

# Rugged Capabilities



## Off-the-Shelf Solutions for Rugged Environments

- **Commercial Level 0 – For development or deployment in benign environments**
- **Air-Cooled Level 1 – For moderate temperature requirements in addition to shock, vibration and humidity**
- **Conduction-Cooled Level 3 – For extremely rugged environments where convection cooling is inappropriate or impossible; includes increased altitude, humidity and vibration regimens**
- **Air Flow-By Level 4 - For extremely rugged environments and maximum heat dissipation**

Rugged products from Mercury Systems master today's most demanding environmental challenges while maintaining functionality, performance and software compatibility with Mercury's commercial environment solutions. System developers can achieve required levels of ruggedization, as well as meet critical environmental specifications and cost criteria using industry-standard multicomputer systems.

### Solutions for All Environmental Levels

Mercury delivers scalable, high-performance computing solutions that address the full range of environmental conditions — from the commercial laboratory to harsh, embedded industrial environments. The broad range of environmental ruggedization options allows a developer to start with a scaled-down, lower-cost commercial system. Once the prototyping and characterization phase of the project is completed, the developer can migrate applications seamlessly to rugged products for deployment in harsh environments.

### Mercury's Rugged Strategy

Mercury products are based on appropriate, industry-accepted open standards and use the latest technologies. This commitment enables Mercury to provide consistently high functionality across multiple environmental levels. As a result, the customer can maintain code compatibility across rugged and commercial environmental applications.

Because Mercury invests in code portability and architecture leverage across product lines, applications developed on commercial-grade Mercury systems are wholly compatible with their more rugged counterparts. The seamless transition between the prototype and deployed phases of a project maintains performance integrity, thereby reducing time to deployment and supporting Quick Response Capability (QRC).

### Designed for Endurance

Not all rugged products in the market are equal. Since the term "rugged" has no industry-standard definition, specifications can vary substantially. One vendor's claim of ruggedness, therefore, could be closer to another vendor's commercial specification. Mercury products are carefully designed and tested to ensure compliance with Mercury's published specifications. Extensive mechanical and thermal modeling is used to validate design approaches, and rigorous production testing creates reliable and deployable products. Mechanical packaging changes include a stiffening frame running across the board and wedgelocks to clamp motherboards into enclosure wall slots.

As power dissipations increase, innovations in mechanical packaging support more efficient heat dissipation while maintaining the characteristics necessary to support high levels of shock and vibration. Boards use conformal coatings to protect against high humidity, chemicals and fungus, and metal surfaces are plated with nickel to protect them against salt/fog intrusion. Board thermal stresses are minimized through a number of design innovations, including technologies to support the mounting of high-powered mezzanine modules on compute baseboards.

*Mercury Systems is a best-of-breed provider of commercially developed, open sensor and Big Data processing systems, software and services for critical commercial, defense and intelligence applications.*



ACQUIRE



DIGITIZE



PROCESS



STORAGE



EXPLOIT



DISSEMINATE

For operation in environments where conventional air-cooling is not possible, Mercury provides fully compatible conduction-cooled and spray-cooled versions of many of its products. Mercury drove the creation of the VITA 48 specification — specifically the VITA 48.2 document, which provides requirements for conduction-cooling of OpenVPX™ products. As editors of the VITA 48, 48.1 and 48.2 specifications, Mercury is well positioned to take advantage of these documents in creating high-performance rugged VPX products.

Other design features that enhance system reliability and quality include reduction of the parts count and selection of lowest wattage versions available for components. These techniques extend the average time between component failures to keep Mercury rugged systems operating even in the most adverse environments.

### Air Flow-By

Both air- and conduction-cooled chassis require filters to remove contaminants from their cooling air streams. Mercury's Air Flow-By™ technology eliminates filtration with the most elegant cooling solution available within a sealed and rugged package. Air Flow-By is resilient, boosts Size, Weight, and Power (SWaP), reduces operating temperature, extends MTBF by an order of magnitude and enables the most powerful processing solutions.

### Chassis Systems

Because the chassis is an integral element of rugged system design, Mercury takes a total system approach to providing the hardware and software engineering, integration and test, installation, and support of chassis systems. Considerations include structural requirements for surviving in harsh environments, and facilities for moving thermal energy from the chassis interior. This assures the customer that the chassis is more than a box: It's a fully qualified part of the system solution that supports and enhances its rugged characteristics.

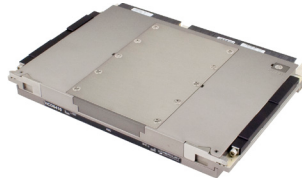
Mercury capabilities include:

- Chassis ruggedization
- High-grade commercial chassis units designed for agency approvals
- Environmentally enhanced chassis systems
- Rugged/EMI systems suitable for rugged and airborne use
- Customer-specific environmental testing for deployed systems

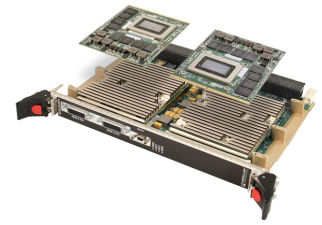
### Life-Cycle Support

Mercury backs its commitment to customer success with an extensive support operation. Available service offerings include front-end design support, configuration management and repair services. Planning services for the multi-year availability of each new product in the original configuration and extended product support are also available. The standard Mercury warranties are one year on parts and labor with a lifetime warranty for design defects.

### Sample Rugged Boards



**Ensemble HCD6410 6U OpenVPX rugged conduction-cooled high-compute density module**



**Ensemble GSC6201 is a 6U carrier module that integrates two high-performance AMD GPGPUs.**  
(Mercury supports both AMD and NVIDIA GPGPU technologies)

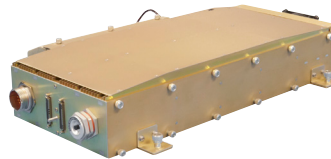


**Space-efficient, rugged Echotek® DCM-V5-XMC digital receiver in mezzanine card form factor**



**Ensemble HDS6602 6U OpenVPX rugged dual ten-core high-density server processing module**

### Sample Rugged Systems



**Configurable, highly rugged Digital Storage Unit (DSU) offers 96 TB of data storage**



**Scalable 3U rugged Open Systems Architecture (OSA) optimizes SWaP limitations**



**Performance optimized, 6U rugged Application Ready Subsystem contains best-of-breed building blocks**



**Ensemble 7100 System delivers extreme processing density for lab and deployed environments**

## Environmental

Environmental		Environmental Qualification Levels				
		Air-cooled			Air Flow-By	Conduction-cooled
		Commercial L0	Rugged L1	Rugged L2	Rugged L4	Rugged L3
Ruggedness		•	••	••	•••	•••
Moisture/dust protection		•	••	••	•••	•••
Typical cooling performance		~140W*	~140W*	~150W*	~200W*	~150W**
Temperature	Operating*	0°C to +40°C	-25°C to +55°C	-45°C to +70°C	-40°C to +60°C	-40°C to +71°C
Operating temperature maximum rate of change		N/A	5°C/min	10°C/min	10°C/min	10°C/min
Temperature	Storage	-40°C to +85°C	-55°C to +85°C	-55°C to +125°C	-55°C to +125°C	-55°C to +125°C
Humidity	Operating*	10-90%, non-condensing	5-95%, non-condensing	5-95%, non-condensing	5-95%, non-condensing 100% condensing	5-95%, non-condensing 100% condensing
	Storage	10-90%, non-condensing	5-95%, non-condensing	5-95%, non-condensing	5-95%, non-condensing 100% condensing	5-95%, non-condensing 100% condensing
Altitude	Operating*	0-10,000ft	0-30,000ft	0-30,000ft	0-30,000ft	0-70,000ft
	Storage	0-30,000ft	0-50,000ft	0-70,000ft	0-70,000ft	0-70,000ft
Vibration	Random	0.003 g <sup>2</sup> /Hz; 20-2000 Hz, 1 hr/axis	0.04 g <sup>2</sup> /Hz; 20-2000 Hz, 1 hr/axis	0.04 g <sup>2</sup> /Hz; 20-2000 Hz, 1 hr/axis	0.1 g <sup>2</sup> /Hz; 5-2000 Hz, 1 hr/axis	0.1 g <sup>2</sup> /Hz; 5-2000 Hz, 1 hr/axis
	Sine	N/A	N/A	N/A	10G peak; 5-2000 Hz, 1 hr/axis	10G peak; 5-2000 Hz, 1 hr/axis
	Shock	z-axis: 20g; x and y-axes: 32g; (11ms 1/2-sine pulse, 3 positive, 3 negative)	z-axis: 50g; x and y-axes: 80g; (11ms 1/2-sine pulse, 3 positive, 3 negative)	z-axis: 50g; x and y-axes: 80g; (11ms 1/2-sine pulse, 3 positive, 3 negative)	z-axis: 50g; x and y-axes: 80g; (11ms 1/2-sine pulse, 3 positive, 3 negative)	z-axis: 50g; x and y-axes: 80g; (11ms 1/2-sine pulse, 3 positive, 3 negative)
Salt/Fog		N/A	Contact Factory	Contact Factory	10% NaCl	10% NaCl
VITA 47		Contact Factory				

\* Customer must maintain required cfm level. Consult factory for the required flow rates.

\*\* Card edge should be maintained below 71°C

Storage Temperature is defined per MIL-STD-810F, Method 502.4, para 4.5.2, where the product under non-operational test is brought to an initial high temperature cycle to remove moisture. Then the unit under non-operational test will be brought to the low storage temperature. The low temperature test is maintained for 2 hours. The product is then brought to the high storage temperature and is maintained for 2 hours. The product is then brought back to ambient temperature. All temperature transitions are at a maximum rate of 10°C/min. One cold/hot cycle constitutes the complete non-operational storage temperature test. This assumes that the board level products are individually packaged in accordance with ASTM-D-3951 approved storage containers. These tests are not performed in Mercury shipping containers, but in an unrestrained condition. Please consult the factory if you would like additional test details.

All products manufactured by Mercury meet elements of the following specifications: MIL-STD-454, MIL-STD-883, MIL-HDBK-217F, and MIL-I-46058 or IPC-CC-830, and various IPC standards. Mercury's inspection system has been certified in accordance with MIL-I-45208A.

Additional Services			
Optional Environmental Screening and Analysis Services		Standard Module, Optional Services	
• Cold Start Testing	• Safety Margin Analysis	• Engineering Change Order (ECO) Notification	• Alternate Mean Time Between Failure (MTBF) Calculations
• Cold Soak Testing	• Temperature Cycling	• ECO Control	• Hazmat Analysis
• Custom Vibration	• Power Cycling	• Custom Certificate of Conformity (CoC)	• Diminished Manufacturing Sources (DMS) Management
• CFD Thermal Analysis	• Environmental Stress Screening	• Custom UID Labeling	• Longevity of Supply (LOS)
• Finite Element Analysis			• Longevity of Repair (LOR)
Contact factory for additional information			

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803.09E-0314-DS-MRCYrugged

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