



EK TECHNOLOGY DAY 2022 EVENT:

How Innovation and Research Are Key to the Evolution of Water Cooling Technologies



SUMMARY

The future of water cooling technology is being shaped as we speak. The demand for improved and reliable performance and compute power is at an all-time high, which means we must deploy innovative approaches to creating liquid cooling solutions. The EK Technology Day event is an opportunity to share the vision of our founder and R&D experts to showcase how coming up with new and green methods for achieving desired goals is the only way to advance the industry forward. We also discuss how EK plans to implement independent supply chains on multiple continents and reduce the production costs of water cooling solutions, thus making them more mainstream-friendly.

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INTRODUCTION TO EK TECHNOLOGY DAY 2022

In the hardware manufacturing industry, **the best way to stay ahead of the curve is to be the very one who bends it.** And that's precisely what EK is doing in the field of water cooling.

We have the privilege to live in extremely exciting and inspiring times for computer technologies where huge breakthroughs occur almost daily. Blink, and you'll miss a new product or even an entirely new approach to how computer hardware is made. This is why EK never blinks when it comes to following the latest industry standards.

In fact, we are the ones who set them, mainly within the domain of liquid cooling.

We are all about performance, reliability and focus. Our goal is to bring the production costs of liquid cooling much closer to those of conventional air-cooling systems, but without sacrificing the performance and reliability standards we have set over the years.

A great example of this is our **LiteBlock on the MSI Z690 Torpedo EK X**, our high-performing yet budget-friendly motherboard that is the fruit of our collaboration with MSI. The Torpedo features the purpose-designed, simplified monoblock that provides cooling for the VRM section in a special way and the powerful Intel 12th Generation Core series CPUs.

The only way to couple this type of premium quality with affordable prices is through

innovation.

Our R&D department is constantly exploring, improving their knowhow and coming up with new approaches that can help our partners achieve their goals. In a collaboration setting, we like to be involved right from the get-go. Only then can we **reach the holy trinity of cost reduction, optimal performance and visually stunning design.** Our focus also lies in personalization. For every project we do with one of our partners, we have an individual, personal approach tailored strictly to the needs of their customers.

Aside from the numerous innovations you are about to see, we also decided to become independent in terms of entire supply chains. From development and knowledge to support and delivery, our products are now available on multiple continents, making sure our consumers are not left with burning holes in their pockets and empty slots in their sockets.



WHAT'S NEW IN LIQUID COOLING TECHNOLOGIES?

Currently, one of the most talked-about topics is how to

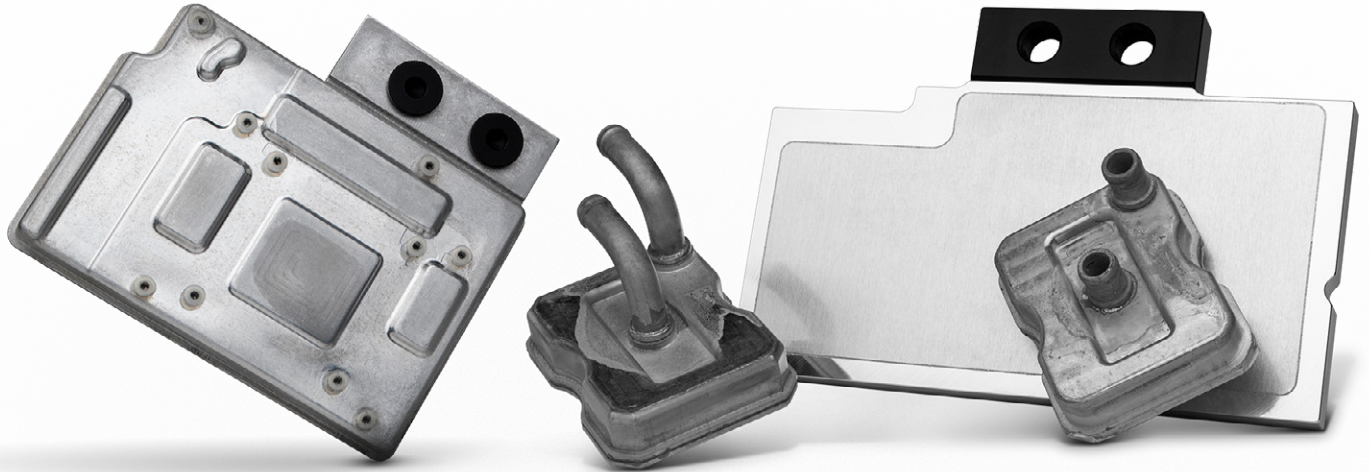
**reduce production costs
and bring them closer to air cooling.**

Probably not the most exciting topic, but a rather important one from the technical development standpoint. Especially now, when the costs of raw materials are reaching record highs. So, now more than ever, **we are conducting base research and testing different approaches to water block design and assembly.**

One of our primary goals is optimizing cost-efficiency and bringing trendsetting technologies to the mainstream market. This is possible through a business model in which the cooling solutions for the products are developed by EK, produced in China, and then the final assembly takes place in a semiconductor vendor's factory – a model we are currently turning into a reality.

The standard water block design and assembly that we are all used to will always have their place wherever these solutions are a good match. Nevertheless, other approaches are considered as **we aim at a broader range of applications in terms of both - lower costs and increased reliability.** We are achieving this by coming up with new development technologies that include brazing of tubes, brazed water blocks, laser-welded water blocks, the use of aluminum, and so on...

In the automotive industry, for example, the focus should be on the robustness of the water blocks rather than on their ability to be disassembled or good-looking. This is where the technologies of metal bonding especially come into place.



By utilizing laser welding or brazing, we can reduce assembly costs and, at the same time, drastically improve resistance to shock and vibration. One of the new water block design approaches that fit into this narrative is using the deep-drawing of copper sheet metal to form water block parts. With high enough volumes, it would be economically feasible to make a die that could, for instance, stamp out a block top with all the channels, enabling to make the cold plate as thin as possible. Subsequently fusing them together through welding or brazing, **we are able to make a water block with minimal machining and material waste.** This helps us to produce high-performing solutions at a reasonable price.

Technological innovations like these often trickle down into our consumer sphere to solve a particular problem.

THE ASUS TUBE BRAZING SOLUTION

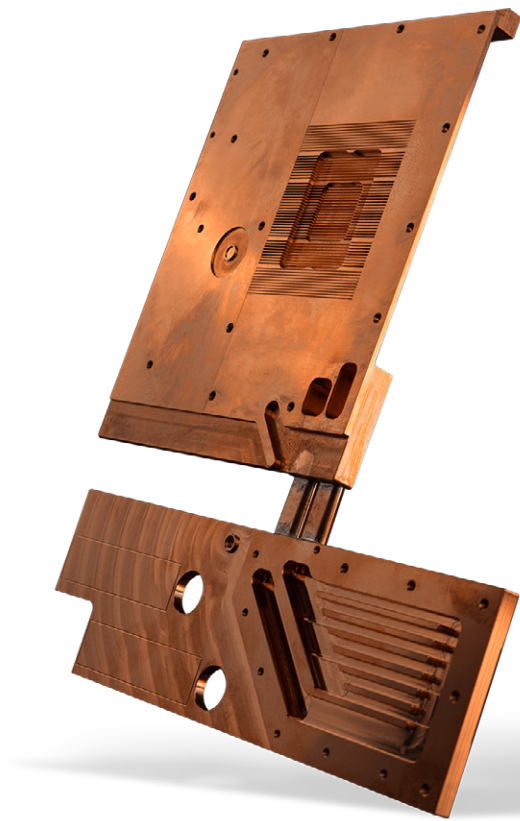
One recent example of using technologies for more industrial purposes is the case of the Ultra block. The goal was to cover as much of the motherboard as possible with the challenge of having very limited space between the upper CPU part, the lower M.2 and the chipset part. We rummaged around our technology approaches bin to see how we could bridge that gap with a cross-section sufficient enough for the optimal coolant flow.



Making this happen by using a single piece of copper or standard milling was not possible. So, the following question was asked - why wouldn't we simply use the brazing process to join the top and bottom water block using copper tubes?

It ticks all the boxes: fits into the space, creates a permanent strong sealed bond, provides the largest possible cross-section for the flow, and we already have proof of concept - so no unknowns.

Sounds like an easy win, right? Wrong!



As always, the devil is in the details, and the detail that gave us real headaches was using an industrial solution process for a high end-product that needed to look and feel premium. Although we thought we had all the building blocks to piece things together, we were missing one crucial component: how large surfaces of copper would react to nickel plating while having a brazed joint in the mix. The sample batches went through without any major issues, but when the large-scale production started, the problems began popping up one after another.

Ultimately, we solved all the issues, reached the desired aesthetics, and delivered the required quantities. But, not without delays, which – understandably - didn't make our customer too happy. The moral here is that - every time new technologies are introduced, there is an inherent risk of failure.

**But without pushing the envelope,
there wouldn't be any progress to be made.**

THE MSI STORY (OPTI-SOCKET)

In some cases, however, all the stars align when you're trying out something new. This happened with our new EK-LiteBlock design. We were approached to produce a cost-effective monoblock that would provide water cooling to the VRMs as well as the CPU. There was always an option to go with the classical approach of using individual copper cold plates for the CPU and VRM. However, as we are EK, we decided this was simply too obvious and a too lazy approach to engineering.

So, we went back to the drawing board, and a couple of brainstorming sessions later, we came up with what we now call Opti-socket.



Here's how an Opti-socket works. The hybrid monoblock is normally mounted to cool the CPU. Additionally, there is a flat spot on the stock motherboard heatsink, right above the VRMs. Using thermal pads, the monoblock also makes contact with the already installed VRM heatsink. This design is simple and cost-effective but still allows us to utilize our latest Velocity Two cooling engine and, although indirectly, water-cool the CPU power delivery.

The beauty of this approach is that the consumer can still use a standard air cooler or AIO to cool the CPU and the stock heatsink will provide sufficient colling to the VRMs. While for that extra performance,

the lite-block is used to ensure additional cooling and keep the VRMs cooler by 20 degrees.

Now is a good moment to point out that we were once again in uncharted waters, as no one has tried anything like this before. Had our calculations and simulations turned out to be wrong, we would have been back to square one with nothing to show for (except two months of wasted work and no time for a do-over). Fortunately, this time around, **not only did our calculated risk pay off, but the project actually exceeded our expectations.**

This design offers yet another benefit. If we were to standardize socket locations in relation to the heatsink contact surface, and if the board manufacturers would adopt the standard, this handy solution won't be limited to a single board.



RELIABILITY AND TESTING

To be clear,

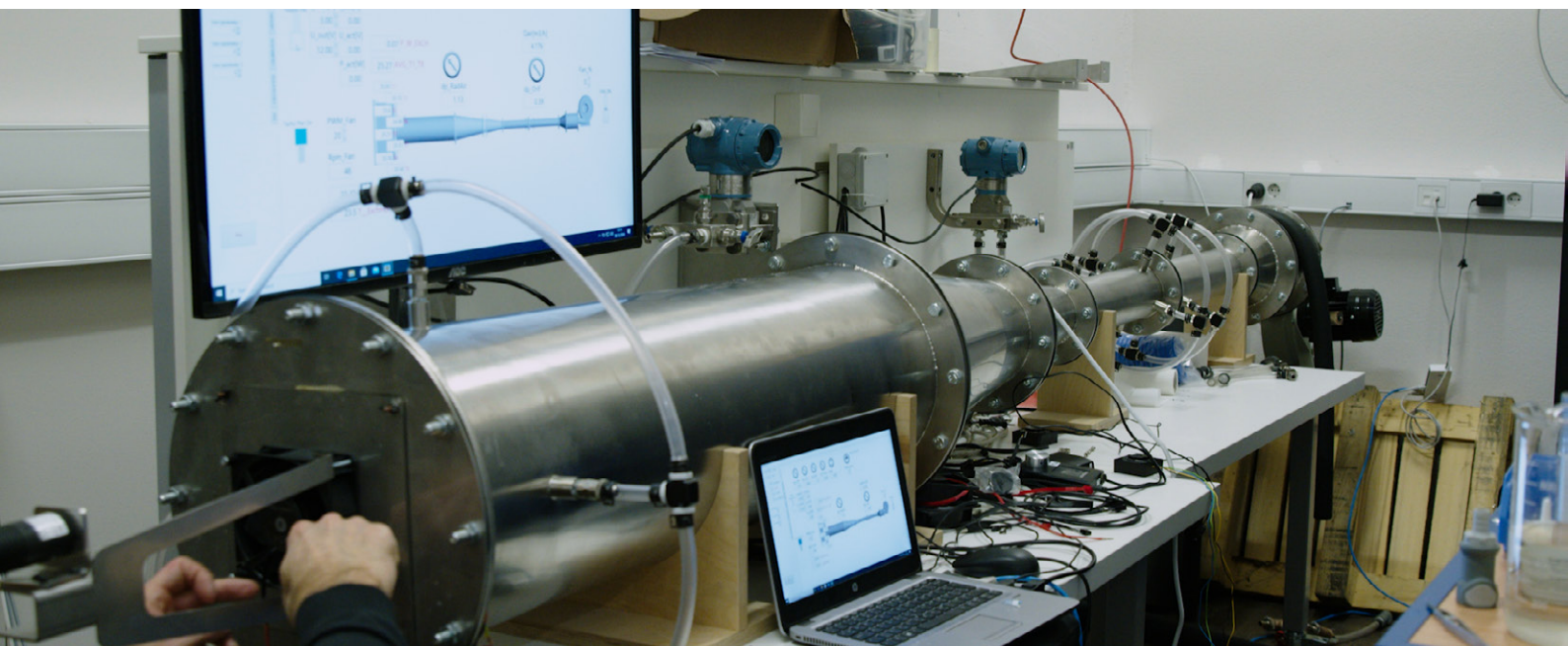
we never implement new solutions and technologies without extensive testing.

This can be in the form of numerical flow and thermal analysis or prototyping with the necessary scaleup in mind.

What we do face quite often are tight timeframes and the lack of test methodology standardization in our field. Standardized tests from other industries can sometimes be used if they suit our purposes. But more often than not, we simply have to come up with our own internal standard, which comes with its own set of challenges, such as verification.

To make sure the testing is top-tier, we have our own in-house personnel while also working closely with certified partners, research institutions and laboratories. By utilizing equipment such as climate chambers, wind tunnels, bench test stations, and other technologies, we are able to perform specialized tests such as shock, vibrations, electrostatic discharge and other simulations that enable us to produce supreme cooling solutions.

Verifying the method and results, as well as ensuring repeatability, is not exactly a quick and easy task. As time is always of the essence and scarcity, sheer creativity is the name of the game, yet again.



EK SANDBOX

Though these cases are sometimes frustrating, it is all worthwhile when our R&D engineers get free rein. When the time and deadlines allow, we work on our Quantum X projects. This is something of an EK Skunkworks division, where we dabble with out-of-the-box ideas that don't typically go past the concept phase.



There are some ongoing projects on the safer end of the spectrum, like an AI-assisted design for a 3D printed copper block, or evaporative cooling that doesn't require the use of a compressor. On the other side of the spectrum, we are playing with laminar flow tubeless block connections.

Basically, no idea is too wild.

EK PARTNERSHIPS - WE ENTER EARLY

Now that you know what trailblazing liquid cooling technologies we are developing, we should address how we work with our strategic partners to help them get the products they desire and do so in cost-optimized ways. EK enables its partners to develop the best possible products, especially if we are there from the beginning.

With knowledge and experience in cooling system development and manufacturing, we add value to the customer when we are included from the start.

The hard truth is that CPUs, GPUs and motherboards are only as efficient as their cooling systems.

There's no way around it. And to make the product perform the way the customer deserves and expects and make it cost-efficient and designed for manufacturing, it is critical for us to participate from the earliest possible stage. This way, we are able to propose and guide the board design process so the cooling system can fit perfectly.

DEVELOPMENT PARTNERSHIPS

Every final, off-the-shelf solution that you develop and offer to an enterprise customer involves some type of compromise. The customer will almost always want something different. So, even though we have off-the-shelf solutions available, our aim and focus are to be a development partner with our customers. We want to tailor the product to meet the customer's needs and requirements perfectly. This is only possible when we develop a product together in a close-collaboration setting.

FAST PROTOTYPING

Quick turnaround is crucial. We know how important it is to have short time-frames for coming from a 3D model stage to real working samples. This is why we are continuously investing a lot of resources into this segment and are proud to say that the results and improvements are obvious.

Namely,

**we can now get from a finished 3D design
to an actual sample in under 24 hours**

- depending on the complexity of the product, of course. This means that our customers overseas can have a finished product in their hands in one week's time.

R&D SUPPORT

We have a lot of experience in thermal management and are working with numerous customers from various industries, and these customers have equally various demands and requirements. If you encounter challenges in the development or lack competence in any field of cooling solutions, please do not hesitate to contact us. We will be happy to offer you assistance, guidance, or execute the complete development of your product for you.

SUPPLY CHAIN ON MULTIPLE CONTINENTS

Over the past two years, we have encountered challenges with the global supply chain as the pandemic brought it to a grounding halt.

EK predicted this and started a project called “3C3P” or “Three Continents - Three Pillars.”



The project's objective is to have independent supply chains on different continents and to be able to purchase, manufacture and supply locally. We are achieving this at a good pace and are becoming independent on the continents where this is currently possible, so we'll soon be able to fully support our customers locally. This makes EK a worldwide company, which is something we are taking very seriously on all levels.

CERTIFICATIONS

Being a company that is fully aware of the environmental changes our world is encountering and because we cannot deny the human influence as the catalyst for said changes, we decided to check what EK can do to help fight climate change and be more environment-friendly. This is why we decided to implement ISO 14001 - an internationally agreed standard that sets out the requirements for an environmental management system. It helps organizations improve their environmental performance through more efficient use of resources and waste reduction.

We know there is no planet B and are proud to take this path.

SUSTAINABILITY

Now more than ever, the aspect of preserving the environment is among the highest priorities for businesses worldwide. This goes for both the manufacturing process and the product's design. Regardless of the industry, we try to design our blocks so that, when disassembled to their basic parts, no remaining component is made of two different permanently bonded materials.

At the end of the product's life, it does require some additional work from the consumer to disassemble, separate, and safely dispose of different materials. Still, this should not pose much of a problem for the environmentally conscious.

The same mentality is applied to our packaging, where we almost entirely eliminated one-time-use plastics, like bags, for example, but there is always a trade-off between sustainability and bringing functionality and unboxing experience to higher levels.





One major stepping stone in doing what we preach is the implementation of our new render farm. Located within the EK Headquarters, it will be our fully liquid-cooled Fluid Works rack-mounted workstation/server. It will be integrated into our heating system, which is already powered by a groundwater heat pump. We will use the waste heat from the server to heat the tap water in our system throughout the year and help heat the offices during winter.

The server should be up and running in a couple of months.

PRODUCT COMPLIANCE

Since we are designing and manufacturing our products and complete solutions for our partners worldwide, we need to understand and fulfill local regulatory requirements. One portion of the product compliance measurements is done in-house. For more complex tests, we partner with various certified laboratories which provide us with special tests or certifications proving our products' compliance with local market legislations.

TECHNOLOGY FOR DESIGN

The third crucial driving force, after performance and reliability, is design.

Design is an integral part of the development of our technologies and solutions,

evident from the evolution of our products over the last 15 years. Water blocks have transformed from pragmatic and straightforward 2.5D shapes to perfectly fitted clean assemblies with a wide range of features and materials. Packing those requirements into a minimalistic design is a real challenge, especially when pursuing excellence in every detail.

EXACT MOUNT

In the case of our latest CPU block release, Velocity 2, we wanted to achieve a completely smooth top with no visible screws or mounting mechanism. At first, the necessary solution sounds simple, attach it from behind the motherboard. However, things become rather complex when we factor in socket specifications and allowable clearances.



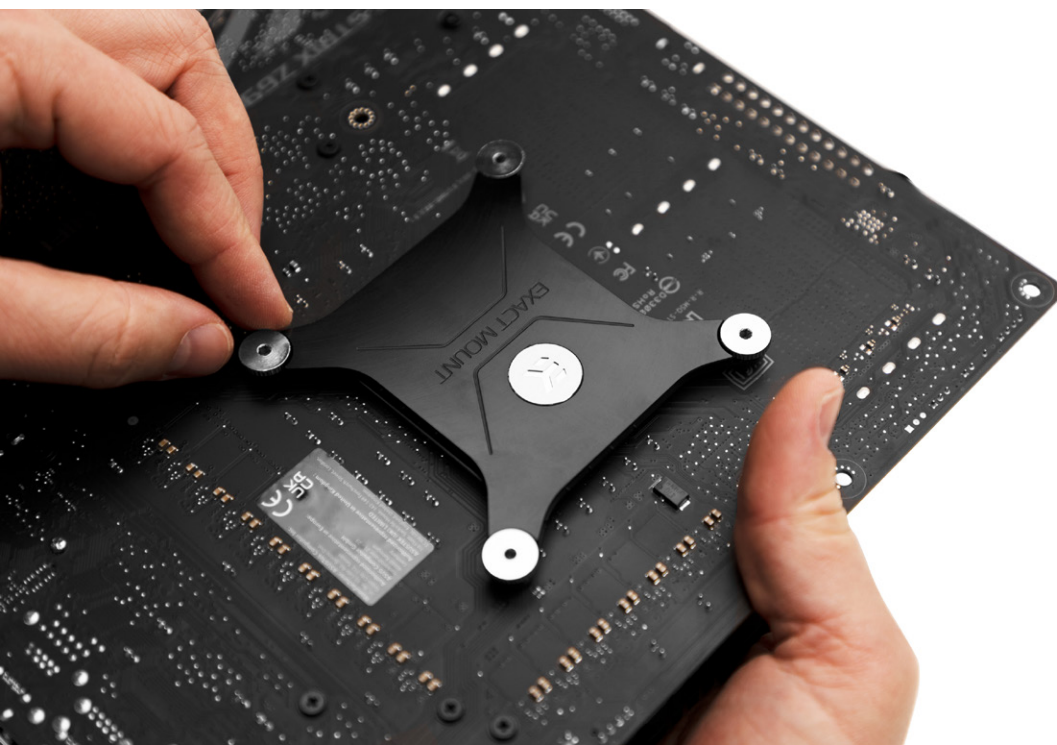
Achieving consistent mounting pressure for the CPU block means that it is necessary to use coil springs. If the pressure is too low, the thermal paste will not spread and perform as it should; while if it is too high, the product will not meet the required socket specifications.





Furthermore, on the secondary side of the motherboard PCB, there is a height restriction preventing any significant protrusions. To package a coil spring, it was apparent that it had to be on the primary side; a thumb nut on the back could then pull on a screw to tension the spring.

To make this practical to install in situations where only one side can be seen, the tensioning screws are held under load and keyed to prevent rotation. This uniquely allows them to reach the load length of the spring with very little thread engagement. Such short engagement ensures that the block is mounted evenly and simple flanges prevent over-tightening, alleviating common user errors and any rotating parts which might damage the PCB.

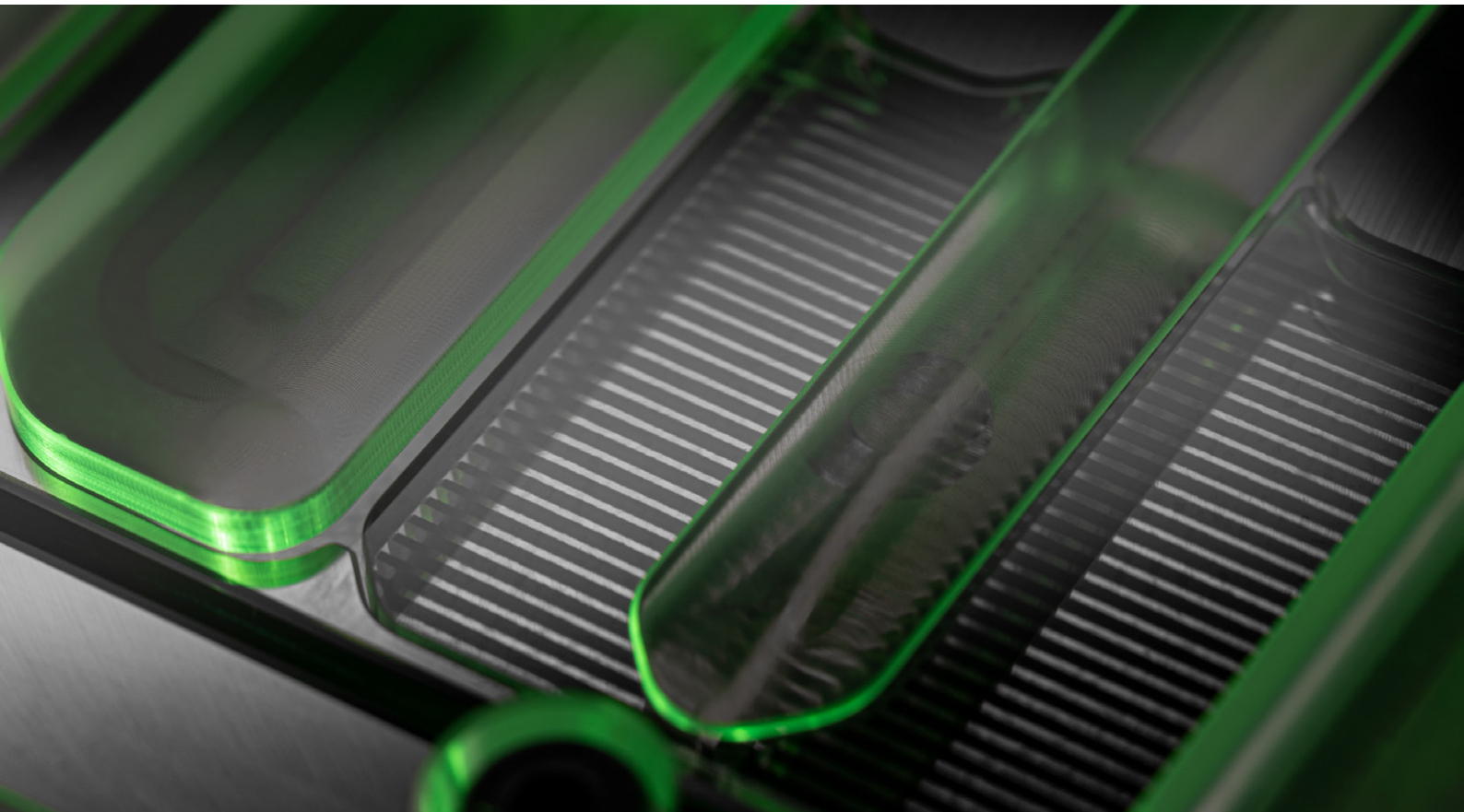


Together, these improvements led to a mounting design that retains and improves upon all expected functionality. It can be implemented across multiple socket specifications with identical parts and crucially stays aesthetically true to the concept.

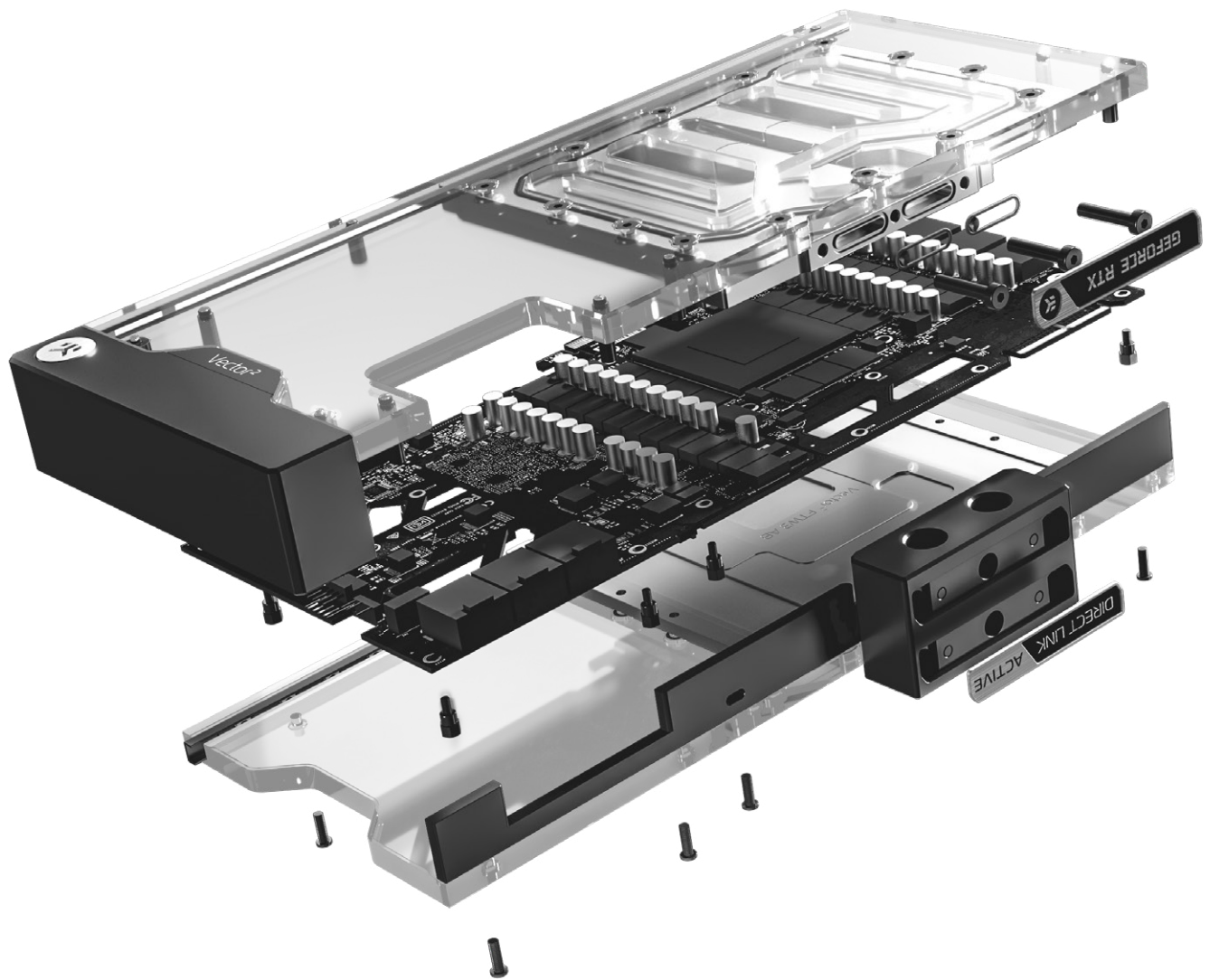
COOLING ENGINES

The most successful designs elegantly relate aesthetics, performance and reliability, elevating all three simultaneously. Often, the simplest solutions unite these three pillars.

One example can be seen in our Vector 2 GPU water blocks cooling engine, an element that has a continuous focus in terms of performance, but on this occasion, we managed to leverage an improvement from an aesthetics-based decision. The coolant itself is the most distinctive visual element in a system that instantly communicates something special and powerful lies within. Second to that element are the cooling fins, so it was only natural to eliminate the stainless steel jet plate, which prevents both of them from being seen.



The jet plate is an integral part of the cooling engine, increasing the flow velocity through the fins and providing some obstruction to crudely distribute the flow, and it could not be removed entirely.



So, we decided to combine it with a plexi insert that was previously a very simple 2.5D shape. Since this made it necessary to machine the part, we could deploy more complex geometry and taper the inlet cavity to better distribute the flow.

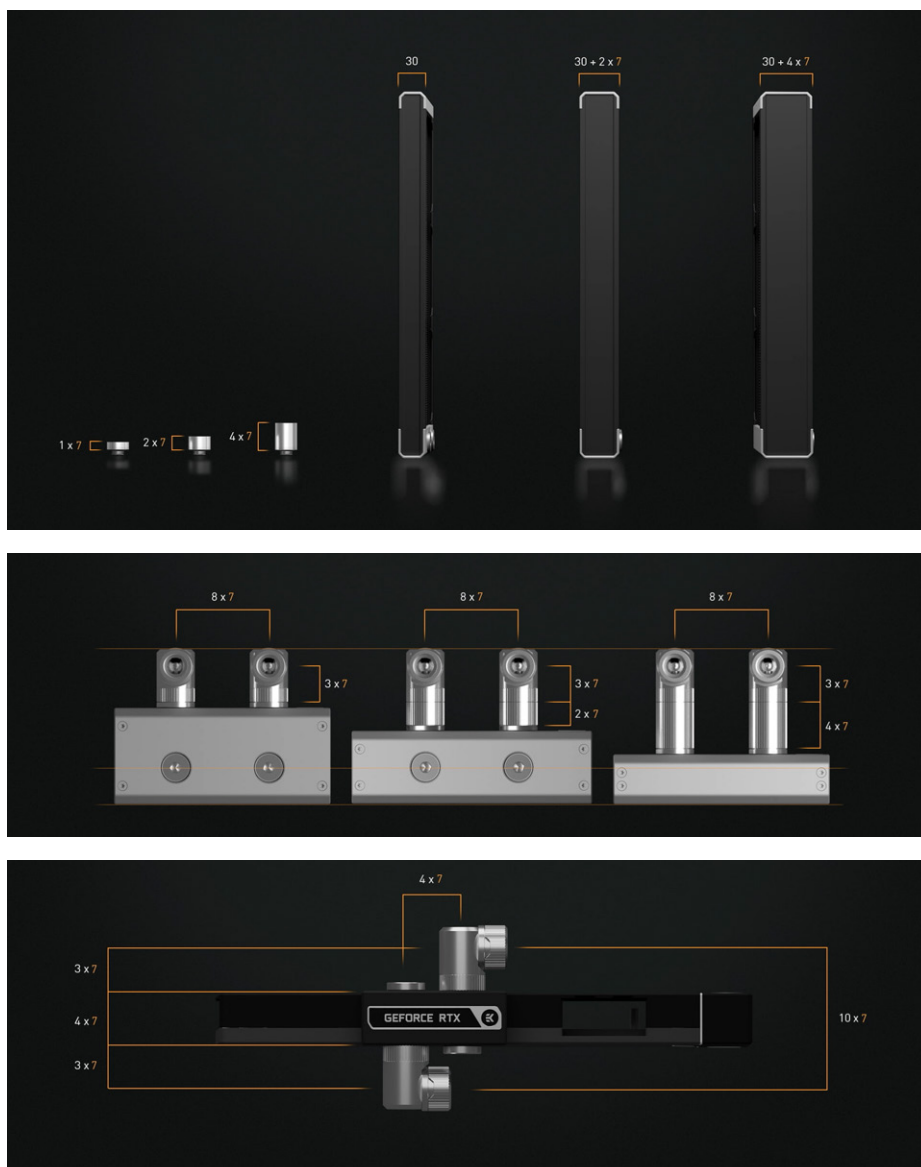
The result - a simple visual and material-based change eliminated one part and improved hydraulic and thermal performance by 1.6°C.

DIRECT LINK

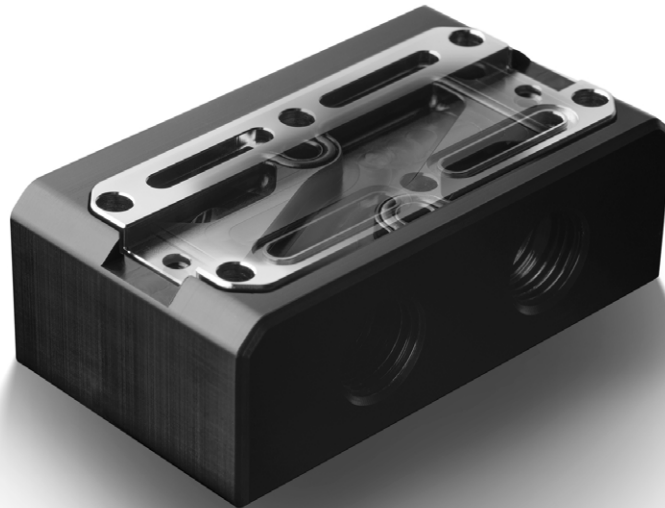
Our most significant change over the last year didn't happen for one single product but rather in terms of how they relate to one another. Since any custom liquid cooling loop must be built from multiple EK products, the biggest aesthetic and ease-of-use distinction comes from the sum of all parts. To address this,

we initiated Matrix7, a system of pre-defined coordinates, dimensions and directions

that define the location of every port on every product, ensuring that they conveniently align.



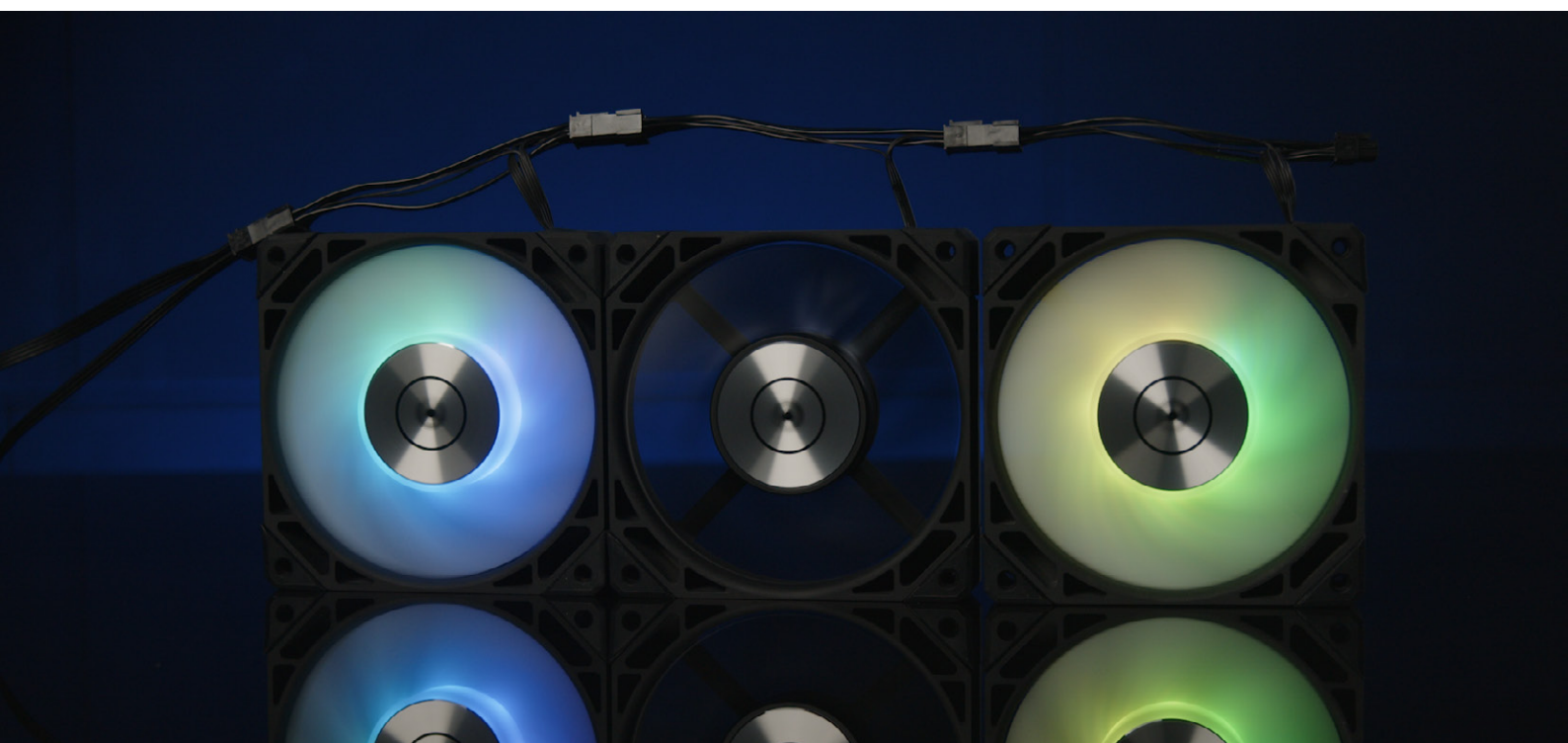
To move forward with the standard, both standard and active backplate-equipped blocks needed to interface exactly the same way, so a multiple-part Direct Link terminal was implemented. Nothing new from the outside. It actually looks just like a standard terminal, which is precisely what was needed. A secondary internal plate allows the primary and secondary blocks to be linked diagonally, thus freeing up space above to provide opposing or adjacent connections, much like a normal block.



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FAN CABLING

Our efforts to streamline the building process do not stop with the loop itself. Another key innovation has been the implementation of daisy-chained fan connectors. At first glance, this may seem old-fashioned, but by taking a closer look at the novelties, you'll see that this is not the case.



Each cable fits the length of a fan and has both male and female connectors. Every fan or device has all 8 of its pins connected in series, regardless of whether that product uses them or not, so a sequence of D-RGB lighting is not interrupted by a non-D-RGB fan.

Furthermore, there are actually two PWM channels so that pumps and fans can be controlled independently with the same cable. A high current rating from all cabling and the connectors ensures that an entire system can be connected from a single series.

As there are no proprietary parts or signals, the accessories like splitters, extenders and adapters can all be made backward compatible with existing products and interface with any standard motherboard or controller.

TRENDSETTING: DESIGN AWARDS

The sum of all these parts, and the result of truly cohesive designs, are ideas and products that have become internationally recognized and praised. These ideas deliver, in equal parts, functional and emotional value to the user. This consistent execution of innovation and refinement across a comprehensive range of products, has established EK as the market leader in water cooling solutions.

CONCLUSION

We hope we managed to bring the magical world of water cooling a little bit closer to you. As the evolution of computer systems moves at record paces, it is important to stay ahead of the proverbial curve we mentioned before.

And the safest way to do so in the water cooling industry - is to stay in the custom loop with us.

At EK, we enjoy elevating computers to new levels of performance, stability, and visual design. But we don't like doing it alone. Each endeavor is much more fun when shared with your friends and partners, so be sure to visit our website and/or contact us for a potential partnership collaboration.

Stay cool.