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Industrial PC

Fanless ultra-compact industrial PC C6025 with Intel® Core™ i-series processors

Ultra-Compact Industrial PC C6025

Beckhoff is known for its wide range of PC-based automation components and solutions for industrial use. Fanless C6025 is part of a family of ultra-small and ultra-powerful industrial PCs from Beckhoff. These industrial PCs are used to control machines or equipment or to visualize information in production environments with demanding operating conditions in terms of dust contamination, temperature, humidity, vibration and electromagnetic interference.

With a robust metal-housing combining aluminium and zinc, and without any rotating parts, C6025 is designed for persistent life span. High-quality components based on open standards and individual design of housings mean that these industrial PCs are ideally equipped for all control requirements in a non-office type application. These ultra-compact devices make modular industrial PC technology available in a miniature format for installation on standardized DIN rails or mounting plates. The fact that Beckhoff develops and produces state-of-the-art motherboards in-house enables the company to respond quickly to latest technological trends on the PC market and also to customer-specific requirements. Typical applications of ultra-compact C6025 IPC involve small space requirements, universal applicability and flexible installa-

tion as well as highest performance requirements. Inside the housing of C6025 is a special compact motherboard with dimensions of 120 x 75 mm, which integrates Intel® Celeron® or Intel® Core™ i-series processors to provide ample computing power and maximum performance with up to four processor cores. It is equipped with three LAN interfaces, four USB 3.0 ports and one DisplayPort. The motherboard CB7268 of this ultra-compact industrial PC integrates CPU, memory and graphics adapter in a one chip package.

The family of ultra-compact C60xx IPCs offers a wide and scalable range of industrial PCs that can be perfectly adapted to all kinds of applications and use cases – from small and mid-sized applications up to highest calculation performance in a modular system.
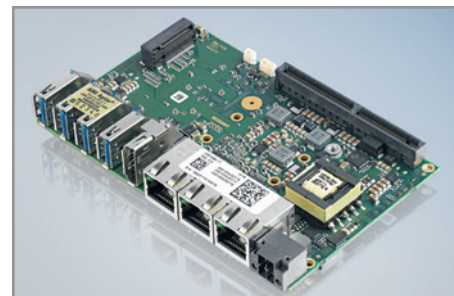
Highly integrated motherboard in robust housing

Beckhoff headquarters in Verl

Thorsten Viefhues, Senior Hardware Developer

Design Challenges

This design is completely new from scratch, because it is a new processor chip set with a different topology as it was used before. Processors with integrated CPU, memory and graphics have different pitch spacings, e.g. for power supply in the center and memory interfaces at the outside pins. "To fan out strobe signals of the DDR4 memories the differential pairs have to be routed in the center of the 17 mils gap between the pin field. We saved a lot of time using the snake routing feature of Allegro PCB Editor", said Thorsten Viefhues, Senior Hardware Developer at Beckhoff and responsible for the layout of the motherboard. In such a fan out, routing is no longer 45 degrees and all spacings have to be centered between pins with a constant spacing inside differential pairs to enable a good signal integrity.

Floor planning of this new design took nearly 2 weeks and started already while schematics were not finished. With placement of major

Dynamic phase tuning per segment

components and all connectors most of the area was covered. This placement was verified with thermal analysis and mechanical integration. After placement was finalized, the entire layout could be completed in less than 8 weeks on a 12-layer stackup.

Beckhoff internal isolated power supply for industrial PCs was reused from a library and adopted with small changes into this design. High speed serial interfaces were routed first to ensure same length at least for each byte. At signal speeds of 10 GBits for USB3.1 Gen2 and 6 GBits for SATA Gen3 and other PCIe Gen3/16 lanes, the dynamic and static phase tuning was a big challenge. For each 45 or 90 degree a length compensation has to be done following after length mismatch specification within 125 mils after the corner. This is a challenge in such a dense board and requires planning of interfaces before routing.

Using constraint regions for various areas of the design and the support from PCB Editor to calculate electrical length for inner and outer layers helps to balance all constraints within constraint tolerance. Very helpful and essential for proper relativ length matching (e.g. DDR4 DRAM interface) when routing over different layers is that z-axis delay also factors into length calculation.

Challenge for industrial PCs is that they have to be very reliable and robust in terms of EMI, signal and power integrity. There are thousands of rules that had to be observed in the design process and this can easily be managed in Allegro Constraint Manager. Real time design rule checks provide immediate feedback to the designer when there

are violations of the rules and changes can be made instantaneous.

For industrial PCs most of the constraints regarding signal and power integrity come from processor manufacturers. This information can be read into Allegro Constraint Manager and guides the designer during placement and layout routing process with real time design rule checks (DRC).

About Beckhoff

Beckhoff implements open automation systems based on PC control technology. The product range covers industrial PCs, I/O and fieldbus components, drive technology, and automation software. Products that can be used as separate components or integrated into a complete and seamless control system are available for all industries, that are used worldwide in a wide variety of different applications, ranging from CNC-controlled machine tools to intelligent building automation.
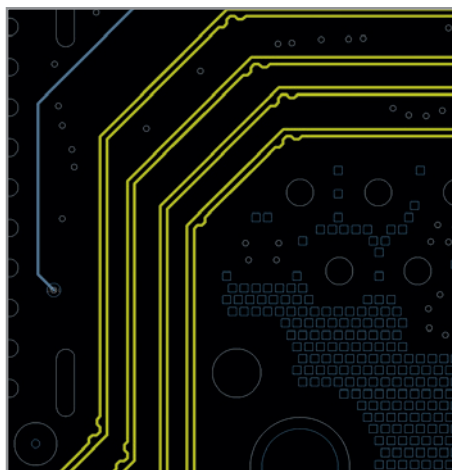www.beckhoff.com

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