Deliver Performance and Customization at The Tactical Edge

Deployed at the tactical edge, Crystal Group's rugged computers deliver high-volume processing of real-time aviation data and intelligence.

Providing Advanced Computing Where it is Needed

Modern avionics and military platforms require field-ready, scalable, and high-performance mission computers to run compute-intensive, safety-critical workloads. However, these platforms need to function in space-constrained environments, in which it is essential to minimize the size, weight, and power (SWaP) of the systems. This goal can be effectively achieved with mission computers equipped with the latest processors embedded within rugged, compact, and power-efficient form factors. Edge computing systems used in missions must be easily customized with all the features and functionality needed to enable rapid decision-making, protect critical data and lead to successful engagements. Seamless integration of a variety of different components and architectures is required, which can be difficult to achieve.

Challenges: Accommodating Customers' Small Form Factors While Minimizing Obsolescence

Systems optimized for SWaP factors must contend with the limited space available onboard jets and helicopters. Concurrently, these systems must supply increasingly large amounts of data storage required by the latest flight systems. The weight of mechanical and electronic parts is significant. The lighter the platform, the more payload aircraft can carry. Lighter vehicles can fly farther, longer, and faster.

Not only do the computer and electronic subsystems need to be SWaP optimized, but these systems must also operate reliably in harsh environments. Operating environments in jets and helicopters include hot and cold temperatures, but also vibrations, humidity, and high altitudes. The computer system mounting rails and fasteners must not be adversely affected by environmental conditions, such as weathering, corrosion, and abrasion.

Life-cycle management of aircraft computers and their subsystems is also important, ensuring operation over the life of the aircraft. Obsolescence management of avionics products is a technically challenging and costly financial problem. Multiple adverse business impacts can affect both the avionics suppliers and their customers. Though obsolescence is not unique to the aerospace industry, the long-life cycles of aircraft make it more challenging, as does the requirement to comply with airworthiness regulations. Continuous change to maintain compliance is complex and costly. Obsolescence is the result of the aerospace industry's dependence on a supply base whose major markets — outside of aerospace — have shorter technology life cycles.

Aerospace has a continual demand for technological progress in aircraft system capabilities and safety improvements, but on a much longer timescale than the technology turnover timescale of the supply base. The evolution of electronic device interfaces and related standards results in general availability parts obsolescence issues. These issues include those associated with timing, power, thermal, environmental, and component/technology size characteristics.

The Solution: Rugged, MIL-SPEC Computers for Critical Mission Programs

Crystal Group, a leading technology company, serves the industrial and defense industries and is positioned at the intersection of high-tech and defense. The company delivers solutions that power a broad range of aerospace and defense products and are optimized for mission success in some of the most challenging and demanding environments. The company envisions, creates, and delivers innovative technology solutions to meet defense customers' most pressing needs.

Crystal Group's RE3101 product is built to strict military standards, including Commercial Solutions for Classified (CSfC) and MIL-SPEC. CSfC is the NSA's commercial strategy for leveraging industry innovation to deliver Information Assurance solutions efficiently and securely. MIL-SPEC computers are designed for the most extreme environments and most challenging computing applications. Constructed of ultra-rugged materials both inside and out, MIL-SPEC hardware often undergoes specialized testing to comply with various standards and certifications.

The feature-rich RE3101 embedded computer systems are powerful, compact and rugged. Configurable to meet customer-specific requirements, this rugged computer boasts advanced thermal management, milled aluminum chassis, extended temperature ranges and is field tested to withstand heavy shock and vibration.

The RE3101 features include:

- Powerful high-performance data collection, processing and storage
- Compact and lightweight form factor 4.8 lbs. (2.2 kg)
- Less than 13-inches (33 cm) deep for compact environments
- Optimal thermal performance (-40° C to +55° C)
- Com Express Type 6 system board with discreet TPM
- 16 GB DDR4
- One removable SATA SSD
- One mini PCIe expansion port
- MIL-CIRC I/O
- Front-mounted indicator lights

The RE3101 comes flight deck ready with:

- **Dzus mounting rails**. Commonly used in aircraft access panels, Dzus slide/push action fasteners provide exceptional vibration endurance, high strength fastening and resistance to accidental opening.
- **The cooling system** is modulated speed, high-volume, long-life thermostatically controlled fans that use a no-air-over-component design.
- **The I/O includes**: 1x VGA, 6x USB 2.0, 2x 1GbE Intel® Ethernet i210, 2x RS-232 Serial, 1553 A/B, 8x GPIO, audio I/O and composite video.
- **The rugged exterior** comes with MIL-CIRC connectors. MIL-SPEC circular connectors are designed and built-in compliance with military specifications. These circular connectors protect connections from environmental threats, making them ideal for military and aerospace applications.

To create a high-performance, rugged computer that would meet the needs of aircraft and military vehicles, Crystal Group evaluated a range of multi-core processors. Ultimately, Crystal Group chose the 11th Generation Intel® Core™ i7 processor for its performance and low-power features.

Intel Processors Helped the RE3101 Meet Performance Goals

The RE3101 rugged embedded computer utilizes 11th Gen Intel Core i7 SoC with an integrated graphics processing unit (GPU). 11th Gen Intel Core processors deliver high-performance CPU/GPU computing with integrated AI acceleration, plus capabilities for running applications that demand high-speed processing, computer vision and low-latency deterministic computing. The Intel Core i7 SoC delivers a balance of performance and responsiveness in a low-power platform. The 11th Generation Intel Core SoCs redefine Intel® CPU performance with 1GbE network speeds, and advanced tuning features that support technical solutions with reduced power usage. Enhanced for IoT, Intel Core i7 processor SKUs feature time-coordinated computing, functional safety design elements, extended temperature for cold and harsh environments and long product availability making them well-suited for aviation use. 11th Gen Intel Core SoCs also provide a compelling SWaP advantage over legacy single-core CPUs with a separate GPU chip.
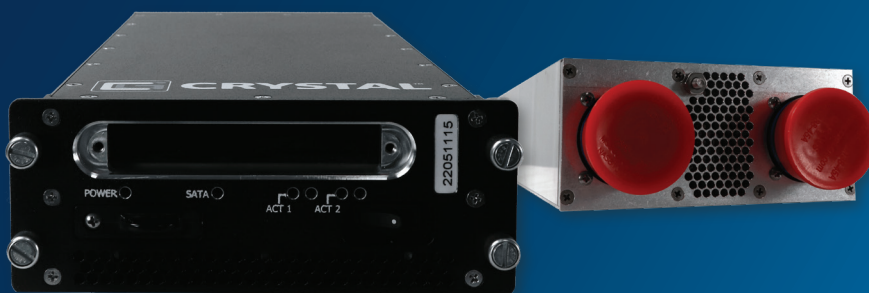
The RE3101 is ideal for military and aerospace applications, such as geospatial mapping and other airborne applications.

Combining four CPU cores operating at up to 4.4 GHz with an integrated Intel® Iris® Xe graphics processor and up to 12 Mb of cache, the Intel Core i7 processor features AI/DL Instruction Sets with Vector Neural Network Instructions (VNNI) and support for Intel® Distribution of OpenVINO™ toolkit. The Intel Core i7 processor also provides four PCIe Gen4 Lanes and supports DDR4 and LPDDR4x, with optional In-Band ECC.

Other benefits of the 11th Generation Intel Core processors include:

▪ **Increased performance across the board:** Built on Intel's third-generation 10 nm microarchitecture, 11th Gen Intel Core processors post up to a 23% gain in single- thread performance, up to a 19% gain in multi-thread performance and up to 2.95x the graphics performance versus 8th Gen Intel® Core™ processors.[1]

▪ **Handling of multiple real-time workloads with minimal jitter:** The combination of the 11th Gen Intel Core processor and Intel Iris Xe graphics performance are complemented with hardware-based acceleration and virtualization to handle multiple compute heavy tasks simultaneously. As an orchestrated system, it maximizes hardware resources efficiently for real-time, multi-workload performance with minimal jitter.

▪ **Put accelerated AI inferencing and computer vision to work:** 11th Gen Intel Core processors deliver accelerated AI inferencing and computer vision in parallel with other core functions. AI and deep-learning inferencing can run on up to 96 graphic execution units or run on the CPU with Vector Neural Network Instructions (VNNI), which condenses three Advanced Vector Extensions (AVX) instructions into one.

▪ **Built-in hardware-based security:** Intel provides security at the platform boot level, security for data at rest on the platform and security for data in-flight. New security features like Intel® Total Memory Encryption (Intel® TME) complement capabilities like Intel® Boot Guard.

Conclusion

Modern aerospace and military platforms require mission computers that are field-ready, scalable and have a variety of features built into them to carry out a mission smoothly. These platforms are typically housed in extremely space-constrained areas and need to survive in rugged environments. A key requirement is minimizing the size, weight, and power of the systems.

Feature-rich Crystal Group embedded computer systems are powerful, compact and rugged. The RE3101 at less than 13-inches deep, with lightweight construction, flight deck ready with Dzus mounting rails, MIL-CIRC I/O and supporting extended temperatures make it perfect for aviation cockpits. Designed to deliver high power with ultra-quiet computing capabilities in a small footprint, the RE3101 is ideal for running geospatial mapping and airborne applications.

For the RE3101, Crystal Group chose to use the 11th Generation Intel Core i7 processor due to its high performance, low power and security features. With the Intel Core i7 processor, the RE3101 can deliver compelling SWaP advantage over legacy single-core CPUs with a separate GPU chip, while only consuming up to 28 W of power.

With decades of experience designing field-tested military computer products, the U.S. Department of Defense deploys Crystal Group rugged military servers, displays, and embedded systems with confidence to keep military operations informed and equipped for mission success.

About Crystal Group

Crystal Group, Inc. is a leading provider of high-performance, rugged compute solutions for defense, government, and industrial markets. Founded in 1987, this small, employee-owned business specializes in the design, customization, build and testing of rugged servers, embedded computers, networking devices, displays, and data storage for high reliability in harsh environments.

Their integrated solutions meet or exceed IEEE, IEC, and military standards, including MIL-STD-810, 167-1, 461, and MIL-S-901, to bring seamless, real-time artificial intelligence, autonomy and cybersecurity to demanding edge applications. All products are manufactured in the company's U.S. facility, certified to ISO 9001:2015/AS9100D standards and are backed by a five-plus-year warranty.

11th Gen Intel® Core i7 Processors

11th Generation Intel® Core™ processors redefine Intel® CPU performance for laptop and desktop PCs. New core and graphics architectures, AI-based performance boosts, low latency wireless and wired connectivity and advanced tuning features deliver higher levels of power and flow to support your aspirations. Learn more at: intel.com/11th-gen-processors

Learn More

To learn more about this solution, visit: RE3101 embedded computer

Solution provided by:

intel + **CRYSTAL**