

Solution Brief

Edge Computing
Military and Defense

intel®

Performance Edge Computing in a Compact Footprint

Crystal Group RE2402 rugged embedded computers deliver data center–grade performance, bandwidth, and security in a compact footprint for easy deployment at the tactical edge.



“Featuring the Intel® Xeon® D-1559 processor and P5000 GPU, the RE2402 uniquely addresses the requirements and intended use cases for a sealed air-cooled system with managed thermal performance. These systems represent a significant leap forward in terms of the horsepower they deliver in a very small box, all while keeping the computing system protected from the environment.”

—Jim Shaw, executive vice president of
Engineering for Crystal Group

Challenges: Deploying AI, virtualization, and other data-intensive applications wherever they’re needed

To help safeguard both military personnel and civilians, defense systems must power complex multi-domain applications and deliver real-time intelligence as it unfolds. This paradigm calls for highly sophisticated edge compute systems equipped with the performance and bandwidth to rapidly process artificial intelligence (AI), graphics, and other data-intensive applications whether on land, at sea, in the air, or in space.

In addition to operating in remote and austere locations, typically with limited or no infrastructure, defense systems must perform optimally under extreme and unpredictable environmental conditions. Whether deployed in mobile ground units in the rainforest, in helicopters landing in the desert, or in submarines well below the ocean’s surface, these compute systems must deliver seamless reliability while withstanding elements ranging from moisture, dust, sand, and altitude to corrosion, wind, vibration, and impact—all in extreme temperatures. They must also be as compact as possible for ease of mobility and deployment, which means minimizing the size, weight, and power (SWaP) consumption to fit into the military’s full range of vehicles, aircraft, ships, and equipment.

To meet the logistical demands of the defense industry, a new generation of rugged edge computing systems is fast emerging. These high-performance systems are designed to power a breadth of defense applications in the harshest of environments, from unmanned aircraft systems and signals intelligence to weapons systems and electronic warfare. To be among the most advanced defense industry computer systems, a unit must deliver the performance, reliability, and bandwidth required to fulfill a myriad of mission objectives in a small, mobile form factor.

Conditions can change rapidly. To advance strategies and win engagements, access to real-time data is essential. Defense systems are becoming more complex as they increasingly power AI inference, virtualization, and other data-intensive applications at the tactical edge. Vast amounts of memory and storage are required to deliver the situational awareness essential to fulfilling missions. To drive next-generation defense applications in mobile ground and airborne operations alike, rugged edge compute systems must perform under full load in extreme temperatures that can range from -40° to +55°C. These systems must also perform optimally in constrained spaces within other military equipment and assets.



Solution: Crystal Group's RE2402 compact, rugged embedded computer for enhanced edge performance

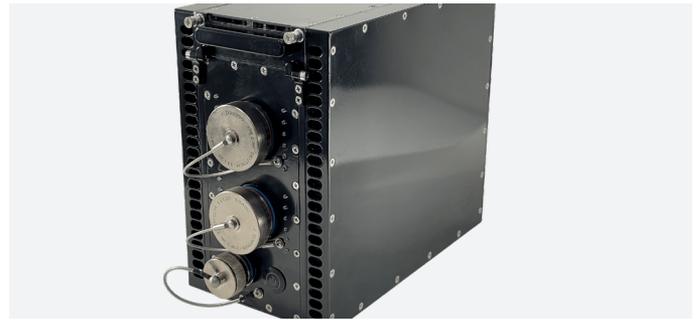
Crystal Group's RE2402 rugged embedded computer delivers on the promise of modern edge computing by providing the performance, I/O bandwidth, security, and compact footprint needed to handle the defense industry's complex, data-rich applications.

The RE2402 powers data-intensive defense applications in the most extreme, unpredictable tactical edge environments, all with data-center characteristics and functionality. Featuring Intel® Xeon® D-1559 processors, the small, yet powerful RE2402 can be configured for ISR, AI inference, storage, virtualization, and other military use cases, to ensure seamless operations in high-temperature, high-vibration environments.

Built to withstand and deliver

Constructed of milled, aircraft-grade aluminum with external fins for cooling, the no-air-over-component design is rated for extreme temperatures ranging from -40°C to +55°C at full load. Two dustproof and waterproof fans create a curtain of air over the system's exterior fins for seamless operation in high temperatures. The external surfaces are sized to accommodate the system's thermal load in ground or air applications using a forced air plenum.

Featuring the 12-core Intel Xeon D-1559 processor, the RE2402's COM Express module supports up to 128 GB of ECC memory (RAM). To improve overall shock and vibration performance, wire harnesses were removed in favor of direct board-to-board connectors. Overall, the system meets the combined C17, C130, and UH60 vibration requirements in accordance with MIL-STD-810 for easy integration into a broad range of platforms. The server-grade computer also uses military-grade circular electronic connectors (MIL-CIRC) to provide a variety of I/O to the system operator. With two 10 GB connections, the system can ingest, process, and distribute battlefield data at line-rate speed.

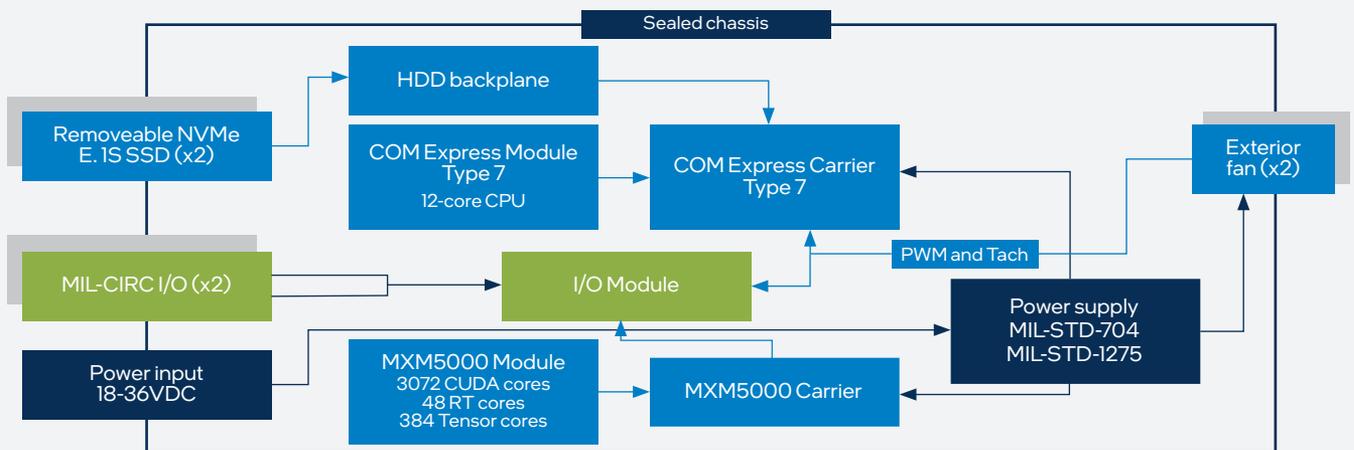


Maximum power, minimal footprint

The RE2402 GPU provides 16 GB of GDDR6 memory, 3,072 CUDA cores, 48 RT cores, and 384 tensor cores. Combined with the 12 cores in the Intel Xeon D-1559 processor, the system delivers leading edge AI and machine learning (ML) in the most challenging and unpredictable environments. The COM Express carrier board featuring the Intel Xeon D-1559 processor is designed for seamless integration with the GPU in an extremely small box packed with these mission-critical features:

- Intel Xeon D-1559 processor to support virtualization
- 128 GB DDR4 with ECC memory
- Two NVMe E.1S drives, providing 8 TB of storage
- Up to two M.2 SSDs for OS
- A mobile high-end workstation graphics card that comes with 16 GB of video memory
- No-air-over components; sealed air-cooled system that meets or exceeds IP65 rating
- MIL-circular I/O
- MIL-STD-704 and MIL-STD-1275 power supply that accepts vehicle power without preconditioning
- Two 10 GB networking ports
- COM Express Type 7 modules to future-proof operations
- Small footprint of 5" W (127 mm) x 8" H (203.2 mm) x 10" D (254 mm)
- Lightweight unit with a composite carbon fiber chassis that weighs approximately 15 lbs (6.8 kg)

RE2402: Modular construction for versatile functionality



Intel Xeon D-1559 processors deliver speed, performance, and security at the tactical edge

Intel Xeon D-1559 processors deliver all the design flexibility, performance, and advanced intelligence of Intel Xeon processors in a system-on-a-chip (SoC) design, which enables low power consumption with thermal design points ranging from about 20W to 65W. Intel Xeon D-1559 processors are also designed to run the same instruction set as more-robust Intel Xeon processors, helping ensure software consistency anywhere they are deployed.

The Intel Xeon D-1559 processor includes two to 16 cores, multiple integrated ports of Gigabit Intel® Ethernet, and support for up to 128 GB of memory. It also includes L1 cache (32K data, 32K instructions per core), L2 cache (256K per core), and LLC cache (1.5 MB per core). Intel® Turbo Boost Technology allows the processor to run at its base clock speed when handling light workloads, then jump to a higher clock speed for heavy workloads. Intel® Hyper-Threading Technology (Intel® HT Technology) allows more than one thread to run on each core. Intel® QuickAssist Technology (Intel® QAT) is included as well, providing hardware acceleration for compute-intensive workloads, such as cryptography and data compression, by offloading the functions to a specialized logic engine (integrated into the chipset).

With the Intel Xeon D-1559 processor, Intel® Virtualization Technology (Intel® VT) is built into the design, delivering near-native compute I/O performance with advanced monitoring of cache and memory bandwidth for superior service-level and infrastructure management. Server-class reliability, availability, and serviceability (RAS) ensure high system reliability and data integrity with support for error correction code (ECC) memory, single device data correction (SDDC), memory demand, and patrol scrubbing.

Hardware-enhanced security and compliance

The Intel Xeon D-1559 processor is designed for security, featuring Intel® Advanced Encryption Standard New Instructions (Intel® AES-NI), which provides integrated support for fast, low-overhead encryption. Intel® Trusted Execution Technology (Intel® TXT) supports platform verification (through authenticated boot) to further strengthen security with minimal impact to performance.

Intel Xeon D-1559 processors offer these essential features:

- 12-core processor
- 18 MB cache
- 2.1 GHz Turbo
- 45W Thermal Design Power (TDP)
- 32 PCIe lanes
- Intel QuickAssist Technology (Intel QAT), Intel Virtualization Technology (Intel VT), and integrated Intel® Ethernet for high-density SoC design
- Integrated Platform Controller Hub (PCH) chipset
- Advanced Encryption Standard (AES) for enhanced security
- Fast clock (operational processing speed)

Conclusion: Intel and Crystal Group deliver mobility and compute performance required for modern military deployments at the tactical edge

Heavy-compute military applications are moving from data centers to the tactical edge. Accordingly, defense systems must support the compute power, speed, accuracy, security, and design flexibility needed to meet a vast array of tactical demands. And they must deliver high performance in a compact footprint minimized for size, weight, and power (SWaP). Featuring Intel Xeon D-1559 processors, the compact Crystal Group RE2402 rugged embedded computer delivers data-center-caliber performance in the world's most unforgiving environments. The result is more secure, reliable execution of complex defense applications with near-real-time accuracy in any domain.

Learn more

Crystal Group RE2402

Built with the Intel Xeon D-1559 processor, the RE2402 rugged embedded computer delivers exceptional performance and bandwidth in a compact footprint at the tactical edge.

[Learn more >](#)

Intel Xeon D-1559 processors

Get amazing performance, more bandwidth, hardware-enabled security features, and design flexibility to enable and enhance complex defense compute applications anywhere they are deployed.

[Learn more >](#)



Notices and disclaimers

Performance varies by use, configuration and other factors. Learn more at [intel.com/PerformanceIndex](https://www.intel.com/PerformanceIndex).

Performance results are based on testing as of dates shown in configurations and may not reflect all publicly available updates.

Intel is committed to respecting human rights and avoiding complicity in human rights abuses. See Intel's [Global Human Rights Principles](#). Intel® products and software are intended only to be used in applications that do not cause or contribute to a violation of an internationally recognized human right.

No product or component can be absolutely secure.

Your costs and results may vary.

Intel® technologies may require enabled hardware, software, or service activation.

Intel does not control or audit third-party data. You should consult other sources to evaluate accuracy.

Altering clock frequency or voltage may void any product warranties and reduce stability, security, performance, and life of the processor and other components. Check with system and component manufacturers for details.

© Intel Corporation. Intel, the Intel logo, and other Intel marks are trademarks of Intel Corporation or its subsidiaries. Other names and brands may be claimed as the property of others.