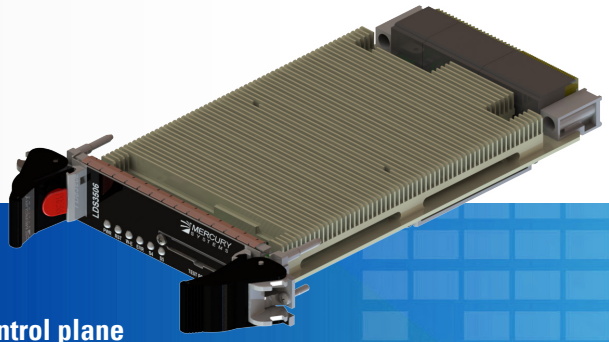
DATASHEET

Ensemble® 3000 Series OpenVPX™ Intel® Xeon® Processor D Family LDS3506 Server-Class with FPGA Module

Powerful combination of Intel® Xeon® D family server-class and FPGA processing in a rugged, 3U OpenVPX module



- **3U OpenVPX™ compliant VITA 65/46/48 (VPX-REDI) module**
- **Broadwell DE Intel® Xeon® D family server-class processor**
- **Xilinx® UltraScale™ FPGA with dual x4 PCIe data plane and Ethernet control plane**
- **Massive processing power in a single slot**
- **Dual 10 Gigabit Ethernet interfaces for sensor I/O or inter-processor communication**
- **x8 PCIe expansion plane for additional I/O or offload**
- **Mercury MultiCore Plus® software infrastructure support**

The Ensemble® LDS3506 combines Intel's Xeon D family of server-class processors with Xilinx's UltraScale family of FPGA devices. This dense union of best available commercial-item general processing and FPGA resources produces a highly versatile, affordable and interoperable building block for embedded, high-performance compute applications with additional low-latency, refresh and mission capabilities.

The Xilinx's UltraScale FPGA provides a platform for third party IP and Mercury's next-generation Protocol Offload Engine Technology (POET) fabric bridge, supporting the paired requirements of flexibility and performance for the PCIe based 3U OpenVPX data plane. By leveraging these elements in combination with Mercury's extensive software and FPGA IP library, the Ensemble LDS3506 becomes a balanced and affordable building block for radar, electronic warfare, and mission processing applications with tight SWaP requirements.

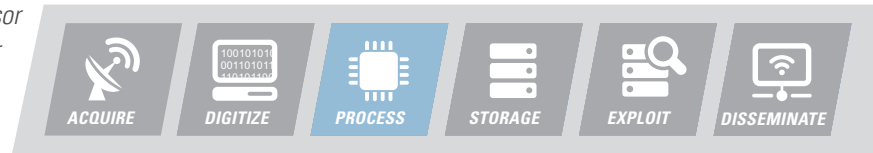
Intel Xeon D Family Server-Class Processor

The Ensemble LDS3506 features a 64-bit Xeon D family processor which is protected and cooled by Mercury's fifth generation of server-class packaging, which has previously been deployed in the HDS6600, HDS6601, HDS6602, and HDS6603 6U OpenVPX processing modules.

The D family of Xeon processors includes a System on Chip (SoC) approach, combining the processor and the Intel Platform Controller Hub (PCH) function within a single device. As a solderable BGA, the Xeon D family extends the applicability of the Xeon family in to the compact 3U space. As an example, the D-1548 device delivers up to 512 GFLOPS of processing power, which is a significant performance boost for the 3U form factor. With two high-speed DDR4-2133 memory controllers, the Xeon processor is able to support up to 16GB of DRAM, with future capabilities of up to 32GB per module. Significant PCIe interface capabilities are built in to the chip, which enable data interfaces both on-board and off-board.

The on-device PCH functionality enables the Ensemble LDS3506 to access additional I/O, including USB and SATA on the backplane. The D family of Xeon processors has dual 10 Gigabit Ethernet interfaces, enabling backplane access for sensor data or additional inter-processor communication and support for the AVX 2.0 instruction set. That boosts floating-point algorithm performance and is portable to future Intel architectures.

Mercury Systems is a leading commercial provider of secure sensor and safety-critical processing subsystems. Optimized for customer and mission success, Mercury's solutions power a wide variety of critical defense and intelligence programs..



Integrated FPGA Resources

The Ensemble LDS3506 integrates a Xilinx UltraScale FPGA device with the Intel processor to provide additional data plane functionality and security offload capabilities. The FPGA resources support the full OpenVPX data plane for flexible PCIe configurations, with the ability to enable dual Non Transparent Bridges (NTB), switching, and high-speed DMA engines in a single device.

In addition to the data plane, the Ethernet control plane is integrated with the UltraScale device to allow for additional flexibility in configuration and capability. By offloading traditional SBC functionality, including serial interfaces to the FPGA, the Ensemble LDS3506 module reduces DMS concerns for long-term support of program requirements. Mercury's FPGA Development Kits are available and support the integration of customer or third party FPGA IP, and to facilitate customer IP development efforts.

High-Speed Fabric Interfaces

Dual x4 PCIe interfaces are routed through the on-board FPGA to the OpenVPX data plane. Because these interfaces are not dependent on native Intel processor resources, the Ensemble LDS3506 is capable of providing dual NTB functions across both x4 interfaces instead of a single NTB, to produce highly scalable and flexible data plane configurations. Being FPGA-based, the protocol operating on the data plane can be transformed to other options, including 10 Gigabit Ethernet and Serial RapidIO®, with a simple firmware change.

PCIe Architecture

The Ensemble LDS3506 supports dual x4 PCIe data plane and a x8 PCIe expansion plane interface to integrate additional 3U modules, including mezzanine carriers, FPGA processing modules, and analog to digital conversion functions.

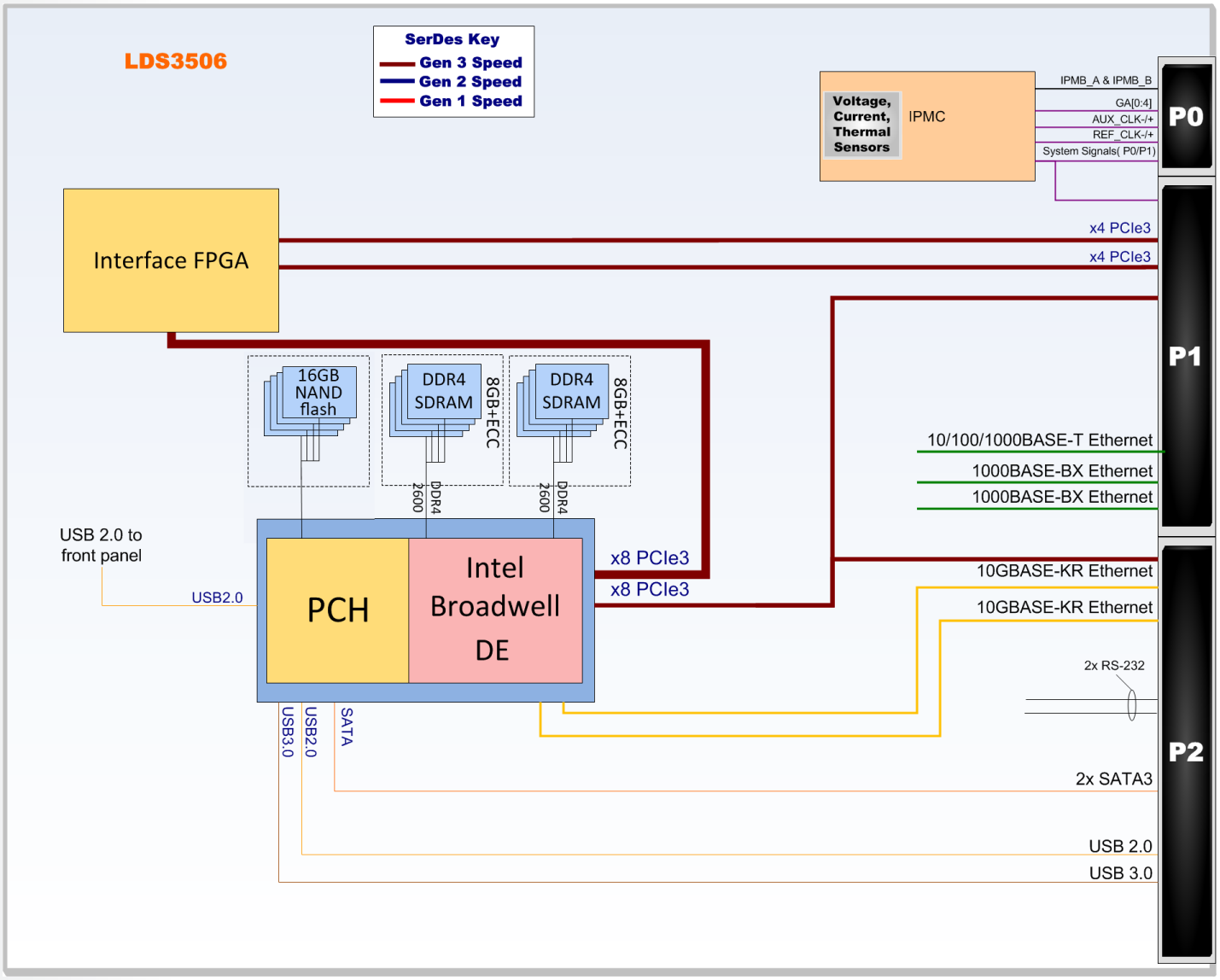


Figure 1 - LDS3506 functional block diagram

Multiple I/O Options

The Ensemble LDS3506 includes a variety of additional built-in I/O options:

- One 10/100/1000BASE-T Gigabit Ethernet connection routed from the Intel processor to the backplane
- Two 1000BASE-BX SERDES Ethernet connections routed from the Xilinx FPGA to the backplane as per the OpenVPX control plane specification
- Two 10 Gigabit Ethernet (KR) interfaces are routed from the Intel processor to the user I/O space on the backplane
- Two RS-232 serial ports are routed to the backplane
- Backplane USB and SATA interfaces are provided for interfacing to I/O or storage devices as needed
- Multiple GPIO lines act as discrete I/O, usable as I/O or to generate interrupts on the module
- Multiple additional bused signals enhance the functionality of the Ensemble LDS3506 module

System Management Plane

The Ensemble LDS3506 module implements the advanced system management functionality architected in the OpenVPX standard to enable remote monitoring, alarm management, and hardware revision and health status.

Using the standard I2C bus and IPMI protocol, the on-board system-management block implements the Intelligent Platform Management Controller (IPMC), in accordance with the VITA 46.11 standard. This allows the Ensemble LDS3506 module to:

- Read sensor values
- Read and write sensor thresholds, allowing an application to react to thermal, voltage, or current variations that exceed those thresholds
- Reset the entire module
- Power up/down the entire module
- Retrieve Field Replaceable Unit (FRU) information
- Be managed remotely by a chassis management controller at the system level

VPX-REDI

The VPX (VITA 46) standard defines 6U and 3U board formats with a modern high-performance connector set capable of supporting today's high-speed fabric interfaces. VPX is most attractive when paired with the Ruggedized Enhanced Design Implementation standard – REDI (VITA 48). The Ensemble LDS3506 module is implemented as a 3U conduction-cooled implementation of VPX-REDI, with air-cooled and Air Flow-By™ variants in the same VPX form factor available for less rugged environments.

Targeted primarily for harsh-environment embedded applications, VPX-REDI offers extended mechanical configurations supporting higher functional density, such as two-level maintenance (2LM). 2LM allows relatively unskilled maintenance personnel to replace a failed module and restore the system to an operational state in a limited time period, minimizing potential damage to the module.

Rugged air cooling, Air Flow-By

Air- and conduction-cooled subsystems rely on filtration 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. Fully compliant to VITA standards (including VITA 48.7), Air Flow-By maintains OpenVPX's 1-inch pitch requirement, is highly resilient to liquid and particle contamination, boosts SWaP, reduces operating temperature, extends MTBF by an order of magnitude and enables embedded deployment of the most powerful and reliable processing solutions.

Mercury's OpenVPX Ecosystem

Sensor chain awareness is having the technical expertise and resources to design and build capable, interoperable solutions along the whole sensor processor chain. From RF/microwave, digital/analog signal manipulation to dense, SWaP optimized processing resources to actionable intelligence dissemination; Mercury's rugged processing subassemblies leverage the best commercial-item technology, enabling prime contractors to win more business.

Modern sensor processing subassemblies are customized assemblies of interoperable building blocks built to open standard architectures. Mercury's hardware and software portfolio of building blocks are physically and electrically interoperable as defined by international industrial standards, including OpenVPX.

Additional Features

The Ensemble LDS3506 module provides all the features typically found on a single-board computer. In addition to the sophisticated management subsystem and fabric interconnect, the Ensemble LDS3506 module provides users with a toolkit enabling many different application use cases.

Features include:

- Thermal and voltage sensors integrated on-board
- Real-time clock with granularity to 1 ms and time measurement of up to 30 years
- General-purpose timers
- Global clock synchronization capabilities via the OpenVPX utility plane clock signals
- Watchdog timer to support interrupt or reset
- Multiple boot paths, include netboot, USB boot, or boot from external SATA

Open Software Environment

Mercury leverages over 25 years of multicomputer software expertise, including recent multicore processor expertise, across its many platforms. This strategy is fully applied to the Ensemble LDS3506 module. Because the processor, memory, and surrounding technologies are leveraged across product lines, software developed on the Ensemble LDS3506 module can interface seamlessly with other Mercury products. The same development and run-time environment is implemented on the Ensemble LDS3506 module as on other Mercury platforms across the Ensemble 3000, 5000, and 6000 series.

The MultiCore Plus® (MCP) open software environment gives the Ensemble LDS3506 module access to a wide ecosystem of stacks, middleware, libraries, and tools.

Software support is available on the Ensemble LDS3506 module for the following products:

- Support for Mercury's standard numeric libraries via the MathPack product, which includes VSIPL and SAL (Scientific Algorithm Library), is optimized for the Intel AVX 2.0 architecture of the Ensemble LDS3506 module.
- Inter-processor Communication System (ICS) support is carried forward from the RACE++®/MCOE™ software environment. ICS provides a low-level inter-processor communication API that lets users take advantage of the high-bandwidth, low-latency PCIe fabric with an easy-to-use software interface.
- OpenMPI/OFED middleware support pairs an open, recognized software interface with Mercury's optimization at the fabric level for unparalleled performance for data transfers over the data plane fabric.
- Trace Analysis Tool and Library (TATL™) is a "logic analyzer for software" that provides insight into the dynamic interaction of up to a few hundred processors.

The MCP software environment lets applications use industry-standard middleware such as MPI, DRI, CORBA, or standard TCP/IP sockets ported to run seamlessly over the fabric. MCP also offers a software tool that can help to migrate legacy applications created with MCOE™ into the MCP domain.

Specifications

Main processor

Intel 8-core, 64 bit, Xeon D-1548
512 GFLOPS peak performance
AVX 2.0

Optional Processors

Xeon D-1559

FPGA

Xilinx UltraScale XCKU040 or XCKU060

System Memory

8 or 16GB DDR4-2133 (32GB planned)
16GB SATA NAND Flash

Mechanical

3U OpenVPX, single width (1-inch)
Module packages:
- Air-cooled
- Conduction-cooled
- Air Flow-By

Compliance

OpenVPX System Specification (VITA 65) encompasses:
- VITA 46.0, 46.3, 46.4, 46.6, 46.11, and VITA 48.1, 48.2 (REDI) and 48.7 (Air Flow-By)

OpenVPX profile
- MOD3-PAY-2F2U

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^2/Hz; 20-2000 Hz, 1 hr/axis	0.04 g^2/Hz; 20-2000 Hz, 1 hr/axis	0.04 g^2/Hz; 20-2000 Hz, 1 hr/axis	0.1 g^2/Hz; 5-2000 Hz, 1 hr/axis	0.1 g^2/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 ½-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 (CofC)	• Diminished Manufacturing Sources (DMS) Management
• CFD Thermal Analysis	• Environmental Stress Screening	• Custom UID Labeling	• Longevity of Suppy (LOS)
• Finite Element Analysis			• Longevity of Repair (LOR)
Contact factory for additional information			

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CORPORATE HEADQUARTERS
50 Minuteman Road • Andover, MA 01810 USA
(978) 967-1401 • (866) 627-6951 • Fax (978) 256-3599

EUROPE MERCURY SYSTEMS, LTD
Unit 1 - Easter Park, Benyon Road, Silchester, Reading
RG7 2PQ United Kingdom
+ 44 0 1189 702050 • Fax + 44 0 1189 702321