

Top-Reasons for Defense Customers to Select Teledyne e2v's Processing Modules

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Read more to discover why Teledyne e2v's ultra-integrated processing modules benefit Military & Defense customers: high reliability & optimum performance, compactness, reduced time-to-market and long-term supply.



ABSTRACT

Processors and their **companion DDR memories** are the **heart of military, defense, and avionics computing systems**.

Today, state-of-the-art COTS processors are significantly outperforming existing mil/aero systems.

Military and Defense system developments can take 5-10 year design cycles, which naturally **leads to a significant gap between the latest technologies available on the market versus chipsets used in systems**, when they start servicing.

Moreover, **high-performance COTS technologies** can become **obsolete within 2 years** (or less), i.e. **before the actual start of the mass production** of those defense systems; **mass production can then last from 20 to 30 years**.

Military and Defense customers often have to **make compromises on those performance and obsolescence issues** to avoid lengthy, and time-consuming, re-qualification and re-validation processes.

Now, as the future generation of Military and Defense systems require high reliability/performing, safety critical, ultra-integrated computing platforms; **Teledyne e2v** provides an exclusive line of superior high performing and high reliability processing modules called Qormino®.



Qormino combines **GHz class 64-bit processors based on PowerArchitecture® or ARM® from NXP (formerly Freescale)**, with **high-speed DDR4 memories**, on Teledyne e2v's specific 44 x 26mm substrates. It comes with a 0.8mm BGA package, and is designed to respond to SWaP (Size, Weight and Power) constraints.

With built-in DDR4 bus layout and **"building-block"** approach, Qormino effectively accelerates **Time-To-Market**, allowing **Military and Defense product launches with up-to-date technologies**.

Teledyne e2v also tackles obsolescence issues thanks to its Teledyne e2v's SLiM™ program, and **eases procurement** by offering two of the most critical components from a single supplier.



1. ULTIMATE MIL / AERO SIP (SYSTEM IN PACKAGE) COTS SOLUTION

Military, Defense, and Avionics electronic system developers can oftentimes lack a coherent/standard approach to processor and DDR memories component selection, despite a long and frustrating history of attempts to settle on just a small number of "acceptable" computer components.

Because **processors are at the heart of today's Military, Defense, and Avionics systems**, it is problematic that the sheer performance of state-of-the-art processors is progressing so rapidly that they can outpace the very systems they are designed to enhance. The situation represents, in electrical engineering terms, **a conflict between the three-to-five-year product life cycles of advanced components, AND the lengthy development cycles of the intended platforms**, which typically last five to ten years, with follow-on service cycles that add another 20 years or more.

This is the **downside of today's COTS era**, in which the dynamic consumer markets are demanding ever-shorter product life cycles; imposing on the major military and defense developers in such a way that they are not able to keep up the pace. In addition, old and proprietary electronic architectures can also constitute a barrier to taking advantage of new commercially developed technology.

Gormino family of modular computing platforms **provides the ULTIMATE system solution for developers who require a coherent/standard approach to processor and DDR component selection.**

Teledyne e2v has a long history of supplying superior/high reliability processors to safety critical airborne military and civil avionics systems. Capabilities include providing PowerArchitecture and ARM based multi-core processors and ecosystems to developments including:

- Space force,
- Military and Defense systems,
- Autonomous/UAV systems,
- Air superiority, etc.

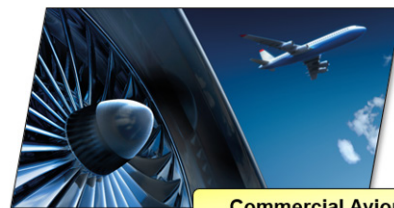
Key differentiators for these developments include:

- 1) **Qualifying processors and DDR to Hi-Rel environments**; high reliability and packaging (components, substrates, SIPs, etc.) to extended temperatures ranges of -55/125C,
- 2) **Power consumption optimization**; ability to screen components to allow more computation with limited cooling and/or limited battery capacity,
- 3) **Lifecycle and Obsolescence management**; long-term support,
- 4) **Teledyne e2v support and product warranties**, and
- 5) **Safety critical**; Avionics (DO-254 Heritage).

Military, Defense, and Avionics system developers requiring a complete, integrated, high reliability computing platform can safely utilize the Gormino family of products.

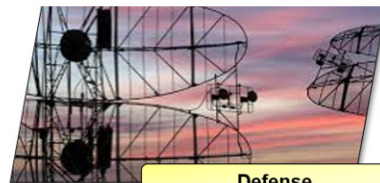
Gormino is comprised of either

- a Hi-Rel / Military-grade qualified 64-Bit NXP **Quad Core PowerArchitecture T1040 @ 1400MHz** : This is QT1040-4GB, or
- a Hi-Rel / Military-grade 64-Bit NXP **Quad Core ARM Cortex A672 LS1046 @ 1600MHz** : This is QLS1046-4GB



- Flight computers
- Mission computers
- Flight control systems
- Voice data recorders
- Engine control

Commercial Avionics



- Radars
- Electronic warfare
- Satcom
- Missile Systems
- Comm. Nav.

Defense



Both are **integrated with 4 GB DDR4 SDRAM-72 bits** (including 8 bits ECC (Error Corrective Code), on a specific Hi-Rel BGA , 44 x 26 mm substate.



Figure 1 - QT1040-4GB (left) and QLS1046-4GB (right)

2. LOWERING RISKS & ACCELERATING ON HIGH RELIABILITY SYSTEMS

Project managers and designers of Military and defense systems must develop embedded state-of-the-art computer platform solutions while simultaneously managing and reducing known and unknown risks.

Risk management dictates:

- Accepting risks when benefits outweigh costs,
- Accepting no unnecessary risks,
- Anticipating and managing risks by planning, and
- Making risk decisions at the right level.

In order to minimize risks, project managers can tend to focus on computer system qualification and subsequent multiple re-qualifications, etc. In addition, no matter what, project managers and designers must prepare themselves and their organizations for technology insertion. Whether or not the end customer wants to embrace new technology, the system can also become obsolete in a relatively short time frame. Some project managers and design engineers fundamentally believe there is much less risk in time and money, by continuing to utilize legacy processors rather than redesigning the system around newer "incompatible" processors. Throughout the development, unbiased risk management assessments must be performed in order to ensure proper decision making.

Therefore, for all Military and Defense computing systems developments, the name **of the game is reducing risk**. It is in this context that Teledyne e2v created its Qormino family of ultra-integrated modular compute platform solutions. This provides the highest computer performances with the smallest footprint, utilizing a comprehensive and pre-validated software ecosystem for strong re-use capability while minimizing obsolescence management issues.

Because Qormino family is a complete integrated modular compute solution (processor + DDR memory), this **allows project managers and design engineers to focus on higher level system differentiators and long-term architectures for multi-platform re-use developments and onetime validation**.

Qormino lower systems development risks thanks to guaranteed performance of the sub-system, and also offer time-to-market reductions with the «building-block» approach.



3. LOWERING THE TOTAL COSTS OF OWNERSHIP

Developing computing platforms that are qualified for military, defense, and avionics usage is generally not a road that leads straight to cost savings. Because of this, the term «cost savings» can apply differently depending on the level of management or technical review, and decision making that is involved. When a particular project development level reports a cost savings of «X%», that alone is meaningless unless the overall project's «100%» reference is known. Therefore, establishing what the «100%» reference is, is of critical importance, but can be extremely difficult to calculate.

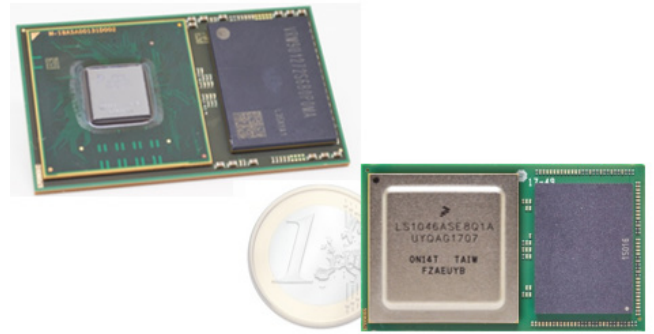


Figure 2 - QT1040-4GB & QLS1046-4GB - Products sizes

For instance, is the specified «X%» cost savings calculated at component level, board level, subsystem level, etc.? Does it include pre-procurement NRE evaluations? Does it include software developments? Qualification and Reliability testing of both hardware and software (individually and combined)? Re-qualifications? Lifetime buy expenditures? The list goes on and on, particularly, for a computing system development.

Qormino family of products provides a **“self-contained” 100% cost reference point for the mission computer platform development from project inception to end of life**; this comes from the facts that those ultra-integrated platforms are a hardware “one-stop shop” (processor + DDR4 in a single module), including Hi-Rel (Military-grade) qualifications, reliability and obsolescence guarantees, together with a proven software ecosystem.

The total cost of ownership for Qormino family of products is elevated in direct contrast to computing system total development costs utilizing DISCRETE components. It is almost impossible to calculate this same 100% cost reference point for computing systems and platforms that are utilizing discrete components; especially from a variety of vendors over the lifetime of a project.

4. OPTIMUM SYSTEM LEVEL AND PCB PERFORMANCE

Figure 3 shows key features of the Qormino devices. Those designs combine both high performance and high compactness which Military, Defense, and Avionics industries are eager for:

Processor	NXP T1040 - Quad Core @1400MHz NXP LS1046 - Quad ARM A72 @1600MHz								
Memory	4GB DDR4 - 72 bits incl. 8 bits ECC								
Ecosystem	Linux , VxWorks , DEOS , PikeOS , LynxOS								
Features	<table border="0"> <tr> <td>Hi-Reliability</td> <td>up to -55/125C</td> </tr> <tr> <td>Small size</td> <td>44 x 26 mm</td> </tr> <tr> <td>Long term support</td> <td>20+ years</td> </tr> <tr> <td>Safety Critical</td> <td>Avionics (DO-254)</td> </tr> </table>	Hi-Reliability	up to -55/125C	Small size	44 x 26 mm	Long term support	20+ years	Safety Critical	Avionics (DO-254)
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Figure 3 - QT1040-4GB & QLS1046-4GB High Level Features



The processors used in Qormino products are the latest state of the art data networking processors. They are GHz class multicore processors, offering a high processing capabilities with parallel computing. This provides product managers with design margin for future evolutions, which is often a strong requirement for HiRel systems due to their extended production and service lifetime. Moreover, these processors can interface over simple interfaces such as SPI, UART, I²C, and they also feature high speed serial interfaces that allow communicating over Gigabit Ethernet and PCIe. This makes them well suited as the main processing hub of the system, in single board computer (SBC) designs for instance.

In order to take full advantage of those processing capabilities, the 4GB DDR4 memory of the Qormino is the ideal companion. With built-in DDR4 bus layout, the optimized and 100% tested timings are provided, so that transfer speed is guaranteed. For example, the QLS1046-4GB is guaranteed for transfer rates up to 2.1GT/S, which provides up to 16GB/s. Qormino offers Error Correction Code (ECC) on the DDR4 bus, which is capable of detecting and correcting a single errors, as well as detecting two errors. This error-proof mechanism is especially valuable for safety critical systems.

Qormino also offers an ultra-compact design fitting in dimensions of 44 x 26mm, leading to PCB real-estate savings compared to a traditional solution with discrete components. This is enhanced by the use of the ultra-compact DDR4 memory. Since the complex DDR4 layout is not needed on the customer's board, this leaves an opportunity for PCB stack-up simplification. As show in Figure 4, Qormino has a BGA soldering interface, i.e. Qormino is designed to be assembled as any other component in order to facilitate integration.

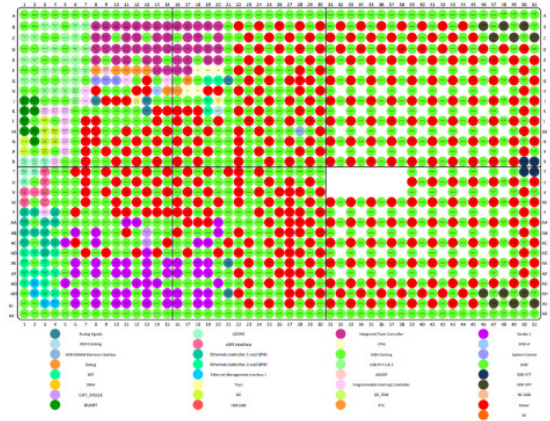


Figure 4 - Example of Qormino ballout

For those reasons, Qormino devices are particularly suitable for demanding applications where sacrificing performance to compactness is not an option, such as UAVs.

5. HIGH RELIABILITY QUALIFICATION

Teledyne e2v's Hi-Rel/(military-grade) Qormino integrated modular computer platform products are a complete solution for military, defense, and avionics designers who need a higher level of quality and reliability than COTS products can provide.

Hi-rel/(military-grade) modular Qormino® integrated products mitigate the risks that military, defense, and avionics markets face with discreet COTS integrated circuits by:

- Ensuring a single controlled assembly/baseline flow,
- Extending temperature ranges from -55°C to 125°C,
- Offering tin-lead solder balls options on ball-grid array (BGA) packages,
- Using rugged material sets,
- Performing extended qualification,
- Offering an extended obsolescence policy.

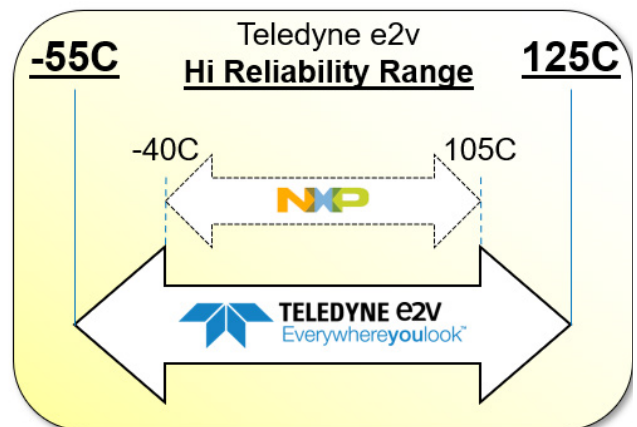
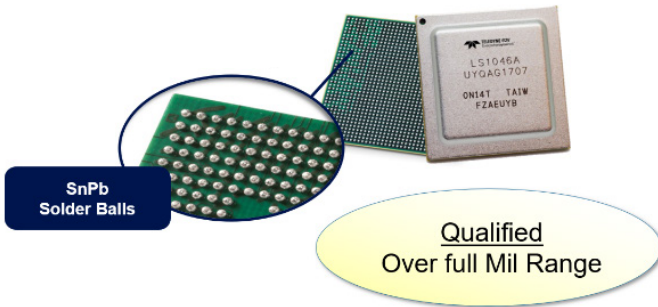


Figure 5 - Teledyne e2v Hi-Reliability range



Quality and reliability are often used interchangeably in order to describe product failure rates. Both terms actually describe entirely different aspects of the behavior of a part over its lifetime. **Quality measures the manufacturing process. Reliability evaluates the effect of a part's quality over time.** Quality is an assessment of the manufacturing, test and screening processes. It measures how well the manufacturer produces parts that match specifications, and how often the manufacturing process produces faulty parts.

Quality is the parts conformance to specification requirements at the start of use. Reliability is the probability of a parts ability to meet relevant specifications over its lifetime. Qualification and screening are not considered as a substitute for manufacturing control, but rather as risk-mitigation measures.

Consequently, the way to address product reliability is by modeling, stress-testing, and statistical process control (SPC) techniques. Hi-Rel / Military-grade product reliability standards are rigorous and can usually require manufacturers to comply with the verification process and to prove that their products meet every requirement. In order to maintain qualification, manufacturers can also provide reports that summarize their testing results periodically, as well as submit requalification requests when necessary. Periodic inspections are sometimes necessary in order to maintain integrity of required specifications as well.

Of course, prior to manufacturing assembly, Qormino products required multiple package simulations as well as measured package characterizations for both thermal and reliability considerations.

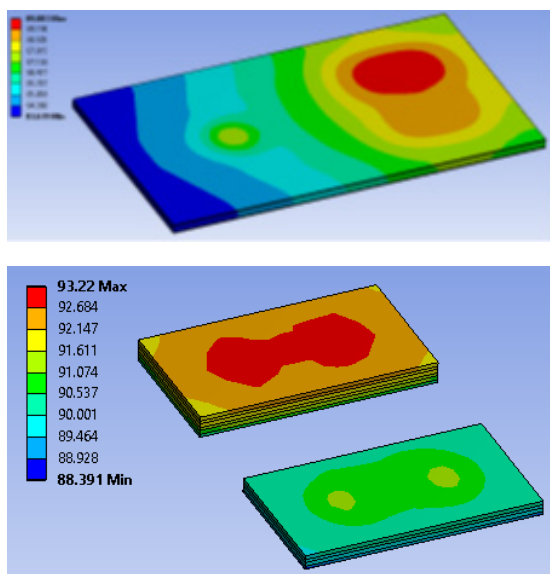


Figure 6 - Thermal Simulation of Qormino substrate and DDR4 stack

For example, Figure 6 shows thermal simulation results of a Qormino. Placing multiple devices within close proximity to each other is challenging in terms of thermal design. Thermal simulations with maximum details are required in order to closely predict junction temperatures on the most critical areas of the components. Teledyne e2v uses boundary conditions in order to simulate performance that will ultimately match with measured results.

On top of the simulations in the design phase, Qormino products were fully qualified through a number of tests to demonstrate their high reliability. Among other tests, this qualification includes in particular, temperature cycling, highly accelerated stress testing (HAST), mechanical shocks and vibrations. In addition, Board Level Reliability (BLR) testing has been conducted for the different versions of the devices with different solder materials. The result of those BLR tests exhibits an outstanding capability of those devices to survive thermal cycling when assembled on the customers' boards.



6. LONG TERM SUPPLY AND OBSOLESCENCE WARRANTY

Obsolescence is an issue of paramount importance for every military, defense, and avionics system developer. COTS technology continues to advance system designs and offers competitive prices; however, Hi-Rel (military-grade) designers of Military and Defense platforms need them to last 20 to 30 years. Powerful COTS technology can advance system performance, but unfortunately the forces that push this technology also create an obsolescence environment of 18 months, in some cases. In the midst of this environment, there has been a slow adoption of ARM-based processors, and the suppliers of these products have been even slower to embrace the requirements of the military, defense, and aerospace design communities. High-reliability integrated circuits need to be guaranteed to operate in harsh environments such as extreme radiation or temperature. It consumes considerable resources and budgets to develop and qualify these components that are guaranteed to operate in such environments – simply put, it is easier for the semiconductor suppliers to play it safe by developing products that will sell in higher volume in consumer applications.

Teledyne e2v has been addressing the obsolescence issue on processors for over 30 years. Specifically, Teledyne e2v has launched approximately 45 processor products over the last 20 years and shipping up to hundreds of thousands units per year to military, defense, and aerospace customers.

Teledyne e2v's has been basing many of these product offerings through the SLiM™ program (Semiconductor Lifecycle Management). The rationale behind this program is to provide system developers:

- The availability of semiconductors that have been driven by short-term consumer markets,
- Meet the growing demand for assured long-term supply of products for hi-rel civil aerospace applications, and to
- Secure stocks and guarantees against counterfeit products entering the supply chain that is required for decades.

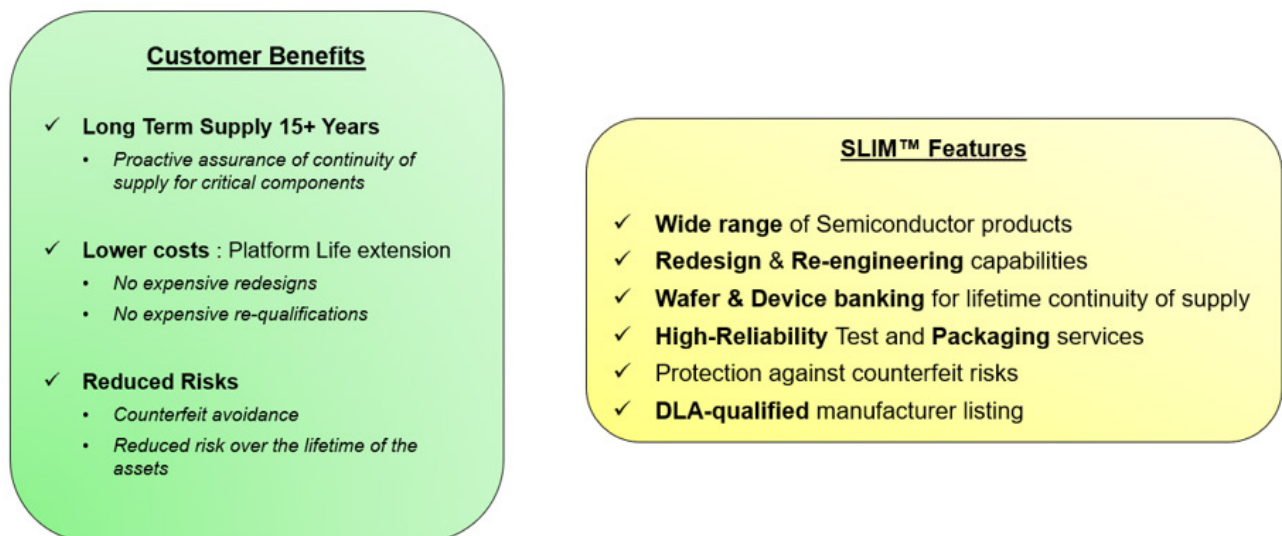


Figure 7 - SLiM Features and Benefits

In addition to all the above, Teledyne e2v can ultimately provide product warranties to developers for complete assurance of the design throughout the system's lifetime. The Qormino® family of products was specifically developed in conjunction with the SLiM™ program to provide developers maximum assurance.



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CONCLUSION

Military and Defense systems require Hi-Rel/ Military-grade processors drive military, defense, and avionics and companion DDR memories in order to fulfill systems development requirements. High-performance COTS technologies can become obsolete in 18 months while military and defense system developments can take 5-10 years design cycles, and service lifespans of 20 to 30 years.

Now, as the future of next generation military, defense, and avionics computing platform developments require high reliability/performance, safety critical, ultra-integrated computer platform solutions; Teledyne e2v's Qormino® family of products offers **an exclusive line of superior high performing and high reliability processing modules** that minimize the risks in regards to ownership costs and obsolescence issues. Qormino combines Multi-Core NXP (formerly Freescale) PowerArchitecture and ARM processors with DDR4 memory, on Teledyne e2v's custom BGA substrates.

Qormino is designed to respond to SWaP constraints and offers:

- Ultra high performance and reliable processors and DDR4 on very small substrates (44 x 26 mm),
- Reduced overall system design time for both hardware and software (project development time reduced by up to 18 months)
- Improved time-to-market while also providing 15+ years availability for obsolescence management.



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