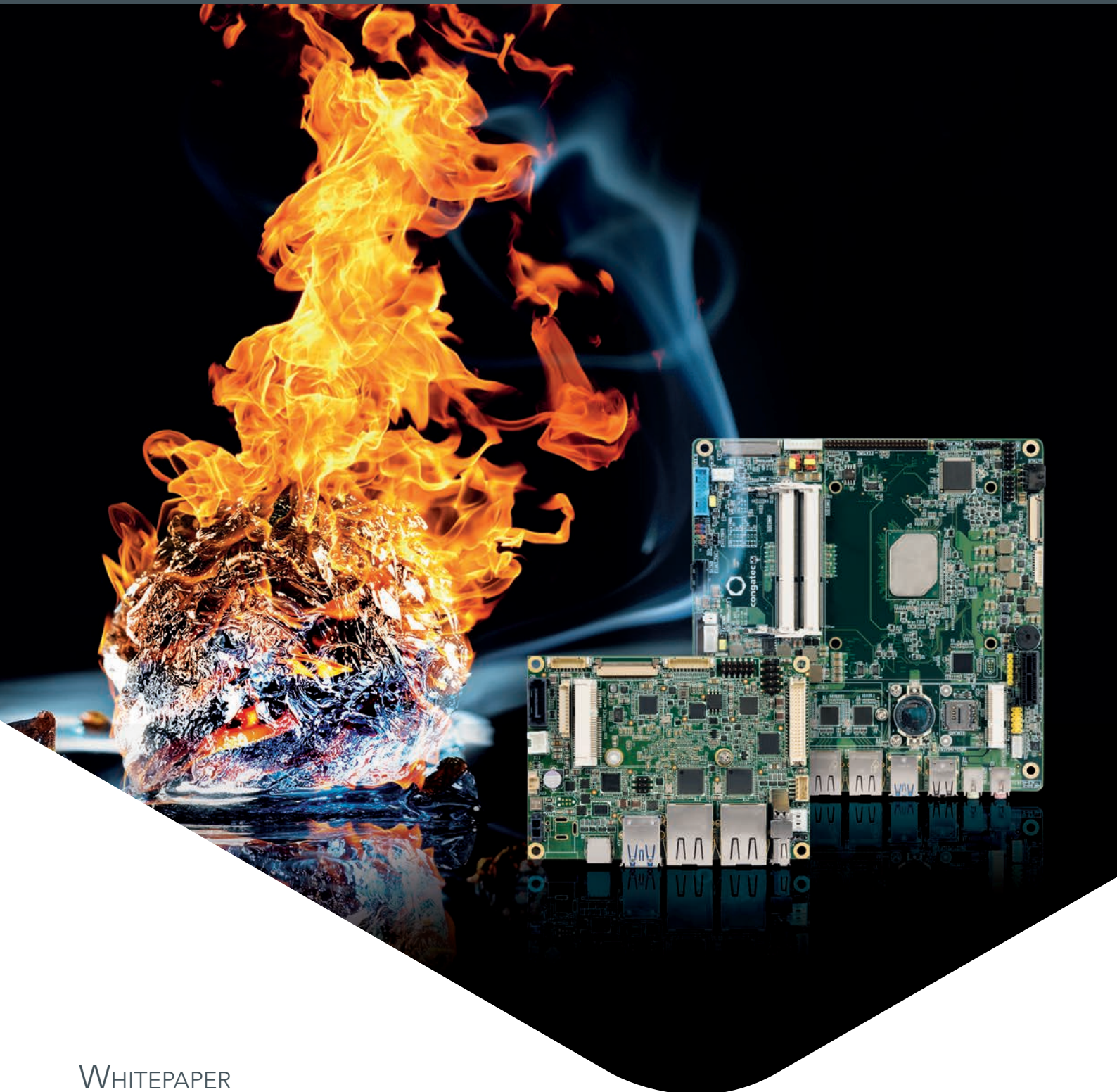congatec

The value of moving beyond commercial-grade durability

THE REAL INDUSTRIAL-GRADE MOTHERBOARD SOLUTION

The value of moving beyond commercial-grade durability

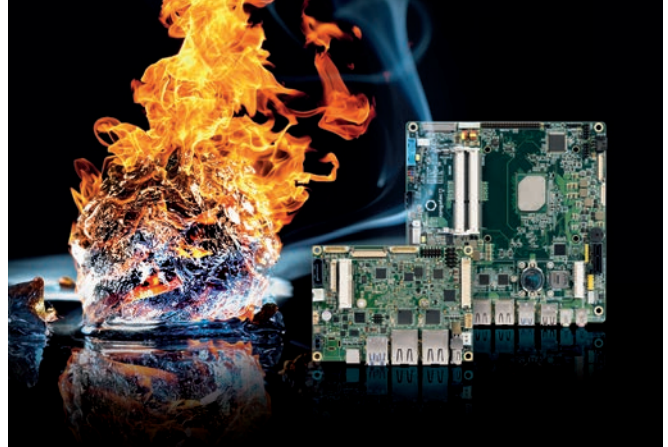## Extending commercial high durability: The Real Industrial-Grade Motherboard Solution

There are many commercial-grade motherboards available that claim to offer high durability at a low cost. When compared against true industrial-grade motherboards, the differences are clear and go far beyond promising extended services for a commercial IT environment.

By supporting the same standards, the commercial/IT and industrial markets both benefit. The ecosystem of re-usable components is larger because chip manufacturers have a larger market to target. And as a result OEMs have a broader supplier base, benefiting from lower unit prices thanks to the larger volumes. The standard specifications also ensure new components have the same footprint, meaning the investments in Non-Recurring Engineering (NRE) costs are also maximized. The Mini-ITX motherboard is one of these standards; it is suitable for a wide range of commercial and industrial applications, such as kiosks and retail systems, gaming machines and digital signage installations, as well as the shop floor and SCADA systems, HMI and GUI solutions for industrial machinery. But OEMs operating in these markets still need to evaluate the available solutions carefully.

congatec Thin Mini-ITX motherboards (170mm x 170mm) and Pico-ITX Single Board Computers (72 x 100 mm) deliver true industrial-grade quality, offering value far beyond durability in a commercial environment.

You can't compare apples with oranges

Vendors of commercial motherboards targeting the higher end of their own market are now also addressing industrial applications and promoting their products as being 'highly durable'. However, it should not be assumed that the durability referred to is comparable to the durability found in motherboards actually designed to meet the needs of the industrial market. But what is the real difference?

In commercial applications, durability will often mean that some of the components used are of a higher quality, such as solid capacitors. It may also include the addition of metal shielding around high speed interfaces such as PCIe and DDR, or the use of a copper-rich layout for ground and power planes in the PCB. While these features can increase durability, it is still only in the context of a commercial application such as a standard office or home environment, where operating temperatures never reach extremes (below 0°C or above 40°C) and well vented casings keep component temperatures below 45°C.

Built for extremes

This is very different from the industrial market's requirements, where shop floor and machinery equipment can routinely experience operating temperatures in the range of 0°C to 60°C. For equipment required to operate outside, the temperature range is even more extreme. Devices permanently or temporarily outside, as well as in-vehicle applications such as trains, busses, commercial vehicles (such as forklifts) and, increasingly, autonomous vehicles will need to withstand temperature extremes in the region of -40°C and +85°C. Can commercial motherboards function in these environments? The answer is, of course, no. Even those promoted as highly durable will still be specified with a working temperature of between 0°C and 40°C. While they may not fail immediately, it is similar to the practice of over-clocking a CPU; if more heat is generated both performance and reliability will suffer. Prolonged exposure will rapidly lead to failure of all components, from processors to controllers, voltage converters, ceramic capacitors and even connectors. If even one of these components fails the reliability of the entire board is at stake. The specified operating temperature range is a major differentiator between commercial- and industrial-grade motherboards.

Stress resistance

Operating temperatures can change rapidly; equipment can experience both hot and cold environments in a matter of moments. Imagine a forklift operating outside in winter that must also work inside next to an industrial oven, for example. If the forklift moves back and forth all of its electronic components will need to be much more hardened against temperature changes than, for example, a motherboard working in an office environment. The mechanical and thermal stress placed on the components means they must meet industrial specifications. While such components will inevitably cost more than their commercial-grade counterparts, the value they offer far exceeds the price premium. In some environments, a commercial motherboard could fail within days or weeks of being installed. Industrial-grade motherboards, on the other hand, are designed to operate 24/7 in harsh environments. Once engineers appreciate this, they will understand the fundamental difference between specifying commercial- and industrial-grade components.

While resistances against thermal stress are fundamentally influenced by the components used, there are also other factors to consider, such as vibration and shock. This is another major differentiating factor for industrial motherboards; their resistance to mechanical stress. For example, a commercial motherboard may use sockets to mount critical components such as the processor; these will often be supplied in relatively fragile packaging such as Land Grid Array (LGA). When mounted in sockets, these components become more susceptible to vibration and shock. In contrast, an industrial motherboard would typically solder nearly all critical components directly to the board, making them much less prone to the effects of shock and vibration. Reliable vendors will be able to show you all the relevant test certifications about the achieved shock and vibration tolerance levels from third party test laboratories.
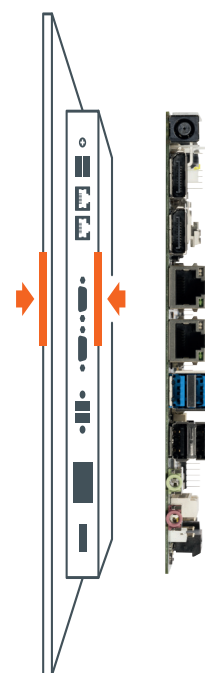
More tolerant

While commercial applications are largely identical, the demands of industrial customers can differ significantly between applications. The interface requirements of a machine GUI or HMI would be vastly different to the requirements of a computer being used in an office or home, for example. These differences start at the most fundamental level; with the power supply. Commercial motherboards are typically designed to operate from a standard ATX power supply, which are large and would

normally provide three different voltages at tolerances of around ±10%. Industrial motherboards are designed to operate in environments where only one voltage may be available, for safety or practical reasons (such as in a vehicle, for example). In these environments the power supply will normally be restricted to a single, less regulated voltage over a single cable. For this reason, industrial motherboards will often feature a more robust and voltage tolerant power supply, able to accept a single voltage in the range of 12V to 24V DC. Some industrial motherboards may also include Smart Battery Support, allowing them to be powered from a battery back-up in safety-critical applications such as medical equipment.

Slimline

congatec is one of the few global vendors of industrial-grade motherboards who put significant effort into creating truly industrial-grade Mini-ITX motherboards, with the goal of simplifying the adaption of mainstream IT technologies for an industrial environment. The company has successfully transformed a standard originally designed for consumer- and office-grade computer technology, into a form factor that can be reliably deployed in industrial applications. Although the Mini-ITX standard didn't need a major revision, it makes a huge difference if the vendor designs, manufactures and delivers a form factor with a real thoroughbred level of industrial-grade quality. As an example, the company implemented a mechanical addition by adopting the 'Thin' specification for Mini-ITX. This was launched by Intel in 2011 and defines the maximum height for the boards as just 20mm. Conforming to this specification makes the Thin Mini-ITX format well suited to space-constrained applications such as HMI terminals and GUIs for machinery. Designs based on this motherboard can be mounted directly behind displays, enabling extremely compact solutions. OEMs also benefit from cooling systems developed by congatec which also fit inside the Thin Mini-ITX envelope. This has led to

Thin Mini-ITX boards make the perfect platform for slim GUIs/HMIs and industrial panel PCs, supporting all-in-one designs that can fit within a 20mm profile.

standalone HMI designs that meet industrial-grade requirements with an overall depth of just 30mm.

Constant

Other factors should also be considered when selecting an industrial-grade motherboard. The solutions developed by congatec use components from the embedded sector, with established roadmaps and long-term availability. This is important, because it ensures the same configuration will be available for several years and not just months, as is often the case with commercial components. This also enables longer design-in phases, ensuring the documentation and certification process for equipment need only be carried out once over the product's entire lifecycle. Servicing equipment also becomes simpler, knowing that the same board configuration is available whenever spares or repairs are needed. And even if one day a component needs to be changed due to obsolescence or other critical reasons, customers will get actively informed – if they subscribe to this cost free service – so that even slightest revisions can be validated immediately and within a reasonable, stress free

time frame. The design of the PCB with more layers is also ruggedized in comparison with commercial solutions, providing improved EMI and EMC compliance.
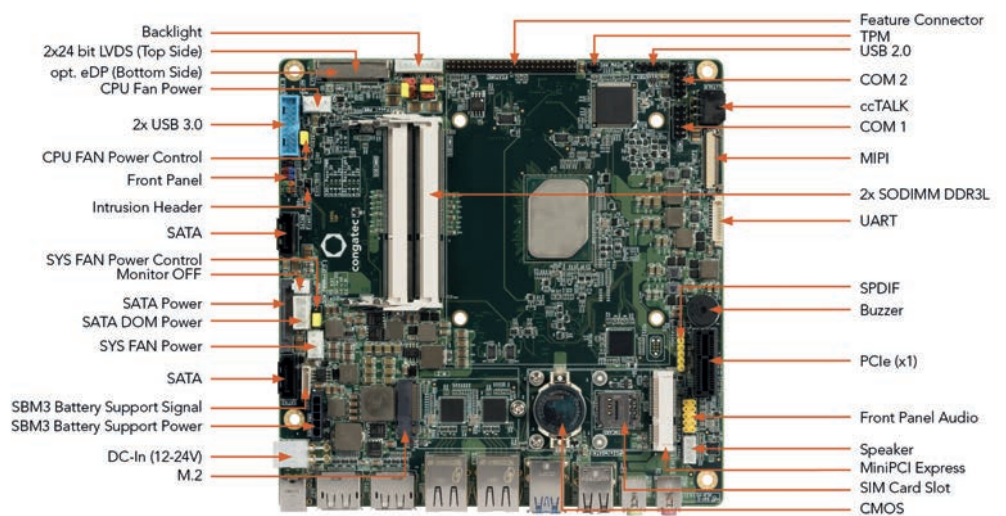
Cool

Choosing the embedded roadmaps of processors also means that industrial-grade motherboard solutions operate with low power or even ultra low power CPUs extending the durability, longevity and eco-friendliness of the entire systems due to the fact that no active fan is needed. The promised performance and endurance of this new technology will be very limited if addressed by SATA, NVMe leaves much more headroom to utilize maximum performance levels.

Transparency

As well as their long-term availability and built-in ruggedness, motherboards designed specifically for industrial applications have additional distinguishing features that further differentiate them from their commercial counterparts. For example, congatec integrates its own Board Management Controller (BMC) technology, which uses non-volatile memory to store critical data such as usage, manufacturer and board information, the BIOS and backup data. This gives OEMs detailed information that supports a professional asset management strategy for large scale deployment. A multi-stage watchdog is also included, which can be configured to restart specific applications or the entire system following any interruption in service, ensuring continuous and autonomous operation. This has proven particularly useful in distributed and unattended installations, such as vending machines. The ability to auto-restart helps minimize downtime and reduce service visits, thereby increasing customer profitability and overall satisfaction.

Flexibility

Besides the generic expansion options via PCIe and mPCIe slots, the industrial sector relies more heavily on a wider range of interfaces than the commercial domain, for peripherals and displays. The commercial sector has effectively standardized on USB, slowly but systematically phasing out other forms of interfaces. In industrial applications, however, the use of serial ports and other interfaces is still commonplace, for connecting devices such as ticket readers, coin dispensers or industrial controls. General purpose I/O is also very common, accessible through dedicated headers, allowing simple

Real industrial-grade Mini-ITX boards offer an extensive set of I/Os and extension options not normally found on commercial IT products.

switches such as tamper detection to be added easily. The ability to add intrusion detection is mandatory in gaming machines, for example, but they are also often used in ATMs and vending

machines. Alongside established interfaces including DisplayPort, HDMI and DVI, allowing several displays to be connected, it is also common for industrial motherboards to support more cost-efficient display technologies such as LCD panels, as often found in industrial or medical panel PCs. In these applications, support for LVDS is also normally required.

Open

This high flexibility often leads to the demand to customize the BIOS/UEFI configuration page which is impossible to do with commercial motherboards and even in the market of industrial-grade motherboards is often a costly customization project due to individual software programming that needs to be executed by the board vendor. Thus, congatec's free CGUTIL flash tool is a highly efficient cost and time saver as it offers everything to customize the BIOS/UEFI firmware on congatec boards that is stored in an onboard flash memory chip.

Smart

As IoT continues to touch all aspects of our lives, vendors now need industrial-grade IoT support at the motherboard level. The congatec motherboards based on the latest Intel Core processors (Generation 7, codenamed Kaby Lake) feature an integrated SIM-Card socket (via M.2 slot) and Cloud API (see box). This is greatly valued by OEMs looking to deploy motherboards as gateways for their machinery or sensor networks, one of the fastest growing application areas in IoT.

Application ready API for Sensor Network Gateways

Software is also a differentiating feature for motherboards targeting commercial or industrial applications. For example, congatec motherboards support the congatec Cloud-API for IoT-Gateways that is capable to communicate with any sensors, process and convert the acquired data and execute automated actions based on a local rule engine, reducing traffic to the IoT cloud and enabling fast local actions up to hard real-time. Secure bidirectional data exchange with any suitable clouds is achieved by using the TLS secured MQTT protocol. congatec provides OEMs on request with all required software modules in the C++ source code, which simplifies the development of IoT applications for Linux and Windows based on this application ready reference design. On demand, congatec also provides additional software services for the Cloud API and its cloud connection.

Multilingual

Also the software support for protocols is more important in the industrial sector. An example is ccTalk, a serial protocol that is in high demand from manufacturers using payment routines. The gaming industry is particularly keen to see support for this protocol implemented on boards featuring the latest computing and graphics processors. In fact it is demanded by any application that relies on machine-based payment. This means it is also widely used in the retail sector and in point-of-sale terminals. Peripherals such as currency detectors for coins and banknotes, found everywhere from toll booths to bus stations, outdoor ticketing or parking payment machines and payphones, nearly all use ccTalk to exchange information with a host processor.

Personal

If engineers need any support with the integration of these boards on any level, congatec serves its OEM customers with dedicated 'personal training'– up to design-in trainings in accordance to PICMGs and/or SGETs individual extension board design guides. One of the most valuable services for the industrial-grade motherboards is the personal integration support, which ensures that customers always will be connected to the same person and do not need to wait on anonymous support hotline where they reach constantly changing staff. congatec's services are available worldwide on a local basis so customers can reach technical support within their standard working times.

Complete

A motherboard becomes a complete industrial-grade solution platform with accessories suitable for the customer's application. Beside form fit function solutions for the cooling of the processors within the strictly limited height of Thin Mini-ITX motherboards, a broad range of additional components are needed as well. Thus it is highly beneficial for OEMs if a single vendor like congatec can additionally deliver components required. This includes I/O shields, cable sets to interface the embedded onboard connectors to the external housing connectors or internal components such as SSDs or display adapters, as well as power supply units, RAM and storage devices that are all tested and approved to operate with the dedicated boards. Such a complete list of accessories makes an industrial grade board a complete and application ready solution platform.
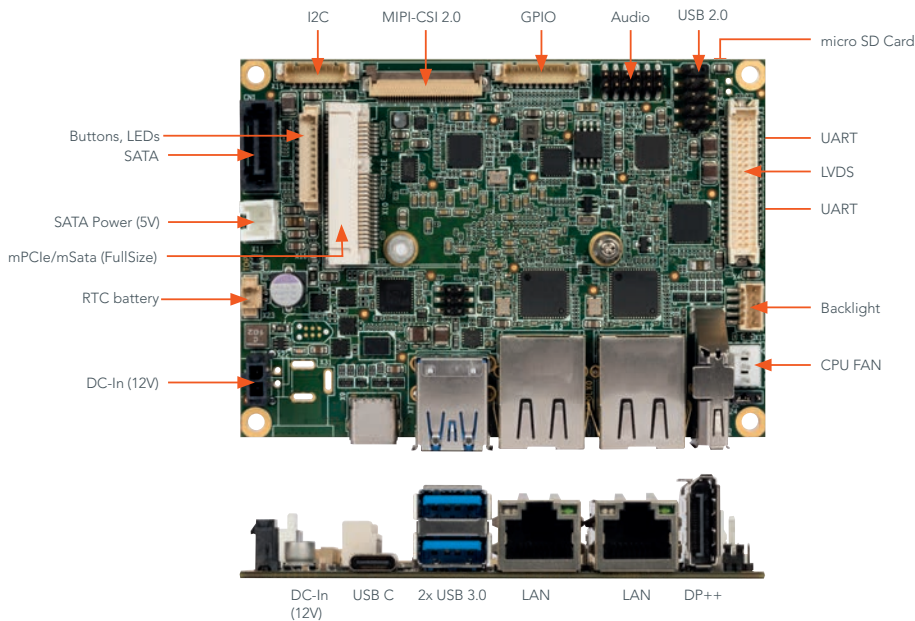
Individual

It is more common for industrial applications to need some level of customization on a motherboard. For instance, in some applications it is beneficial (for security reasons) to remove USB interfaces. In these cases, congatec's Embedded Design & Manufacturing Services - or EDMS - can help by producing bespoke solutions. Of course, all boards supplied by congatec come fully documented with comprehensive lifecycle management and supply chain services for OEMs (such as Kanban and consignment stock).

Have it your way

All of these industrial-grade characteristics transform the Mini-ITX and Pico-ITX form factors into true industrial-grade solutions; an easy to use, professional product suitable for a wide range of industrial applications.

For more information on congatec real industrial-grade motherboards please visit www.congatec.com and see the amazing range of industrial-grade Thin Mini ITX boards which cover all the latest industrial-grade processor technologies including Intel Atom (Apollo Lake) and 7th gen Intel Core processors (Kaby Lake). Discuss your project with our specialists today – and order your sample for evaluation or field testing.

congatec – We **simplify** the use of **embedded technology**.

I2C   MIPI-CSI 2.0   GPIO   Audio   USB 2.0

micro SD Card

Buttons, LEDs
SATA

UART

LVDS

SATA Power (5V)

UART

mPCIe/mSata (FullSize)

RTC battery

Backlight

DC-In (12V)

CPU FAN

DC-In   USB C   2x USB 3.0   LAN   LAN   DP++
(12V)

What if 'Mini' is not small enough?

If the Thin Mini-ITX small form factor standard (170mm x 170mm) is not small enough and only the typical industrial I/Os are required, OEMs can choose an even smaller form factor standard; the Pico-ITX (72mm x 100mm). With the same footprint as a 2.5" SSD, these boards provide all of the industrial features mentioned above in the same envelope as a compact Single Board Computer. The latest conga-PA5 is the first product to feature the new USB Type C connector, with full support for the USB -3.0 Gen 1 (5Gbit/s), DisplayPort++ and Power over a single cable. The board can be supplied with the energy-saving Intel Atom processors E3930, E3940 and E3950 for the industrial-grade extended temperature range of -40°C to +85°C. It is also available with the higher performing, low power dual-core Intel Celeron N3350 and quad-core Intel Pentium N4200 processors. Despite its compact size, it connects to up to three independent, high resolution 4k displays via one DisplayPort++ interfaces with full 4k@60Hz and dual channel LVDS.

About congatec AG

congatec AG has its head office in Deggendorf, Germany and is a leading supplier of industrial computer modules using the standard form factors COM Express, Qseven, and SMARC, as well as single board computers and EDM services. congatec's products can be used in a variety of industries and applications, such as industrial automation, medical technology, automotive supplies, aerospace and transportation. Core knowledge and technical know-how includes unique extended BIOS features as well as comprehensive driver and board support packages. Following the design-in phase, customers are given support via extensive product lifecycle management. The company's products are manufactured by specialist service providers in accordance with modern quality standards. Currently congatec has approximately 200 employees worldwide and entities in Taiwan, Japan, China, USA, Australia and the Czech Republic. More information is available on our website at www. congatec.com or via Facebook, Twitter, Google Plus and YouTube.

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