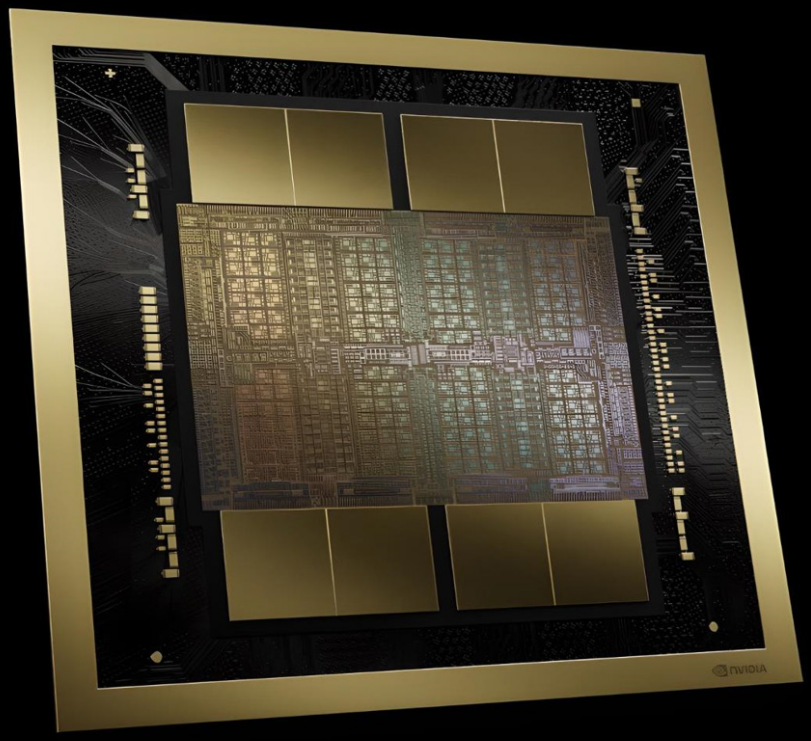
WOLF



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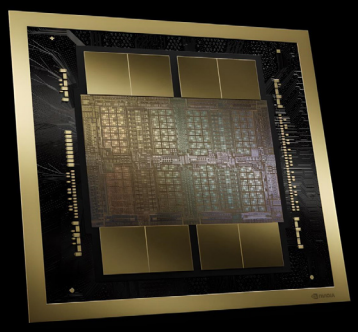

WOLF-1636, VPX3U-BW5000E-VO-HPC

Blackwell GPU for HPC, with options for VO

- NVIDIA Blackwell RTX5000 with HPC and options for video outputs
- PCIe Gen5 – all lanes connected directly to rear connector, no switch
- One DisplayPort output under a removable front plate
- HPC options for SOSA aligned 14.6.11/13 (no rear video output); When using these slot profiles the WOLF-1636 may be used to upgrade **1538/1448/1348**
- OpenVPX slot profile supports two rear video outputs on P2B

WOLF-163S, VPX3U-BW5000E-SWITCH

The functionality of a HPC module and a Switch in one slot-saving module.

- NVIDIA Blackwell RTX5000 for HPC
- Network switch with 8 ports, each up to 25GbE, plus one 1000BASE-T port
- PCIe Gen5 switch with up to 16 lanes to the GPU, plus an additional 8 lanes to support other modules' switching needs
- Pin-compatible upgrade for **WOLF-134S**

WOLF-163L, VPX3U-BW5000E-CX7

An HPC module which includes the networking and security features of the ConnectX-7

- NVIDIA Blackwell RTX5000 for HPC
- ConnectX-7 provides 100GbE with support for RoCE
- PCIe Gen5 connectivity to the GPU via ConnectX-7
- Security features include secure boot and network data encryption
- Pin-compatible upgrade for **WOLF-153L/144L**

WOLF-2638, VPX6U-BW5000E-VO

Module with dual or single Blackwell GPUs for HPC and video output

- NVIDIA Blackwell RTX5000 with HPC and options for video outputs
- Configurable PCIe Gen5 switch
- Up to 4 video outputs per GPU (depending on slot profile)
- SOSA aligned 10.6.3/4 or OpenVPX
- Pin-compatible upgrade for **WOLF-2538**

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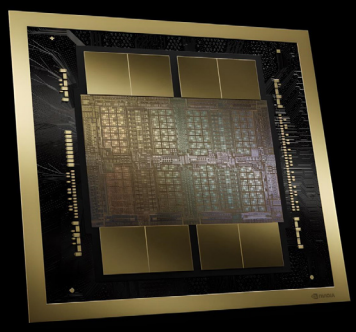

BLACKWELL IMPROVEMENTS

Memory: The easiest improvement to point out when going from Ada to Blackwell is the memory. Going from GDDR6 to GDDR7 will bring big bandwidth improvements, and going from 16GB to 24GB means more memory for handling big datasets and complex algorithms.

CUDA Cores: While there are not that many more cores than for Ada it is significant that they will now all be able to handle FP or INT, which could be especially significant for AI. Previously only half the CUDA cores could handle both FL and INT, while the other half were dedicated to FL only.

Tensor Cores: Blackwell Tensor cores are Gen5 cores, which will bring support for new data precisions, and a new user-defined data type. In general, each new Tensor core generation does improve performance, but NVIDIA does not disclose exactly how those improvements are achieved. The improvements are likely related to larger permitted matrix sizes and/or parallel units used for each calculation, but that is speculation.

Performance from NVIDIA GPU whitepapers for fused multiply-accumulate (FMA) operations peformed by Tensor cores:

Tensor Core Generation	FP16 FMAs/clock
Gen 1 (Volta)	64
Gen 2 (Turing)	64
Gen 3 (Ampere)	128
Gen 4 (Ada)	256
Gen 5 (Blackwell, expected)	512

Note that when calculating TOPS each FMA is counted as two operations, a multiply and an add, so the FMAs/clock numbers above can be doubled for TOPS calculations.

PCIe Gen5: This is the first generation of NVIDIA GPU to support PCIe Gen5. This may be particularly of interest when combined with a PCIe Gen5 switch, because while the host may only support PCIe Gen4 the switch can take that data in at Gen4 speeds and then use half as many lanes at Gen5 speeds to send the data from the switch to the GPU. It may come in handy on a 6U VPX with a dual GPU, for example, where the total number of lanes supported is a concern.

Lifecycle: The Blackwell GPU is expected to go EOL in 2030.

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VPX3U-BW5000E-VO-HPC

NVIDIA Blackwell RTX5000 with HPC and video outputs

Key Features

- NVIDIA RTX™ 5000 (GB203) GPU with 10496 CUDA Cores, 320 Tensor Cores
- 24 GB GDDR7 256-bit VRAM with ECC support
- DisplayPort outputs, HDMI option for rear outputs
- Module power: 90W to 150W, configurable

GPU Features

- Blackwell GPGPU parallel processing:
  - CUDA Toolkit 12, Compute capability 10.0
  - CUDA-X AI and CUDA-X HPEC libraires
  - OpenCL™ 3.0, DirectX® 12 Ultimate, OpenGL 4.6, OpenGL ES 3.2, Vulkan™ 1.2
- 5th Gen Tensor Cores with additional new data precisions (new: FP4 and FP6, FP8 Gen2)
- GDDR7 memory provides over 50% more bandwidth compared to the previous generation
- NVENC (9th Gen) and NVDEC (6th Gen) with up to 8K video encoding and hardware decoding support

Connectivity / System Management

- PCIe Gen5 support, x8 and x16 profiles
- IPMI system management
- NVIDIA GPUDirect RDMA support
- Linux and Windows drivers
- GB203 GPU support requires one of the following host CPUs: Intel H/HX/P/PX/S or AMD H/HS Class

Mechanical / Open Systems Architecture

- High level of ruggedization:
  - Rugged conduction cooled
  - Operating temp: CC: -40°C to +70°C standard, operational to +85°C
  - Vibration Random: VITA 47.1 Class V3 (5 to 2000Hz)
  - Vibration Sine: 10g peak (5 to 2000 Hz)
  - Shock: 40G (MIL-STD-810H, Method 516.8)
- Dimensions: 160mm x 100mm x 25.4mm
- Weight (approximately): 1.3 kg
- ANSI/VITA 48, 65 (VPX-REDI, OpenVPX)
- SOSA™ Aligned profile support: 14.6.11-0, 14.6.13-0, or OpenVPX 14.2.7

Overview

The VPX3U-BW5000E-VO-HPC module is powered by an NVIDIA RTX™ RTX 5000 Blackwell embedded GPU in a rugged WOLF 3U VPX module. The NVIDIA RTX 5000 GPU provides the advanced processing capabilities for high performance embedded computing (HPC) and artificial intelligence (AI) processing. This module includes a removeable front panel that exposes DisplayPort outputs on the front. It can also be configured to support an OpenVPX profile that provides two DisplayPort outputs on the rear.

The NVIDIA Blackwell architecture includes CUDA cores and 5th generation Tensor cores for HPC, AI and data science computations. The Blackwell GPU has an improved architecture which provides increased efficiency. The module supports 24GB of GDDR7 memory which provides over 50% higher bandwidth compared to the previous generation. The GPU supports PCIe Gen5, providing a fast data transfer path to/from the module.

Unlocking the best performance requires the best cooling capability. WOLF's advanced cooling technology is designed to move heat using a low weight, high efficiency path from the hot GPU die to the wedgelocks.

NVIDIA RTX

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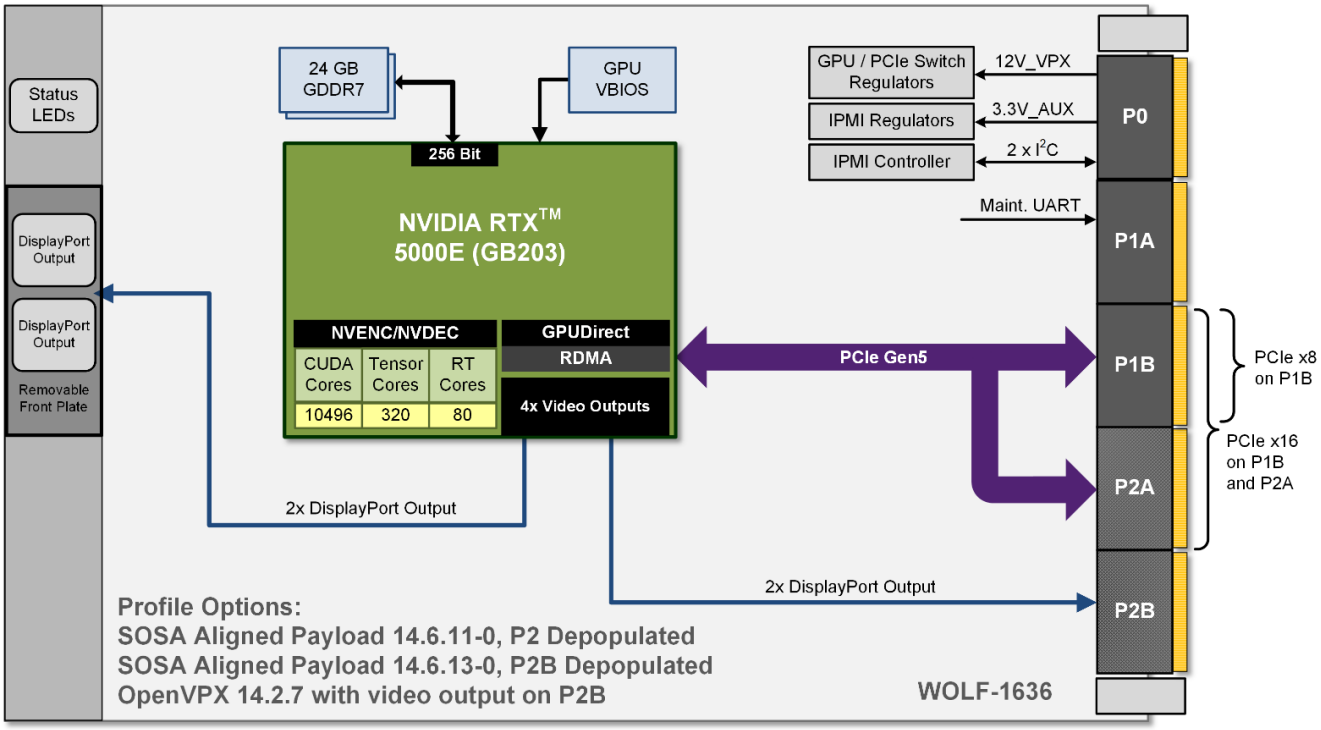
VPX3U-BW5000E-VO-HPC

The VPX3U-BW5000E-VO-HPC module uses a WOLF chip-down design to provide NVIDIA's advanced Blackwell architecture GPU technology on an extremely rugged board, making it an excellent choice for aerospace and defense applications. WOLF designs and manufactures these modules in North America with full component traceability.



The OpenVPX profile supports DisplayPort video output, with two outputs supported on the rear connector, and two supported on the front panel under a small removeable panel. Note that the P2B pin assignment used for the DisplayPort video output for this product is not pin compatible with the previous generation WOLF-1538/1448/1348.

SOSA aligned slot profile options for this module include 14.6.13-0 with support for PCIe x16, and 14.6.11-0 with support for PCIe x8. The DisplayPort output under the removable front plate will be available for all slot profiles, including the SOSA aligned slot profiles.

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Power and Performance

An NVIDIA GPU clock speed is dependent on the TGP (total GPU subsystem power) and the GPU temperature. The highest clock speeds are available at the highest TGP power allowed by the GPU. When the TGP setting is decreased the clock speed will also decrease resulting in a decrease in processing speed. If the GPU temperature exceeds 87°C the GPU clock speed will also decrease to protect the GPU from heat damage. If the GPU temperature is below 86.5°C the GPU can operate at maximum boost clock speeds at the currently available power when the GPU detects that higher processing is required.

The Blackwell GB203 GPU in this 3U VPX module will default to a TGP power of 100W. At 100W the GPU base clock of 1125 MHz provides up to 24.2 TFLOPS, and at higher GPU processing demands the boost clock can run up to 1792 MHz, providing up to 38.5 TFLOPS. A higher TGP of up to 150W can be configured if the GPU can be cooled sufficiently, with a maximum boost clock of 2370 MHz providing up to 50 TFLOPS.

NVIDIA Blackwell GPU

NVIDIA Blackwell GPUs have an improved architecture which provides increased efficiency. Blackwell GPUs have CUDA cores that can all handle either FL or INT operations, whereas previous generations restricted half of the CUDA cores for FL operations only. This is important for tasks that require lots of small, frequent lookups resulting in frequent address computations, which are commonly required by the matrix operations used by AI and HPC calculations. Optimizing these lookups ensures the data can reach the processing cores efficiently, permitting full use of the GPU processing power. The new Blackwell architecture also supports GDDR7 memory, which provides 55% more memory bandwidth. With the increased performance and memory handling abilities, and improved next Gen Tensor cores, the Blackwell GPUs are able provide significant performance increases compared to the previous generation.

Tensor Cores for Artificial Intelligence and HPC

Tensor Cores are designed to speed up the tensor / matrix computations used for deep learning neural network training and inferencing operations. NVIDIA Blackwell architecture GPUs include the fifth-generation Tensor Core design which supports many data types for improved performance, efficiency, and programming flexibility, including support for new INT4 and INT6 precision modes and microscaling formats. NVIDIA provides CUDA-X AI and CUDA-X HPEC libraires designed to work with NVIDIA GPUs to provide the tools needed to accelerate development of applications for AI and HPEC.

Hardware Accelerated Video Encode / Decode

The Blackwell GPU includes the NVENC video encode and NVENC decode hardware acceleration engine. Using the GPU for video encoding provides an efficient, high quality method to achieve real time 8K and 4K encoding without burdening the system CPU. The Blackwell encoding engine includes support for several popular codecs including AV1 hardware encoding and decoding support. The NVIDIA Video Codec SDK provides APIs, samples and documentation for hardware accelerated video encode and decode.

SOSA and OpenVPX Slot Profile Support

This module can be configured to support SOSA aligned and OpenVPX slot profiles, including:

- SOSA Aligned 14.6.11-0 Payload Slot Profile, P2 depopulated
- SOSA Aligned 14.6.13-0 Payload Slot Profile, P2B depopulated
- OpenVPX 14.2.7 Slot Profile

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Ordering Codes

The following table defines series of common order codes for the VPX3U-BW5000E-VO-HPC module. The asterisks denote characters of the part number that are defined based on common configuration options. Some configuration options for this module include:

- SOSA or OpenVPX profiles
- Display Interfaces
- Variant Locked
- Default Power Threshold
- Conformal Coatings

Ordering Number	Description
3U VPX Blackwell AD5000 Single Slot Configurations	
163633-F***-***VPX3vA0	3U VPX, Conduction Cooled, 1", OpenVPX, NVIDIA Blackwell RTX 50000, 24GB GDDR7, PCIe x16 up to Gen5, Rear: 2x DP out, Front: 2x DP out
163633-F***-***VPX3vA0	3U VPX, Conduction Cooled, 1", SOSA 14.6.11-0 with P2 depopulated, NVIDIA Blackwell RTX 50000, 24GB GDDR7, PCIe x8 up to Gen5, Front: 2x DP out

* Contact Sales for the latest Ordering Numbers and available options.

Manufacturing and Quality Assurance

WOLF designs modules to pass the following environmental standards:

- MIL-STD-810 (United States Military Standard for Environmental Engineering Considerations and Laboratory Tests)
- MIL-HDBK-217 (Reliability Prediction of Electronic Equipment)
- RTCA DO-160 (Environmental Conditions and Test Procedures for Airborne Equipment) on request

WOLF complies with the following management systems:

- AS9100D: Quality Management System - Requirements for Aviation, Space and Defense Organizations (certified)
- ISO 9001:2015: Quality management systems (certified)
- AS5553: Counterfeit Electronic Parts; Avoidance, Detection, Mitigation, and Disposition (compliant)
- NIST SP 800-171: Protecting Controlled Unclassified Information in Nonfederal Systems (compliant)

Boards are manufactured to meet the following standards:

- IPC-A-610 CLASS 3 (Acceptability of Electronic Assemblies)
- IPC 6012 CLASS 3 (Qualification and Performance Specification for Rigid Printed Boards, Class 3 for High Reliability Electronic Products)
- IPC J-STD-001 (Requirements for Soldered Electrical and

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VPX3U-BW5000E-SWITCH

System Switch and HPC: PCIe & Network Switch, Blackwell GPU

Key Features

- NVIDIA RTX™ 5000 (GB203) Blackwell GPU with 10496 CUDA Cores, 320 Tensor Cores
- 24 GB GDDR7 256-bit VRAM with ECC support
- Network switch and PCIe switch
- Module power: 100W to 180W, configurable

GPU Features

- Blackwell GPGPU parallel processing:
  - ☐ CUDA Toolkit 12, Compute capability 10.0
  - ☐ OpenCL™ 3.0, DirectX® 12 Ultimate, OpenGL 4.6, OpenGL ES 3.2, Vulkan™ 1.2
- 5th Gen Tensor Cores with new data precisions (new: FP4 and FP6, FP8 Gen2)
- GDDR7 memory provides over 50% more bandwidth compared to the previous generation
- NVENC (9th Gen) and NVDEC (6th Gen) with up to 8K video encoding and hardware decoding support

Connectivity / System Management

- Configurable PCIe Gen5 switch
- Configurable 200 GbE network switch: 8 ports up to 25GbE and one 1000BASE-T
- NVIDIA GPUDirect RDMA support
- IPMI system management
- Linux and Windows drivers
- GB203 GPU support requires one of the following host CPUs: Intel H/HX/P/PX/S or AMD H/HS Class

Mechanical / Open Systems Architecture

- High level of ruggedization:
  - ☐ Rugged conduction cooled
  - ☐ Operating temp: CC: -40°C to +70°C standard, operational to +85°C
  - ☐ Vibration Random: VITA 47.1 Class V3 (5 to 2000Hz)
  - ☐ Vibration Sine: 10g peak (5 to 2000 Hz)
  - ☐ Shock: 40G (MIL-STD-810H, Method 516.8)
- Dimensions: 160mm x 100mm x 25.4mm
- Weight (approximately): 1.6kg
- ANSI/VITA 48, 65 (VPX-REDI, OpenVPX)
- SOSA™ Aligned switch slot profile: 14.4.15

Overview

The VPX3U-BW5000E-SWITCH rugged 3U VPX module includes an NVIDIA RTX™ 5000 Blackwell embedded GPU, a PCIe Gen5 switch, and a 200 GbE Network switch. This module can operate both as a system switch and an HPC node, all in one slot-saving module.

The NVIDIA Blackwell GPU has an improved architecture which provides increased efficiency. The module also supports 24GB of GDDR7 memory which provides over 50% higher bandwidth compared to the previous generation. The GPU supports PCIe Gen5, providing a fast data transfer path to/from the module.

This module can also act as a switch, directing up to 8 ports of 25GbE network traffic each. The PCIe switch has enough lanes to be used both to send data to the GPU and to direct PCIe data to other modules in the system.

Unlocking the best performance requires the best cooling capability. WOLF's advanced cooling technology is designed to move heat using a low weight, high efficiency path from the hot chips to the wedgelocks.

NVIDIA RTX

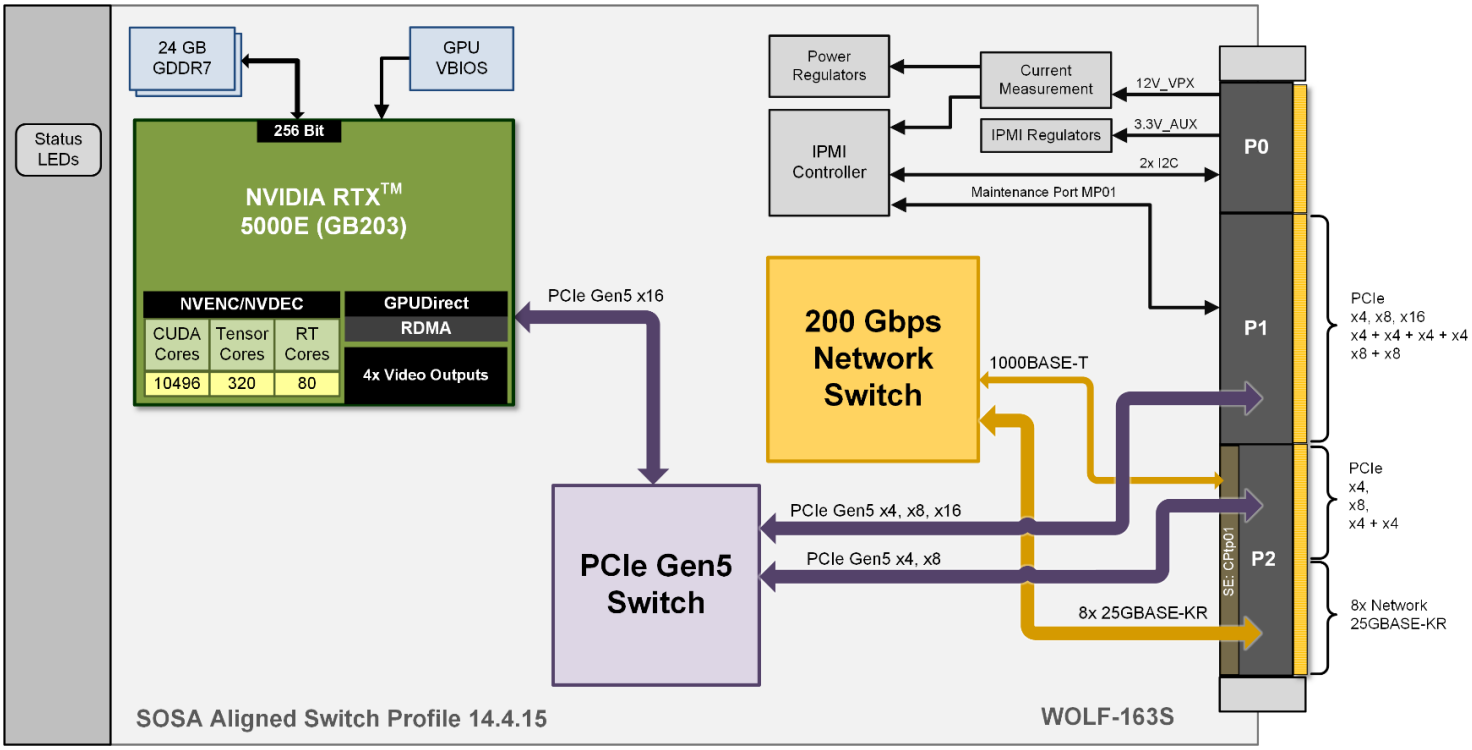
This information is subject to change

VPX3U-BW5000E-SWITCH

Chip-Down Design

The VPX3U-BW5000E-SWITCH module uses a WOLF chip-down design to provide switches and NVIDIA's advanced Blackwell architecture GPU technology on an extremely rugged board, making it an excellent choice for aerospace and defense applications. WOLF designs and manufactures these modules in North America with full component traceability.

This SOSA Aligned module supports slot profile 14.4.15 with PCIe Gen5 support and 200 GbE.



Switch and HPC in One Module

This module can operate as both a system switch and an HPC node, allowing the system designer to make efficient use of the available 3U VPX chassis space. The network switch can direct ethernet traffic between modules, with 8 ports, each up to 25 GbE. The PCIe switch can be used to route data to the GPU, while still provisioning the additional available lanes to meet other modules data switching needs.

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Power and Performance

An NVIDIA GPU clock speed is dependent on the TGP (total GPU subsystem power) and the GPU temperature. The highest clock speeds are available at the highest TGP power allowed by the GPU. When the TGP setting is decreased the clock speed will also decrease resulting in a decrease in processing speed. If the GPU temperature exceeds 87°C the GPU clock speed will also decrease to protect the GPU from heat damage. If the GPU temperature is below 86.5°C the GPU can operate at maximum boost clock speeds at the currently available power when the GPU detects that higher processing is required.

The Blackwell GB203 GPU in this 3U VPX module will default to a TGP power of 100W. At a TGP of 100W the base clock of 1125 MHz provides up to 24.2 TFLOPS, and at higher GPU loads the boost clock can run up to 1792 MHz which provides up to 38.5 TFLOPS. A higher TGP of up to 150W can be configured if the GPU can be cooled sufficiently, with a maximum boost clock of 2370 MHz providing up to 51.0 TFLOPS.

NVIDIA Blackwell GPU

NVIDIA Blackwell GPUs have an improved architecture which provides increased efficiency. Blackwell GPUs have CUDA cores that can all handle either FL or INT operations, whereas previous generations restricted half of the CUDA cores for FL operations only. This is important for tasks that require lots of small, frequent lookups resulting in frequent address computations, which are commonly required by the matrix operations used by AI and HPC calculations. Optimizing these lookups ensures the data can reach the processing cores efficiently, permitting full use of the processing power. The new Blackwell architecture also supports GDDR7 memory, which provides 55% more memory bandwidth. With the increased performance and memory handling abilities, and improved next Gen Tensor cores, the Blackwell GPUs are able provide significant performance increases compared to the previous generation.

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Hardware Accelerated Video Encode / Decode

The Blackwell GPU includes the NVENC video encode and NVENC decode hardware acceleration engine. Using the GPU for video encoding provides an efficient, high quality method to achieve real time 8K and 4K encoding without burdening the system CPU. The Blackwell encoding engine includes support for several popular codecs including AV1 hardware encoding and decoding support. The NVIDIA Video Codec SDK provides APIs, samples and documentation for hardware accelerated video encode and decode.

SOSA Slot Profile Support

This module provides support for the SOSA aligned switch slot profile. The module is compatible with the previous generation WOLF-134S module, which allows the WOLF-163S to be a plug-in upgrade for the previous WOLF product.

The following SOSA aligned profile is supported: 14.4.15 Switch Slot Profile.

This information is subject to change

Ordering Codes

The following table defines series of common order codes for the VPX3U-BW5000E-SWITCH module. The asterisks denote characters of the part number that are defined based on common configuration options. Some configuration options for this module include:

- Network config options
- PCIe config options
- Variant Locked
- Default Power Threshold
- Conformal Coatings

Ordering Number	Description
3U VPX Switch and Blackwell BW5000E Configurations	
163S33-F***-***VPX3vA0	3U VPX, Conduction Cooled, 1", 14.4.15 switch profile, NVIDIA Blackwell RTX 50000, 24GB GDDR7, PCIe P1 x16 and P2 x8, Network 8 ports each 25GbE
163S33-F***-***VPX3vA0	3U VPX, Conduction Cooled, 1", 14.4.15 switch profile, NVIDIA Blackwell RTX 50000, 24GB GDDR7, PCIe P1 x16 and P2 x4 + x4, Network 8 ports each 10GbE

* Contact Sales for the latest Ordering Numbers and available options.

Manufacturing and Quality Assurance

WOLF designs modules to pass the following environmental standards:

- MIL-STD-810 (United States Military Standard for Environmental Engineering Considerations and Laboratory Tests)
- MIL-HDBK-217 (Reliability Prediction of Electronic Equipment)
- RTCA DO-160 (Environmental Conditions and Test Procedures for Airborne Equipment) on request

WOLF complies with the following management systems:

- AS9100D: Quality Management System - Requirements for Aviation, Space and Defense Organizations (certified)
- ISO 9001:2015: Quality management systems (certified)
- AS5553: Counterfeit Electronic Parts; Avoidance, Detection, Mitigation, and Disposition (compliant)
- NIST SP 800-171: Protecting Controlled Unclassified Information in Nonfederal Systems (compliant)

Boards are manufactured to meet the following standards:

- IPC-A-610 CLASS 3 (Acceptability of Electronic Assemblies)
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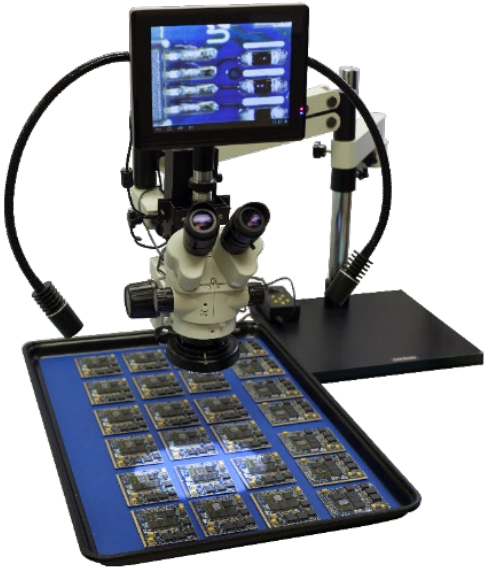
- IPC J-STD-001 (Requirements for Soldered Electrical and



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VPX3U-BW5000E-CX7

HPC with NVIDIA Blackwell RTX 5000 GPU and ConnectX-7

Key Features

- NVIDIA RTX™ 5000 (GB203) GPU with 10496 CUDA Cores, 320 Tensor Cores
- NVIDIA® ConnectX®-7 provides the module with up to 100GbE Ethernet and a configurable PCIe switch
- 24 GB GDDR7 256-bit VRAM with ECC support
- Module power: 100W - 180W, configurable

GPU Features

- Blackwell GPGPU parallel processing:
  - CUDA Toolkit 12, CUDA Compute capability 10.0
  - OpenCL™ 3.0, DirectX® 12 Ultimate, OpenGL 4.6, OpenGL ES 3.2, Vulkan™ 1.2
- 5th Gen Tensor Cores with new data precisions (new: FP4 and FP6, FP8 Gen2)
- NVENC (9th Gen) and NVDEC (6th Gen) with up to 8K video encoding and hardware decoding support

Connectivity / System Management

- On-board IPMI controller for system management
- PCIe configurable switch
- Switching is offloaded from the CPU to the ConnectX with NVIDIA ASAP^2 technology
- Support for 40/100GBASE-KR4 protocols
- 10/25GBASE-KR Data and Control planes
- GPUDirect RDMA and RoCE support
- Block-level hardware encryption and the use of dedicated encryption keys per user
- Linux and Windows drivers
- GB203 GPU support requires one of the following host CPUs: Intel H/HX/P/PX/S or AMD H/HS Class

Mechanical / Open Systems Architecture

- High level of ruggedization:
  - Rugged conduction cooled
  - Operating temperature: -40°C to +70°C standard, operational to +85°C
  - Vibration Random: VITA 47.1 Class V3 (5 to 2000Hz)
  - Vibration Sine: 10g peak (5 to 2000 Hz)
  - Shock: 40G (MIL-STD-810H, Method 516.8)
- Dimensions: 160mm x 100mm x 25.4mm
- Weight (approximately): 1.6 kg
- SOSA™ Aligned slot profile: 14.6.11-0 or 14.6.13-0

Overview

The VPX3U-BW5000E-CX7 HPEC module includes an NVIDIA RTX 5000 Blackwell embedded GPU and a ConnectX SmartNIC. The NVIDIA RTX 5000 Blackwell embedded GPU provides the advanced processing capabilities for high performance embedded computing (HPC) and artificial intelligence (AI) processing. The ConnectX-7 provides the Ethernet and PCIe connectivity needed to move large datasets efficiently.

The NVIDIA Blackwell architecture includes CUDA cores for HPC, and 5th generation Tensor cores for AI and data science computations. The Blackwell GPU has an improved architecture which provides increased efficiency. The module also supports 24GB of GDDR7 memory which provides over 50% higher bandwidth compared to the previous generation. The GPU supports PCIe Gen5, providing a fast data transfer path to/from the module.

The NVIDIA ConnectX-7 SmartNIC provides PCIe and Ethernet connectivity. ConnectX-7 is ideal for the high-speed, secure, data transfer capabilities required for data-heavy tasks such as sensor data processing and other C5ISR tasks. The ConnectX-7 also provides support for RDMA over Converged Ethernet (RoCE), enabling the fastest method for transferring data across the network to the GPU.

NVIDIA RTX

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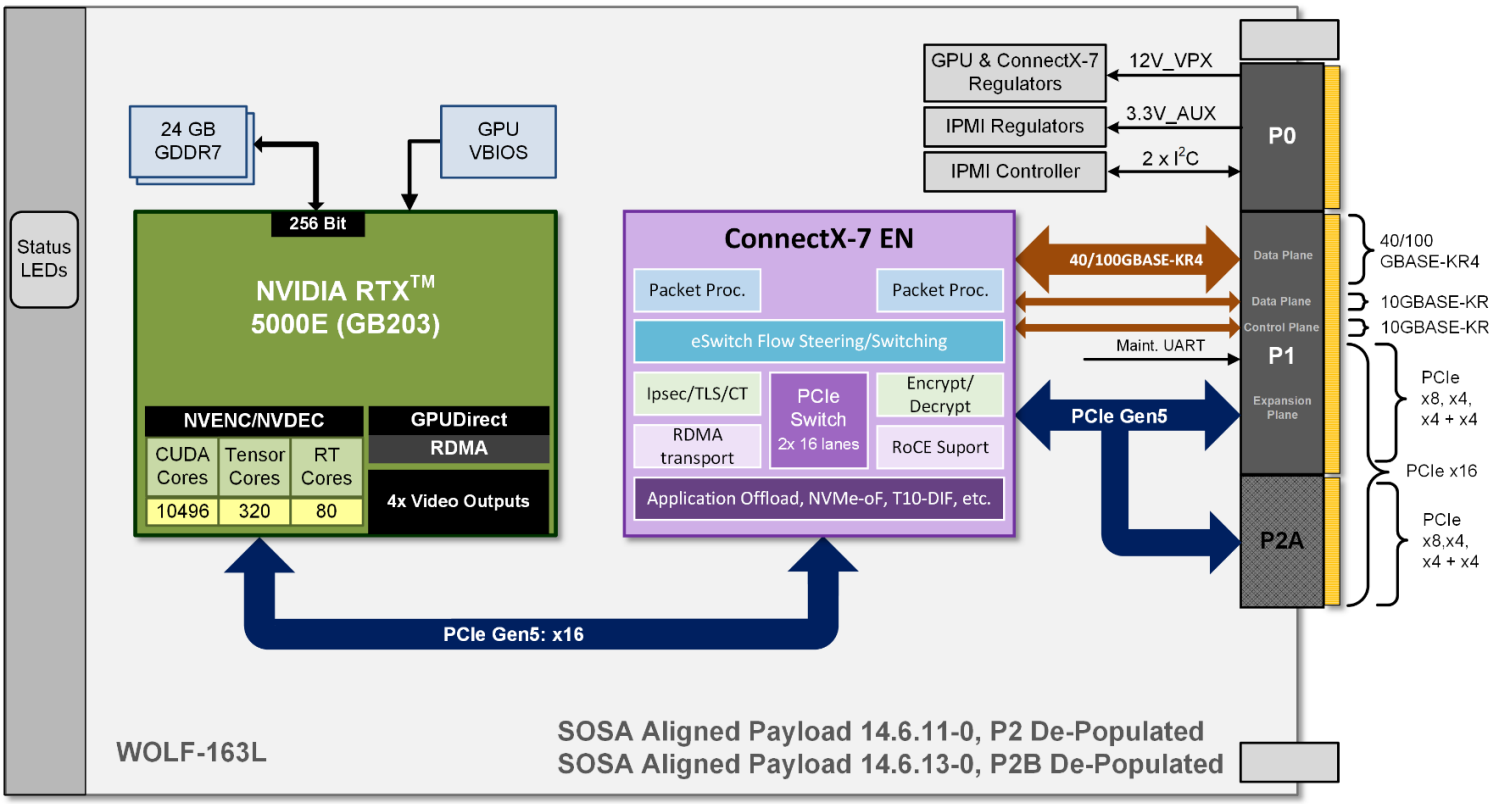
Chip-Down Design

The VPX3U-BW5000E-CX7 module uses a WOLF chip-down design to provide NVIDIA's advanced Blackwell architecture GPU and ConnectX SmartNIC technology on an extremely rugged board, making it an excellent choice for aerospace and defense applications. WOLF designs and manufactures modules in North America with full component traceability.



Power and Performance

An NVIDIA GPU clock speed is dependent on the TGP (total GPU subsystem power) and the GPU temperature. The highest clock speeds are available at the highest TGP power allowed by the GPU. When the TGP setting is decreased the clock speed will also decrease resulting in a decrease in processing speed. If the GPU temperature exceeds 87°C the GPU clock speed will also decrease to protect the GPU from heat damage. If the GPU temperature is below 86.5°C the GPU can operate at maximum boost clock speeds at the currently available power when the GPU detects that higher processing is required.

The Blackwell GB203 GPU in this 3U VPX module will default to a TGP power of 100W. At a TGP of 100W the base clock of 1125 MHz provides up to 24.2 TFLOPS, and at higher GPU loads the boost clock can run up to 1792 MHz which provides up to 38.5 TFLOPS. A higher TGP of up to 150W can be configured if the GPU can be cooled sufficiently, with a maximum boost clock of 2370 MHz providing up to 51.0 TFLOPS.

This information is subject to change

NVIDIA Blackwell GPU

NVIDIA Blackwell GPUs have an improved architecture which provides increased efficiency. Blackwell GPUs have CUDA cores that can all handle either FL or INT operations, whereas previous generations restricted half of the CUDA cores for FL operations only. This is important for tasks that require lots of small, frequent lookups resulting in frequent address computations, which are commonly required by the matrix operations used by AI and HPC calculations. Optimizing these lookups ensures the data can reach the processing cores efficiently, permitting full use of the processing power. The new Blackwell architecture also supports GDDR7 memory, which provides 55% more memory bandwidth. With the increased performance and memory handling abilities, and improved next Gen Tensor cores, the Blackwell GPUs are able provide significant performance increases compared to the previous generation.

Tensor Cores for Artificial Intelligence and HPC

Tensor Cores are designed to speed up the tensor / matrix computations used for deep learning neural network training and inferencing operations. NVIDIA Blackwell architecture GPUs include the fifth-generation Tensor Core design which supports many data types for improved performance, efficiency, and programming flexibility, including support for new INT4 and INT6 precision modes and microscaling formats. NVIDIA provides CUDA-X AI and CUDA-X HPEC libraires designed to work with NVIDIA GPUs to provide the tools needed to accelerate development of applications for AI and HPEC.

ConnectX-7 with PCIe Gen5 and Ethernet 100GbE Support

Getting large amounts of data into and out of a module is an important system design consideration. The WOLF-163L module includes a ConnectX-7 SmartNIC, which provides a configurable PCIe interface. It also provides up to 100GBASE-KR4 on the data plane, RDMA over Converged Ethernet (RoCE) with support for NVIDIA GPUDirect RDMA, and enhanced security features such as hardware-verified secure boot, hardware-accelerated cryptography, and encrypted storage.

Hardware Accelerated Video Encode / Decode

The Blackwell GPU includes the NVENC video encode and NVENC decode hardware acceleration engine. Using the GPU for video encoding provides an efficient, high quality method to achieve real time 8K and 4K encoding without burdening the system CPU. The Blackwell encoding engine includes support for several popular codecs and is the first GPU to include AV1 hardware encoding and decoding support. The NVIDIA Video Codec SDK provides a complete set of APIs, samples and documentation for hardware accelerated video encode and decode.

SOSA Slot Profile Support

This module's configurable switch provides support for SOSA aligned slot profiles. The module can be configured with pin mappings that are compatible with previous generation WOLF-153L and 144L modules, which allows the WOLF-163L to be a plug-in upgrade for previous WOLF products.

The following SOSA aligned profiles are supported:

- 14.6.11-0 Payload Slot Profile, P2 depopulated
- 14.6.13-0 Payload Slot Profile, P2B depopulated

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Ordering Codes

The following table defines series of common order codes for the VPX3U-BW5000E-CX7 module. The asterisks denote characters of the part number that are defined based on common configuration options. Some configuration options for this module include:

- Default Power Threshold
- Conformal Coatings
- PCIe Configuration Options
- Ethernet configuration
- Variant Locked
- P2 or P2B de-populated

Ordering Number	Description
3U VPX Blackwell RTX5000 with ConnectX-7 SmartNIC Configurations	
163L33-F***-***VPX3vA0	3U VPX, Conduction Cooled, NVIDIA Blackwell RTX5000, ConnectX-7, SOSA Payload profile 14.6.11-0 with P2 depopulated
163L33-F***-***VPX3vA0	3U VPX, Conduction Cooled, NVIDIA Blackwell RTX5000, ConnectX-7, SOSA Payload profile 14.6.13-0 with P2B depopulated
Related Payload Product:	
163633-F00*-***VPX3vA0	3U VPX, Conduction Cooled, 1”, NVIDIA Blackwell RTX5000, SOSA Payload profile 14.6.11-0 or 14.6.13

* Contact Sales for the latest Ordering Numbers and available options.

Manufacturing and Quality Assurance

WOLF designs modules to pass the following environmental standards:

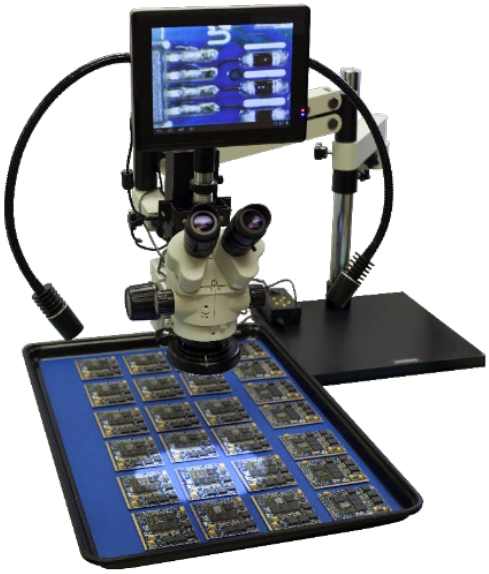
- MIL-STD-810 (United States Military Standard for Environmental Engineering Considerations and Laboratory Tests)
- MIL-HDBK-217 (Reliability Prediction of Electronic Equipment)
- RTCA DO-160 (Environmental Conditions and Test Procedures for Airborne Equipment) on request

WOLF complies with the following management systems:

- AS9100D: Quality Management System - Requirements for Aviation, Space and Defense Organizations (certified)
- ISO 9001:2015: Quality management systems (certified)
- AS5553: Counterfeit Electronic Parts; Avoidance, Detection, Mitigation, and Disposition (compliant)
- NIST SP 800-171: Protecting Controlled Unclassified Information in Nonfederal Systems (compliant)

Boards are manufactured to meet the following standards:

- IPC-A-610 CLASS 3 (Acceptability of Electronic Assemblies)
- IPC 6012 CLASS 3 (Qualification and Performance Specification for Rigid Printed Boards, Class 3 for High Reliability Electronic Products)
- IPC J-STD-001 (Requirements for Soldered Electrical and Electronic Assemblies)



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GOVERNMENT-INDUSTRY DATA EXCHANGE PROGRAM GIDEP

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Datasheet Rev.1

VPX6U-BW5000E-DUAL-VO

Dual NVIDIA Blackwell, 10496 CUDA Cores per GPU, 8 Video Outputs

Key Features

- Two NVIDIA RTX™ 5000 (BW203) GPUs, each with 10496 CUDA Cores, 320 Tensor Cores
- 24 GB GDDR7 256-bit VRAM per GPU with EEC support
- Up to 8 DisplayPort outputs, options for HDMI
- Module power: 190W to 320W, configurable

GPU Features

- Blackwell GPGPU parallel processing:
  - ☐ CUDA Toolkit 12, CUDA Compute capability 10.0
  - ☐ CUDA-X AI and CUDA-X HPEC libraires
  - ☐ OpenCL™ 3.0, DirectX® 12 Ultimate, OpenGL 4.6, OpenGL ES 3.2, Vulkan™ 1.2
- 320 Tensor Cores (4th Gen) per GPU
- 80 Ray Tracing cores (3rd Gen) per GPU
- NVENC (9th Gen) and NVDEC (6th Gen) with up to 8K video encoding and hardware decoding support

Connectivity / System Management

- IPMI system management
- NVIDIA GPUDirect RDMA support
- Configurable PCIe Gen5 switch
- Linux and Windows drivers
- NVIDIA driver support requires the following host CPU: Intel H/HX/P/PX/S Class, AMD H/HS Class

Mechanical / Open Systems Architecture

- High level of ruggedization:
  - ☐ Rugged conduction cooled (CC), air cooled (AC), or liquid flow through (LFT)
  - ☐ Operating temperature: CC: -40°C to +70°C standard, operational to +85°C, AC: -40° to +60°C standard, operational to +71°C
  - ☐ Vibration (sine wave): 10G peak, 5 - 2000Hz
  - ☐ Shock: 40G peak for conduction cooled, 30G peak for air cooled
- Dimensions: 160mm x 233mm x 25.4mm
- Weight (approximately): TBD
- ANSI/VITA 48, 65 (VPX-REDI, OpenVPX)
- OpenVPX and SOSA Aligned profile support 10.6.4

Overview

The VPX6U-BW5000E-DUAL-VO module includes two NVIDIA RTX™ 5000 Blackwell embedded GPUs and a PCIe Gen5 switch in a rugged 6U VPX module. The NVIDIA RTX5000 embedded GPU provides advanced processing capabilities for high performance embedded computing (HPEC) and artificial intelligence (AI) data processing.

The NVIDIA Blackwell architecture includes CUDA cores for HPC, and 5th generation Tensor cores for AI and data science computations. The Blackwell GPU has an improved architecture which provides increased efficiency. The module also supports 24GB of GDDR7 memory which provides over 50% higher bandwidth compared to the previous generation. The GPU supports PCIe Gen5, providing a fast data transfer path to/from the module.

Unlocking the best performance requires the best cooling capability. WOLF's advanced cooling technology is designed to move heat using a low weight, high efficiency path from the GPU die to the wedgelocks.

NVIDIA RTX

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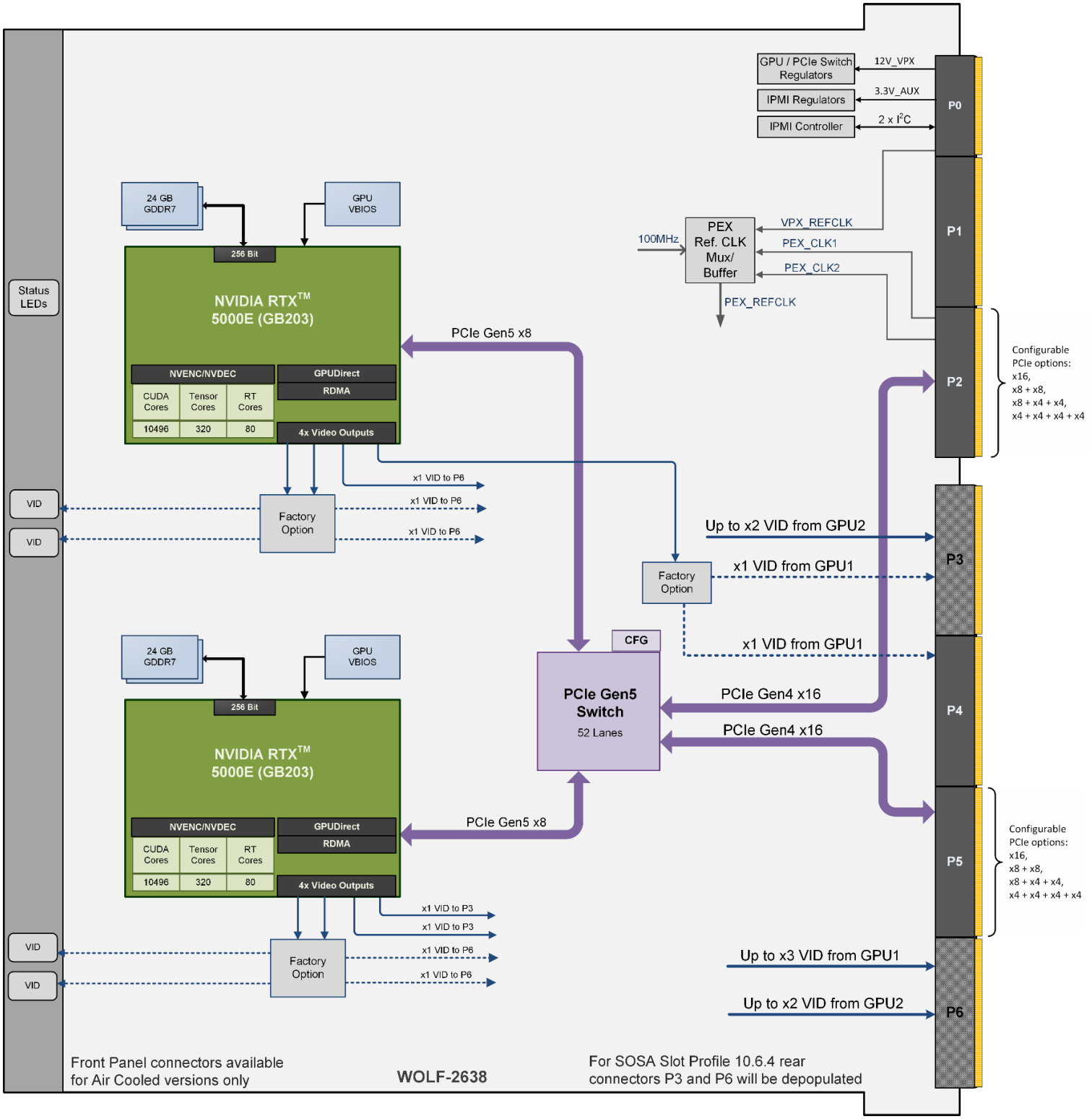
VPX6U-BW5000E-DUAL-VO



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SOSA and OpenVPX Slot Profile Support

This module's configurable switch provides support for SOSA aligned and OpenVPX slot profiles. The module can be configured with pin mappings that are compatible with previous generation WOLF-2538/2348 modules, which allows the WOLF-2638 to be a plug-in upgrade for previous WOLF products. The following SOSA aligned profile is supported:

- 10.6.4 Payload Slot Profile, P3 and P6 depopulated

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Ordering Codes

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- Display Interfaces
- Conformal Coating Type
- COTS, MCOTS or Locked
- PCIe Switch Configuration
- OpenVPX or SOSA Aligned configuration

	Ordering Number	Description
	6U VPX Blackwell RTX5000 Single Slot Configurations	
	263823-F***-***VPX6vA0	6U VPX, Air Cooled, 1”, Dual NVIDIA RTX5000 Blackwell, Front: 4x video outputs, Rear: 4x video outputs
	263833-F***-***VPX6vA0	6U VPX, Conduction Cooled, 1”, Dual NVIDIA RTX5000 Blackwell, Rear: 8x video outputs
	263823-F***-***VPX6vA0	6U VPX, Air Cooled, 1”, Single NVIDIA RTX5000 Blackwell, Front: 2x video outputs, Rear: 2x video outputs
	263833-F***-***VPX6vA0	6U VPX, Conduction Cooled, 1”, Single NVIDIA RTX5000 Blackwell, Rear: 4x video outputs

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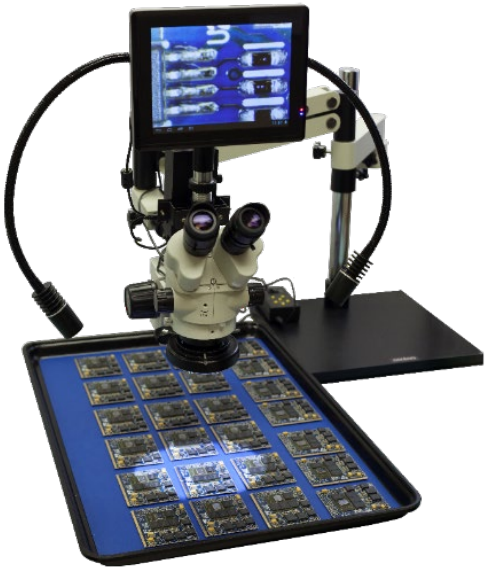

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Datasheet Rev.1

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Contact us with any questions and quote needs

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