CooliBlade®

APPLICATION NOTE

Advanced Thermal Management Solutions
for Electric Vehicle Charging

MORE CHARGING POWER FROM A SMALLER CABINET – SAVING VALUABLE REAL ESTATE

When the number of electric cars is growing, the demand for electric vehicle fast charging stations is increasing. An EV battery can be charged from 0% to 80% at the fast-charging points in approximately 20 minutes.

Levels of EV charging

To make sense of EV chargers, the EV industry created three "levels" of charging that roughly correlate to charging power and speed—level 1 being the lowest power/slowest speed. This gives us a straightforward way to categorize and organize EV chargers.

Level 1 Charging

Level 1 charging is the slowest and most accessible form of charging. It uses the standard home wall outlet (120v in the US, 220v in the EU) and your EV's onboard charging hardware to charge your EV's batteries. Level 1 charging usually delivers around 3-5 miles (5-8 km) of range per hour of charging.

Level 2 Charging

Level 2 is the fastest way to charge your vehicle at home. It uses the 240v power lines in your home that are dedicated to high-power appliances like clothes dryers, electric ovens, or central air conditioners. These higher-voltage lines provide more current (amperage) than a standard wall outlet.

DC Fast Charging

Direct current (DC) fast charging is the fastest way to charge up your EV. Lithium-ion batteries store and release DC power, and there's no way to charge them without first transforming the alternating current (AC) power in the electrical grid to DC power. Level 2 home chargers can only handle so much power. Commercial DC fast chargers connect directly to high-voltage AC power lines and have dedicated infrastructure for transforming them into DC power. Because of this, they can deliver much more power than level 2 home chargers. DC fast chargers can typically charge an EV from 20 to 80 percent in as little as 15 minutes.

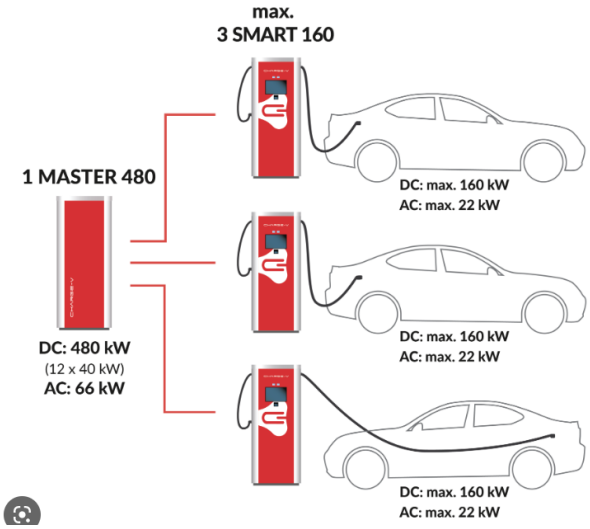
The main challenges

Especially in urban areas and city centers, the available space for the infrastructure is limited. The charging stations should be fitted into the existing parking halls without using too much space and valuable real estate. The facility managers are looking for more compact and modular product offerings, where charging stations can be easily upgraded and expanded with more charging posts and higher capacity as the percentage of electric vehicles is growing, and demand for EV charging is steadily increasing.

The maximum charging speed of an EV charger is highly dependent on the performance of the power module cooling system. A well-designed thermal management solution will also make the systems more reliable and thus reduce need for maintenance.

The advances in semiconductor and power electronics manufacturing are leading towards constantly increasing power densities and heat fluxes. The smaller module sizes and higher power dissipations are challenging the existing thermal management solutions and the traditional aluminum heat sinks are not sufficient anymore.

New improved heat sink designs are needed, capable of handling higher power densities, without compromising device reliability, performance, and service life.



NEOcore technology

CooliBlade has developed a new and advanced forced convection solution for high-power electronic systems. NOVA solutions are designed for forced convection cooling applications, for instance, high-power IGBTs. NOVA offers a modular structure that enables easy integration with power semiconductors. The heat coupler of NOVA modules offer an excellent thermal connection directly from the semiconductor module into CooliBlade's proprietary Thermal Channel structure.

The modular structure of the NOVA allows the free design of the cooling solutions and scales up the usage of cooling elements easily. The CooliBlade NEOcore technology provides an outstanding heat distribution capability for the NOVA series products. Ultimate thermal conductivity combined with an optimized air interface enables cooling up to 1800 W of thermal power @ 5 m/s forced convection airflow.

Key Benefits

- Increased power level, i.e., faster charging
- Reliability due to improved thermal management
- Size of the cooling unit can be reduced
- Higher ambient temperature
- Lower airflow requirements

CooliBlade Solutions

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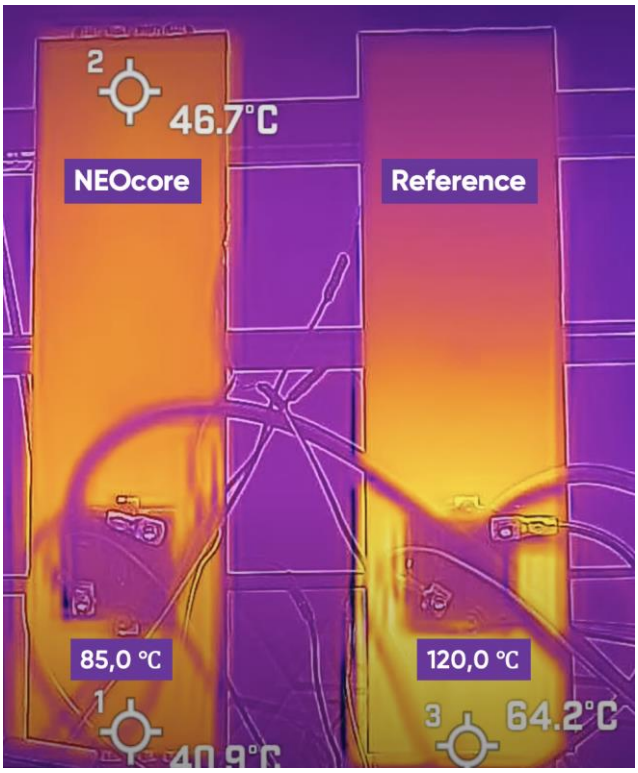
Test: NEOcore Thermal Channel vs. Pure Aluminium Heat Sink



NEOcore thermal channel transfers heat instantly and keeps the heat source cooler leading to a longer lifespan.

Cooliblade OEM Solutions

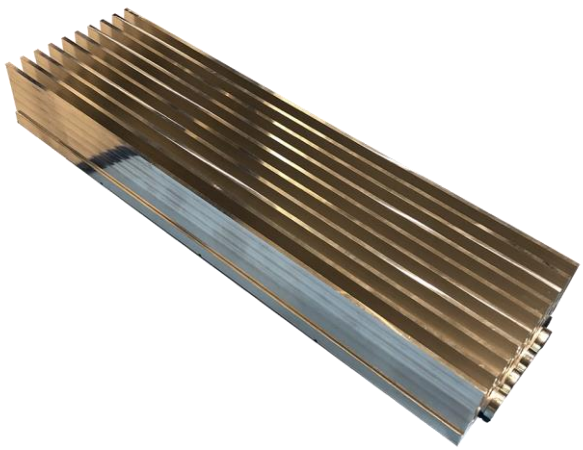
CooliBlade develops OEM solutions for the most demanding applications. We have unique platforms for different applications such as EV charging, renewable energy, 5G telecommunications and LED lighting.

CooliBlade's NOVA product family offers superior thermal performance in power electronics cooling applications. The optimized thermal interface enables efficient thermal flow from the IGBT module to CooliBlade's NEOcore thermal channel. The thermal channel transfers heat instantly from the power component to the entire heat sink structure, and the fins of the NOVA module are designed to maximize the air interface. Due to the NOVA fin design, the airflow required is smaller than in many other forced flow air-cooling solutions, leading to additional energy savings and reduced noise levels in many power electronics applications.

CooliBlade NOVA products offer very powerful cooling capacity in a compact form factor. The cooling power of up to 1800 W of thermal power (@ 5 m/s forced convection airflow) can be achieved with a very compact NOVA module. This equals three NOVA modules that can cool up to a total thermal load of 5400 W in a single device. An estimated actual temperature rise of the heatsink +40@1800W (thermal power) is reached by a 5 m/s forced convection airflow. The first initiative simulated temperature rise of the heat sink surface was around 30°C. The one NOVA module size in the reference design is 160 x 130 x 218 mm.

CooliBlade Technology Platforms for EV Charging Application

CooliBlade NOVA



CooliBlade NEOplane

Conclusion

Thermal management is very critical in advanced, high-power EV charging applications. NEOcore technology from CooliBlade enables the design of efficient and cost-efficient charging solutions ranging from level 1 charging to DC fast charging.

CooliBlade's NEOplane and NOVA series' adaptable structure makes it simple to design cooling units with varying power levels and form factors. A well-designed thermal management solution offers new design freedom to electronics designers. It improves product performance, making it possible to design more compact and cost-efficient products, and significantly increasing the lifespan of PCBs and power modules.

With CooliBlade as the thermal management partner, EV charging manufacturers can create innovative charger designs without the limitations of size and shape of the thermal management solution.