

Rugged COM Express - a standard for harsh environments

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Modular designs based on VITA's Rugged COM Express standard are the first choice for the latest processor technology in the most rugged of applications.



Rugged COM Express design based on AMD Ryzen Embedded processor

■ All embedded electronics designs are subject to hard limiting factors depending on the required computing power and the area of application. One such factor is the maximum permissible dissipation. New CPU series, such as the AMD Ryzen Embedded V1000 series or the 8th generation of Intel Core processors, have a TDP (Thermal Design Power) between 12 and 56 watts. If developers want to exploit their full potential on a COM Express module, they are above a critical TDP limit. Under those circumstances, conventional COM Express designs can only be realized with active cooling concepts. Many developers are therefore under the conception that fanless designs are only possible up to a maximum of 25 watts. But the embedded markets also require rugged systems with fanless operation above this limit. Rugged COM Express has been designed to meet these needs and offers, besides better heat dissipation, numerous advantages for operation in harsh environments. The foundation for this is standardization.

COMs offer many advantages. They combine the ready availability of CPU modules with flexibility of full custom designs. Buying in the complex parts of the circuit technology (CPU, memory, core voltage regulator) significantly lowers development costs (by about 50%). The exchangeability of COMs provides

easy retrofit and scaling options even across different processor architectures and vendors. Safety-critical applications with long product development and lifecycles and high certification requirements benefit from easy upgradeability with new standardized modules. When replacing the computer unit of a certified end system, requalification in modular systems is largely limited to the part of the system that is related to the new module.

The leading standard among Computer-on-Modules is COM Express. Specified by the PCI Industrial Computer Manufacturers Group, PICMG for short, it is hard to imagine the embedded world without it – from ultra-compact low-power designs based on single/dual or quad core ARM or Intel Atom CPUs to high-performance computers in basic format based on server CPUs with 16 or more cores. With the large number of manufacturers of COMs, carrier boards and development kits, COM Express has the most comprehensive ecosystem in the Computer-on-Module world. The wide distribution ensures a balanced price/performance ratio for products and services as well as the long-term availability of the standard, as it is supported by many companies. Some applications demand a highly rugged computing system. Since the COM Express specification does not consider harmful influences, such as mechanical shock,

strong vibration, rapid temperature fluctuations, moisture or electromagnetic radiation, it was expanded to include the Rugged COM Express specification (VITA 59). On the basis of VITA 59 it is possible to realize high-performance Rugged COM Express (RCE) modules with completely fanless cooling at a TDP of 55 watts.

Based on the COM Express standard, RCE modules provide everything that COM Express modules offer. The VITA 59 specification extends the printed circuit board (PCB) of the modules with additional side wings for embedding in a standardized aluminum frame (CCA) to establish optimal thermal connection. This precisely specified frame ensures that the hot spots (CPU, memory and voltage transformers) are cooled. In addition, heat is dissipated via the PCB towards the frame. From there, any waste heat can be transported by conduction directly to the surrounding housing to be then dissipated by convection to the environment via cooling fins.

These measures lower the assembly's thermal resistance to the housing. Compared to a standard COM Express heat sink, this can reduce temperature rises of electronic components by up to 5°C. The lower thermal load on the components leads to fewer failures and main-

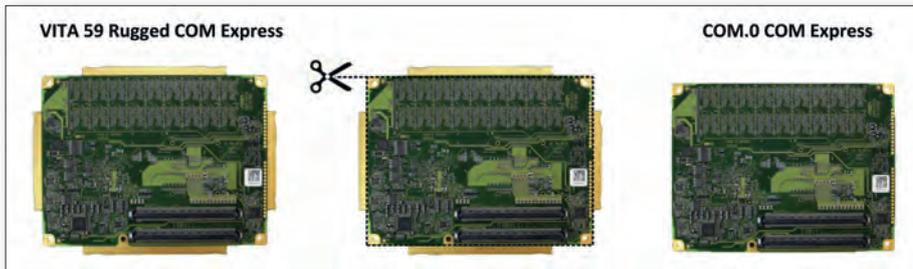


Figure 1. From Rugged COM Express to standard COM Express. If the wings on the four outer edges are omitted, the two standards have the same form factor.

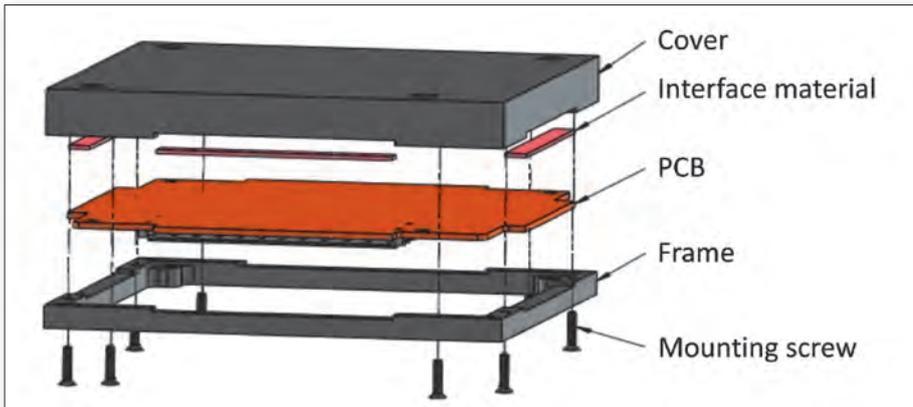


Figure 2. Mechanical design of VITA 59-compliant Rugged COM Express modules

tenance calls, thereby improving the reliability of RCE modules over traditional COM Express designs. Since the entire concept has been standardized by VITA, RCEs are fully manufacturer-independent as well as future-proof, and it is possible to change a module together with its standardized aluminum frame at any time.

RCE modules are more robust in other respects, too. The aluminum housing means they are well shielded and highly immune to electromagnetic radiation. Additionally, the modules come with a protective varnish as standard. This conformal coating offers effective protection against environmental influences such as dust, moisture or even chemicals. The VITA 59 standard has its origins in the railway sector, which means that the cooling concept also fulfills the requirements of EN 50155. Here, one of the biggest challenges is to cope with the sudden high temperature fluctuations or thermal shocks that occur when a train enters a cool tunnel in a hot and humid climate and the cooling air temperature changes abruptly by up to 20°C. With conventional COMs, the thermal stress leads to failures due to cracked solder joints in the medium term. So-called underfilling is therefore applied to bond critical components to the circuit board and increase robustness against sudden temperature changes. In addition, firmly screwing the frame to the carrier board ensures particularly high resistance to mechanical shocks and vibration. Amplitudes of up to 5G for vibration and even up to 50G

for shocks are realistic, making the modules even suitable for use in off-road vehicles.

All these features make Rugged COM Express the ideal standard for ultra-reliable high-performance computers in conjunction with adverse environmental conditions, such as those found in wind farms and electrical distribution stations or in road, commercial and rail vehicle applications. By using RCE modules, the manufacturers of medical devices benefit from high computing power in completely enclosed designs, which are hygienic and easy to disinfect. These requirements are similar to those found in the food and pharmaceutical industries, because if required fanless systems can even be washed down with a high pressure cleaner. ■