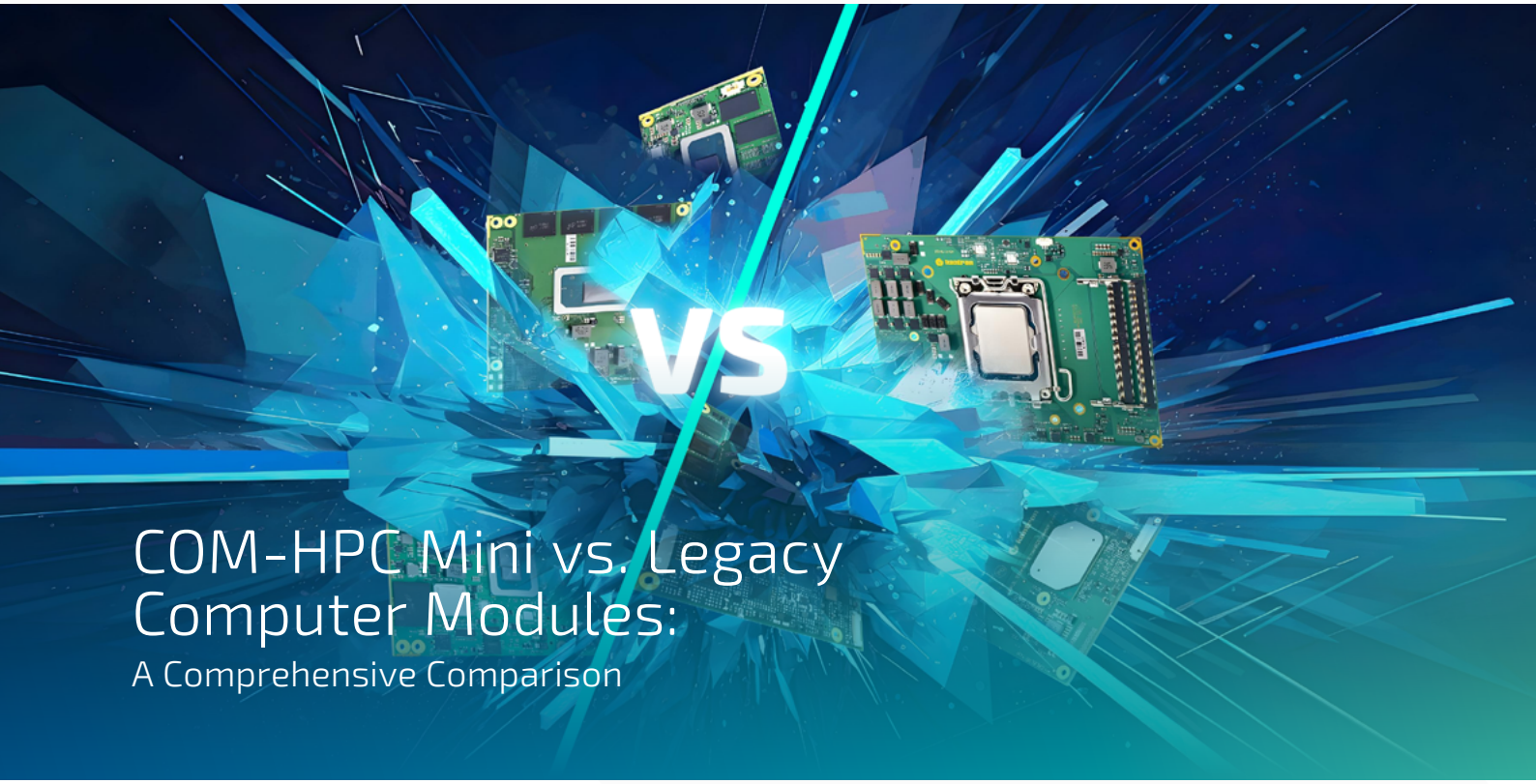
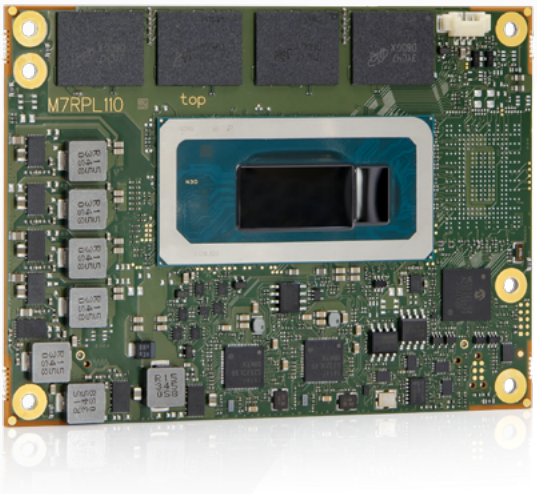


COM-HPC Mini vs. Legacy Computer Modules:

A Comprehensive Comparison

When it comes to COMs, there are a number of choices. But there's likely one option that the best fit for your needs. Understand how to make that determination.

The COM-HPC Mini form factor is intended for applications needing the advanced features of COM-HPC or other higher end architectures, but with smaller size, power, and cost requirements. It is designed to a smaller form factor than COM-HPC using a single 400-pin connector. Comparable to its larger COM counterparts, COM-HPC Mini supports high-speed interfaces like USB 4.0, Thunderbolt, PCIe Gen 5/6, and 10-Gbit/s Ethernet. It also includes interfaces common to smaller devices, such as a CAN bus, two SGMII ports, and an extra I2C port. In this white-paper, we will compare COM-HPC Mini to some other available architectures, showing where and how it should be applied in various applications.



JUMPtec®

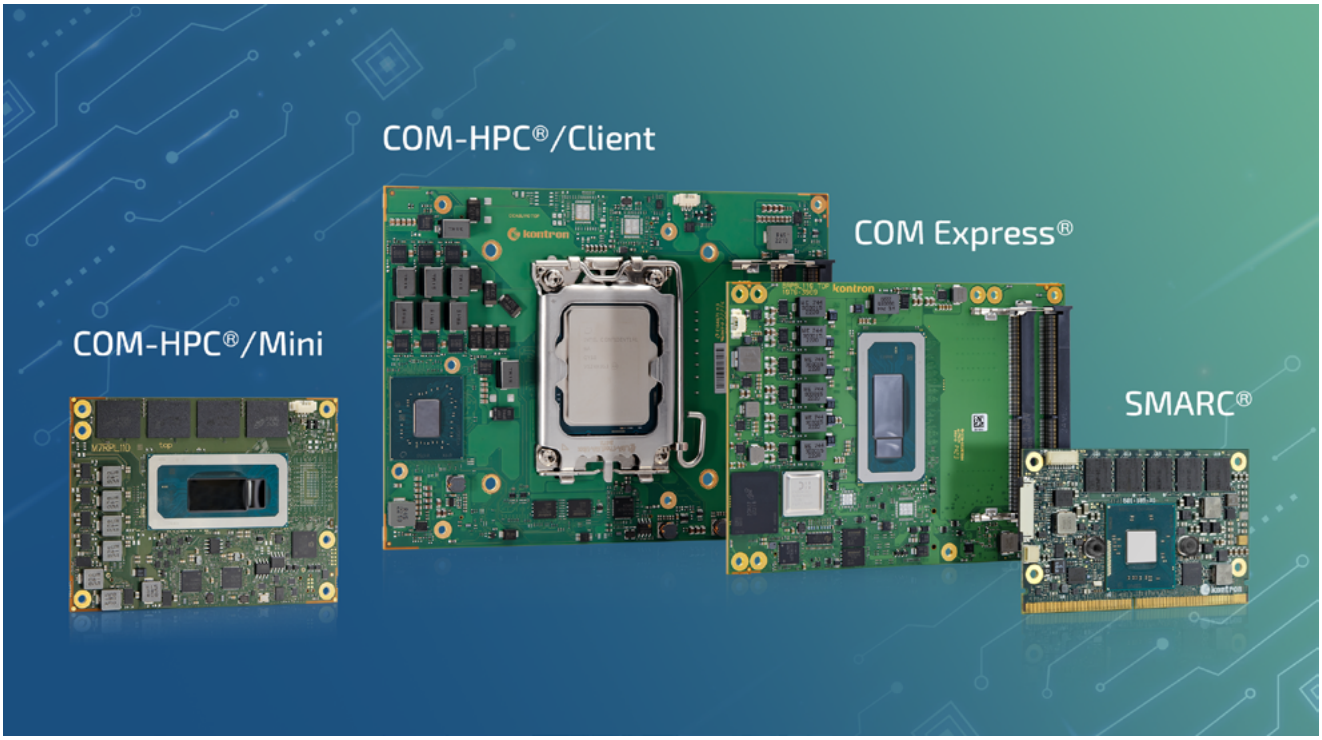
Table of content

Introduction

COM-HPC Mini is the latest standard in the COM-HPC family, and as its name implies, it's a smaller form factor than its existing COM-HPC family members. The Mini version typically measures 95 mm x 70 mm, and is aimed at space-constrained applications, such as edge devices and portable systems. Whereas the more established COM-HPC Client comes in three different sizes: 95 mm x 120 mm (size A); 120 mm x 120 mm (size B); and 160 mm x 120 mm (size C). The larger form factor models are built for applications demanding more robust performance and more connectivity options.

Like COM Express the various flavors of COM-HPC, including COM-HPC Mini, are defined by the PCI Industrial Computer Manufacturers Group (PICMG). The standardization offers customers a set of various different standardized platforms aiming to offer customers proven products widely supported by the embedded industry.

This whitepaper provides a comparison of COM-HPC Mini with other popular computer modules, including the various flavors of COM-HPC, COM Express, and SMARC. It explores the architectural differences, performance metrics, application scenarios, and future prospects of COM-HPC Mini. It will also briefly touch on COM Express Mini and COM Express Compact, which can be considered as alternative platforms to COM-HPC Mini.



Inside COM-HPC Mini

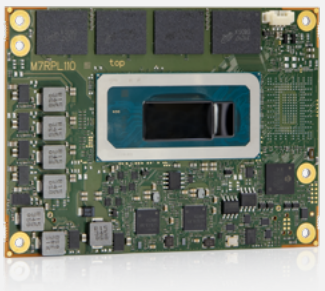
The genesis of the COM-HPC Mini architecture lies in the need for a versatile, high-performance computing standard suitable for compact embedded systems. Whereas COM-HPC was originally developed to address the demands for greater computational power, enhanced I/O capabilities, and faster data processing in applications such as AI, machine learning, and edge computing, the Mini version was introduced to bridge the gap between the existing COM Express and the larger COM-HPC modules. It provides a smaller form factor while retaining the advanced features of the COM-HPC standard.

This newer specification aims to meet the increasing demand for more powerful and efficient computing solutions in space-constrained environments, enabling developers to implement cutting-edge technologies in smaller devices without sacrificing performance or scalability. COM-HPC Mini supports high-speed interfaces, multiple connectivity options, and robust processing power, making it an ideal choice for next-generation embedded and industrial applications.

The need for COM-HPC Mini arises from the growing demand for powerful computing solutions in compact, space-constrained environments. Traditional COM-HPC modules offer high performance but are often too large for smaller devices and embedded systems. COM-HPC Mini addresses this issue by providing a smaller form factor without compromising on advanced features, making it suitable for a wide range of applications such as industrial automation, medical devices, robotics, and edge computing.

This need is driven by the increasing integration of advanced technologies like AI, machine learning, and real-time data processing into various fields, requiring robust computational power and high-speed connectivity. COM-HPC Mini enables developers to implement these technologies in smaller, more efficient devices, meeting the industry's push towards miniaturization and higher performance in limited spaces. By offering scalability and versatility, COM-HPC Mini ensures that high-performance computing can be deployed in diverse and demanding environments.

It's become clear that miniaturization in the embedded compute space is important, particularly because we now see many space-constrained environments, such as industrial and automation machinery and medical devices. And smaller devices tend to be more rugged, enhancing reliability and longevity, further enhancing the applicability.



Comh-m7RP

- **High performance on small form factor**
- **Up to 64 GByte LPDDR5 6000 MT/s - In-Band ECC**
- **16 PCIe lanes**
- **2x 2.5 GbE with TSN support**
- **Optional NVMe SSD onboard**

Comparing to larger COM-HPC form factors

The COM-HPC Mini and COM-HPC Client modules differ in the number of interfaces and size of the form factors.. Obviously, the Mini with one 400-pin connector features fewer interfaces compared to the Client variant with two 400-pin connectors. It supports up to 16x PCIe Gen5/6 lanes, and includes less graphics and ethernet interfaces.

Conversely, the Client offers up to 48 PCIe lanes, including PCIe Gen5/6 and up to two 25Gb Ethernet ports, enabling advanced expansion options.

Beyond the Client is COM-HPC Server, with even larger form factors, up 64x PCIe Gen5/6 lanes and instead of graphics interfaces offering a large number of high-speed Ethernet lanes for supporting up to 100GbE.

	COM-HPC®/Mini	COM-HPC®/Client
Size	Mini -- 95 mm x 70 mm	A - 95 mm x 120 mm B - 120 mm x 120 mm C - 160 mm x 120 mm
PCIe	16	48 +1
MIPI-CSI	2x via Flatfoil connector	2
25 GbE KR	-	2
SGMII	2x (shared with PCIe 3, 4)	-
DDI + eDP	2x (shared with USB 4) + 1	3 + 1
SoundWire / I²S	2 / 1	2 / 1
10GBASE-T	2	2
USB 4 USB 3.2 Gen 2x2 USB 3.2 Gen 1 / Gen 2	4 USB 4 or USB 3.2 Gen 2x2 or USB 3.2 Gen 1 / Gen 2	4 USB 4 or USB 3.2 Gen 2x2 or USB 3.2 Gen 1 / Gen 2
USB 2.0 (USB 4 and USB 3.2 make use of USB 2.0)	8	8
SATA	2 (shared with PCIe 6, 7)	2
UART / CAN	2 / 1	2 / -
eSPI / G-SPI	1 / 1	1 / 1
SMB / I²C	1 / 2 + 1 for SGMII	1 / 2
FuSa	1	1

Comparing to Legacy Architectures

COM Express is a widely adopted standard that offers a range of module sizes and types, providing flexibility for various embedded applications. Modules are available in various sizes, including Mini (84 mm x-55 mm), Compact (95mm x 95 mm), and Basic (125 mm x 95 mm), providing flexibility in design. The modules utilize Type 10 for COM Express Mini Type 6 and Type 7 for COM Express Compact and Basic pinouts, supporting PCIe Gen4, USB 3.2, and SATA interfaces, offering a good balance between legacy and modern interfaces. When it comes to power consumption, COM Express can be flexible, as it offers various power profiles, generally ranging from 5 to 40 W, which is used to balance performance and energy efficiency.

Smart Mobility ARChitecture (SMARC) modules are designed for low-power, small form factor applications. They are particularly suited for mobile and IoT applications where power efficiency (typically 2 to 6 W) and compact size are crucial. Modules measure 82 mm x 50 mm and 82 mm x 80 mm for larger variants. From a connector perspective, SMARC employs a 314-pin MXM3 connector, supporting PCIe Gen3, USB 3.0, and SATA, suitable for low-power applications.

COM-HPC Mini Vs. COM Express Mini/Compact

Some may compare COM-HPC Mini and COM Express Mini, so let's quickly show the differences before moving on to a comparison of COM Express Compact.

While COM-HPC Mini and COM Express Mini retain a similar form factor (95 mm x 70 mm vs. 85 mm x 55 mm), COM-HPC Mini is designed for higher performance due to its support of more interfaces with a 400 pin connector suitable for higher-speed, making it suitable for applications like Edge computing and AI. On COM Express Mini typically also lowest power processors such as Intel Atom design are accommodated.

Comparing COM-HPC Mini against COM Express Compact, The latter is slightly larger, at 95 mmx 95 mm. While COM Express Compact is quite capable from a performance perspective, it's not in the same class as COM-HPC Mini. The former generally supports older PCIe generations .

	COM Express Compact T6	COM-HPC® Mini	COM Express Mini T10
Size	95 mm x 95 mm	95 mm x 70 mm	84 mm x 55 mm
Connector	2x 220 pin	1x 400 pin	1x 220 pin
Power Consumption	Typ. up to 50W	Typ. up to 40W	Typ. up to 20W
NBASE-T	1x NBASE-T (max 10Gb)	2x NBASE-T (max 10Gb) 2x SGMII (shared with PCIe lanes 3 and 4)	1x NBASE-T (max. 10Gb)
PCIe	24x PCIe Gen4	16x PCIe Gen5/6 (some lanes shared with SATA and SGMII)	4x PCIe Gen4
Graphics	3x DDI 1x dual channel LVDS (option with eDP) 1x VGA	2x DDI (shared with USB4) 1x eDP	1x DDI 1x single LVDS (option with eDP)
SATA	2x SATA	2x SATA, shared with PCIe lane 6 and 7	2x SATA
USB	2x USB4 (instead of DDI), 4x USB 3.2 + 4x USB 2.0 (USB3/4 makes use of 4x USB 2.0) 8x USB 2.0	4x USB4 or USB 3.2 Gen 2x2 or USB 3.2 Gen 1 / Gen 2 (USB3/4 makes use of 4x USB 2.0) 8x USB 2.0	2x USB 3.2 (makes use of 2x USB2.0) 8x USB 2.0
Serial	2x COM (option CAN interface on one)	2x COM	2x COM (option CAN interface on one)
MIPI	2x MIPI-CSI via Flatfoil connector	2x MIPI-CSI via Flatfoil connector	2x MIPI-CSI via Flatfoil connector
CAN	1x shared with COM #2	-	1x shared with COM #2
Functional Safety	No	Yes	No
Others	„Low Speed“ (eSPI/LPC, SPI (BIOS), GPP SPI, SMB, I2C, 8x GPIO/SDIO, MISC)	„Low Speed“ (eSPI, SPI (BIOS), GPP SPI, SMB, 2x I2C, 12x GPIO, MISC)	„Low Speed“ (eSPI/LPC, SPI (BIOS), GPP SPI, SMB, I2C, 8x GPIO/SDIO, MISC)

Application Scenarios and Use Cases

In terms of applications, all of the architectures discussed here are suited for industrial automation, but at different performance levels. For example, COM-HPC is ideal for high-performance industrial applications requiring real-time processing, advanced AI, and machine learning. COM Express is suited for industrial applications looking for a balance between performance and power consumption. COM-HPC Mini fills the need where both high performance and smaller size are needed. And SMARC is best for low-power, portable industrial devices and IoT gateways.

A great example of where the COM-HPC Mini form factor makes perfect sense is in the healthcare space. Its small form factor and scalable architecture suit it for integration into medical devices like imaging systems, portable diagnostic tools, and robotic surgical systems.

With support for high-speed data transfer and advanced processing capabilities, it excels in applications such as real-time imaging, AI-driven diagnostics, and telemedicine solutions. The module's ability to handle large volumes of data ensures rapid and accurate analysis, crucial for technologies like MRI, CT scans, and patient monitoring systems.

Because COM-HPC Mini can operate safely in demanding environments, it is quite suitable for aerospace and defense applications. Its small form factor and robust design allow integration into space-constrained systems such as UAVs, satellites, and military vehicles. The module's rugged construction ensures reliability in extreme temperatures, vibration, and shock conditions.

With its support for high-speed interfaces, advanced processing, and real-time performance, COM-HPC Mini can handle mission-critical tasks like radar and sensor data processing, avionics control, and secure communication systems. Its modular design enables scalability, allowing developers to customize and upgrade computing power based on evolving requirements.

Future Prospects

Looking down the road, COM-HPC and COM-HPC Mini are poised to lead the market in high-performance computing applications, driven by support for the latest processors, high-speed interfaces, and large memory capacities. Adoption will likely increase in industries requiring advanced computing capabilities, such as AI, machine learning, and real-time data processing.

More specifically, COM-HPC Mini will be driven by the expanding need for powerful edge computing solutions in the applications we've highlighted, calling out those in particular where space is at a premium. Standardization and scalability make it adaptable to evolving technologies, ensuring long-term relevance and interoperability.

COM Express, which is not headed to the scrap heap anytime soon, will continue to be a versatile and widely adopted standard, catering to a broad range of applications. Its ability to balance performance and power consumption makes it suitable for both existing and emerging markets.

And SMARC's focus on low power and compact size positions it well for the growing IoT and mobile device markets. As these markets expand, SMARC's adoption is expected to increase, particularly in applications where energy efficiency is crucial.

Making the Right Choice

The choice of a computer module standard obviously depends on the specific requirements of the application, including performance, power consumption, size, and interface support. COM-HPC stands out for high-performance applications, offering the latest in computing power and interface speeds. COM-HPC Mini falls into a similar camp, adding smaller size to its resume. COM Express provides a balanced approach suitable for a wide range of uses. And SMARC caters to low-power, compact applications.

As technology continues to evolve, each of these standards will find its niche, driven by the specific needs of the industries that they serve. Understanding the strengths and limitations of each can help engineers and decision-makers choose the right solution for their projects, ensuring optimal performance and efficiency.

Look Beyond the Specs

Also keep in mind that there are factors beyond the technical features that go into the decision on which architecture to deploy. Aspects that could influence that decision certainly revolve around the ecosystem, long-term availability, and total cost of ownership (TCO).

The ecosystem for a module has to do with the supporting hardware and software, as well as the tools that a developer might need to deploy the system. On the software side, it ranges from operating systems and application code to drivers for various functions and features.

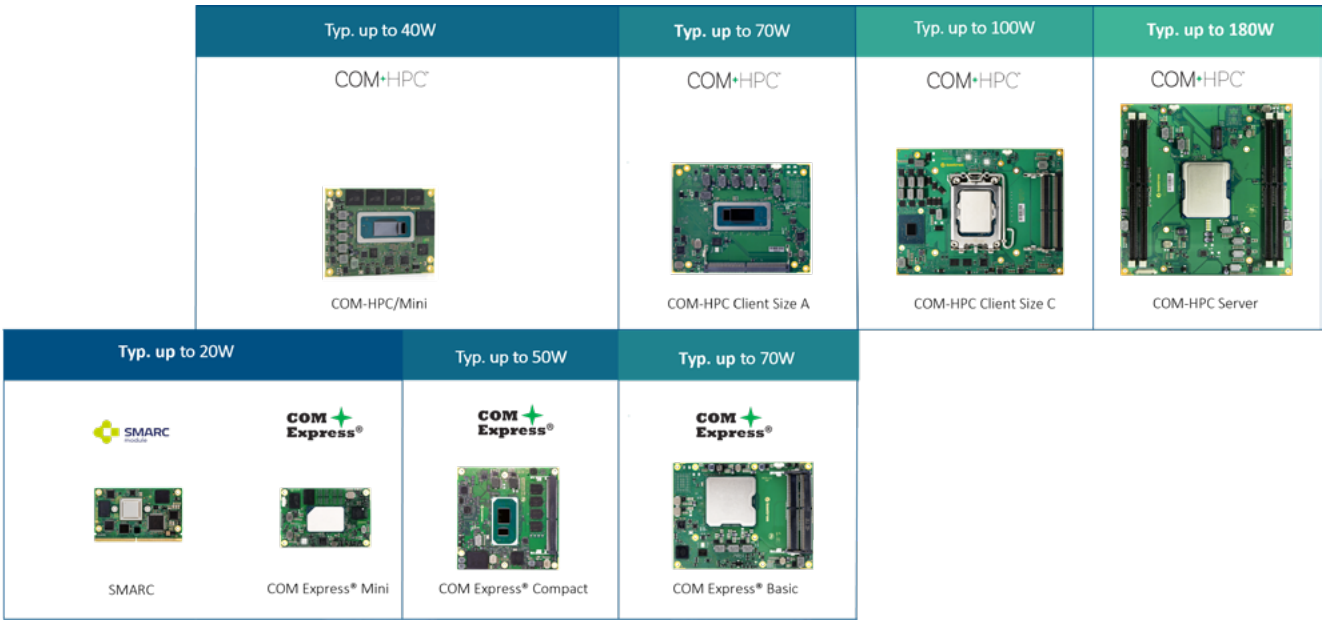
Long-term availability can encompass myriad aspects, from the modules themselves to the components that make up the modules. If a CPU or any other component gets "end-of-lifed," that could spell trouble for the OEM. That's where the choice of a module supplier comes in. Choosing a supplier with a reputation for maintaining the right amount of stock and the ability to fulfill longer term orders is a plus.

TCO can be difficult to manage, but the modular approach takes some of the guesswork out of play because an OEM can swap in a new (upgraded) module far more easily and cost effectively than replacing an entire motherboard in a system.

Conclusion

The goal of this whitepaper is to provide a good understanding of the merits of COM-HPC Mini, and where it fits in the embedded computing space, as compared to competitive architectures. We wanted to show the various applications/spaces where it makes sense to deploy COM-HPC Mini, and the places where developers should be looking at other potential architectures. Hopefully, it provides enough insight for developers to make informed decisions, or at least understand how and where to get more information.

Jumptec can support the developer's needs either way, using COM-HPC Mini modules or with any of the other architectures discussed here. The company offers unparalleled support, customization capabilities, and a commitment to product longevity. In addition to system integration, Jumptec provides complete software solutions, including system software and middleware. For more information, contact Jumptec.



More information:
JUMPtec COM-HPC®

About JUMPtec®

We specialize in designing both standard and highly customized compute products. Our newly optimized structure enables us to take customers from prototyping and design through to mass production faster than ever before.

We are uniquely positioned to leverage our global design and manufacturing expertise alongside Kontron's extensive worldwide network. While JUMPtec remains a fully owned subsidiary of Kontron, we benefit from their global distribution capabilities and work closely with Kontron's other solution businesses. With more OEMs seeking to mitigate risk and outsource complex manufacturing, the shift to modular solutions is becoming more prevalent. JUMPtec, backed by Kontron, is well-positioned to support customers in implementing this modular approach, offering high-quality, scalable solutions without compromising on size or capability.

For more information, please visit: **www.jumptec.com**

Your Contact

JUMPtec GmbH

Brunwiesenstrasse 16
94469 Deggendorf
Tel.: +49 991 37024-0
info@jumptec.com

www.jumptec.com

Your Contact

3900 Newpark Mall Ste 201
Newark, CA, 94560-5241
United States of America
info.americas@kontron.com