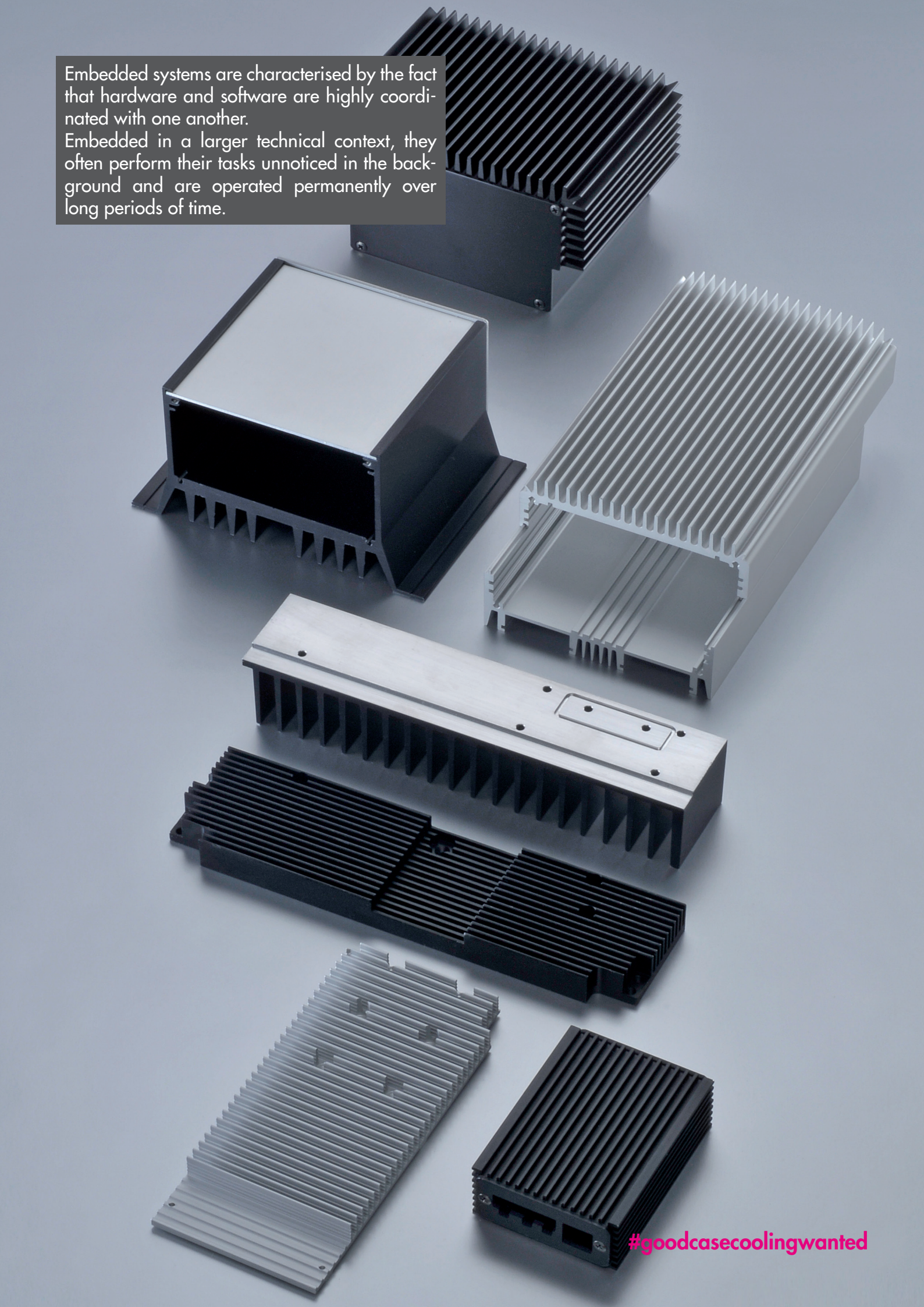
fischer elektronik

to cool to protect to connect

Aluminium Cases for Embedded Systems – Good Case Cooling Wanted


Embedded systems are characterised by the fact that hardware and software are highly coordinated with one another.
Embedded in a larger technical context, they often perform their tasks unnoticed in the background and are operated permanently over long periods of time.
#goodcasecoolingwanted

A case can protect sensitive electronics against high temperatures, external hazards such as dust or water, and electromagnetic radiation. Aluminium cases are robust, of high quality and have significant advantages, especially in the area of heat dissipation.
The following is an overview of the requirements that are relevant when selecting a case.

Active or Passive Cooling

The miniaturisation of electronics is unstoppable. The resulting power loss in the form of heat creates high temperatures in very small spaces. The surface of the electronic components may be so small that the heat cannot be dissipated to the environment in sufficient quantity. Exceeding the permissible maximum temperature of semiconductors leads to a drastic reduction in service life which can ultimately lead to the sudden failure of a system.
Particularly with permanently operated devices, as is often the case with embedded systems, there is no possibility of cooling down the system by pausing operation. This can be remedied by targeted thermal management so that the resulting power loss is efficiently dissipated to the environment.
There are two different principles for cooling the electronics:
Natural or free convection and forced convection.
In free convection the warm air flows upwards. The resulting pressure difference causes cold air to flow in from elsewhere. The principle of free convection can be found both in heat sinks and in cases with ventilation slots. Heat sinks, often made of aluminium, can not only be used in the case, but they can also be found as case walls in heat dissipation cases.
The principle of forced convection is used when a fan is installed. Compared to free convection, this enables an increased speed of the air flow and thus a faster removal of the heat. In cases with ventilation slots, fans can be used to supplement heat sinks mounted directly on the electronics.

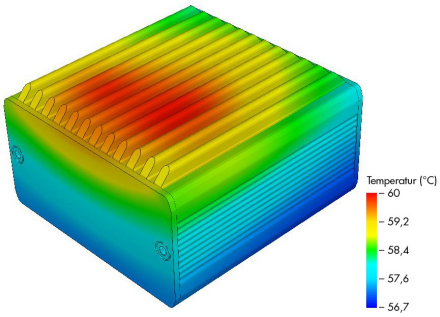


Illustration 2:
Typical temperature distribution in a heat dissipation case

Heat-conducting materials between the heat sink and the electronics ensure full-surface contact between the electronics and the heat sink and thus ensure efficient heat dissipation. Thermally conductive foils, pastes or adhesives can be used here.

IP Protection

In many areas of application, electronics must be protected from external hazards such as contact, solids, dust and water.
Knowing the place of use and its environmental conditions is important and has an influence on the requirements for a case and thus also on its costs.
In industrial environments, protection against moisture and dust is often necessary, while in systems that work with water, protection against splash water or occasional submersion can play an important role. On the other hand, units that are located in appropriately protected cases only require a low type of protection.
DIN EN 60 529 defines the IP protection of cases with the aid of two code numbers where IP stands for Ingress Protection or International Protection.
Protection against foreign bodies and contact can be found in the first code number. The code number is selected between 0 and 6, where 0 means no protection at all and 6 means the best possible protection, in this case complete protection against the ingress of dust. The second code number varies between 0 and 9 and describes the protection against water. Here too, 0 means no protection at all, while the highest number 9 describes a very high level of protection: The protection against water during high pressure / steam jet cleaning. Protection against submersion, temporary or permanent, can be found in codes 7 and 8.
If a case needs to have a certain protection class, the appropriate seals must be used. These include polyurethane seals, flat seals, sealing compounds and cord seals. Each seal has its own area of application.
Thus, for example, flat gaskets can be used to seal the gaps between the case and the cover plates and cord gaskets can be used to fill narrow grooves and gaps.

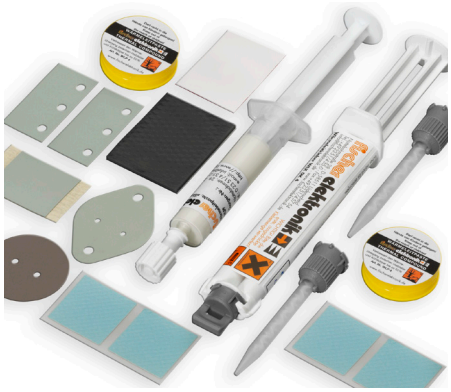


Illustration 3:
Heat conducting foils, pastes or adhesives from the heat conducting material range of Fischer Elektronik.

Illustration 1:
Different case types for embedded systems.

Electromagnetic Compatibility

Cases not only protect against obvious and visible hazards, they also serve to protect against the less obvious hazards: Electromagnetic waves.
Electromagnetic waves are created where electricity flows. This means that electromagnetic waves are generated in every electronic device. The influence of electromagnetic waves can impair the function of other electrical devices.
As a result, it can be a requirement for a case to prevent the electromagnetic waves from exiting the case and, conversely, to prevent the electromagnetic waves from entering the case.
If a device has such shielding, we speak of electromagnetic compatibility, or EMC for short. Electromagnetic shielding often already begins with the design of circuit board layouts.
Cases can assist the electronics in shielding the electromagnetic waves by creating an electrically conductive surface. This works according to the principle of the Faraday cage and intercepts the electromagnetic radiation.
With regard to aluminium cases, this means that the aluminium surface must be provided with an electrically conductive passivation. This permanently prevents the formation of the natural, electrically non-conductive oxide layer of the aluminium. In addition, a case should be completely closed for electromagnetic compatibility because a case with slits and openings may not provide sufficient protection against electromagnetic waves. For this purpose, special electrically conductive seals can be used to connect the different parts of a case with each other over the entire surface and in an electrically conductive manner. The seals consist of elastomers or silicones which are coated or covered with conductive materials such as nickel, copper or silver.

Aluminium Cases

The technological advantages of aluminium are obvious. The thermal conductivity with regard to the heat dissipation of the electronics and the electrical conductivity with regard to electromagnetic compatibility offer major advantages. Another advantage is the ease with which aluminium can be machined. Casing specialists such as Fischer Elektronik offer a wide range of processing steps.

Illustration 4:
Different case types for embedded systems.

In addition to electrically conductive passivation there are other surface coating options. Anodising aluminium creates an artificial oxide layer that forms a scratch-resistant surface and is available in many colours. Powder coating or painting is also an option. If required, all these surfaces can also be provided with printing (logos, user information, etc.).

Conclusion

An early list of the requirements for a casing makes it possible to plan the costs precisely. The conditions of use must be known as well as the location of the unit. Use on a top-hat rail, the need for wall mounting or installation on a table are additional criteria to those mentioned above.
A dedicated prioritisation of the requirements is necessary as some of the requirements are related or even contradictory. For example, an electronics case with ventilation slots cannot be waterproof.
Casing manufacturers such as Fischer Elektronik offer their customers a wide range of embedded casings as well as comprehensive, qualified advice on the properties of casings including simulation-based advice on the thermal management of the installed electronics.

Contact Person:
Bettina Lochen
is employed in the Development Department for the Cases Division at Fischer Elektronik in Lüdenscheid, Germany

Contact details:
b.lochen@fischerelektronik.de
Tel. +49 2351/435-106