spreading surfaces because cooling is directly at the component. Furthermore, there is no noise and no vibration on the component to be cooled, which is the case when using fan motors. A suitable re-cooling system for the heated liquid, as well as adapted hose and coupling systems, round off the highly efficient liquid cooling system.

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