DATASHEET

Ensemble 6000 Series
Dual NVIDIA GPGPU Processing
OpenVPX GSC6201 6U GPGPU Module

NVIDIA® Fermi™ architecture-ready high-performance stream processing in a single 6U slot for rugged environments

- **NVIDIA Fermi GPGPU processing through industry-standard GPU MXM cards**
- **Mercury's StreamDirect™ for GPGPUs increases overall system efficiency and intelligence gathering**
- **C/C++ application development with open standards OpenCL™, NVIDIA CUDA™ and Mercury's Scientific Algorithm Library (SAL™)**
- **Rugged conduction-cooled module exceeds strict VITA 47 standards for shock and vibration**

The GSC6201 is a 6U OpenVPX™ carrier module that integrates two high-performance NVIDIA GPGPUs for applications that can benefit from massively parallel processing on streams of high-bandwidth data. GPGPUs offer some of the highest GFLOP processing performance as well as the highest GFLOP/Watt performance efficiency in the industry.

Meeting Today's Processing Demands

Commercial and defense applications such as radar, electro-optical/infrared (EO/IR), electronic warfare and cyber generate large amounts of raw sensor or network data that need to be processed in real-time to extract actionable intelligence. Each new generation of sensor arrays ushers in higher resolutions and frame rates; along the same lines, network traffic is also increasing exponentially. Consequently, the input levels from both of these data streams are now reaching "Big Data" proportions. By offloading compute-intensive operations to GPGPUs such as Fast Fourier Transforms (FFTs), matrix multiplication, Constant False Alarm Rate (CFAR), QR Decomposition (QRD), Synthetic Aperture Radar (SAR), video codecs (H.264, JPEG2000), pattern recognition or deep packet inspection, system architects can engineer solutions that can meet today's processing demands — with room to scale for higher performance requirements in the future while preserving significant IP investment.

The GSC6201 is Mercury's 3rd generation 6U dual GPGPU MXM module, backed with a history of field-proven deployments in a number of defense programs since 2008. Updates to the new GSC6201 include higher I/O bandwidth, StreamDirect for GPGPUs and support for NVIDIA Fermi GPGPUs.

StreamDirect for GPGPUs: Faster Intelligence

Mercury's StreamDirect writes data directly from the sensor straight into GPGPU memory, reducing data latency by 50 percent, thereby

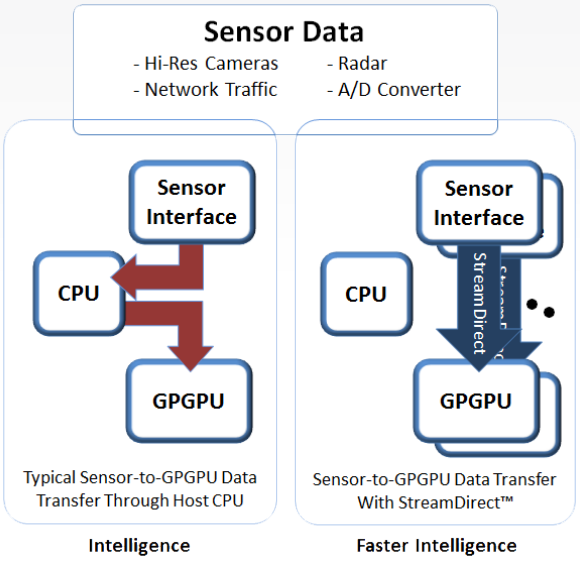
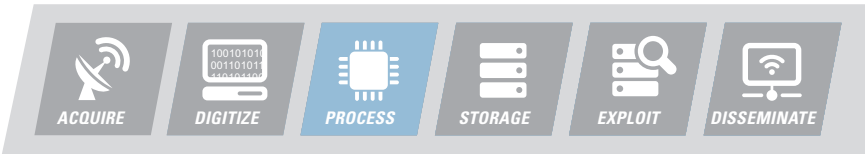


Figure 1. *StreamDirect reduces the time from raw data to intelligence by 50 percent by writing sensor data directly into the GPU's memory for immediate processing*

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.



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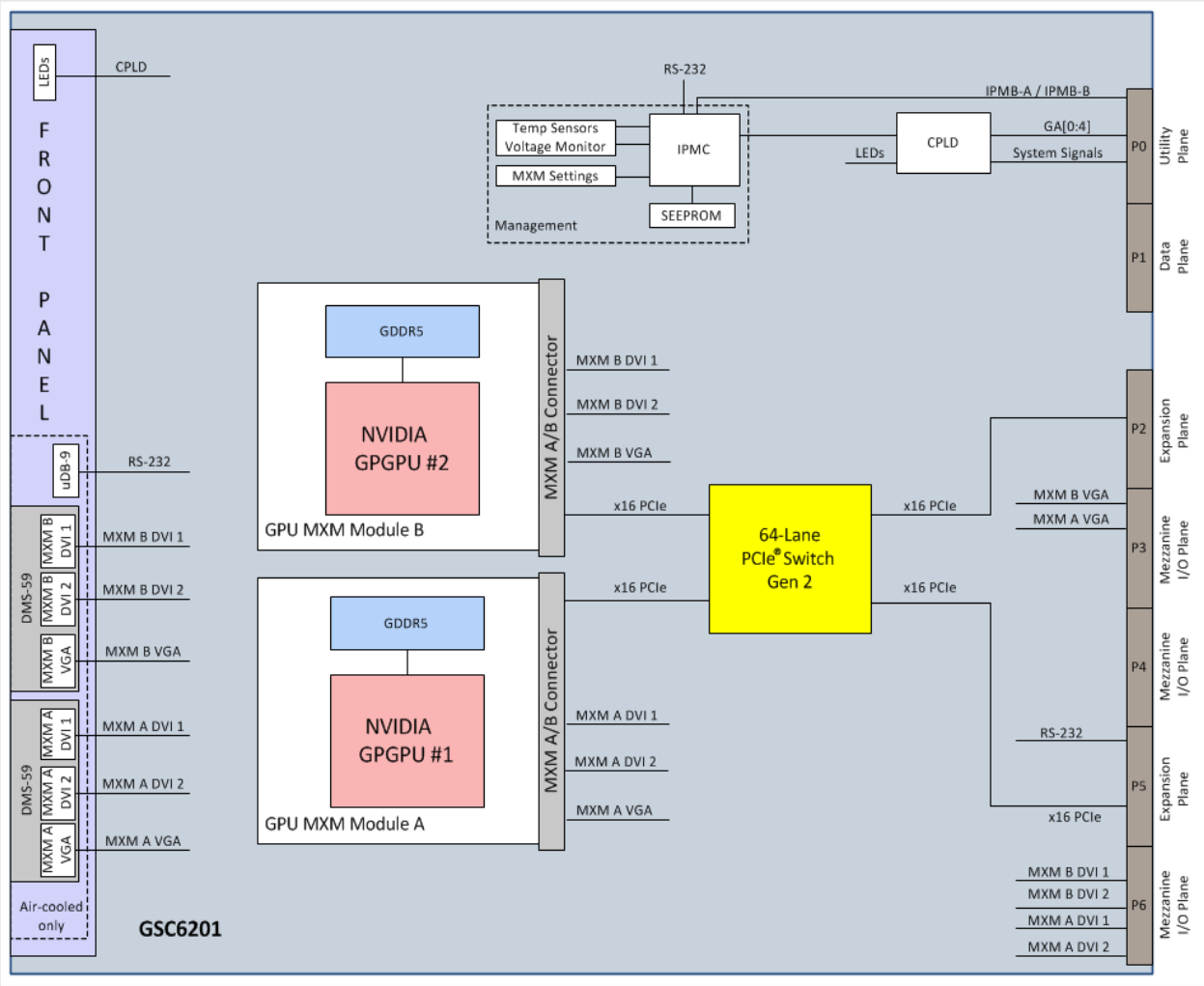

Figure 2. *GSC6201 functional block diagram with two NVIDIA® Fermi™ Architecture GPGPU MXMs.*

allowing the raw data to be processed immediately for analysis and intelligence. It does this by bypassing the CPU that previously served as traffic manager. Because the CPU is no longer the bottleneck, additional sensor/GPGPU processing slices can be added to the system to significantly increase processing capability while optimizing for SWaP (size, weight and power).

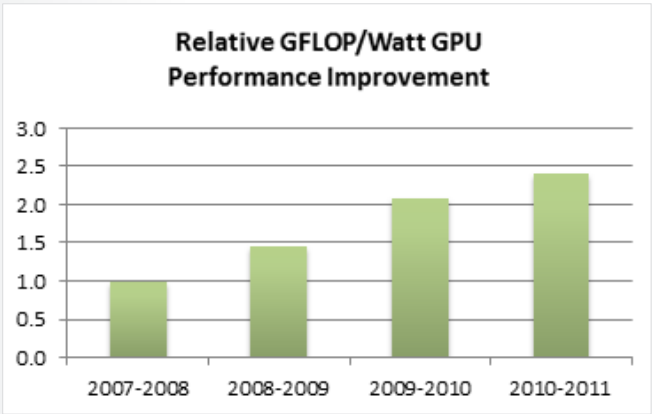

Figure 3. *GPU technology is evolving at such a rapid pace that the industry benefits from a significant bump in performance every year. Within a span of three years, the GFLOP/Watt performance increased by almost a factor of 2.5x*

To keep up with the rapid evolution of GPGPU technology, the GSC6201 is a carrier card built using two industry-standard Mobile PCI Express® Modules (MXM) from NVIDIA. Because of the modular nature of the MXM, the GSC6201 carrier card only needs to be engineered once while maintaining the flexibility of updating GPUs. This approach saves significant engineering development time, allowing programs to deploy with the latest, highest performing embedded GPGPU technology as soon as they are available from NVIDIA.

To meet the harshest operational environments, the GSC6201 uses rugged MXM connectors specifically engineered by Mercury to exceed the mechanical requirements of VITA 47, while maintaining the flexibility to upgrade the GSC6201 to next-generation GPGPUs.

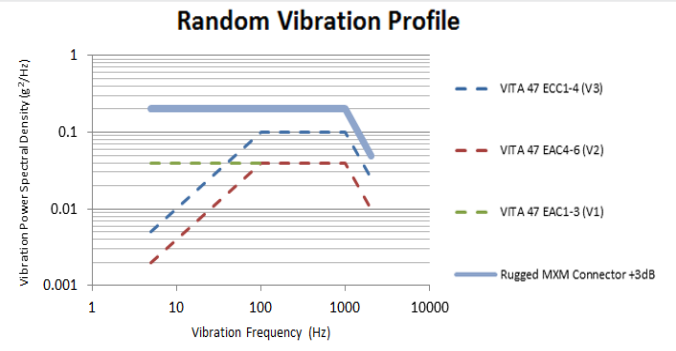

Figure 4. *Random Sine Vibration Sweep (5-2000 Hz, 10G peak, 2 hour/axis). Performance of Mercury-developed Rugged MXM Connector (solid line) exceeds VITA 47 standards by being tested +3 dB above conduction-cooled specifications).*

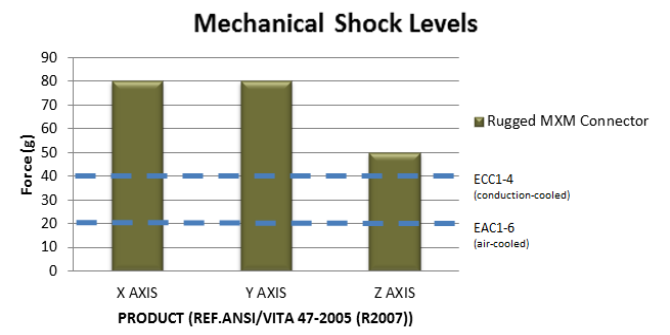

Figure 5. *Mechanical shock levels for each axis for Mercury-developed rugged MXM connector (green bars) compared to the VITA 47 air-cooled (EAC) and conduction cooled (ECC) standards (dashed lines).*

Open Software Environment

Mercury leverages over 25 years of multicomputer software expertise across its many platforms, including the latest multicore processors found in GPGPUs. This strategy is fully applied to the GSC6201 module. Because the processor, memory and surrounding technologies are leveraged across product lines, software developed on the GSC6201 can interface seamlessly with other Mercury products.

The GSC6201 runs on Red Hat® Linux® with MRG real-time kernel extensions. Several software development environments are available for the GSC6201 processing module:

- NVIDIA CUDA™: A parallel computing architecture that is accessible to software developers through industry standard programming languages.
- OpenCL™: An open-source standard for cross-platform and parallel programming.
- Mercury's Scientific Algorithm Library (SAL™) with MathPack™: A high-throughput, low-latency signal processing library containing efficient algorithms with the fewest possible instructions and computing resources. Port legacy applications to the latest generation hardware or support cross-platform development while taking advantage of unique, highly optimized processing functions for each hardware platform.

VPX-REDI

The VPX™ (VITA 46) standard defines 6U boards with a modern, high-performance connector 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 GSC6201 module is implemented as a 6U VPX-REDI conduction-cooled board with an air-cooled variant available in the same VPX form factor 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.

Open Standards Mean Interoperability and Planning for the Future

The OpenVPX™ Industry Working Group was an industry initiative launched by defense prime contractors and COTS system developers to take a proactive approach to solving the interoperability issues associated with the VITA 46 (VPX) family of specifications. This group has created an overarching system specification defining VPX system architecture through pinout definitions to establish a limited set of application-specific reference solutions. These OpenVPX standard solutions provide clear design guidance to COTS suppliers and the user community, assuring interoperability across multi-vendor implementations.

Specifications

GPGPU

Two NVIDIA® GPGPU MXMs designed specifically for embedded GPGPU applications

Fermi Architecture

NVIDIA EXMF104 40nm Fermi™ Architecture GPGPU

480 total processing cores (240 cores per MXM)

864 total peak theoretical GFLOPS (432 peak theoretical per MXM)

x32 total PCIe® 2.0 lanes (x16 PCIe 2.0 per MXM)

4 GB total GDDR5 Memory (2 GB per MXM)

- 256-bit Memory Interface
- 160 GB/s Memory Bandwidth (80 GB/s per MXM)

Compute Capability 2.1

4 DVI display outputs (two DVI outputs per MXM)

- To front panel (air-cooled only) and OpenVPX backplane

2 analog VGA display outputs (one per MXM)

- To front panel (air-cooled only) and OpenVPX backplane

64-Lane Configurable PCIe Switch

Configurable switch allows for multiple system-level configurations

x16 PCIe 2.0 connections to each MXM site (32 lanes total)

x32 PCIe 2.0 total connections to backplane

- x16 PCIe 2.0 OpenVPX P2 Expansion Plane
- x16 PCIe 2.0 OpenVPX P5 Expansion Plane

IPMI (System Management)

On-board IPMI controller

Voltage and temperature monitor

Geographical address monitor

Power/reset control

On-board CPLD, FRU EEPROM interfaces

OpenVPX Multi-Plane Architecture

System management via IPMB-A and IPMB-B link on P0 management plane

Dual full x16 or dual x8 PCIe on P2 and P5 expansion plane

4 DVI display outputs and 2 analog VGA outputs on P6 mezzanine I/O plane

Mechanical

6U OpenVPX (air-cooled and conduction-cooled)

1.0" slot pitch

OpenVPX and VPX™-REDI

Environmental

Air-Cooled – Mercury Commercial

Temperature	
Operating:	0°C to +40°C*
Storage:	-40°C to +85°C

*Customer must maintain the required cfm level.

Humidity	
Operating	10-90%, non-condensing
Vibration	0.003 g2/Hz; 20-2,000 Hz, 1 hr/axis
Shock	20g, z-axis; 32g, x-, y-axes; 11 ms half-sine pulse
Altitude	
Operating	0-10,000 ft*

*Customer must maintain the required cfm level.

Conduction-Cooled – Mercury Rugged Level 3

Temperature	
Operating:	-40°C to +71°C*
Storage:	-55°C to +125°C
Humidity	
Operating	0-100%
Vibration	0.1g2/Hz, 5-2,000Hz, 1 hr/axis
Shock	50g z-axis; 80g x,y axis; 11ms half-sine
Altitude	
Operating	0-70,000 ft*

*Customer must maintain the card edge at 71˚C.

Compliance

OpenVPX™ System Specifications encompasses VITA 46.0, 46.3, 46.4, 46.6, 46.11

Compatible with VITA 65

VITA 46/48.1/48.2 (REDI)

PCI Express®

2903.02E-0817-DS-GSC6201

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