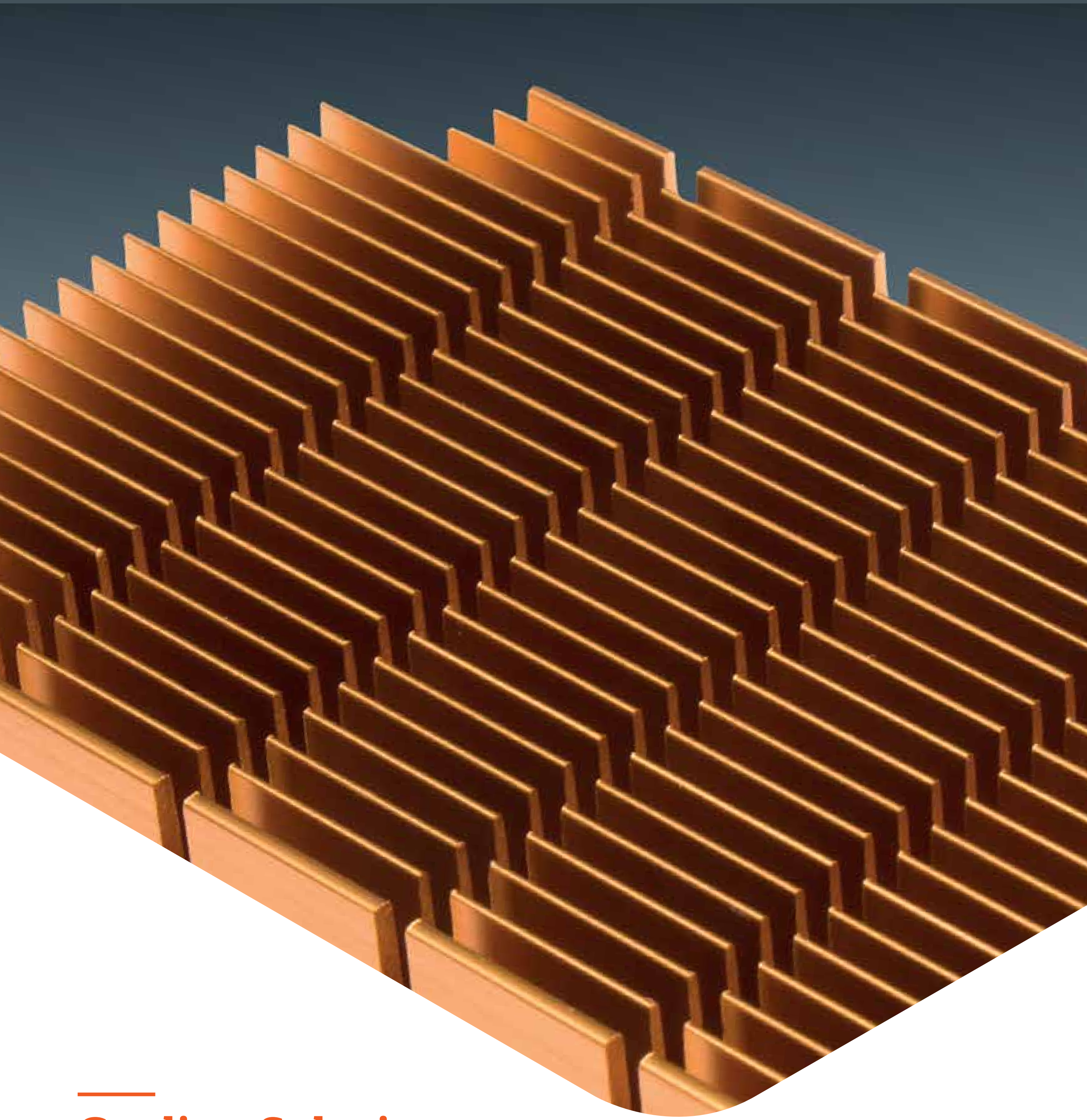
congatec



Cooling Solutions

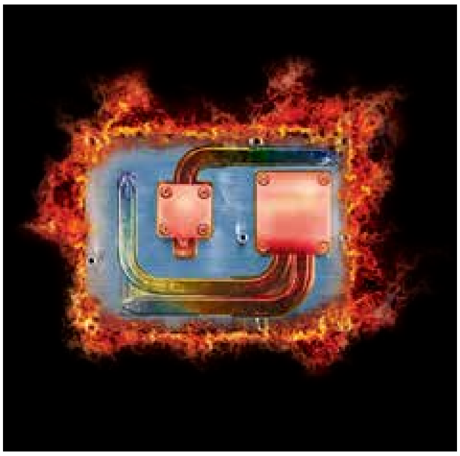
Full speed ahead while keeping a cool head:

A smart cooling solution for unbridled processor performance

Electronics are getting smaller and more and more powerful. As component functionalities and packing densities on the chip and board increase, more heat is produced per unit area. congatec's patented cooling concept for COM Express modules paves the way for future performance growth.

A hot performance

Heat is not distributed evenly across a circuit board. Hot spots occur in the vicinity of the processors and chipsets, since these components generate the most heat. For this reason, the processors feature integrated mechanisms to protect against overheating and consequent damage. Users want to take advantage of the full performance potential. Underclocking the CPU, or shutting the processor down, can only be an emergency solution. New cooling concepts are needed to allow users to exploit the available computing power to the fullest. Existing cooling solutions have already reached their limits while the trend towards more performance continues unabated.



The modular COM Express concept can pave the way for future performance growth. Newer and more powerful modules are easily mounted on an existing customer-specific carrier board. While this scalable design solution helps customers to quickly and inexpensively create a wide variety of applications, full performance depends on the processor staying cool.

Classic cooling designs for up to 35W TDP

The classic COM cooling design resembles a sandwich with the different functions layered on top of each other. A copper or aluminum block is mounted on the chip to absorb heat. Between the chip and copper or aluminum block, an optional phase-change material can be placed to mitigate the effects of thermal peaks. To account for different component heights and manufacturing tolerances, the next layer is a height-balancing, thermally conductive material, the so-called gap filler. The last layer consists of a heatspreader, an approximately 3mm thick aluminum or copper plate. All heat generated by the module is distributed across the complete heatspreader.

The module dimensions and interfaces are defined by the COM Express specification. While this standardization guarantees compatibility, size specifications may mean that the heat sink cannot necessarily be as large as desired. As a consequence this cooling structure is only suitable for modules with a maximum power dissipation of 35W.

Hot spots unwelcome

Modern COM Express modules such as the conga-BM67 feature an Intel® Core™ i7 or i5. The power dissipation of these processors is significantly higher than 35W and hot spots around the processor and chipset become a real problem. An improved cooling concept is needed to lower CPU temperature, which is crucial when utilizing the 2nd generation Turbo Boost technology in order to achieve maximum performance and energy efficiency. As a result, the processor can operate above the maximum permitted thermal design power (TDP) levels.

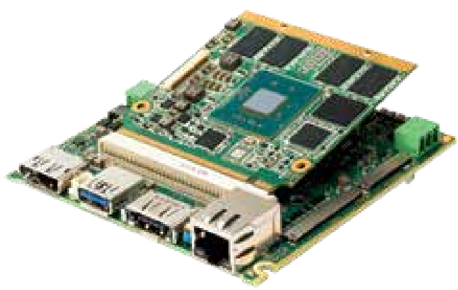


Fig 1. Computer-on-Module concept, carrier board and computer module

Limitations of the conventional solution

For the best heat dissipation results, a perfect thermal connection to the cooling system is required. The thermal conductivity of the gap filler material is limited. When power losses are high, the gap filler layer inevitably gets thinner. Thin gap filler layers have lower mechanical tolerances. To compensate for differences in component height more pressure must be applied. The cooling capacity depends to a large degree on the amount of heat-absorbing material used and the heat dispensing surface area. Copper is expensive; large heat sinks are heavy and require space that is generally not available. Simply increasing the size of the heat sink is therefore not a viable long-term solution.

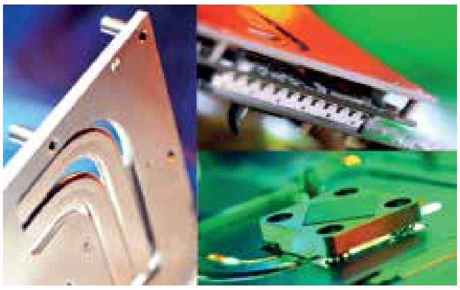


Fig 2. Cooling solution composition: heat pipes

Heat pipe – a suitable alternative?

In laptops heat pipes are used to solve the problem. Heat pipes transport about 100 to 1000 times more heat than an equivalent pipe made of solid copper. The secret lies in the physical fact that energy is absorbed during evaporation and released during condensation. The heat pipe is connected both to a hot and cold interface and filled with a working fluid. This evaporates at the hot end and condenses at the cold end. The condensate returns to the hot interface by capillary action and the cycle begins again. Since the heat pipe contains a vacuum, the working fluid evaporates even at low temperatures. The capillary forces depend on the structure of the heat pipe. Geometry and location influence how fast the working fluid is transferred, hence also affecting the cooling performance. Bend radius, the diameter of the heat pipe and mounting position also need to be considered. A laptop provides a comparatively large space to accommodate a heat pipe solution. By contrast, COM modules must always be connected to the cooling solution at the same geometrical position in the system, because the modules are interchangeable.

Classic cooling meets heat pipe

Fast spot cooling, good thermal connection, elimination of mechanical stress and greater cooling performance while retaining geometric dimensions – achieving all these requirements sounds like asking the impossible. However, congatec has mastered the challenge by skillfully combining the classical solution with a structurally modified heat pipe. Unlike the classical design, a flattened heat pipe is used to transfer heat from the chip to the heatspreader plate. The heat pipe is attached directly to the cooling blocks on the chip and the heat spreader plate. As a result, more heat is transported from the processor environment to the heatspreader, hot spots are cooled more quickly and the processor is cooled more optimally. Spiral springs with defined spring tension, as well as the heat pipe itself with its flexible height, put optimum pressure on the processor chip.

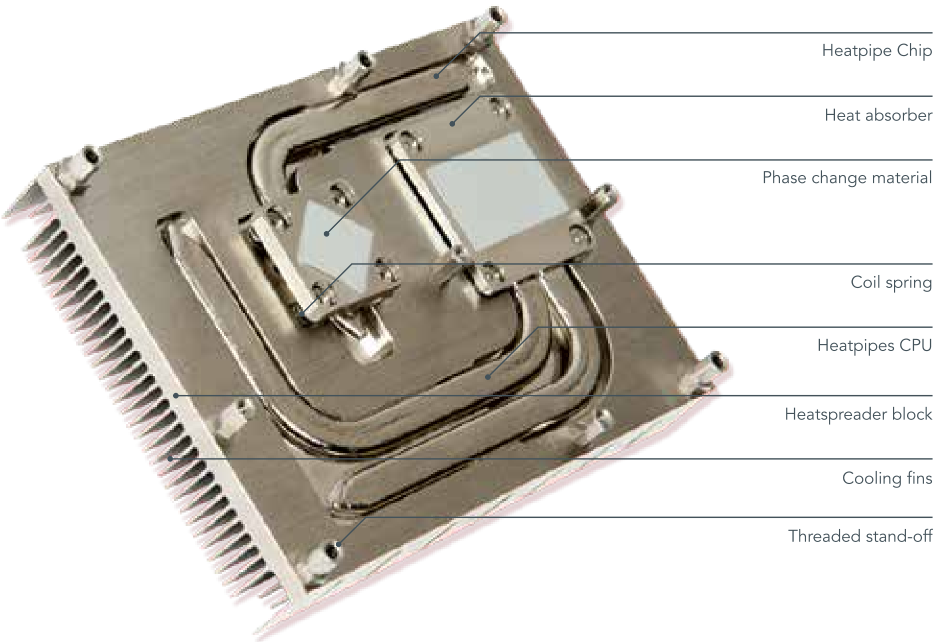


Fig 3. Description of the individual components of congatec's cooling pipe solution

Manufacturing tolerances in the soldering process or height differences of the chips can be balanced in every direction, making a gap filler layer unnecessary. This is another advantage because when gap filler materials heat up they can leak silicone oil, which can lead to negative consequences elsewhere in the system. Recesses in the heatspreader accommodate the flattened heat pipe, thereby maintaining the height. At the hot interface the heat pipe rests freely in a recess; at the condensation end it is placed in a wide groove on the heat spreader plate. This ensures there is plenty of room to deflect the pipe while guaranteeing a thermal connection at both ends.

New cooling module inspires innovative customer ideas

congatec's new cooling solution provides scope for innovative customer ideas. For example, the heat pipe can be designed in such a way that it can be connected to a customer-specific heat sink. Fanless designs are possible, provided the casing is equipped with appropriately sized cooling fins. Ultimately, the design depends on the specific application. The key features of the concept are equally applicable to other electronic circuits. Hot spots also occur in power modules. Semiconductor circuits in rectifiers and inverters, for instance, could benefit from this effective, inexpensive, small-scale cooling solution.

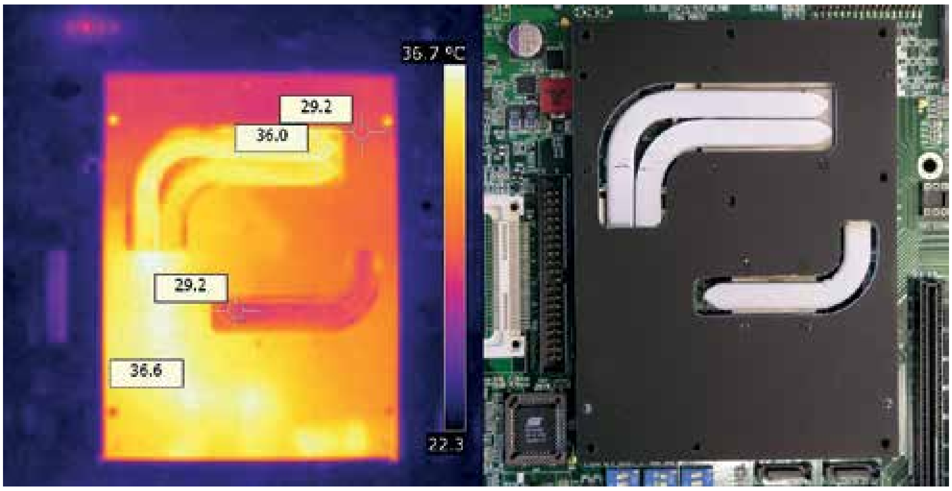


Fig 4. Explosion graphic: Basic structure of the optimized cooling solution for COMs

Extended life spans thanks to thermal reserves

The new cooling solution is also suitable for systems with low power dissipation. The modules have a higher thermal reserve, which increases their life span and reliability. Average temperature reductions of only 5 Kelvin can double the statistical life span – a convincing argument when considering the total cost over the lifetime of a system.

The advantages at a glance:

- Rapid spot cooling for full performance
- Elimination of gap filler layer
- Elimination of mechanical stress leads to higher quality
- Better cooling extends the life span of the module
- Heat pipe principle enables innovative customer-specific cooling concepts

congatec's new patent-pending cooling solution for COM modules paves the way for new dimensions of performance.

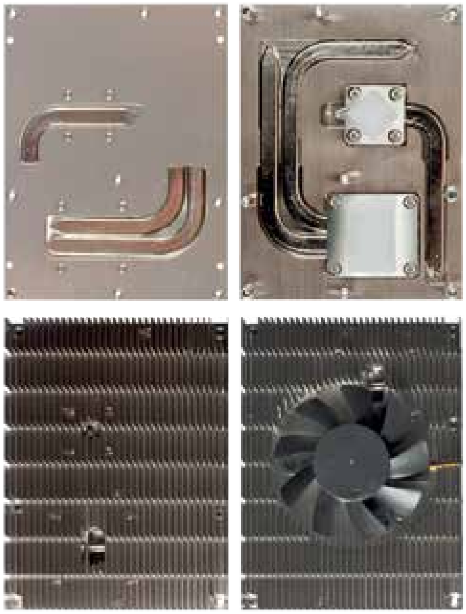


Fig 5. View from below and top, plus passive and active version of congatec's cooling pipe solution

Summary

Lab tests showed a thermal advantage of up to 14°C when comparing the standard heat stack cooling solutions with the congatec heat pipe cooling solutions. This can enhance the lifetime of COM Express computing solutions by up to x8.

Keeping COMs cool

Flexible cooling solution for COM Express®, XTX™ and ETX® embedded computer modules.

COM Express, XTX and ETX embedded computer modules allow for a fairly easy implementation of customer-specific applications. The specific functions, connectors and components for the necessary peripherals can be conveniently placed on a carrier board developed especially for this purpose. The PC itself is attached as a COM (computer-on-module). The performance of the COM and power consumption are easily scalable.

The required cooling system can vary depending on the selected performance class. A reasonably sized cooling system automatically extends a system's lifespan. An average temperature reduction of only 20 Kelvin results in a statistical doubling of the lifespan. A well thought out cooling concept thus has positive implications both for quality and total cost of ownership.

Heatspreader

The specifications for COM Express®, XTX™ and ETX® embedded computer modules include a heatspreader, which is a mechanical thermal interface. All the heat generated by components such as chipsets and processors is transferred to the system's cooling system via the heatspreader. This can be achieved by either a thermal connection to the casing, a heat pipe or a heat sink.

The heat spreader (figure 1) consists of an aluminum plate with a surface area equivalent to that of the COM (computer-on-module). Depending on the type, 5 to 7 standoffs are used for mounting purposes. In principle there are two different styles. For top-mounted modules (figure 2), standoffs that do not have a thread are used and the screws inserted from the top engage the thread of the soldered or pressed-in standoffs located on the carrier board. If the screws are inserted from below then threaded standoffs are used on the heat spreader and the standoffs attached to the carrier board do not have thread (figure 3).

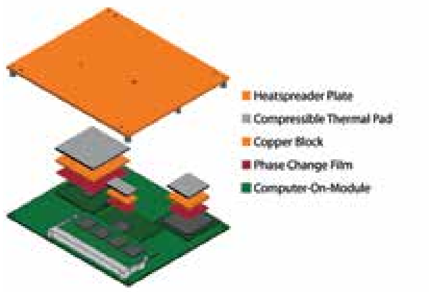


Figure 1: Basic design of a heatspreader

So-called "thermal stacks" are used to bridge the gap between the heatspreader and heat generating components on the COM. They consist of a phase change film, a copper block and a compressible thermal pad. The size and overall thickness of the thermal stacks does not depend on the particular COM. The phase change film is placed between the chip and the copper block. This aids effective thermal conduction between the chip and the block (see figure 4).

The material changes its physical condition from a solid to a liquid when it reaches a temperature of 70°C. The phase change film melts, filling even the smallest of irregularities between the components to be cooled and the copper block. This improved surface contact enables much better thermal conduction and when compared with traditional thermal heat sink paste this special design delivers easier handling and storage as well.

Admittedly, the copper that is used for the thermal stack has a negative effect on the overall weight of the combined COM and heatspreader, however its benefits outweigh the disadvantages. The high thermal conductivity of copper also makes it possible to combine heatspreaders with high-performing CPUs and chipsets. The high density of the copper blocks provides an excellent draw of thermal peaks allowing the cooling solution to dissipate the excess energy.

Flexible thermal gap pads that provide good thermal conductivity are used to offset mechanical tolerance. The tolerances occur during the manufacturing of the heatspreader and the mounting of parts on the COMs.

The efficient thermal conductive properties of the entire thermal stack depends on the gap between the COM and the heatspreader, the material used in the individual components and the thickness of the compressible thermal pads and copper block. Due to the fact that compressible thermal pads are only available in certain strength levels, it is difficult to find the correct combination of copper block and thermal gap pad for the tolerances to be compensated for.

A thermal image of a Compact COM Express module without any additional cooling (figure 5) provides a clear illustration of the distribution of heat that a heatspreader can achieve over a relatively large area. For lower performance COMs, the use of a heatspreader without any further cooling connection is often sufficient.

However, if high performance CPUs are used an additional thermal connection to the heatspreader is definitely required.

In most cases the heatspreader and an additional thermal gap pad are attached to a metal casing to offset mechanical tolerance. The metal casing functions as a cooling device. This marked increase in available surface for the purposes of dispensing heat enables even relatively resource-intensive processors to passively maintain appropriate operating temperatures.

The heatspreader is also useful at unusually low temperatures. By adding a heating film to the heatspreader, the COM can be warmed up. A regulator in the system switches on the heating during particularly cold boots and the system itself is only started after a suitable temperature has been attained. The simplest type of such a regulator is an analog switch with a threshold monitor.

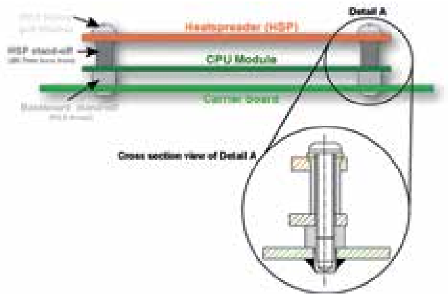


Figure 2: Top-mounted heatspreader

Thermal Stacks

The above described "thermal stacks" can also be used separately without a heatspreader. It is distinguished from a heatspreader by its lack of a thermal conductive surface. This also reduces differences in temperature.

The disadvantage here is its slightly more complex construction. When using heatspreaders, the customer receives a pre-mounted heatspreader (thermal stack + aluminum plate). The heatspreader only has to be attached to the COM via screws. The customer then has the entire heatspreader surface available as a connector to a cooling solution. With thermal stacks the customer needs to plan the mounting of the thermal stacks and the connection to the COM and cooling solution.

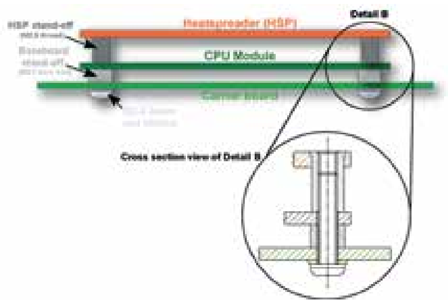


Figure 3: Back-mounted heatspreader

Active and passive standard cooling solutions

Compared with previous sandwich-type constructions for heatspreaders and cooling systems, active and passive cooling solutions remove one layer from the process. The heat spreader and cooler are manufactured as one unit, which enables them to provide faster thermal conduction.

For an active cooling solution, a high performance quiet fan has been integrated within the cooling fins.

Whether a COM can be utilized in a customer application with the associated active or passive cooling systems depends on a number of factors. They include environmental temperature, the workload of the COM and particular MTBF requirements. The customer themselves must validate each cooling system for a specific application.

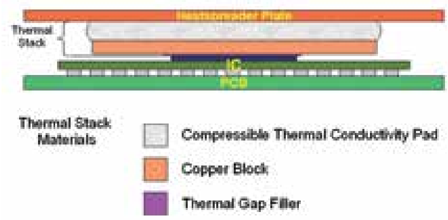


Figure 4: Construction detail of a thermal stack

Thermal concept

The validity of a thermal concept can be obtained using a simulation model of the complete system. An initial thermal concept can in most cases be estimated with the help of a few parameters.

The following initial conditions must be established:

- Minimum and maximum environmental temperatures
- TDPs (Thermal Design Power) of the CPU and the chipset
- The use of heatspreaders, thermal stacks, active/passive standard cooling solutions or a completely new thermal concept

The following is an example of the development of a thermal concept with a heatspreader.

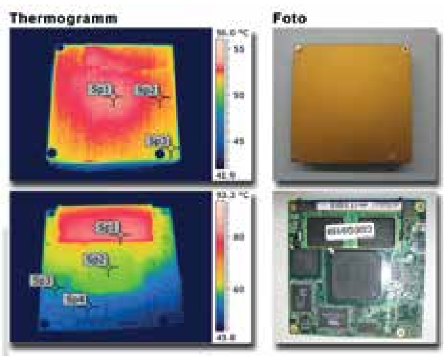


Figure 5: Thermal image of a heatspreader without additional cooling. The distribution of the point-shaped heat sources is clearly visible.

The CPU and chipset used for the sample calculation in Figure 7 have a combined TDP of 25.3 Watts. These Thermal Design Power specifications are "worst case" scenarios. Since it uses a heatspreader, the upper limit for the surface temperature of the thermal concept is 60°C. The maximum environmental temperature is set at 40°C.

With these details the maximum thermal resistance required by the cooling system can now be determined in order to stay below a heat spreader surface temperature of 60°C: An appropriate type of cooling unit can now be selected. For the purposes of selection, it is important to consider construction height, the mechanical orientation of the COM and the ability to mount fans. The configuration of cooling blades for the aeration of the system is also important.

Thermal simulation

In order to gain a precise impression of temperature distribution within a system before the construction of a prototype, it is possible to conduct a simulation. The example in figure 8 was produced with the following marginal conditions:

- Horizontal construction of the COM
- Free circulation of air, no forced aeration
- Orientation of the cooling fins down the length of the COM
- Material for the cooling unit: aluminum
- "Worst case" scenario TDPs of the chips are used for power loss
- An extra memory module with 1.25 Watts power loss is factored in as a hotspot
- For the sake of simplification, an additional power loss of 3 Watts was distributed across the entire circuit board

Figure 8 shows the results of this simulation. The speed of circulating air and temperature distribution can be clearly seen.

The simulation is also able to vary individual parameters to, e.g. determine the optimum height of a cooling unit or the best distance between the cooling fins.

The construction of the cooling device can now be optimized with the help of the thermal simulation. This is achieved by using Flomerics's Flotherm simulation software to adjust the variable properties of the cooling device to the requirements. (Figure 8)

All of the cooling solutions discussed here are adapted for all congatec embedded computer modules based on the COM Express, XTX and ETX standards. For COM Express and XTX modules a temperature-dependent fan control feature is offered.

A clearly defined cooling concept is an important foundation for the ideal design of a system. The currently available options provide simple and cost effective solutions for all application areas.

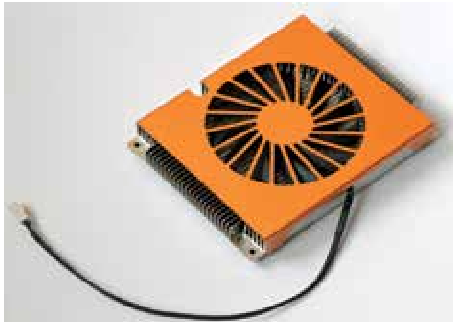


Figure 6: Active cooling solution for COM Express module with more than 35 Watt power loss

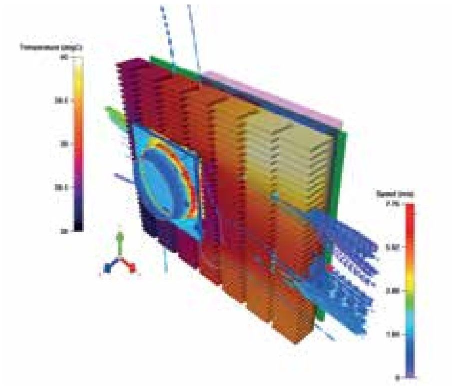


Figure 8: Simulation results (Flotherm by the Flomerics company)

$$R_{thCS} = \frac{(\vartheta_{HSP}\ max - \vartheta_{amb}\ max)}{\sum TDP} = \frac{(60\,°C - 40\,°C)}{(25{,}3\,W)} = 0{,}79\,\frac{K}{W}$$

Figure 7: Formula to determine dimensions of a cooling device

Summary

The Computer-On-Modules (COMs) products i.e. COM Express or Qseven define standardized cooling interfaces to allow for maximum flexibility. When deciding for a COMs supplier it's also important to have a close look to the offered cooling solutions. Proper cooling is key for reliable operation.

Qseven Cooling

The Qseven specification defines a heatspreader as a standardized cooling interface. congatec offers module specific implementations of heatspreaders.

Setup of all Qseven heatspreaders and cooling solutions:

- Phase change foil reduces to compensate gaps between the dies and the copper block.
- Copper block to handle the heat transfer. The copper block is fixed by a central pin in order to allow movements only in the height dimension.
- Gap pad material between the copper block and the heatspreader/cooling solution to compensate for the height tolerances and to provide proper mechanical pressure to the dies.

Heatspreader

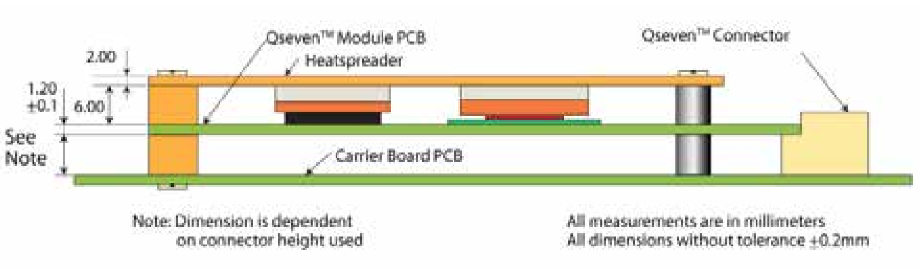
Heatspreaders are compliant to the Qseven specification and are shipped with mounting screws (2x M2.5 x 5mm, 2x M2.5 x 14mm). Heatspreaders are a thermal interface and need to be conducted to other system cooling parts, i.e. metal housing.

Cooling Solutions

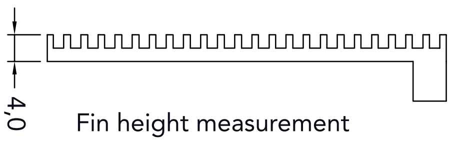
Cooling solutions have fins and are not intended for conduction cooling. Depending on the CPUs power consumption, the system solution has to provide a certain amount of air flow. This must be defined and tested during the system design. The stated fin height includes the thickness of the base.

Mounting

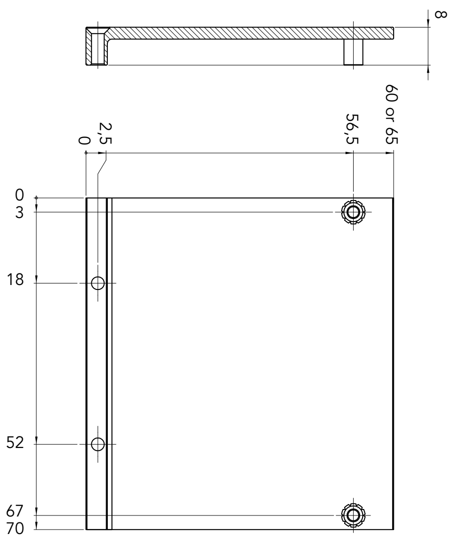
- Top mounting versions have 2.7 mm **b**ore hole standoffs (xx/xx-xx-**B**)
- Bottom mounting versions have 2.5 mm **t**hreaded standoffs (xx/xx-xx-**T**)



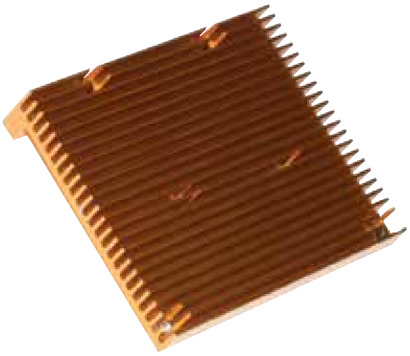
Installed Qseven heatspreader, top mounting (bore hole version)



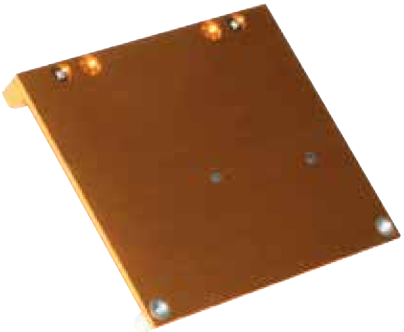
The specified fin height include the base material.



Maximum size of a Qseven heatspreader



Qseven cooling solution



Qseven heatspreader

Qseven heatspreader copper blocks

Pin avoids sliding of the copper block

Module	Reference	Art.-No.	Type	Mounting	Fin Height	Size	Note
conga-QA3	QA3/HSP-T	015190	Heat Spreader	Bottom	Flat	70x65mm	Orange anodized
conga-QA3	QA/HSP-B	015191	Heat Spreader	Top	Flat	70x65mm	Orange anodized
conga-QA3	QA/CSP-T	015192	Cooling Solution	Bottom		70x65mm	Orange anodized
conga-QA3	QA/CSP-B	015193	Cooling Solution	Top		70x65mm	Orange anodized
conga-QA6	QA6/HSP-B	015060	Heat Spreader	Top	Flat	70x60mm	Orange anodized
conga-QA6	QA6/HSP-T	015061	Heat Spreader	Bottom	Flat	70x60mm	Orange anodized
conga-QA6	QA6/CSP-B	015062	Cooling Solution	Top	4 mm	70x60mm	Orange anodized
conga-QAF	QAF/HSP-B	015330	Heat Spreader	Top	Flat	70x60mm	Orange anodized
conga-QAF	QAF/HSP-T	015331	Heat Spreader	Bottom	Flat	70x60mm	Orange anodized
conga-QAF	QAF/CSP-B 6mm	015332	Cooling Solution	Top	6 mm	70x60mm	Orange anodized
conga-QMX6	QMX6/HSP1	016160	Heat Spreader	Top	Flat	70x65mm	For Dual/Quad core industrial (lidded FCBGA)
conga-QMX6	QMX6/HSP2	016161	Heat Spreader	Top	Flat	70x65mm	For Solo/Dual Lite all variants (MAP BGA)
conga-QMX6	QMX6/HSP3	016162	Heat Spreader	Top	Flat	70x65mm	For Dual/Quad core commercial (open FCBGA)

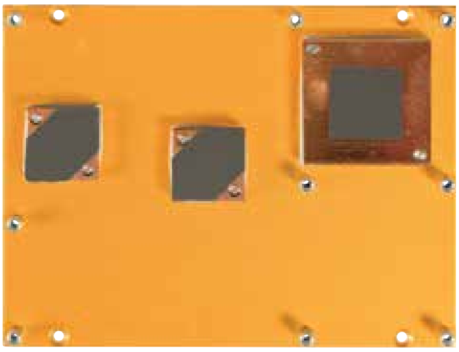
COM Express® Cooling

Setup of COM Express heatspreaders and cooling solutions: Standard

The COM Express modules with low power consumption use this setup:

- Phase change foil compresses to compensate for gaps between the dies and the copper block.
- Copper block to handle the heat transfer. This block is fixed with two pins to allow movement only in the height dimensions.
- Gap pad material between the copper block and the heatspreader/cooling solution to compensate for the height tolerances and to provide proper mechanical pressure to the dies.

Standard Heatspreader



Heatspreader with standard technology with fixing pins to avoid copper block sliding

Heat Pipe

High performance COM Express modules use this setup:

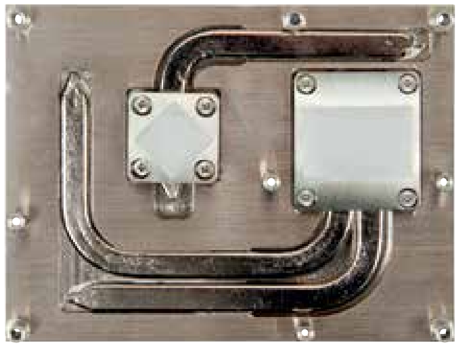
- Phase change foil compresses to compensate for gaps between the dies and the copper block.
- Copper block to handle the heat transfer. This block is fixed by four spring loaded screws that allow movements only in height and to provide the correct mechanical pressure to the dies.
- The copper blocks are mounted to flat heat pipes. These pipes provide a fast transport of the heat from the copper block to the base plate of the heatspreader or cooling solution.

The used heat pipes are filled with a minimum amount of water. The air is evacuated in order to reach a vacuum environment. This enables the liquid-vapor phase change (boiling/evaporation and condensation) at room temperature.

The water will freeze at minus temperatures but this will cause no damage to the heat pipes. Once the CPU and Chipset are powered on and starting to generate heat the water will melt within a few seconds and the heat transmission will work again.

The congatec patented heat pipe based heatspreaders and cooling solutions provide major improvements for computing performance because the thermal based Intel® Turboboost feature can be utilized to a higher extent. With lower chip temperatures, the lifetime of the computing solution can be improved by up to x8.

Heat Pipe Heatspreader



Heatspreader with heat pipe technology for high reliability and computing performance

Flat Pipe

Medium to high performance COM Express modules use this setup:

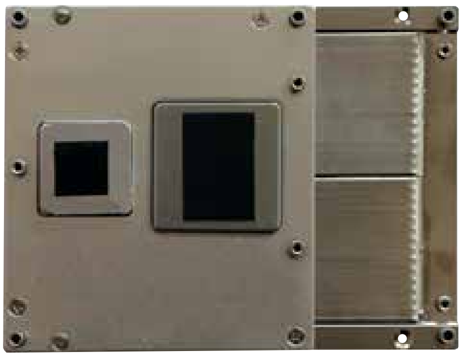
Phase change foil compresses to compensate for gaps between the dies and the copper block.

- Copper block to handle the heat transfer.
- Gap pad material between the copper block and the base plate of the heatspreader/cooling solution to compensate for the height tolerances and to provide proper mechanical pressure to the dies.
- Base plate with integrated flat heat pipes all over the plate area. This distributes the heat from the copper blocks quickly to the complete surface of the heatspreader/cooling solution.

The used flat pipes are filled with a minimum amount of acetone. The air is evacuated in order to reach a vacuum environment. This enables the liquid-vapor phase change (boiling/evaporation and condensation) at room temperature.

In contrast to the heat pipe concept mentioned earlier, the flat pipe transmits the heat in a point-to-point way, the heat spreading itself is performed by the passive aluminum base plate. The flat pipe concept transmits the heat all over the base plate. congatec patented flat pipe heatspreaders and cooling solutions are even more efficient than heat pipe versions.

Flat Pipe Heat Spreader



Heatspreader with flat pipe technology for enhanced heat distribution

Heatspreader

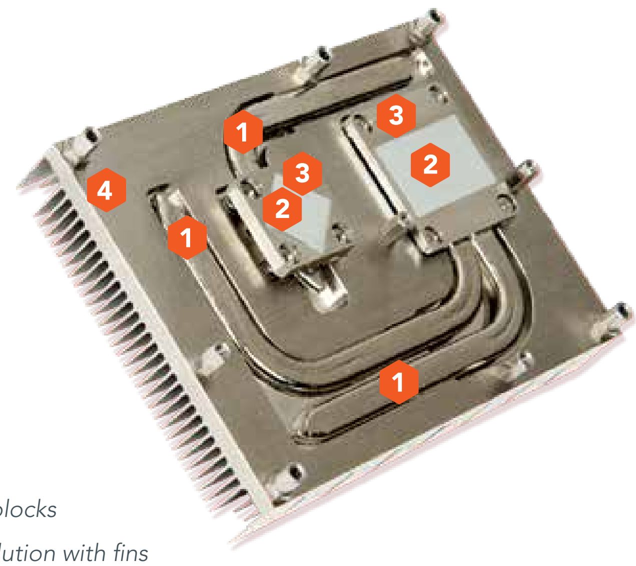
Heatspreaders are compliant to the COM Express 2.1 specification and are shipped with mounting screws. Heat spreaders need to be conducted to other system cooling parts i.e. metal housing. The heat spreader is delivered with mounting material (screws and washer). The longer screws mount the module to the carrier board. There is one addition, short screw to fix the heat spreader to the module. This allows to generate prepared mounting bundles containing module, memory and heat spreader.

Cooling Solutions

Cooling solutions have fins and are not intended for conduction cooling. The stated fin height included the thickness of the base.

Mounting

– Top mounting versions have 2.7 mm **b**ore hole standoffs (xx/xx-xx-**B**)
– Bottom mounting versions have 2.5 mm **t**hreaded standoffs (xx/xx-xx-**T**)



1 *Heat pipes*

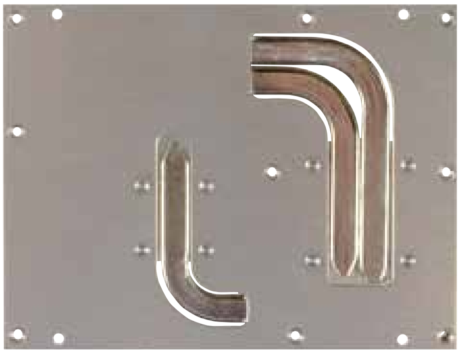
2 *Phase change material*

3 *Spring loaded copper blocks*

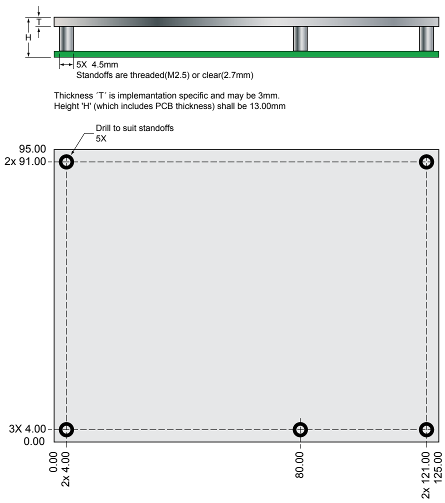
4 *Single block cooling solution with fins*

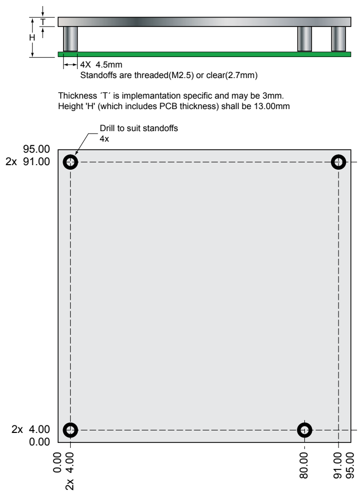
Cooling Solution with heat pipe technology

Active cooling solution with large fan for quiet operation and installed fan shield



Top view of a heat pipe heatspreader

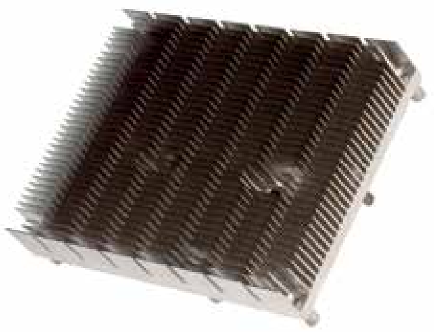
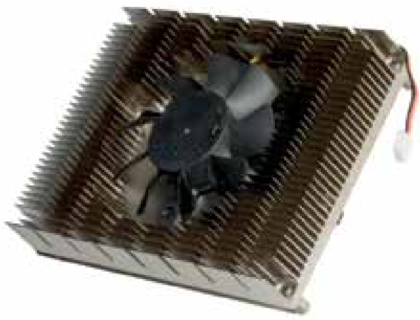




Included mounting material

COM Express® Type 2 Cooling

Module	Reference	Art.-No.	Type	Technology	Mounting	Fin Height	Note
conga-BAF	BAF/CSP-B	041025	Cooling Solution	Standard	Top	12 mm	Passive
conga-BAF	BAF/CSP-T	041026	Cooling Solution	Standard	Bottom	12 mm	Passive
conga-BAF	BAF/CSP-B	041027	Cooling Solution	Standard	Top	12 mm	Passive
conga-BAF	BAF/CSP-T	041028	Cooling Solution	Standard	Bottom	12 mm	Passive
conga-BAF	BAF/HSP-B	041020	Heat Spreader	Standard	Top		
conga-BAF	BAF/HSP-T	041021	Heat Spreader	Standard	Bottom		
conga-BM57	BM57/CSA-HP-B	046024	Cooling solution	Heat Pipe	Top	20 mm	Nickel plated, Fan 12V 3Pin
conga-BM57	BM57/CSA-HP-T	046025	Cooling Solution	Heat Pipe	Bottom	20 mm	Nickel plated, Fan 12V 3Pin
conga-BM57	BM57/CSP-HP-B	046022	Cooling Solution	Heat Pipe	Top	20 mm	Nickel plated, Passive
conga-BM57	BM57/CSP-HP-T	046023	Cooling Solution	Heat Pipe	Bottom	20 mm	Nickel plated, Passive
conga-BM57	BM57/HSP-HP-B	046020	Heat Spreader	Heat Pipe	Top		Nickel plated
conga-BM57	BM57/HSP-HP-T	046021	Heat Spreader	Heat Pipe	Bottom		Nickel plated
conga-BM67	BM67/CSA-HP-B	046124	Cooling Solution	Heat Pipe	Top	20 mm	Nickel plated, Fan 12V 3Pin
conga-BM67	BM67/CSA-HP-T	046125	Cooling Solution	Heat Pipe	Bottom	20 mm	Nickel plated, Fan 12V 3Pin
conga-BM67	BM67/CSP-HP-B	046122	Cooling Solution	Heat Pipe	Top	20 mm	Nickel plated, Passive
conga-BM67	BM67/CSP-HP-T	046123	Cooling Solution	Heat Pipe	Bottom	20 mm	Nickel plated, Passive
conga-BM67	BM67/HSP-HP-B	046120	Heat Spreader	Heat Pipe	Top		Nickel plated
conga-BM67	BM67/HSP-HP-T	046121	Heat Spreader	Heat Pipe	Bottom		Nickel plated
conga-BS57	BS57/CSA-HP-B	046028	Cooling Solution	Heat Pipe	Top	20 mm	Nickel plated, Fan 12V 3Pin
conga-BS57	BS57/CSA-HP-T	046029	Cooling Solution	Heat Pipe	Bottom	20 mm	Nickel plated, Fan 12V 3Pin
conga-BS57	BS57/CSP-HP-B	046026	Cooling Solution	Heat Pipe	Top	20 mm	Nickel plated, Passive
conga-BS57	BS57/CSP-HP-T	046027	Cooling Solution	Heat Pipe	Bottom	20 mm	Nickel plated, Passive
conga-BS57	BS57/HSP-HP-B	040120	Heat Spreader	Heat Pipe	Top		
conga-BS57	BS57/HSP-HP-T	040121	Heat Spreader	Heat Pipe	Bottom		
conga-BS67 / BS77 / BP77	BS67/CSA-HP-B	046174	Cooling Solution	Heat Pipe	Top	20 mm	Nickel plated, Fan 12V 3Pin
conga-BS67 / BS77 / BP77	BS67/CSA-HP-T	046175	Cooling Solution	Heat Pipe	Bottom	20 mm	Nickel plated, Fan 12V 3Pin
conga-BS67 / BS77 / BP77	BS67/CSP-HP-B	046172	Cooling Solution	Heat Pipe	Top	20 mm	Nickel plated, Passive
conga-BS67 / BS77 / BP77	BS67/CSP-HP-T	046173	Cooling Solution	Heat Pipe	Bottom	20 mm	Nickel plated, Passive
conga-BS67 / BS77 / BP77	BS67/HSP-HP-B	046170	Heat Spreader	Heat Pipe	Top		Nickel plated
conga-BS67 / BS77 / BP77	BS67/HSP-HP-T	046171	Heat Spreader	Heat Pipe	Bottom		Nickel plated
conga-CA6	CA6/HSP-B	061220	Heat Spreader	Standard	Top		
conga-CA6	CA6/HSP-T	061221	Heat Spreader	Standard	Bottom		
conga-CCA	TCA/CSP-B-HF	047035	Cooling Solution	Standard	Top	12 mm	Orange anodized, passive
conga-CCA	TCA/CSP-B-LF	047031	Cooling Solution	Standard	Top	5.5 mm	Orange anodized, passive
conga-CCA	TCA/CSP-T-HF	047034	Cooling Solution	Standard	Bottom	12 mm	Orange anodized, passive
conga-CCA	TCA/CSP-T-LF	047030	Cooling Solution	Standard	Bottom	5.5 mm	Orange anodized, passive
conga-CCA	TCA/HSP-B	047033	Heat Spreader	Standard	Top		Orange anodized
conga-CCA	TCA/HSP-T	047032	Heat Spreader	Standard	Botom		Orange anodized

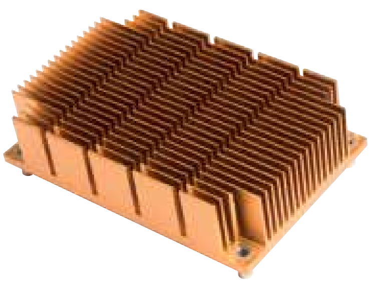
Passive and active version of a cooling solution based on heat pipe technology

COM Express® Type 6 Cooling

Module	Reference	Art.-No.	Type	Technology	Mounting	Fin Height	Note
conga-TC87	TC87/CSP-B	046951	Cooling Solution	Standard	Top	20 mm	Orange anodized, passive
conga-TC87	TC87/CSP-T	046952	Cooling Solution	Standard	Bottom	20 mm	Orange anodized, passive
conga-TC87	TC87/HSP-B	046953	Heat Spreader	Standard	Top		Orange anodized
conga-TC87	TC87/HSP-T	046954	Heat Spreader	Standard	Bottom		Orange anodized
conga-TCA	TCA/CSP-B-HF	047035	Cooling Solution	Standard	Top	12 mm	Orange anodized, passive
conga-TCA	TCA/CSP-B-LF	047031	Cooling Solution	Standard	Top	5.5 mm	Orange anodized, passive
conga-TCA	TCA/CSP-T-HF	047034	Cooling Solution	Standard	Bottom	12 mm	Orange anodized, passive
conga-TCA	TCA/CSP-T-LF	047030	Cooling Solution	Standard	Bottom	5.5 mm	Orange anodized, passive
conga-TCA	TCA/HSP-B	047033	Heat Spreader	Standard	Top		Orange anodized
conga-TCA	TCA/HSP-T	047032	Heat Spreader	Standard	Bottom		Orange anodized
conga-TCA3	TCA3/CSP-B-HF	047353	Cooling Solution	Standard	Top	20 mm	Passive, orange anodized
conga-TCA3	TCA3/CSP-T-HF	047352	Cooling Solution	Standard	Bottom	20 mm	Passive, orange anodized
conga-TCA3	TCA3/HSP-B	047351	Heat Spreader	Standard	Top		Orange anodized
conga-TCA3	TCA3/HSP-T	047350	Heat Spreader	Standard	Bottom		Orange anodized
conga-TCG	TCG/CSP-B	042053	Cooling Solution	Standard	Top	20 mm	Nickel plated, passive
conga-TCG	TCG/CSP-T	042054	Cooling Solution	Standard	Bottom	20 mm	Nickel plated, passive
conga-TCG	TCG/HSP-B	042051	Heat Spreader	Standard	Top		Nickel plated
conga-TCG	TCG/HSP-T	042052	Heat Spreader	Standard	Bottom		Nickel plated
conga-TFS	TFS/CSA-B	041154	Cooling Solution	Flat Pipes	Top	20 mm	Nickel plated, fan 12V, fan shield
conga-TFS	TFS/CSA-T	041155	Cooling Solution	Flat Pipes	Bottom	20 mm	Nickel plated, fan 12V, fan shield
conga-TFS	TFS/HSP-B	041150	Heat Spreader	Flat Pipes	Top		Nickel plated
conga-TFS	TFS/HSP-T	041151	Heat Spreader	Flat Pipes	Bottom		Nickel plated
conga-TS67	TS67/CSA-HP-B	046454	Cooling Solution	Heat Pipe	Top	20 mm	Nickel plated, fan 12V
conga-TS67	TS67/CSA-HP-T	046455	Cooling Solution	Heat Pipe	Bottom	20 mm	Nickel plated, fan 12V
conga-TS67	TS67/CSP-HP-B	046452	Cooling Solution	Heat Pipe	Top	20 mm	Nickel plated, passive
conga-TS67	TS67/CSP-HP-T	046453	Cooling Solution	Heat Pipe	Bottom	20 mm	Nickel plated, passive
conga-TS67	TS67/HSP-HP-B	046450	Heat Spreader	Heat Pipe	Top		Nickel plated
conga-TS67	TS67/HSP-HP-T	046451	Heat Spreader	Heat Pipe	Bottom		Nickel plated
conga-TS87	TS87/CSA-FP-B	046853	Cooling Solution	Flat Pipes	Top	20 mm	Nickel plated, passive
conga-TS87	TS87/CSA-FP-T	046854	Cooling Solution	Flat Pipes	Bottom	20 mm	Nickel plated, passive
conga-TS87	TS87/CSP-FP-B	046855	Cooling Solution	Flat Pipes	Top	20 mm	Nickel plated, passive
conga-TS87	TS87/CSP-FP-T	046856	Cooling Solution	Flat Pipes	Bottom	20 mm	Nickel plated, passive
conga-TS87	TS87/HSP-FP-B	046851	Heat Spreader	Flat Pipes	Top		Nickel plated
conga-TS87	TS87/HSP-FP-T	046852	Heat Spreader	Flat Pipes	Bottom		Nickel plated

COM Express® Type 10 Cooling

Module	Reference	Art.-No.	Type	Technology	Mounting	Fin Height	Note
conga-MA3 / MA3E	MA30/CSP-B	047453	Cooling Solution	Standard	Top	20 mm	Orange anodized, passive
conga-MA3 / MA3E	MA30/CSP-T	047452	Cooling Solution	Standard	Bottom	20 mm	Orange anodized, passive
conga-MA3 / MA3E	MA30/HSP-B	047451	Heat Spreader	Standard	Top		Orange anodized
conga-MA3 / MA3E	MA30/HSP-T	047450	Heat Spreader	Standard	Bottom		Orange anodized



Cooling solution and heatspreader for COM Express Type 10

ETX / XTX Cooling

Setup of all ETX and XTX heatspreaders and cooling solutions:

– Phase change foil compresses to compensate for gaps between the dies and the copper block
– Copper block to handle the heat transfer.
– Gap pad material between the copper block and the heatspreader/cooling solution to compensate for the height tolerances and to provide proper mechanical pressure to the dies

Heatspreader

Heatspreaders are compliant to the ETX 3.0 / XTX 1.2 specification and are shipped with mounting screws. Heatspreaders need to be conducted to other system cooling parts, i.e. metal housing. The heatspreader is delivered with mounting material. The longer screws mount the module to the carrier board. The shorter screw fixes the heat spreader to the module. This provides the ability to generate prepared assemblies containing module, memory and heatspreader.

Cooling Solutions

Cooling solutions have fins and are not intended for conduction cooling. The stated fin height includes the thickness of the base.

Mounting

– Top mounting versions have 2.7 mm bore hole standoffs
– Bottom mounting versions have 2.5 mm threaded standoffs

Module		Reference	Art.-No.	Type	Mounting	Fin Height	Note
conga-ELX	conga-ELXeco	ELX/DD-HSP-B	045458	Heat Spreader	Top	Flat	Deep drawn Stamped (no copper block) Orange anodized
conga-ELX	conga-ELXeco	ELX/DD-HSP-T	066558	Heat Spreader	Bottom	Flat	Deep Drawn Stamped (no copper block) Orange anodized
conga-XLX		XLX/HSP-B	074215	Heat Spreader	Top	Flat	Orange anodized
conga-XLX		XLX/HSP-T	057821	Heat Spreader	Bottom	Flat	Orange anodized
conga-XAF	conga-EAF	XAF/CSA-B	041057	Cooling Solution	Top		Black anodized Integrated 50 mm fan 12V, 3 pin
conga-XAF	conga-EAF	XAF/CSA-T	041058	Cooling Solution	Bottom		Black anodized Integrated 50 mm fan 12V, 3 pin
conga-XAF	conga-EAF	XAF/CSP-B	041055	Cooling Solution	Top		Passive, black anodized
conga-XAF	conga-EAF	XAF/CSP-T	041056	Cooling Solution	Bottom		Passive, black anodized
conga-XAF	conga-EAF	XAF/HSP-B	041050	Heat Spreader	Top	Flat	Orange anodized
conga-XAF	conga-EAF	XAF/HSP-T	041051	Heat Spreader	Bottom	Flat	Orange anodized

congatec COMs and SBCs

COM Express® Type 10 (Size 84x55mm)

conga-MA3	3rd Gen Intel® Atom™ processors
conga-MA3E	3rd Gen Intel® Atom™ processors with ECC protected memory up to 8 GByte

COM Express® Type 6 has USB 3.0, DDI and more PCIe lanes

Basic (Size 125x95mm)

conga-TS87	4th Gen Intel® Core™ processors
conga-TS77	3rd Gen Intel® Core™ processors
conga-TS67	2nd Gen Intel® Core™ processors
conga-TFS	AMD Embedded R-Series processors

Compact (Size 95x95mm)

conga-TCA3*	3rd Gen Intel® Atom™ processors
conga-TC97	5th Gen Intel® Core™ processors
conga-TC87	4th Gen Intel® Core™ processors
conga-TCA	2nd Gen Intel® Atom™ processors
conga-TCG	AMD Embedded G-Series SOC

COM Express® Type 2 has PCI Bus, IDE and SDVO but no USB 3.0

Basic (Size 125x95mm)

conga-BS77	3rd Gen Intel® Core™ processors
conga-BP77	3rd Gen Intel® Core™ processors with ECC support
conga-BM67	2nd Gen Intel® Core™ processors (socket version)
conga-BS67	2nd Gen Intel® Core™ processors
conga-BM57	1st Gen Intel® Core™ processors (socket version)
conga-BS57	1st Gen Intel® Core™ processors
conga-BAF	AMD G-Series processors

Compact (Size 95x95mm)

conga-CCA	2nd Gen Intel® Atom™ processors
conga-CA6*	Intel® Atom™ E600 processors

*Optional industrial temperature range: Operating -40 to 85°C

Mini-ITX (Size 170x170mm)

conga-IGX	AMD Embedded GX-Series processors
conga-IA3	3rd Gen Intel® Atom™ processors
conga-IC87	4th Gen Intel® Core™ processors
conga-IC97	5th Gen Intel® Core™ processors

Pico-ITX (Size 100x72mm)

conga-PA3	3th Gen Intel® Atom™ processors

Qseven® (Size 70x70mm)

conga-QA3*	3rd Gen Intel® Atom™ processors
conga-QA6*	Intel® Atom™ E600 processors
conga-QAF	AMD G-Series processors
conga-QG	AMD GX-Series processors
conga-QMX6	Freescale® i.MX6 ARM processors

XTX™ (Size 114x95mm)

conga-XAF	AMD Fusion G-Series processors
conga-XLX	AMD Geode LX800 processors

ETX® (Size 114x95mm)

conga-EAF	AMD Fusion G-Series processors
conga-ELX	AMD Geode LX800 processors
conga-ELXeco	AMD Geode LX800 processors - eco version

Rev. March 9, 2015 MR

congatec

Headquarters

congatec AG

Auwiesenstraße 5
94469 Deggendorf
Germany

Phone +49 (991) 2700-0
Fax +49 (991) 2700-111

info@congatec.com
www.congatec.com

Subsidiaries

congatec Asia Ltd.

14F-2, No. 270, Sec 4,
Zhongxiao E. Rd.
106 Taipei City, Taiwan

Phone +886 (2) 2775-4645
Fax +886 (2) 2775-3263

sales-asia@congatec.com
www.congatec.tw

congatec, Inc.

6262 Ferris Square
San Diego
CA 92121 USA

Phone +1 (858) 457-2600
Fax +1 (858) 457-2602

sales-us@congatec.com
www.congatec.us

congatec Japan K.K.

Shiodome building 301,
Minato-ku Hamamatsucho 1-2-7,
105-0013 Tokyo-to, Japan

Phone +81 3 (6435) 925-0
Fax +81 3 (6435) 925-1

sales-jp@congatec.com
www.congatec.jp

congatec Australia Pty Ltd.

Unit 2, 62 Township Drive
West Burleigh
Queensland 4219, Australia

Phone +61 (7) 55200-841

sales-au@congatec.com
www.congatec.com.au

congatec China Technology Ltd.

Sunyoung Center, 901 Building B,
No. 28 Xuanhua Road, Changning District,
Shanghai 200050, China

Phone +86 (21) 6025-5862
Fax +86 (21) 60256561

sales-asia@congatec.com
www.congatec.cn