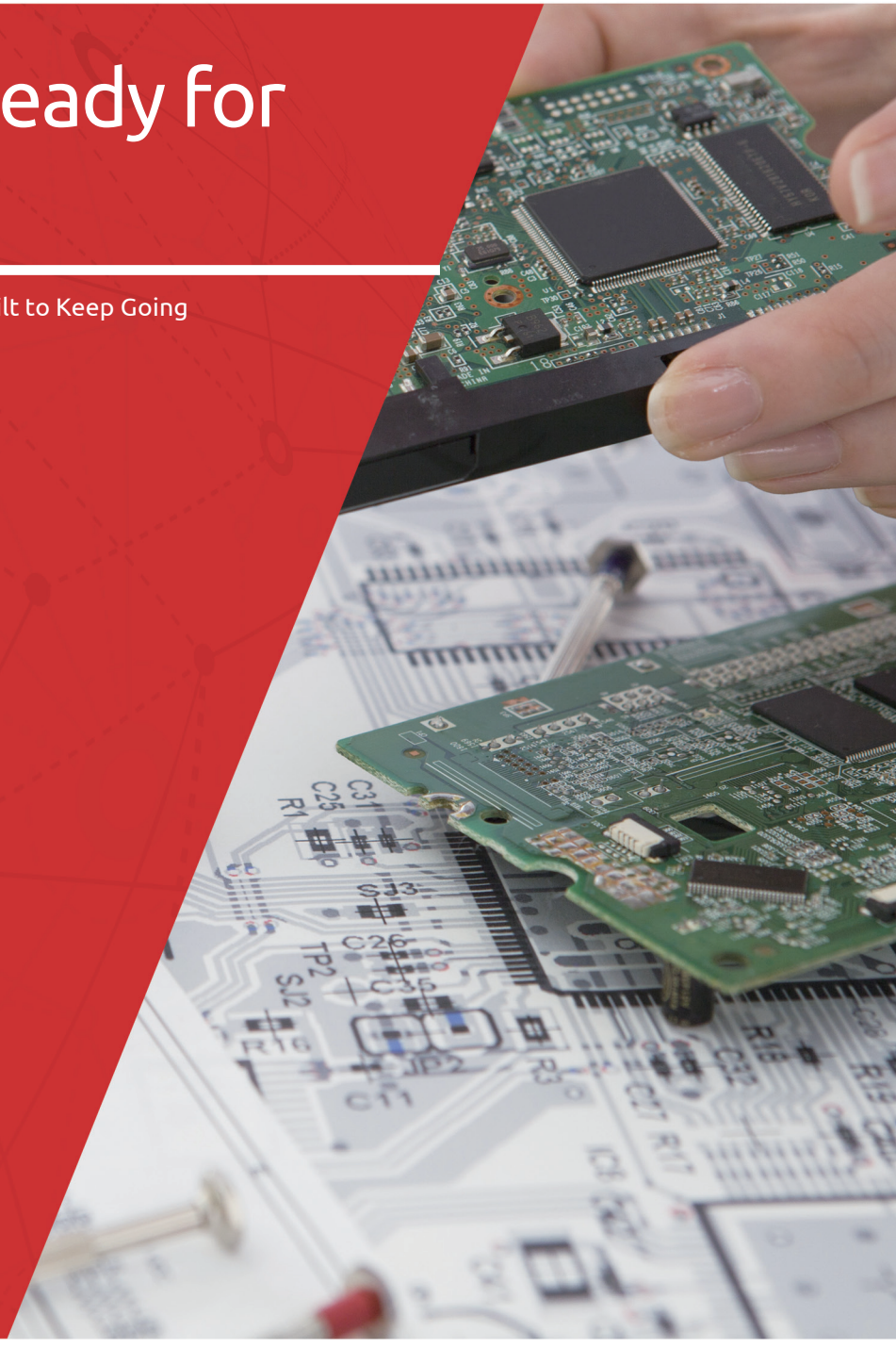
ADLINK
Leading EDGE COMPUTING

White Paper

Embedded Ready for Extremes

How Rugged ADLINK Solutions Are Built to Keep Going



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Embedded Ready for Extremes

How Rugged ADLINK Solutions Are Built to Keep Going

Harsh environments wreak havoc on electronics. Workstations, laptops, and other devices work without issue in a climate-controlled office. However, hostile temperatures (subzero or Saharan), high humidity, and dust, can be very problematic. Moreover, weather isn't the only factor with which field professionals must contend. Shocks and vibration can also damage components. Extreme conditions demand extreme hardware; component failure during mission-critical operations cannot be tolerated.

Many industries benefit from, if not require, rugged electronics. Military and industrial use is obvious, but professionals in medical, oil and gas, science, transportation, and other industries also need hardware that stands up to punishing situations.

ADLINK has emerged as a trusted leader in the rugged embedded computing field, thanks to the company's innovative solutions and a portfolio bolstered by strategic mergers and acquisitions, such as Ampro Computers, LiPPERT, PENTA, and PrismTech. As a result, ADLINK delivers exceptional hardware and seamlessly moves into existing sales channels, logistics centers, and custom service networks by rapidly expanding its infrastructure and opening new markets.

ADLINK strategically adds manufacturers to its corporate umbrella in the ongoing pursuit of building a cohesive, broadly integrated web of tools and services for next-generation industrial and commercial computing needs. This is particularly applicable in the rugged market, where all hardware is created far from equal. For example, other component manufacturers may simply encase commercial-grade hardware in a protective shell and brand it "ruggedized." This approach naturally affords a degree of protection against certain hazardous conditions, but beneath the casing rests the same circuitry found in consumer electronics. ADLINK goes further, infusing its hardware with rugged technology from the innermost components to the protective shell. Beginning with unrivaled R&D, ADLINK produces "Extreme Rugged" hardware in a class of its own.



Defining "Extreme Rugged"

Any manufacturer can slap an "extreme rugged" label on its products. Stickers are cheap. However, close scrutiny often reveals that they can't withstand constant exposure to extreme temperatures, humidity, and/or high impacts. Hardware must be more than superficially rugged.

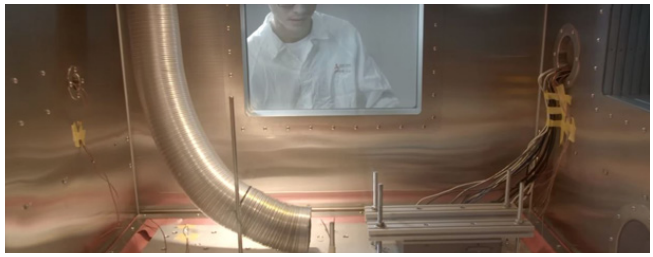
ADLINK serves the market as a trusted source of extremely rugged electronics because the company understands precisely what the market needs. In addition to resilience-focused research and development, ADLINK adheres to stringent design rules and an exhaustive component selection process to ensure that its "Extreme Rugged" family lives up to its name. Testing and qualification (including MIL-HDBK STD specifications, HALT testing, etc.) at both the design and manufacturing phases help ADLINK manufacture dependably durable and long-lasting products. Additionally, ADLINK stands behind its "Extreme Rugged" promise by offering customers exceptional after-sales support.

ADLINK's Mission

Among a crowded field of rugged component manufacturers, ADLINK aims to become the most trusted provider of embedded industrial products. Aside from the company's pursuit of incredibly resilient hardware at every stage of product development, ADLINK subjects its embedded components to rigorous and extensive testing. Instead of cutting corners, ADLINK pushes solutions even harder than necessary to exceed customer field requirements and industrial application needs. ADLINK meets these exacting requirements through a mix of standard, semi-custom, and custom components.

Many manufacturers make claims of a customer-centric focus but fail to deliver on such promises. ADLINK delivers extensive customer service and support that goes far beyond official commitments to service after point of sale. ADLINK integrates customers into the product development phase, which presents professionals an opportunity to tailor embedded solutions specific to their business's needs. By working hand in hand with ADLINK, professionals receive embedded solutions that enhance and expand end-user applications.

ADLINK Extreme Rugged embedded solutions thrive in environments that easily ruin commercial electronics, and the company is very thorough in its mission. ADLINK strains components with Extended Temperature Testing (ETT) to an operating temperature range of up to -40° C to 85° C (-40° F to 185° F) – conditions that are lethal to humans.



HASS - Highly Accelerated Stress Screen
HALT - Highly Accelerated Life Test

ADLINK executes its vision at every step, including component selection, circuit design, thermal management, PCB thickness, board layout, enclosure design, and manufacturing process. Rather than perform a single test at the end of production, ADLINK uses a battery of tests throughout multiple stages to ensure that products live up to the Extreme Rugged designation.

Test Early, Test Often

Starting at the design phase, ADLINK uses a variety of test protocols and methodologies. When ADLINK selects individual components for its Extreme Rugged embedded products, ETT plays a crucial role. Moreover, ADLINK uses high-margin circuit design – ICs proven to maintain functionality across wide temperature and voltage ranges — to better ensure reliable, high-performance functionality under environmental duress far in excess of what could be expected from consumer-grade components. ADLINK complements the ICs with IT Equipment (ITE) 180-compliant high-temperature PCB material, as per ASHRAE recommendations. All components feature full derating with MTBF calculations for commercial and extended temperatures.



Climate, Temperature, Humidity Testing

After ADLINK signs off on a design, the next step is prototyping, which involves more testing. In particular, ADLINK uses HALT (Highly Accelerated Life Test) methodology to put prototypes through the wringer. HALT testing reveals a design's limitations and maximum operating range by simulating product aging. The process batters components with extreme temperatures at both ends of the thermometer, six-axis vibration, and then a combination of temperature and vibration stress testing. Ultimately, HALT allows ADLINK to pinpoint normally undetected defects and correct them early in the development cycle.

Because durability and reliability at high temperatures are critical to a design's success or failure, ADLINK also tests thermal solutions — active and passive — to find an optimal match for a given prototype's needs. For example, ADLINK use advanced FloTHERM CFD (computational fluid dynamics) techniques to assess the suitability of a cooler in various thermal conditions. With thermal testing at the prototype stage, ADLINK can run coolers through several thermal parameters and customize a cooling solution to match a design. Customers can also request wind tunnel testing for products' heatsinks in ADLINK's state of the art labs.

HALT Torture Testing

ADLINK uses a variety of testing simulators to rigorously check and verify product performance. Our Extended Temperature Testing (ETT) procedure tests components for proper operation in both extreme heat (up to 85° C) and extreme cold (as low as -40° C). However, ADLINK's procedure is far more meticulous than sticking motherboards in an oven. Depending on customers' specific requests, ADLINK uses an exhaustive array of processes to verify products' thermal resilience.



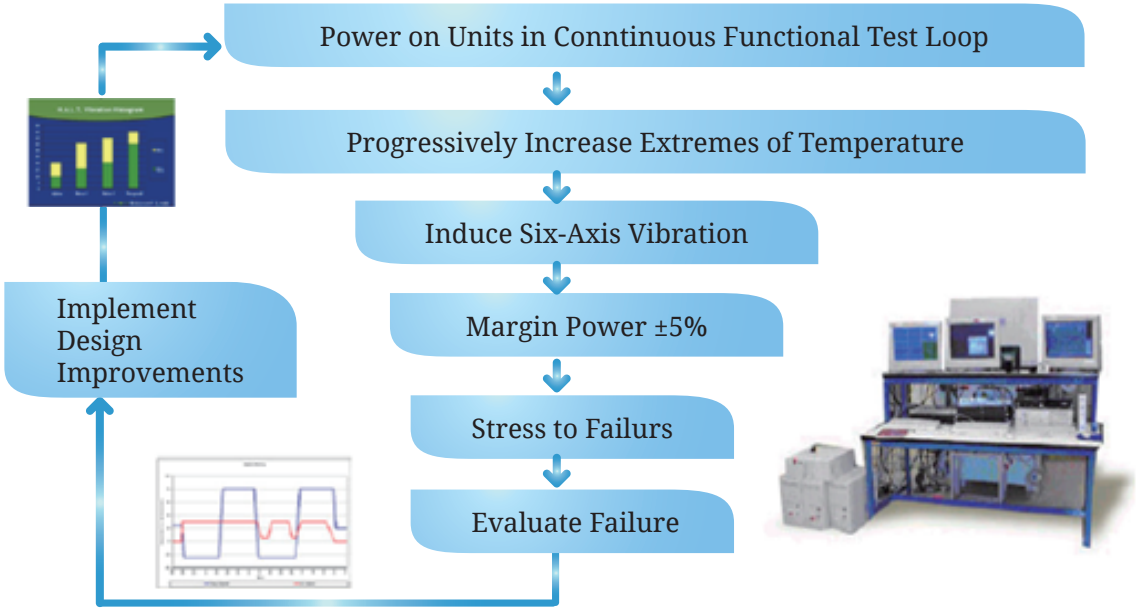
Environment/Climate test chamber

ETT screening occurs in three stages. During the design check, ADLINK technicians verify that a board continues to function over and beyond the full extended temperature range during functional, burn-in, and boot-up tests. Once ADLINK produces an engineering sample, the company also employs four-corner testing to guarantee stable, dependable performance at every minimum/maximum combination of temperature and voltage. At this stage, technicians also complete thermal shock and HALT testing. Prototypes must pass each of these tests before they advance to a pilot run. At this stage, ADLINK verifies that a component is ready for production by using functional and burn-in tests to assess ETT yield.

During the product development process, ADLINK implements HALT testing that places progressively higher strain on components, including rapid thermal transition, six-axis vibration, and tests that measure temperature and vibration simultaneously. For each of these tests, ADLINK examines key subsystem (CPU, I/O ports, disk controllers, and video) performance under stress. When a failure appears, ADLINK analyzes it and moves swiftly to engineer an appropriate fix. Testing resumes until the component reaches its destruct limit (the stress level at which operation ceases). ADLINK collects both hardware failures and physical damage data to improve its rugged designs.

ADLINK's HALT procedure follow these essential steps:

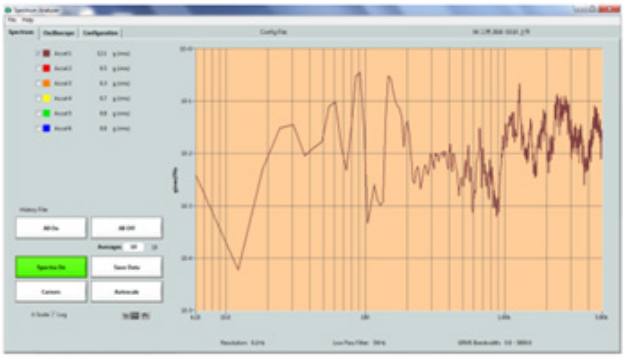
1. Power on units in continuous functional test loop
2. Progressively increase extremes of temperature
3. Induce six-axis vibration
4. Margin power (±5%)
5. Stress to failure
6. Evaluate failure
7. Implement design improvements



Labels matter to ADLINK. When the company gives its Extreme Rugged solutions a “Pass” label, it signifies that these products have completed ADLINK’s gauntlet of tests, like ETT and HALT. ADLINK maintains full transparency with customers, entering all test results into a database that clients may request, and further uses this same test data for internal quality assurance audits.

Additionally, ADLINK’s six-axis vibration tests are one of many steps ADLINK takes to prepare products for the severe bumps and bruises of field deployment. By default, ADLINK’s Extreme Rugged components comply with two U.S. Department of Defense standards. Motherboards meet the MIL-STD-202G Electronic and Electrical Component Parts test standard, which calls for multiple 50G shocks and 11.95 Grms of random vibration ranging from a minimum range of 100 to 1000 Hz along each axis. ADLINK Extreme Rugged solutions must also pass MIL-STD-810G, the U.S. Department of Defense’s standard for evaluating the influences of environmental stresses on materials.

After the final step, the process continues in a loop until a component survives ADLINK’s gauntlet.

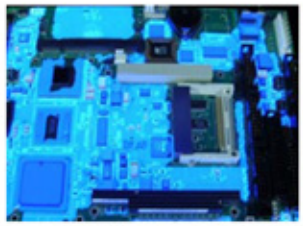


Vibration test screen shot

To meet and exceed the U.S. military’s strict shock and vibration requirements, ADLINK prepares its system boards with a collection of specialized components. These include thicker circuit boards, high-retention sockets, epoxy-reinforced bonding of vulnerable components (if required), test fastening for high-mass components, and immersion silver plating. Of course, rugged component design will only take a solution so far without a similarly rugged enclosure surrounding it. ADLINK designs and customizes enclosures certified to protect internal components against a broad spectrum of environmental threats. For the highest quality protection, ADLINK enclosures pass rigorous U.S. military durability standards.

The Extra Mile: Conformal Coating

Although extreme temperatures and high impacts clearly threaten electronics, other environmental conditions pose risks, as well. Industrial, military, nautical, and aerospace industries regularly expose components to hazards beyond humidity. Salt spray, fungus, and other contaminants are just as harmful, so ADLINK takes additional measures to safeguard embedded solutions. Designs may optionally incorporate a conformal coating that protects against moisture, dust, dendritic growth, corrosion, short circuits, abrasions, and other operational threats.



Coating Inspection under Blacklight



Coating Thickness Gauge

ADLINK employs HumiSeal 1B31 acrylic coating, which possesses several advantageous properties. It dries quickly and is typically easy to repair. HumiSeal 1B31 resists moisture, has exceptional dielectric properties, is very flexible, and contains a UV safety tracer to simplify blacklight inspections.

ADLINK can apply the coating in several ways. Technicians can spray it over a board, submerge the board into the coating, or use flow coating. Regardless of the method, coatings dry with an average three-mil (0.003-inch) thickness, effectively conforming to the board. Alternatively, ADLINK can apply epoxy, urethane, paraxylylene, and silicone-based coatings upon customer request.

Wide Range, Individual Focus

ADLINK stands committed to serve the full spectrum of rugged markets, and the company's portfolio boasts a range of supporting certifications (including MIL-I-46058, ISO-7637, and IPC-CC-830). However, the company's Extreme Rugged product line serves many other less common industries, such as gaming, communications, dedicated testing and measurement, automation and process control, networking, and security. In addition to the long list of durability certifications ADLINK's Extreme Rugged components meet, ADLINK also guarantees regulatory requirements for electromagnetic compatibility (EMC), safety, and environment.

In-line with ADLINK's pledge of product longevity, the company selects Intel® processors that support long lifecycles and rugged requirements. Intel® processors offer a wide range of thermal specifications for extended temperature applications, and today's multi-core Intel® processors deliver tremendous processing performance per watt with cores that communicate via low-latency data paths. Intel's processors available with ruggedized options are software compatible across a wide range of performance from Intel® Quark™ Microcontrollers to Intel® Atom™, Core™, and server-class Xeon® processor families.

To fulfill customers' unique requirements, ADLINK supplements its standard hardware with semi-customizable and fully customized options. For instance, end-users can combine ADLINK's PC104 stackable modules to create unlimited applications. A mix-and-match modularity approach leads to a longer hardware life cycle, a strong support system, and lower costs. Furthermore, customers can build modular solutions with customizable peripheral interface connections and module upgrades.

ADLINK's Extreme Rugged products help professionals accomplish their objectives in the field, and ADLINK matches hardware toughness with unwavering customer service and support. For instance, Extreme Rugged product lifecycles exceed seven years. For ADLINK's products, the company issues a 60-day written notice of necessary changes that affect the form, fit, or function of a particular board. That way, customers can fully grasp changes well in advance of implementation. ADLINK also continues "last shipments" for a full year.

Ultimately this combination of ADLINK/customer collaboration in design, exceptional development testing and durability, and superior client support results in perfectly tailored hardware that doesn't fail and remains reliable. ADLINK gives embedded market professionals the tools they need to succeed with their value-added, rugged offerings today and far into the future.

ADLINK technology is a Premier member of the Intel® Internet of Things Solutions Alliance. From modular components to market-ready systems, Intel and the 400+ global member companies of the Intel® Internet of Things Solutions Alliance provide scalable, interoperable solutions that accelerate deployment of intelligent devices and end-to-end analytics. Close collaboration with Intel and each other enables Alliance members to innovate with the latest technologies, helping developers deliver first-in-market solutions.

Learn more at: intel.com/iotsolutionsalliance



About ADLINK

ADLINK Technology is enabling the Internet of Things (IoT) with innovative embedded computing solutions for edge devices,intelligent gateways and cloud services. ADLINK's products are application-ready for industrial automation, communications, medical, defense, transportation, and infotainment industries. Our product range includes motherboards, blades, chassis, modules, and systems based on industry standard form factors, as well as an extensive line of test & measurement products, smart touch computers, displays and handhelds that support the global transition to always connected systems. Many products are Extreme Rugged, supporting extended operating temperature ranges, and MIL-STD levels of shock and vibration.

ADLINK is a Premier Member of the Intel® Internet of Things Solutions Alliance and is active in several standards organizations, including the PCI Industrial Computer Manufacturers Group (PICMG), the PXI Systems Alliance (PXISA), and the Standardization Group for Embedded Technologies (SGET).

ADLINK is a global company with headquarters in Taiwan and manufacturing in Taiwan and China; R&D and integration in Taiwan, China, the US, and Germany; and an extensive network of worldwide sales and support offices. ADLINK is ISO-9001, ISO-14001, ISO-13485 and TL9000 certified and is publicly traded on the TAIEX Taiwan Stock Exchange (stock code: 6166).

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