NVIDIA BlueField-3 DPU User Guide

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About This Manual

This User Manual describes NVIDIA® BlueField®-3 InfiniBand/Ethernet DPU (Data Processing Unit). It provides details as to the interfaces of the board, specifications, required software and firmware for operating the board, and a step-by-step plan of how to bring up the BlueField-3 DPUs.

Ordering Part Numbers

The tables below list the ordering part numbers (OPNs) for available BlueField-3 DPUs in Full-Height Half-Length (FHHL) form factor.

Form Factor	NVIDIA OPN	Model	Series/ Cores	Data Transmission Rate	No. of Ports	PCIe Support	x16 PCIe Extension Option	External Power Connector	Crypto	On-Board DDR5 Memory	Integrated BMC	Bracket Type	Device ID	PSID	Lifecycle
Single-Slot FHHL	900-9D3B4-00EN-EA0	B3140L	E-Series / 8 Arm-Cores	InfiniBand: NDR 400Gb/s (Default) Ethernet: 400GbE	1-Port QSFP112	PCIe Gen 5.0 x16	-	-	✓	16GB	✓	Tall	41692	MT_0000001010	Engineering Samples
	900-9D3B4-00PN-EA0	B3140L	E-Series / 8 Arm-Cores	InfiniBand: NDR 400Gb/s (Default) Ethernet: 400GbE	1-Port QSFP112	PCIe Gen 5.0 x16	-	-	-	16GB	✓	Tall	41692	MT_0000001011	Engineering Samples
	900-9D3B6-00CC-EA0	B3210E	E-Series / 16 Arm-Cores	InfiniBand: HDR100 100Gb/s Ethernet: 100GbE (Default)	2-Ports QSFP112	PCIe Gen 5.0 x16	✓	✓	✓	32GB	✓	Tall	41692	MT_0000001024	Engineering Samples
	900-9D3B6-00SC-EA0	B3210E	E-Series / 16 Arm-Cores	InfiniBand: HDR100 100Gb/s Ethernet: 100GbE (Default)	2-Ports QSFP112	PCIe Gen 5.0 x16	✓	✓	-	32GB	✓	Tall	41692	MT_0000001025	Engineering Samples
	900-9D3B6-00CV-AA0	B3220	P-Series / 16 Arm-cores	InfiniBand: NDR200 200Gb/s Ethernet: 200GbE (Default)	2-Ports QSFP112	PCIe Gen 5.0 x16	✓	✓	✓	32GB	✓	Tall	41692	MT_0000000884	Mass Production

Form Factor	NVIDIA OPN	Model	Series/ Cores	Data Transmission Rate	No. of Ports	PCIe Support	x16 PCIe Extension Option	External Power Connector	Crypto	On-Board DDR5 Memory	Integrated BMC	Bracket Type	Device ID	PSID	Lifecycle
	900-9D3B6-00SV-AA0	B3220	P-Series / 16 Arm-cores	InfiniBand: NDR200 200Gb/s Ethernet: 200GbE (Default)	2-Ports QSFP112	PCIe Gen 5.0 x16	✓	✓	-	32GB	✓	Tall	41692	MT_0000000965	Mass Production
Dual-Slot FHHL	900-9D3B6-00CN-AB0	B3240	P-Series / 16 Arm-Cores	InfiniBand: NDR 400Gb/s (Default) Ethernet: 400GbE	2-Ports QSFP112	PCIe Gen 5.0 x16	✓	✓	✓	32GB	✓	Tall	41692	MT_0000000883	Engineering Samples
	900-9D3B6-00SN-AB0	B3240	P-Series / 16 Arm-Cores	InfiniBand: NDR 400Gb/s (Default) Ethernet: 400GbE	2-Ports QSFP112	PCIe Gen 5.0 x16	✓	✓	-	32GB	✓	Tall	41692	MT_0000000964	Engineering Samples

EOL'ed (End of Life) DPUs

Intended Audience

This manual is intended for the installer and user of these cards. The manual assumes basic familiarity with InfiniBand/Ethernet network and architecture specifications.

Technical Support

Customers who purchased NVIDIA products directly from NVIDIA are invited to contact us through the following methods:

- URL: www.nvidia.com → Support
- E-mail: enterprisesupport@nvidia.com

Customers who purchased NVIDIA M-1 Global Support Services, please see your contract for details regarding Technical Support.

Customers who purchased NVIDIA products through an NVIDIA-approved reseller should first seek assistance through their reseller.

Related Documentation

InfiniBand Architecture Specification	InfiniBand Trade Association (IBTA) InfiniBand® specification Release 1.3.1, November 2, 2016 and Vol. 2, Release 1.4 , and Vol 2 - Release 1.5.
IEEE Std 802.3 Specification	IEEE Ethernet specification.
PCI Express Specifications	Industry Standard PCI Express Base and Card Electromechanical Specifications.
NVIDIA LinkX Interconnect Solutions	The NVIDIA® LinkX® product family of cables and transceivers provide the industry's broadest portfolio of QDR/FDR10 (40Gb/s), FDR (56Gb/s), EDR/HDR100 (100Gb/s), HDR (200Gb/s) and NDR (400Gb/s) cables, including Direct Attach Copper cables (DACs), copper splitter cables, Active Optical Cables (AOCs) and transceivers in a wide range of lengths from 0.5m to 10km. In addition to meeting IBTA standards, NVIDIA tests every product in an end-to-end environment ensuring a Bit Error Rate of less than 1E-15.
BlueField DPU Platform BSP Documentation	This guide provides product release notes as well as information on the BSP and how to develop and/or customize applications, system software, and file system images for the BlueField platform.
DOCA SDK Software Documentation	NVIDIA DOCA SDK software.

Document Conventions

When discussing memory sizes, GB and GBytes are used in this document to mean size in gigabytes. The use of Gb or Gbits (small b) indicates size in gigabits. In this document PCIe is used to mean PCI Express.

Revision History

A list of the changes made to this document are provided in Document Revision History.

Introduction

The NVIDIA® BlueField®-3 data processing unit (DPU) is the 3rd-generation data center infrastructure-on-a-chip that enables organizations to build software-defined, hardware-accelerated IT infrastructures from cloud to core data center to edge. With 400Gb/s Ethernet or NDR 400Gb/s InfiniBand network connectivity, BlueField-3 DPU offloads, accelerates, and isolates software-defined networking, storage, security, and management functions in ways that profoundly improve data center performance, efficiency, and security. Providing powerful computing, and a broad range of programmable acceleration engines in the I/O path, BlueField-3 is perfectly positioned to address the infrastructure needs of the most demanding applications, while delivering full software backward compatibility through the NVIDIA DOCA™ software framework.
BlueField-3 DPUs transform traditional computing environments into secure and accelerated virtual private clouds, allowing organizations to run application workloads in secure, multi-tenant environments. Decoupling data center infrastructure from business applications, BlueField-3 enhances data center security, streamlines operations, and reduces the total cost of ownership. Featuring NVIDIA's in-network computing technology, BlueField-3 enables the next generation of supercomputing platforms, delivering optimal bare-metal performance and native support for multi-node tenant isolation.

System Requirements

Item	Description
PCI Express slot	**In PCIe x16 Configuration** PCIe Gen 5.0 (32GT/s) through x16 edge connector. **In PCIe x16 Extension Option - Switch DSP (Data Stream Port)** • PCIe Gen 5.0 SERDES @32GT/s through edge connector • PCIe Gen 5.0 SERDES @32GT/s through PCIe Auxiliary Connection Card
System Power Supply	Minimum 75W or greater system power supply for all cards.
	P-Series DPUs with PCIe Gen 5.0 x16 require a supplementary 8-pin ATX power supply connectivity available through the external power supply connector. ⚠ NOTE: The power supply harness is not included in the package. To power-up the DPU, power the ATX power supply and the PCIe golden fingers simultaneously. Failure to do so may harm the DPU.
Operating System	BlueField-3 DPU is shipped with Ubuntu - a Linux commercial operating system - which includes the NVIDIA OFED stack (MLNX_OFED), and is capable of running all customer-based Linux applications seamlessly. For more information, please refer to the DOCA SDK documentation or NVIDIA BlueField-3 Software User Manual.
Connectivity	• Interoperable with 1/10/25/40/50/100/200/400 Gb/s Ethernet switches and SDR/DDR/EDR/HDR100/HDR/NDR200/NDR InfiniBand switches • Passive copper cable with ESD protection • Powered connectors for optical and active cable support

For detailed information, see Specifications.

Package Contents

Prior to unpacking your DPU, it is important to make sure your server meets all the system requirements listed above for a smooth installation. Be sure to inspect each piece of equipment shipped in the packing box. If anything is missing or damaged, contact your reseller.

Card Package

For FHHL P-Series DPUs, you need an 8-pin PCIe external power cable to activate the card. The cable is not included in the package. For further details, please refer to External PCIe Power Supply Connector.

Item	Description
Card	1x BlueField-3 DPU
Accessories	1x tall bracket (shipped assembled on the card)

Accessories Kit

This is an optional accessories kit used for debugging purposes and can be ordered separately.

Kit OPN	Contents
MBF35-DKIT	4-pin USB to female USB Type-A cable
	20-pin shrouded connector to USB Type-A cable

PCIe Auxiliary Card Package

This is an optional kit which applies to following OPNs: 900-9D3B6-00CV-AA0, 900-9D3B6-00SV-AA0, 900-9D3B6-00CC-AA0, 900-9D3B6-00SC-AA0, 900-9D3B6-00CN-AB0 and 900-9D3B6-00SN-AB0.

The PCIe auxiliary kit can be purchased separately to operate selected DPUs in a dual-socket server. For package contents, refer to PCIe Auxiliary Card Kit.

Features and Benefits

> This section describes hardware features and capabilities. Please refer to the relevant driver and/or firmware release notes for feature availability.

<table>
<tr><th>Feature</th><th>Description</th></tr>
<tr><td>InfiniBand Architecture Specification v1.5 compliant</td><td>BlueField-3 DPU delivers low latency, high bandwidth, and computing efficiency for high-performance computing (HPC), artificial intelligence (AI), and hyperscale cloud data centers applications.
BlueField-3 DPU is InfiniBand Architecture Specification v1.5 compliant.
InfiniBand Network Protocols and Rates:
<table>
<tr><th rowspan="2">Protocol</th><th rowspan="2">Standard</th><th colspan="2">Rate (Gb/s)</th><th rowspan="2">Comments</th></tr>
<tr><th>4x Port
(4 Lanes)</th><th>2x Ports
(2 Lanes)</th></tr>
<tr><td>NDR/NDR200</td><td>IBTA Vol2 1.5</td><td>425</td><td>212.5</td><td>PAM4 256b/257b encoding and RS-FEC</td></tr>
<tr><td>HDR/HDR100</td><td>IBTA Vol2 1.4</td><td>212.5</td><td>106.25</td><td>PAM4 256b/257b encoding and RS-FEC</td></tr>
<tr><td>EDR</td><td>IBTA Vol2 1.3.1</td><td>103.125</td><td>51.5625</td><td>NRZ 64b/66b encoding</td></tr>
<tr><td>FDR</td><td>IBTA Vol2 1.2</td><td>56.25</td><td>N/A</td><td>NRZ 64b/66b encoding</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Feature</th><th>Description</th></tr>
<tr><td>Up to 400 Gigabit Ethernet</td><td>BlueField-3 DPU complies with the following IEEE 802.3 standards:
400GbE / 200GbE / 100GbE / 50GbE / 40GbE / 25GbE / 10GbE
<table>
<tr><th>Protocol</th><th>MAC Rate</th></tr>
<tr><td>IEEE802.3ck</td><td>400/200/100 Gigabit Ethernet
(Include ETC enhancement)</td></tr>
<tr><td>IEEE802.3cd
IEEE802.3bs
IEEE802.3cm
IEEE802.3cn
IEEE802.3cu</td><td>400/200/100 Gigabit Ethernet
(Include ETC enhancement)</td></tr>
<tr><td>IEEE 802.3bj
IEEE 802.3bm</td><td>100 Gigabit Ethernet</td></tr>
<tr><td>IEEE 802.3by
Ethernet Consortium25</td><td>50/25 Gigabit Ethernet</td></tr>
<tr><td>IEEE 802.3ba</td><td>40 Gigabit Ethernet</td></tr>
<tr><td>IEEE 802.3ae</td><td>10 Gigabit Ethernet</td></tr>
<tr><td>IEEE 802.3cb</td><td>2.5/5 Gigabit Ethernet
(For 2.5: support only 2.5 x1000BASE-X)</td></tr>
<tr><td>IEEE 802.3ap</td><td>Based on auto-negotiation and KR startup</td></tr>
<tr><td>IEEE 802.3ad
IEEE 802.1AX</td><td>Link Aggregation</td></tr>
<tr><td>IEEE 802.1Q
IEEE 802.1P VLAN tags and priority</td><td></td></tr>
<tr><td>IEEE 802.1Qau (QCN)
Congestion Notification
IEEE 802.1Qaz (ETS)
EEE 802.1Qbb (PFC)
IEEE 802.1Qbg
IEEE 1588v2
IEEE 802.1AE (MACSec)
Jumbo frame support (9.6KB)</td><td></td></tr>
</table></td></tr>
<tr><td>On-board Memory</td><td>Quad SPI NOR FLASH - includes 256Mbit for Firmware image.
UVPS EEPROM - includes 2Mbit.
FRU EEPROM - Stores the parameters and personality of the card. The EEPROM capacity is 128Kbit. FRU I2C address is (0x50) and is accessible through the PCIe SMBus.
DPU_BMC Flashes:
2x 64MByte for BMC Image
512MByte for Config Data
eMMC pSLC 40GB with 30K Write Cycles eMMC for SoC BIOS and OS.
SSD (onboard BGA) 128GByte for user SoC OS, logs and application SW.
DDR5 SDRAM - 16GB/32GB @5600MT/s single/dual-channel DDR5 SDRAM memory. Solder down on-board. 128bit + 16bit ECC</td></tr>
<tr><td>BlueField-3 IC</td><td>The NVIDIA BlueField-3 DPU integrates x8 / x16 Armv8.2+ A78 Hercules cores (64-bit) is interconnected by a coherent mesh network, one DRAM controller, an RDMA intelligent network adapter supporting up to 400Gb/s, an embedded PCIe switch with endpoint and root complex functionality, and up to 32 lanes of PCIe Gen 5.0.</td></tr>
</table>

Feature	Description
Overlay Networks	In order to better scale their networks, data center operators often create overlay networks that carry traffic from individual virtual machines over logical tunnels in encapsulated formats such as NVGRE and VXLAN. While this solves network scalability issues, it hides the TCP packet from the hardware offloading engines, placing higher loads on the host CPU. NVIDIA DPU effectively addresses this by providing advanced NVGRE and VXLAN hardware offloading engines that encapsulate and de-capsulate the overlay protocol.
RDMA and RDMA over Converged InfiniBand/ Ethernet (RoCE)	NVIDIA DPU, utilizing IBTA RDMA (Remote Data Memory Access) and RoCE (RDMA over Converged InfiniBand/Ethernet) technology, delivers low-latency and high-performance over InfiniBand/Ethernet networks. Leveraging data center bridging (DCB) capabilities as well as advanced congestion control hardware mechanisms, RoCE provides efficient low-latency RDMA services over Layer 2 and Layer 3 networks.
Quality of Service (QoS)	Support for port-based Quality of Service enabling various application requirements for latency and SLA.
Storage Acceleration	• A consolidated compute and storage network achieves significant cost-performance advantages over multi-fabric networks. Standard block and file access protocols can leverage RDMA for high-performance storage access: NVMe over Fabric offloads for the target machine • BlueField-3 DPU may operate as a co-processor offloading specific storage tasks from the host, isolating part of the storage media from the host, or enabling abstraction of software-defined storage logic using the NVIDIA BlueField-3 Arm cores. On the storage initiator side, NVIDIA BlueField-3 DPU can prove an efficient solution for hyper-converged systems to enable the host CPU to focus on compute while all the storage interface is handled through the Arm cores.
NVMe-oF	Non-volatile Memory Express (NVMe) over Fabrics is a protocol for communicating block storage IO requests over RDMA to transfer data between a host computer and a target solid-state storage device or system over a network. NVIDIA BlueField-3 DPU may operate as a co-processor offloading specific storage tasks from the host using its powerful NVMe over Fabrics Offload accelerator.
SR-IOV	NVIDIA DPU SR-IOV technology provides dedicated adapter resources and guaranteed isolation and protection for virtual machines (VM) within the server.
High-Performance Accelerations	• Tag Matching and Rendezvous Offloads • Adaptive Routing on Reliable Transport • Burst Buffer Offloads for Background Checkpointing
GPU Direct	GPUDirect RDMA is a technology that provides a direct P2P (Peer-to-Peer) data path between the GPU Memory directly to/from the NVIDIA HCA devices. This provides a significant decrease in GPU-GPU communication latency and completely offloads the CPU, removing it from all GPU-GPU communications across the network. NVIDIA DPU uses high-speed DMA transfers to copy data between P2P devices resulting in more efficient system applications
Isolation	BlueField-3 DPU functions as a “computer-in-front-of-a-computer,” unlocking unlimited opportunities for custom security applications on its Arm processors, fully isolated from the host’s CPU. In the event of a compromised host, BlueField-3 may detect/block malicious activities in real-time and at wire speed to prevent the attack from spreading further.
Cryptography Accelerations	From IPsec and TLS data-in-motion inline encryption to AES-XTS block-level data-at-rest encryption and public key acceleration, BlueField-3 DPU hardware-based accelerations offload the crypto operations and free up the CPU, reducing latency and enabling scalable crypto solutions. BlueField-3 “host-unaware” solutions may transmit and receive data, while BlueField-3 acts as a bump-in-the-wire for crypto.
Securing Workloads	BlueField-3 DPU accelerates connection tracking with its ASAP2 technology to enable stateful filtering on a per-connection basis. Moreover, BlueField-3 includes a Titan IC regular expression (RXP) acceleration engine supported by IDS/IPS tools to detect host introspection and Application Recognition (AR) in real-time.

Feature	Description
Security Accelerators	A consolidated compute and network solution based on DPU achieves significant advantages over a centralized security server solution. Standard encryption protocols and security applications can leverage NVIDIA BlueField-3 compute capabilities and network offloads for security application solutions such as Layer4 Statefull Firewall.
Virtualized Cloud	By leveraging BlueField-3 DPU virtualization offloads, data center administrators can benefit from better server utilization, allowing more virtual machines and more tenants on the same hardware, while reducing the TCO and power consumption
Out-of-Band Management	The NVIDIA BlueField-3 DPU incorporates a 1GbE RJ45 out-of-band port that allows the network operator to establish trust boundaries in accessing the management function to apply it to network resources. It can also be used to ensure management connectivity (including the ability to determine the status of any network component) independent of the status of other in-band network components.
BMC	Some BlueField-3 DPUs incorporate local NIC BMC (Baseboard Management Controller) hardware on the board. The BMC SoC (system on a chip) can utilize either shared or dedicated NICs for remote access. The BMC node enables remote power cycling, board environment monitoring, BlueField-3 chip temperature monitoring, board power and consumption monitoring, and individual interface resets. The BMC also supports the ability to push a bootstream to BlueField-3. Having a trusted on-board BMC that is fully isolated for the host server ensures highest security for the DPU boards.

BlueField DPU Administrator Quick Start Guide

This page is tailored for system administrators wishing to install BlueField and perform sample administrative actions on it. For a quick start guide aimed at software developers wishing to develop applications on the BlueField DPU using the DOCA framework, please refer to the *NVIDIA DOCA Developer Quick Start Guide*.

> Not sure which guide to follow? For more details on the different BlueField user types, please refer to the NVIDIA BlueField and DOCA User Types document.

Verifying DPU Connection and Setting Up Host Environment

This section takes you through the basic steps of installing BlueField DPU and performing a sample administrative task on it.

1. Install your DPU into your host server according to the instructions under Hardware Installation.

   > Ensure your host OS is included in the supported operating systems list and that the BlueField's out-of-band (OOB) management interface is connected to the network. The OOB interface must be connected to a DHCP/DNS server. The MAC address of the OOB port is found on the sticker on the BlueField DPU.

2. Verify that the host server correctly identifies the BlueField DPU. The following commands rescan the PCIe bus and list the BlueField's name and PCIe address:

   ```
   # sudo update-pciids
   # sudo lspci | grep BlueField
   ```

   The list of identified devices should include a network controller for every physical (Ethernet) port and a DMA controller for DPU management. Expected output example:

   ```
   17:00.0 Ethernet controller: Mellanox Technologies MT43244 BlueField-3 integrated ConnectX-7 network
   controller (rev 01)
   17:00.1 Ethernet controller: Mellanox Technologies MT43244 BlueField-3 integrated ConnectX-7 network
   controller (rev 01)
   17:00.2 DMA controller: Mellanox Technologies MT43244 BlueField-3 SoC Management Interface (rev 01)
   ```

3. If an older DOCA software version is installed on your host, make sure to uninstall it before proceeding with the installation of the new version:
   - For Ubuntu/Debian:

     ```
     $ for f in $( dpkg --list | grep doca | awk '{print $2}' ); do echo $f ; apt remove --purge $f -y ;
     done
     $ sudo apt-get autoremove
     ```

   - For CentOS/RHEL/Rocky:

     ```
     host# for f in $(rpm -qa |grep -i doca ) ; do yum -y remove $f; done
     host# yum autoremove
     host# yum makecache
     ```

4. Download and install the latest "DOCA for Host" package compatible with your specific operating system and version listed here under the "BlueField Drivers" tab.

   > ⚠ Make sure to accept cookies from the website when prompted.

At this stage the host environment is all set and you can now perform administrative tasks on the DPU.

Connecting to BlueField and Verifying Version

To connect to your DPU:

1. SSH to the DPU using the OOB IP or the RShim IP (192.168.100.2) using the default credentials (`ubuntu`/`ubuntu`).
2. When logging into the DPU for the first time after installing the BFB, you must change the default password.

   ```
   WARNING: Your password has expired.
   You must change your password now and login again!
   Changing password for ubuntu.
   Current password:
   New password:
   ```

3. To check the current running BFB:

   ```
   dpu# sudo cat /etc/mlnx-release
   ```

Updating BlueField BFB Image

> ⚠ These instructions are tailored for installing the BlueField BFB image on the default Ubuntu OS. To install it on other OSs, please contact NVIDIA Support.

The BlueField BFB image includes all the DOCA packages.

1. Installing a new BFB on the DPU is performed using the `bfb-install` utility that is included in the RShim tool.

   ```
   # bfb-install --bfb <BFB-image>.bfb --rshim rshim0
   ```

   Expected output example:

   ```
   Pushing bfb
   Collecting BlueField booting status. Press Ctrl+C to stop…
    INFO[BL2]: start
    …
    INFO[MISC]: Ubuntu installation started
    INFO[MISC]: Installation finished
    INFO[MISC]: Rebooting...
   ```

2. Upgrade the firmware of the BlueField DPU:
   a. Upgrade the BlueField DPU's firmware:

```
dpu# sudo /opt/mellanox/mlnx-fw-updater/mlnx_fw_updater.pl --force-fw-update
```

Expected output example:

```
Device #1:
----------
  Device Type:      BlueField-3   [...]
  Versions:         Current        Available
     FW             <Old_FW_ver>   <New_FW_ver>
  [...]
  Done
```

b. Power cycle the host for the changes to take effect.

3. Verify that the BFB has been installed and the firmware has been upgraded successfully by accessing the DPU again:
   a. SSH to the BlueField DPU from the host using OOB IP or RShim IP:

```
ssh <ip>
```

   b. Check the versions of the DPU image and firmware:

```
# sudo bfvcheck
```

Expected output example:

```
Beginning version check...

-RECOMMENDED VERSIONS-
ATF: v2.2(release):4.0.3-3-g886241c
UEFI: 4.0.3-1-g2162ecf
FW: 32.37.1300

-INSTALLED VERSIONS-
ATF: v2.2(release):4.0.3-3-g886241c
UEFI: 4.0.3-1-g2162ecf
FW: 32.37.1300

Version check complete.
No issues found.
```

Additional Reading

To learn more about BlueField please see:

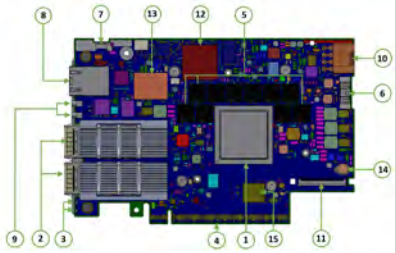
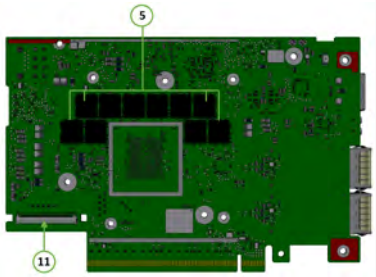
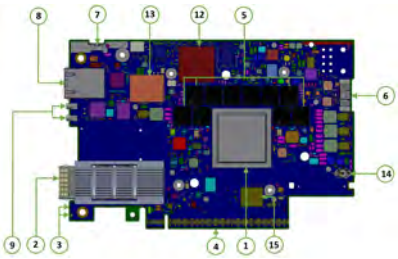
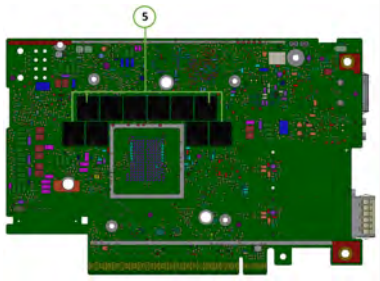
- BlueField hardware troubleshooting
- BlueField software installation
- BlueField software troubleshooting

Supported Interfaces

This section describes the DPU-supported interfaces. Each numbered interface referenced in the figures is described in the following table with a link to detailed information.

> ⚠ The below figures are for illustration purposes only and might not reflect the current revision of the DPU.

FHHL DPU Layout and Interface Information

OPN	*DPU Component Side*	*DPU Print Side*
900-9D3B6-00CC-EA0 900-9D3B6-00SC-EA0 900-9D3B6-00CV-AA0 900-9D3B6-00SV-AA0 900-9D3B6-00CC-AA0 900-9D3B6-00SC-AA0 900-9D3B6-00CN-AB0 900-9D3B6-00SN-AB0		
900-9D3B4-00EN-EA0 900-9D3B4-00PN-EA0		

Item	Interface	Description
1	DPU System on Chip	• **BlueField-3 P-Series** - 16 Arm-Cores - 560MHz/2133MHz • **BlueField-3 E-Series** - 8 Arm-Cores - 505MHz/2000MHz
2	Networking Interface	The network traffic is transmitted through the DPU QSFP112 connectors. The QSFP112 connectors allow the use of modules and optical and passive cable interconnect solutions
3	Networking Ports LEDs Interface	One bi-color I/O LEDs **per port** to indicate link and physical status
4	PCI Express Interface	PCIe Gen 5.0 through an x16 edge connector
5	DDR5 SDRAM On-Board Memory	Single-Channel Cards: 10 units of DDR5 SDRAM for a total of 16GB @ 5600MT/s 64bit + 8bit ECC, solder-down memory Dual-Channel Cards: 20 units of DDR5 SDRAM for a total of 32GB @ 5600MT/s. 128bit + 16bit ECC, solder-down memory

Item	Interface	Description
6	NC-SI Management Interface	NC-SI 20 pins BMC connectivity for remote management
7	USB 4-pin RA Connector	Used for OS image loading
8	1GbE OOB Management Interface	1GbE BASE-T OOB management interface
9	MMCX RA PPS IN/OUT	Allows PPS IN/OUT
10	External PCIe Power Supply Connector	An external 12V power connection through an 8-pin ATX connector
11	Cabline CA-II Plus Connectors	Two Cabline CA-II plus connectors are populated to allow connectivity to an additional PCIe x16 Auxiliary card Applies to OPNs: Applies to OPNs 900-9D3B6-00CV-AA0, 900-9D3B6-00SV-AA0, 900-9D3B6-00CC-AA0, 900-9D3B6-00SC-AA0, 900-9D3B6-00CN-AB0, 900-9D3B6-00SN-AB0
12	Integrated BMC	DPU BMC
13	SSD Interface	128GB
14	RTC Battery	Battery holder for RTC
15	eMMC	x8 NAND flash

Interfaces Detailed Description

DPU SoC (System on Chip)

NVIDIA® BlueField®-3 DPU is a family of advanced DPU IC solutions that integrate a coherent mesh of 64-bit Armv8.2+ A78 Hercules cores, an NVIDIA® ConnectX®-7 network adapter front-end, and a PCI Express switch into a single chip. The powerful DPU IC architecture includes an Armv multicore processor array, enabling customers to develop sophisticated applications and highly differentiated feature sets. Leverages the rich Arm software ecosystem and introduces the ability to offload the x86 software stack.

At the heart of BlueField-3, the ConnectX-7 network offload controller with RDMA and RDMA over Converged Ethernet (RoCE) technology delivers cutting-edge performance for networking and storage applications such as NVMe over Fabrics. Advanced features include an embedded virtual switch with programmable access lists (ACLs), transport offloads, and stateless encaps/decaps of NVGRE, VXLAN, and MPLS overlay protocols.

Encryption

⚠ Applies to Crypto enabled OPNs.

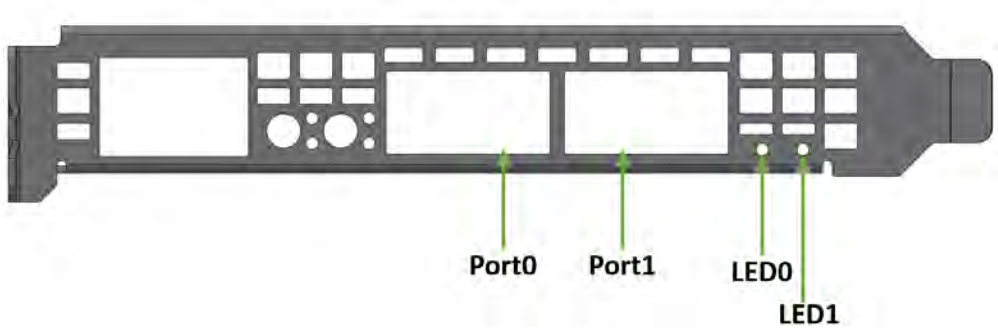
DPU addresses the concerns of modern data centers by combining hardware encryption accelerators with embedded software and fully integrated advanced network capabilities, making it an ideal platform for developing proprietary security applications. It enables a distributed security architecture by isolating and protecting each workload and providing flexible control and visibility at the server and workload level; controlling risk at the server access layer builds security into the DNA of the data center and enables prevention, detection, and response to potential threats in real-time. DPU can deliver powerful functionality, including encryption of data-in-motion, bare-metal provisioning, stateful L4 firewall, and more.

Networking Interface

> ⚠ The DPU includes special circuits to protect the card/server from ESD shocks when plugging copper cables.

The network ports are compliant with the InfiniBand Architecture Specification, Release 1.5. InfiniBand traffic is transmitted through the cards' QSFP112 connectors.

Networking Ports LEDs Interface



One bicolor (Yellow and Green) I/O LED per port indicates speed and link status.

Link Indications

<table>
<tr><th>State</th><th>Bi-Color LED (Yellow/Green)</th><th></th></tr>
<tr><td>Beacon command for locating the adapter card</td><td>1Hz blinking Yellow</td><td></td></tr>
<tr><td>Error</td><td>4Hz blinking Yellow Indicates an error with the link. The error can be one of the following:
<table>
<tr><th>Error Type</th><th>Description</th><th>LED Behavior</th></tr>
<tr><td>I²C</td><td>I²C access to the networking ports fails</td><td>Blinks until error is fixed</td></tr>
<tr><td>Over-current</td><td>Over-current condition of the networking ports</td><td>Blinks until error is fixed</td></tr>
</table></td><td></td></tr>
</table>

State	Bi-Color LED (Yellow/Green)	
Physical Activity	Blinking Green	
Link Up	Solid Green	
Physical Up (InfiniBand Mode Only)	Solid Yellow	

PCI Express Interface

The DPU supports PCI Express Gen 5.0/4.0 through x16 edge connectors. Some cards allow connectivity to an additional PCIe x16 Auxiliary card through the Cabline CA-II Plus connectors.

The following lists PCIe interface features:

- PCIe Gen 5.0, 4.0, 3.0, 2.0 and 1.1 compatible
- 2.5, 5.0, or 8.0, 16.0 or 32.0 GT/s link rate x16 lanes
- Auto-negotiates to x16, x8, x4, x2, or x1

DDR5 SDRAM On-Board Memory

The DPUs incorporate 10 or 20 units of DDR5 SDRAM. See the following table for DDR5 SDRAM memory specifications per ordering part number.

OPNs	DDR5 SDRAM On-Board Memory
900-9D3B4-00EN-EA0 900-9D3B4-00PN-EA0	Single-channel with 10 DDR5 + ECC (64bit + 8bit ECC) for a total of 16GB @ 5200MT/s
900-9D3B6-00CC-EA0 900-9D3B6-00SC-EA0	Dual-channel with 20 DDR5 + ECC (128bit + 16bit ECC) for a total of 32GB @ 5200MT/s
900-9D3B6-00CV-AA0 900-9D3B6-00SV-AA0 900-9D3B6-00CC-AA0 900-9D3B6-00SC-AA0 900-9D3B6-00CN-AB0 900-9D3B6-00SN-AB0	Dual-channel with 20 DDR5 + ECC (128bit + 16bit ECC) for a total of 32GB @ 5600MT/s

NC-SI Management Interface

The DPU enables the connection of a Baseboard Management Controller (BMC) to a set of Network Interface Controller (NICs) to enable out-of-band remote manageability. The NC-SI management is supported over RMII and has a connector on the DPU. Please refer to NC-SI Management Interface for pins.

UART Interface Connectivity

A UART debug interface is available on DPU cards via a 20-pin NC-SI connector. For DPUs without onboard BMC hardware, the UART interface is that of the BlueField-3 device. For DPUs with onboard BMC hardware, the UART interface is that of the NIC BMC device. The connectivity for both cases is shown in the following table:

NC-SI Connector Pin #	Signal on DPU without BMC	Signal on DPU with BMC
14	BF_UART0_RX	BMC_RX5
16	BF_UART0_TX	BMC_TX5
12	GND	GND

The UART interface is compliant with the TTL 3.3V voltage level. Use a USB-to-UART cable that supports TTL voltage levels to connect the UART Interface for Arm console access.

It is prohibited to connect any RS-232 cable directly! Only TTL 3.3V voltage level cables are supported.

Do not use the USB-to-UART cable for NC-SI management purposes.

USB 4-pin RA Connector

The USB 4-pin RA USB connector is used to load operating system images. Use a 4-pin male connector to a male Type-A cable to connect to the board.

The male connector to the male Type-A cable is not included in the shipped DPU card box and should be ordered separately as part of the accessories kit (P/N: MBF35-DKIT).

1GbE OOB Management Interface

The DPU incorporates a 1GbE RJ45 out-of-band port that allows the network operator to establish trust boundaries in accessing the management function to apply it to network resources. It can also be used to ensure management connectivity (including the ability to determine the status of any network component) independent of other in-band network components' status.

For DPUs with integrated BMC: 1GbE OOB Management can be performed via the integrated BMC.

1GbE OOB Management LEDs Interface

Two OOB management LEDs, one Green and one Yellow, behave as described in the table below.

Green LED	Yellow LED	Link/Activity
OFF	OFF	Link off
ON	OFF	1 Gb/s link / No activity
Blinking	OFF	1 Gb/s link / Activity (RX,TX)
OFF	ON	Not supported
OFF	Blinking	
ON	ON	
Blinking	Blinking	

PPS IN/OUT Interface

The DPU incorporates an integrated Hardware Clock (PHC) that allows the DPU to achieve sub-20u Sec accuracy and also offers many timing-related functions such as time-triggered scheduling or time-based SND accelerations (time-based ASAP^2). Furthermore, 5T technology enables the software application to transmit fronthaul (ORAN) at high bandwidth. The PTP part supports the subordinate clock, master clock, and boundary clock.

The DPU PTP solution allows you to run any PTP stack on your host.

With respect to testing and measurements, selected NVIDIA DPUs allow you to use the PPS-out signal from the onboard MMCX RA connecter. The DPU also allows measuring PTP in scale with the PPS-In signal. The PTP HW clock on the Network adapter is sampled on each PPS-In signal, and the timestamp is sent to the SW.

External PCIe Power Supply Connector

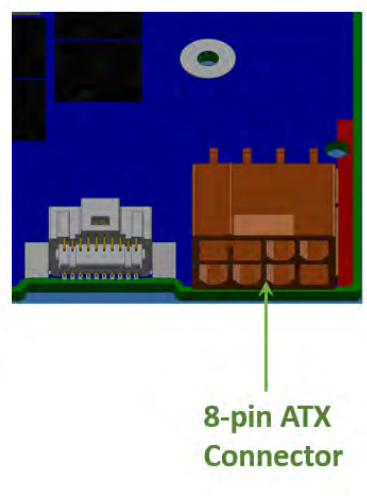
Applies to following DPUs only: 900-9D3B6-00CC-EA0, 900-9D3B6-00SC-EA0, 900-9D3B6-00CV-AA0, 900-9D3B6-00SV-AA0, 900-9D3B6-00CC-AA0, 900-9D3B6-00SC-AA0, 900-9D3B6-00CN-AB0 and 900-9D3B6-00SN-AB0.
The external ATX power cable is not supplied with the DPU package; however, this is a standard cable usually available in servers.

To power-up the DPU, power the ATX power supply and the PCIe golden fingers simultaneously. Failure to do so may harm the DPU. For more information, refer to DPU Power-Up Instructions.

The FHHL P-Series DPUs incorporate an external 12V power connection through an ATX 8-pin PCI connector (Molex 455860005). The DPU includes a special circuitry that provides current balancing between the two power supplies; the 12V from the PCIe x16 standard slot and the 12V from the ATX 8-pin connector. Since the power provided by the PCIe golden fingers is limited to 75W, a total maximum of up to 150W is enabled through the ATX 8-pin connector and the PCIe x16 golden fingers (the ATX 8-pin connector draws its power from the server and can supply up to 150W, per ATX specifications).

The maximum power consumption which does not exceed 150W, is in accordance with the mode of operation of the DPU, and is split between the two power sources as follows:

- Up to 66W from the PCIe golden fingers (12V)
- The rest of the consumed power is drawn from the external PCIe power supply connector



Please refer to External PCIe Power Supply Connector Pins for the external PCIe power supply pins.

Cabline CA-II Plus Connectors

> ⚠ Applies to OPNs: 900-9D3B6-00CC-EA0, 900-9D3B6-00SC-EA0, 900-9D3B6-00CV-AA0, 900-9D3B6-00SV-AA0, 900-9D3B6-00CC-AA0, 900-9D3B6-00SC-AA0, 900-9D3B6-00CN-AB0 and 900-9D3B6-00SN-AB0.

The Cabline CA-II connectors on the DPU enable connectivity to an additional PCIe x16 bus in addition to the PCIe x16 bus available through the golden-fingers. The Cabline CA-II Plus connectors allow connectivity to flash cards and NVMe SSD drives.

Specific applications have an interest in direct connectivity to the far end of the Cabline CA-II cables, through the two 60-pin Cabline CA-II connectors, directly to the motherboard, in order to cut the insertion loss and/or the additional space associated with a PCIe x16 Flash Auxiliary Board.

The Cabline CA-II connectors mate with two 60-pin Cabline CA-II cables that can be distinguished by their black or white external insulators and connector pinouts. The black Cabline CA-II cable mates with the DPU's component (top) side, whereas the white Cabline CA-II cable mates with the DPU print (bottom) side. The Cabline CA-II cables are offered in three standard lengths; 150mm, 350mm, and 550mm.

For connector pinouts, please refer to Cabline CA-II Plus Connectors Pinouts.

Integrated BMC Interface

> ⚠ The BMC Interface applies to DPUs with integrated BMC only.

The DPU incorporates an onboard integrated NIC BMC and an Ethernet switch. The BMC becomes available once the host server powers up the card. The NIC BMC can control the DPU's power and enables DPU shutdown and power-up.

NVMe SSD Interface

> ⚠ The Self Encrypting Disk (SED) capability is not supported.

The NVMe SSD interface is used for storing the user applications and logs. The NVMe SSD interface size is 128GB.

RTC Battery

The DPU incorporates a Coin type Lithium battery CR621 for RTC (Real Time Clock).

eMMC Interface

The eMMC is an x8 NAND flash used for Arm boot and operating system storage. Memory size is 128GB, where it is effectively pSLC 40GB.

Pinouts Description

PCI Express Interface

The following table lists the PCI Express pins description. For further details, please refer to PCI Express Interface.

DPU PCI Express x16 Pin Description

Pin #	Signal Name	Description	Pin #	Signal Name	Description
A1	PRSNT1#	Mechanical Present	B1	12V	
A2	12V		B2	12V	
A3	12V		B3	12V	
A4	GND		B4	GND	
A5	TCK	JTAG - Not Connected	B5	SMCLK	Host SMBus
A6	TDI	JTAG - Not Connected	B6	SMDAT	Host SMBus
A7	TDO	JTAG - Not Connected	B7	GND	
A8	TMS	JTAG - Not Connected	B8	3.3V	3.3V - (Connected in 900-9D3B4-00CC-EA0 & 900-9D3B4-00SC-EA0 only)
A9	3.3V	3.3V - (Connected in 900-9D3B4-00CC-EA0 & 900-9D3B4-00SC-EA0 only)	B9	TRST#	JTAG - Not Connected
A10	3.3V	3.3V - (Connected in 900-9D3B4-00CC-EA0 & 900-9D3B4-00SC-EA0 only)	B10	3.3V_AUX	
A11	PERST#	PCIe Reset	B11	WAKW#/RSVD	
A12	GND		B12	RSVD	
A13	REFCLK+	Host Reference Clock	B13	GND	
A14	REFCLK-	Host Reference Clock	B14	PETP0	
A15	GND		B15	PETN0	
A16	PERP0		B16	GND	
A17	PERN0		B17	RSVD	
A18	GND		B18	GND	
A19	RSVD		B19	PETP1	
A20	GND		B20	PETN1	
A21	PERP1		B21	GND	
A22	PERN1		B22	GND	
A23	GND		B23	PETP2	
A24	GND		B24	PETN2	
A25	PERP2		B25	GND	
A26	PERN2		B26	GND	
A27	GND		B27	PETP3	
A28	GND		B28	PETN3	

Pin #	Signal Name	Description	Pin #	Signal Name	Description
A29	PERP3		B29	GND	
A30	PERN3		B30	RSVD	
A31	GND		B31	RSVD	
A32	RSVD		B32	GND	
A33	RSVD		B33	PETP4	
A34	GND		B34	PETN4	
A35	PERP4		B35	GND	
A36	PERN4		B36	GND	
A37	GND		B37	PETP5	
A38	GND		B38	PETN5	
A39	PERP5		B39	GND	
A40	PERN5		B40	GND	
A41	GND		B41	PETP6	
A42	GND		B42	PETN6	
A43	PERP6		B43	GND	
A44	PERN6		B44	GND	
A45	GND		B45	PETP7	
A46	GND		B46	PETN7	
A47	PERP7		B47	GND	
A48	PERN7		B48	RSVD	
A49	GND		B49	GND	
A50	RSVD		B50	PETP8	
A51	GND		B51	PETN8	
A52	PERP8		B52	GND	
A53	PERN8		B53	GND	
A54	GND		B54	PETP9	
A55	GND		B55	PETN9	
A56	PERP9		B56	GND	
A57	PERN9		B57	GND	
A58	GND		B58	PETP10	
A59	GND		B59	PETN10	
A60	PERP10		B60	GND	
A61	PERN10		B61	GND	
A62	GND		B62	PETP11	
A63	GND		B63	PETN11	
A64	PERP11		B64	GND	
A65	PERN11		B65	GND	
A66	GND		B66	PETP12	
A67	GND		B67	PETN12	
A68	PERP12		B68	GND	
A69	PERN12		B69	GND	

Pin #	Signal Name	Description	Pin #	Signal Name	Description
A70	GND		B70	PETP13	
A71	GND		B71	PETN13	
A72	PERP13		B72	GND	
A73	PERN13		B73	GND	
A74	GND		B74	PETP14	
A75	GND		B75	PETN14	
A76	PERP14		B76	GND	
A77	PERN14		B77	GND	
A78	GND		B78	PETP15	
A79	GND		B79	PETN15	
A80	PERP15		B80	GND	
A81	PERN15		B81	PRSNT2#	Mechanical Present
A82	GND		B82	GND	

External Power Supply Connector

The following table provides the External Power Supply pins of the external power supply interfaces on the DPU. For further details, please refer to External PCIe Power Supply Connector.

> The mechanical pinout of the 8-pin external +12V power connector is shown below. The +12V connector is a GPU power PCIe standard connector. Care should be taken to ensure the power is applied to the correct pins as some 8-pin ATX-type connectors can have different pinouts.

Pin Number	Description
1	12V
2	12V
3	12V
4	Sense1
5	GND
6	Sense0
7	GND
8	GND

NC-SI Management Interface

The following table list the NC-SI management interface pinout descriptions. For further details, please refer to NC-SI Management Interface.

Pin#	Signal Name	I/O	Signal Description
1	GND	GND	Ground
2	PKG_ID1	Input (to BlueField-3)	NC-SI PKG_ID Shoul be connected to the Primary controller NC-SI PKG_ID pins to set the appropriate package ID. PKG_ID0 should be connected to the endpoint device GPIO associated with Package ID[0]. PKG_ID1 should be associated with Package ID[1]. Baseboard should connect to GND or leave floating. DPU should have a 4.7k PU.
3	RBT_RXD0	Output (from BlueField-3)	Receive data. Data signals from the network controller to the BMC. For baseboards, this pin should be connected between the baseboard NC-SI over RBT PHY and the connector. This signal requires a 100 kΩ pull down resistor to GND on the baseboard between the BMC and the RBT isolator to prevent the signal from floating when no card is installed. For DPUs, this pin should be connected between the connector and the RBT PHY. External termination determined by the DPU RBT PHY requirements.
4	RBT_REF_CLK	Input	RBT Reference clock. Synchronous clock reference for receive, transmit and control interface. The clock should have a typical frequency of 50MHz ±50 ppm. For baseboards, this pin should be connected between the baseboard NC-SI over RBT PHY and the DPU cable connector. The RBT_REF_CLK should not be driven until 3.3V AUX is present on the DPU. The RBT_REF_CLK should be continuous once it has started. For DPUs, this pin should be connected between the connector and the RBT PHY. No external termination is required.
5	RBT_RXD1	Output	Receive data. Data signals from the network controller to the BMC. For baseboards, this pin should be connected between the baseboard NC-SI over RBT PHY and the connector. This signal requires a 100 kΩ pull down resistor to GND on the baseboard between the BMC and the RBT isolator to prevent the signal from floating when no card is installed. For DPUs, this pin should be connected between the connector and the RBT PHY. External termination determined by the DPU RBT PHY requirements.
6	GND	GND	Ground
7	RBT_CRS_DV	Output	Carrier sense/receive data valid. This signal is used to indicate to the baseboard that the carrier sense/receive data is valid. For baseboards, this pin should be connected between the baseboard NC-SI over RBT PHY and the connector. This signal requires a 100 kΩ pull down resistor on the baseboard between the BMC and the RBT isolator to prevent the signal from floating when no DPU is installed. For DPUs, this pin should be connected between the connector and the RBT PHY. External termination determined by the DPU RBT PHY requirements.
8	RBT_ISOLATE_N	Output	This signal is used to indicate the DPU has powered and is ready for NC-SI physical layer connection to be present. When low the baseboard circuitry will isolate the NC-SI connection to the DPU. When high normal NC-SI RBT connectivity is available. Baseboards should terminate this with a 47K-100K PD resistor. DPUs should terminate with a 10k PU resistor.
9	GND	GND	Ground
10	PKG_ID0	Input	NC-SI PKG_ID should be connected to the Primary controller NC-SI PKG_ID pins to set the appropriate package ID. PKG_ID0 should be connected to the endpoint device GPIO associated with Package ID[0]. PKG_ID1 should be associated with Package ID[1]. Baseboard should connect to GND or leave floating. DPU should have a 4.7k PU.

Pin#	Signal Name	I/O	Signal Description
11	RBT_TX_EN	Input	Transmit enable. For baseboards, this pin should be connected between the baseboard NC-SI over RBT PHY and the connector. This signal requires a 100 kΩ pull down resistor to ground on the baseboard between the RBT isolator and the DPU cable connector to prevent the card-side signals from floating when the RBT signals are isolated. For DPUs, this pin should be connected between the connector and the RBT PHY. External termination determined by the DPU RBT PHY requirements.
12	GND	GND	Ground
13	RBT_TXD0	Input	Transmit data. Data signals from the BMC to the network controller. For baseboards, this pin should be connected between the baseboard NC-SI over RBT PHY and the connector. This signal requires a 100 kΩ pull down resistor to GND on the baseboard between the RBT isolator and the DPU cable connector to prevent the card-side signals from floating when the RBT signals are isolated. For DPUs, this pin should be connected between the connector and the RBT PHY. External termination determined by the DPU RBT PHY requirements.
14	UART_TX	Input	3.3V UART TX signal from the baseboard
15	RBT_TXD1	Input	Transmit data. Data signals from the BMC to the network controller. For baseboards, this pin should be connected between the baseboard NC-SI over RBT PHY and the connector. This signal requires a 100 kΩ pull down resistor to GND on the baseboard between the RBT isolator and the DPU cable connector to prevent the card-side signals from floating when the RBT signals are isolated. For DPUs, this pin should be connected between the connector and the RBT PHY. External termination determined by the DPU RBT PHY requirements.
16	UART_RX	Output	3.3V UART RX signal to the baseboard
17	PRESENCE_N		Presence of DPU. Baseboard should implement a 200 Ω series resistor and 4.7kohm pull-up resistor to 3.3V AUX. DPU should tie this to GND.
18	GND	GND	Ground
19	RBT_ARB_OUT	Input	NC-SI hardware arbitration output. If the baseboard supports multiple DPUs cards connected to the same RBT interface, it should implement logic that connects the RBT_ARB_OUT pin of the first populated DPU card to its RBT_ARB_IN pin if it is the only card present or to the RBT_ARB_IN pin of the next populated card and so on sequentially for all cards on the specified RBT bus to ensure the arbitration ring is complete. This logic should bypass slots that are not populated or powered off.
20	RBT_ARB_IN	Output	NC-SI hardware arbitration input. If the baseboard supports multiple DPUs cards connected to the same RBT interface, it should implement logic that connects the RBT_ARB_IN pin of the first populated DPU card to its RBT_ARB_OUT pin if it is the only card present or to the RBT_ARB_OUT pin of the next populated card and so on sequentially for all cards on the specified RBT bus to ensure the arbitration ring is complete. This logic should bypass slots that are not populated or powered off.

Cabline CA-II Plus Connectors Pinouts

Component Side

Pin#	Signal Name	Wire Type	AWG#	Pin# on other end
1	GND	GND BAR		1
2	PCIE_REFCLK1_P	Micro coax	38	2
3	PCIE_REFCLK1_N	Micro coax	38	3
4	GND	GND BAR		4
5	PCIE_CPU_CX_15N	Micro coax	38	5
6	PCIE_CPU_CX_15P	Micro coax	38	6
7	GND	GND BAR		7
8	PCIE_CPU_CX_14N	Micro coax	38	8
9	PCIE_CPU_CX_14P	Micro coax	38	9
10	GND	GND BAR		10
11	PCIE_CPU_CX_13N	Micro coax	38	11
12	PCIE_CPU_CX_13P	Micro coax	38	12
13	GND	GND BAR		13
14	PCIE_CPU_CX_12N	Micro coax	38	14
15	PCIE_CPU_CX_12P	Micro coax	38	15
16	GND	GND BAR		16
17	PCIE_CPU_CX_11N	Micro coax	38	17
18	PCIE_CPU_CX_11P	Micro coax	38	18
19	GND	GND BAR		19
20	PCIE_CPU_CX_10N	Micro coax	38	20
21	PCIE_CPU_CX_10P	Micro coax	38	21
22	GND	GND BAR		22
23	PCIE_CPU_CX_9N	Micro coax	38	23
24	PCIE_CPU_CX_9P	Micro coax	38	24
25	GND	GND BAR		25
26	PCIE_CPU_CX_8N	Micro coax	38	26
27	PCIE_CPU_CX_8P	Micro coax	38	27
28	GND	GND BAR		28
29	PCIE_CPU_CX_7N	Micro coax	38	29
30	PCIE_CPU_CX_7P	Micro coax	38	30
31	GND	GND BAR		31
32	CIE_CPU_CX_6N	Micro coax	38	32
33	PCIE_CPU_CX_6P	Micro coax	38	33
34	GND	GND BAR		34
35	PCIE_CPU_CX_5N	Micro coax	38	35

Pin#	Signal Name	Wire Type	AWG#	Pin# on other end
36	PCIE_CPU_CX_5P	Micro coax	38	36
37	GND	GND BAR		37
38	PCIE_CPU_CX_4N	Micro coax	38	38
39	PCIE_CPU_CX_4P	Micro coax	38	39
40	GND	GND BAR		40
41	PCIE_CPU_CX_3N	Micro coax	38	41
42	PCIE_CPU_CX_3P	Micro coax	38	42
43	GND	GND BAR		43
44	PCIE_CPU_CX_2N	Micro coax	38	44
45	PCIE_CPU_CX_2P	Micro coax	38	45
46	GND	GND BAR		46
47	PCIE_CPU_CX_1N	Micro coax	38	47
48	PCIE_CPU_CX_1P	Micro coax	38	48
49	GND	GND BAR		49
50	PCIE_CPU_CX_0N	Micro coax	38	50
51	PCIE_CPU_CX_0P	Micro coax	38	51
52	GND	GND BAR		52
53	I2C_DPU_BMC_SDA	Micro coax	38	53
54	I2C_DPU_BMC_SCL	Micro coax	38	54
55	AUX_PGOOD	Micro coax	38	55
56	No wire	Micro coax	38	56
57	I2C_AUX_SCL	Micro coax	38	57
58	I2C_AUX_SDA	Micro coax	38	58
59	S_PRSNT1_L	Micro coax	38	59
60	No wire			60

Print Side

Pin#	Signal Name	Wire Type	AWG#	Pin# on other end
1	SER_CLK	Micro coax	38	1
2	SER_CAPTURE	Micro coax	38	2
3	SER_DO	Micro coax	38	3
4	S_PERST2_CONN_L	Micro coax	38	4
5	SER_DI	Micro coax	38	5
6	Reserved_06	Micro coax	38	6
7	Reserved_07	Micro coax	38	7
8	Reserved_08	Micro coax	38	8
9	GND	GND BAR		9
10	PCIE_CPU_CX_0P	Micro coax	38	10

Pin#	Signal Name	Wire Type	AWG#	Pin# on other end
11	PCIE_CPU_CX_0N	Micro coax	38	11
12	GND	GND BAR		12
13	PCIE_CPU_CX_1P	Micro coax	38	13
14	PCIE_CPU_CX_1N	Micro coax	38	14
15	GND	GND BAR		15
16	PCIE_CPU_CX_2P	Micro coax	38	16
17	PCIE_CPU_CX_2N	Micro coax	38	17
18	GND	GND BAR		18
19	PCIE_CPU_CX_3P	Micro coax	38	19
20	PCIE_CPU_CX_3N	Micro coax	38	20
21	GND	GND BAR		21
22	PCIE_CPU_CX_4P	Micro coax	38	22
23	PCIE_CPU_CX_4N	Micro coax	38	23
24	GND	GND BAR		24
25	PCIE_CPU_CX_5P	Micro coax	38	25
26	PCIE_CPU_CX_5N	Micro coax	38	26
27	GND	GND BAR		27
28	PCIE_CPU_CX_6P	Micro coax	38	28
29	PCIE_CPU_CX_6N	Micro coax	38	29
30	GND	GND BAR		30
31	PCIE_CPU_CX_7P	Micro coax	38	31
32	PCIE_CPU_CX_7N	Micro coax	38	32
33	GND	GND BAR		33
34	PCIE_CPU_CX_8P	Micro coax	38	34
35	PCIE_CPU_CX_8N	Micro coax	38	35
36	GND	GND BAR		36
37	PCIE_CPU_CX_9P	Micro coax	38	37
38	PCIE_CPU_CX_9N	Micro coax	38	38
39	GND	GND BAR		39
40	PCIE_CPU_CX_10P	Micro coax	38	40
41	PCIE_CPU_CX_10N	Micro coax	38	41
42	GND	GND BAR		42
43	PCIE_CPU_CX_11P	Micro coax	38	43
44	PCIE_CPU_CX_11N	Micro coax	38	44
45	GND	GND BAR		45
46	PCIE_CPU_CX_12P	Micro coax	38	46
47	PCIE_CPU_CX_12N	Micro coax	38	47
48	GND	GND BAR		48
49	PCIE_CPU_CX_13P	Micro coax	38	49
50	PCIE_CPU_CX_13N	Micro coax	38	50
51	GND	GND BAR		51

Pin#	Signal Name	Wire Type	AWG#	Pin# on other end
52	PCIE_CPU_CX_14P	Micro coax	38	52
53	PCIE_CPU_CX_14N	Micro coax	38	53
54	GND	GND BAR		54
55	PCIE_CPU_CX_15P	Micro coax	38	55
56	PCIE_CPU_CX_15N	Micro coax	38	56
57	GND	GND BAR		57
58	S_PERST1_CONN_L	Micro coax	38	58
59	No wire	No Wire		59
60	S_PRSNT2_L	Micro coax	38	60

Hardware Installation

Installation and initialization of the DPU require attention to the mechanical attributes, power specification, and precautions for electronic equipment.

Safety Warnings

Safety warnings are provided here in the English language.

Please observe all safety warnings to avoid injury and prevent damage to system components. Note that not all warnings are relevant to all models.

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Installation Procedure Overview

The installation procedure of DPU involves the following steps:

Step	Procedure	Direct Link
1	Check the system's requirements.	Refer to System Requirements
2	Pay attention to the airflow consideration within the host system	Refer to Airflow Requirements
3	Follow the safety precautions	Refer to Safety Precautions
4	Unpack the package	Refer to Unpacking
5	Follow the pre-installation checklist	Refer to Pre-Installation Checklist
7	Install the DPU according to the form-factor you have purchased.	Refer to DPU Installation
8	Connect cables or modules to the DPU	Refer to Cables and Modules Installation
9	Power-up the DPU	Refer to DPU Power-Up Instructions

System Requirements

Hardware Requirements

Unless otherwise specified, products are designed to work in an environmentally controlled data center with low levels of gaseous and dust (particulate) contamination.

The operating environment should meet severity level G1 as per ISA 71.04 for gaseous contamination and ISO 14644-1 class 8 for cleanliness level.

The below table lists the motherboard and power supply requirements per DPU series.

FHHL DPUs	**E-Series:** A minimum of 75W system power supply through the PCIe x16 interface (Relevant for 900-9D3B4-00EN-EA0 and 900-9D3B4-00PN-EA0)
	P-Series: Require a supplementary 8-pin ATX power supply connectivity available through the external power supply connector (Relevant for OPNs: 900-9D3B6-00CV-AA0, 900-9D3B6-00SV-AA0, 900-9D3B6-00CC-AA0, 900-9D3B6-00SC-AA0, 900-9D3B6-00CN-AB0 and 900-9D3B6-00SN-AB0)

Airflow Requirements

DPU is offered with one airflow direction: from the heatsink to the network ports.

> Any use of the product in the opposite airflow direction (from network ports to heatsink) must be validated thermally to ensure proper cooling of the product.

Please refer to the Specifications section for airflow numbers per DPU model.

Software Requirements

- See System Requirements section under the Introduction section.
- Software Stacks - The DPU is shipped with Linux based Operating System burned on it which includes all needed drivers. For more information, please refer to the Software User Manual.

Safety Precautions

The DPU being installed in a system that operates with voltages that can be lethal. Before opening the case of the system, observe the following precautions to avoid injury and prevent damage to system components.

- Remove any metallic objects from your hands and wrists.
- Make sure to use only insulated tools.
- Verify that the system is powered off and is unplugged.
- It is strongly recommended to use an ESD strap or other antistatic devices.

Unpacking

Check against the package contents list that all the parts have been sent. Check the parts for visible damage that may have occurred during shipping. Please note that the DPUs must be placed on an antistatic surface.

> Please note that if the DPU is removed hastily from the antistatic bag, the plastic ziplock may harm the EMI fingers on the networking connector. Carefully remove the DPU from the antistatic bag to avoid damaging the EMI fingers.

For package contents, please refer to Package Contents.

Pre-Installation Checklist

1. Verify that your system meets the hardware and software requirements stated above.
2. Shut down your system if active.
   Turn off the power to the system, and disconnect the power cord. Refer to the system documentation for instructions. Before you install the DPU, make sure that the system is disconnected from power.

Installation Instructions

This section provides detailed instructions on how to install your DPU in a system.

Choose the installation instructions according to the DPU configuration you would like to use.

OPNs	Installation Instructions
All DPUs	PCIe x16 DPUs Installation Instructions
900-9D3B6-00CV-AA0 900-9D3B6-00SV-AA0 900-9D3B6-00CC-AA0 900-9D3B6-00SC-AA0 900-9D3B6-00CN-AB0 900-9D3B6-00SN-AB0	PCIe Extension Option (2x PCIe x16) Installation Instructions

Cables and Modules

Networking Cable Installation

1. All cables can be inserted or removed with the unit powered on.
2. To insert a cable, press the connector into the port receptacle until the connector is firmly seated.
   a. Support the weight of the cable before connecting the cable to the DPU. Do this by using a cable holder or tying the cable to the rack.
   b. Determine the correct orientation of the connector to the DPU before inserting the connector. Do not try and insert the connector upside down. This may damage the DPU.
   c. Insert the connector into the DPU. Be careful to insert the connector straight into the cage. Do not apply any torque, up or down, to the connector cage in the DPU.
   d. Make sure that the connector locks in place.

> ⚠ When installing cables make sure that the latches engage.

> ⚠ Always install and remove cables by pushing or pulling the cable and connector in a straight line with the DPU.

3. After inserting a cable into a port, the Green LED indicator will light when the physical connection is established (that is, when the unit is powered on and a cable is plugged into the port with the other end of the connector plugged into a functioning port). See Networking Ports LEDs interface under the Supported Interfaces section.
4. After plugging in a cable, lock the connector using the latching mechanism particular to the cable vendor. When data is being transferred the Green LED will blink.
5. Make sure not to impede the air exhaust flow through the ventilation holes. Use cable lengths that allow for routing horizontally around to the side of the chassis before bending upward or downward in the rack.
6. To remove a cable, disengage the locks and slowly pull the connector away from the port receptacle. LED indicator will turn off when the cable is unseated.

DPU Power-Up Instructions

To power-up the DPU, power the ATX power supply and the PCIe goldfinger interface simultaneously. Failure to do so may harm the DPU.

In all DPU operation states, it is important to turn on or off both the ATX power supply and the PCIe golden fingers at the same time. It is prohibited that the DPU ATX power supply is powered on while the PCIe golden-finger interface is powered-down or powered-up.

PCIe x16 DPUs Installation Instructions

Installation Instructions

This section provides detailed instructions on how to install your DPU in a system.

> Please note that the following figures are for illustration purposes only.

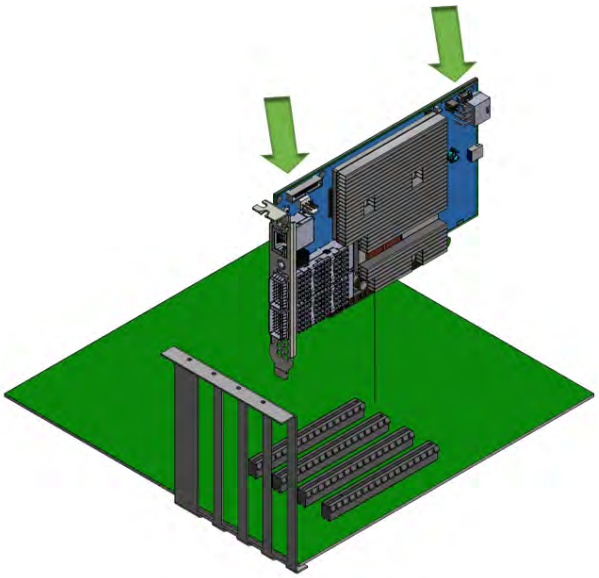
> To power-up the FHHL P-Series DPUs, you need to connect a PCIe external power cable. The PCIe external power cable should be supplied by the customer. Refer to External Power Supply Connector for pin descriptions.

1. Open the system case.

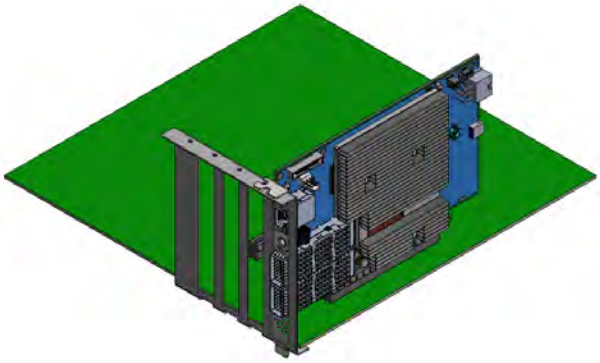
2. Place the DPU in an available PCI Express slot.

3. Applying even pressure at both corners of the card, insert the DPU into the PCI Express slot until firmly seated.

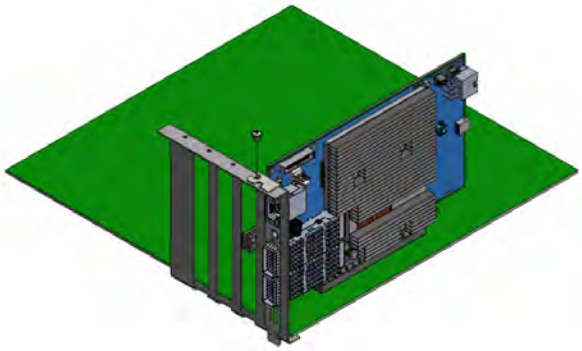
   > Do not use excessive force when seating the card, as this may damage the system or the DPU.



4. When the DPU is properly seated, the port connectors are aligned with the slot opening, and the DPU faceplate is visible against the system chassis.



5. Secure the DPU with the screw.



6. For the FHHL 100Gb/s P-Series DPUs, install the PCIe external power cable. Connect the 6-pin power connector from the power supply to the power connector on the top edge of the DPU. Note that the connector and socket on the graphics card have a unique shape and connect one way only.
   For further instructions, please refer to the cable vendor documentation. Please refer to the pinout description in External Power Supply Connector.
7. Close the system case.
8. Install the networking cables. For instructions, please refer to Networking Cable Installation.

Uninstalling the DPU

Safety Precautions

The DPU is installed in a system that operates with voltages that can be lethal. Before uninstalling the DPU, please observe the following precautions to avoid injury and prevent damage to system components.

1. Remove any metallic objects from your hands and wrists.
2. It is strongly recommended to use an ESD strap or other antistatic devices.
3. Turn off the system and disconnect the power cord from the server.

Card Removal

Please note that the following images are for illustration purposes only.

1. Verify that the system is powered off and unplugged.
2. Wait 30 seconds.
3. To remove the card, disengage the retention mechanism on the bracket (screws).

4. Holding the DPU from its center, gently pull the DPU out of the PCI Express slot.
5. When the port connectors reach the top of the chassis window, gently pull the DPU in parallel to the motherboard.

PCIe Extension Option (2x PCIe x16) Installation Instructions

> This section applies to the following DPUs when used as Socket Direct cards in dual-socket servers:
>
> - 900-9D3B6-00CV-AA0, 900-9D3B6-00SV-AA0
> - 900-9D3B6-00CC-AA0, 900-9D3B6-00SC-AA0
> - 900-9D3B6-00CN-AB0, 900-9D3B6-00SN-AB0
> - 900-9D3B6-00CC-EA0, 900-9D3B6-00SC-EA0
>
> For more information on the PCIe Auxiliary Kit, refer to PCIe Auxiliary Card Kit.

> The below images are for illustration purposes only.

The hardware installation section uses the terminology of white and black harnesses to differentiate between the two supplied cables. Due to supply chain variations, some DPUs may be supplied with two black harnesses instead. To clarify the difference between these two harnesses, one black harness was marked with a “WHITE” label and the other with a “BLACK” label.

The Cabline harness marked with a "WHITE" label should be connected to the connector on the DPU and Auxiliary PCIe card engraved with “White Cable”, while the one marked with a "BLACK" label should be connected to the connector on the DPU and Auxiliary PCIe card engraved with “Black Cable”.

> The harnesses' minimal bending radius is 10[mm].

Installing the DPU

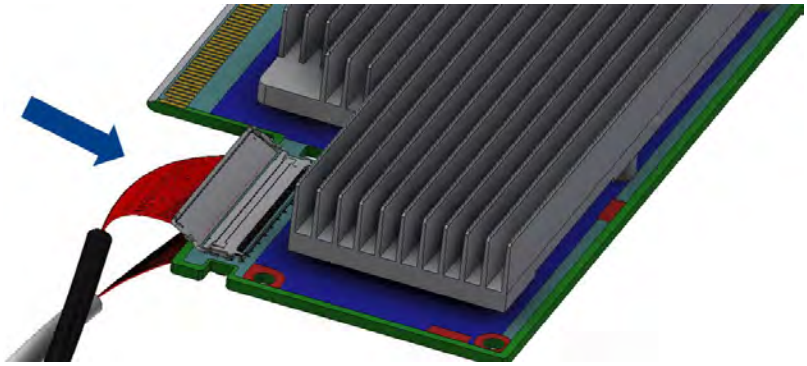
> The installation instructions include steps that involve a retention clip to be used while connecting the Cabline harnesses to the DPUs. Please note that this is an optional accessory.

> Please make sure to install the DPU cards in a PCIe slot that is capable of supplying the required power and airflow as stated in Specifications.

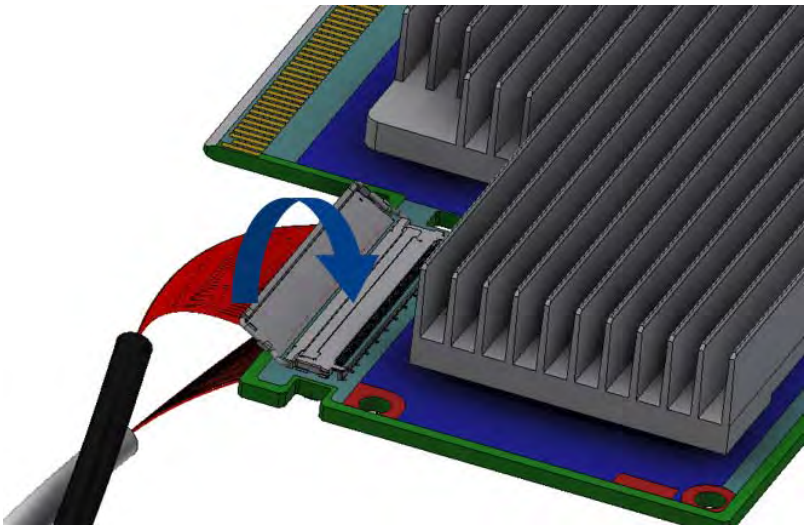
➢ Connect the DPU with the Auxiliary connection card using the supplied Cabline CA-II Plus harnesses.

Step 1: Slide the black and white Cabline CA-II Plus harnesses through the retention clip while making sure the clip opening is facing the plugs.

Step 2: Plug the Cabline CA-II Plus harnesses on the DPU while paying attention to the color-coding. As indicated on both sides of the card; plug the black harness to the component side and the white harness to the print side.

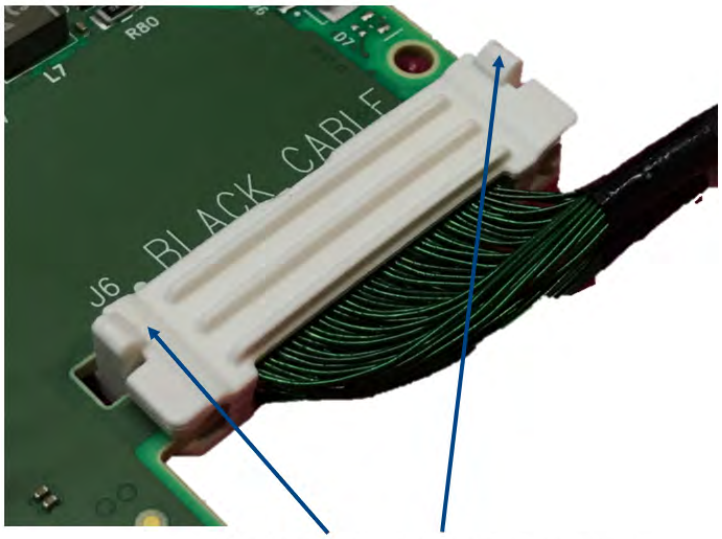


Step 3: Verify the plugs are locked.



Step 4: Slide the retention clip latches through the cutouts on the PCB. The latches should face the annotation on the PCB.

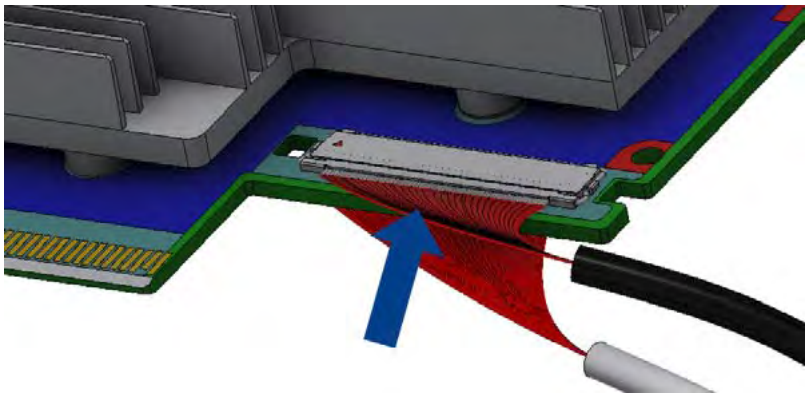
Step 4: Clamp the retention clip. Verify both latches are firmly locked.



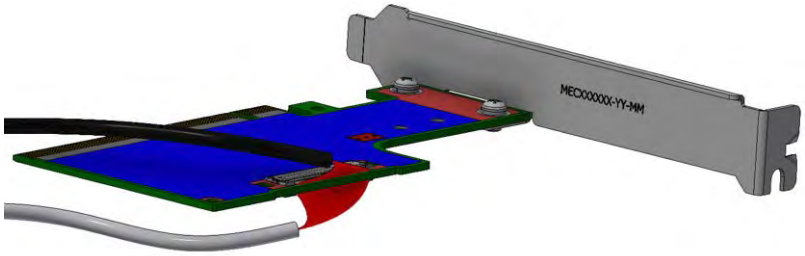
Verify that both latches are firmly snapped

Step 5: Slide the Cabline CA-II Plus harnesses through the retention clip. Make sure that the clip opening is facing the plugs.

Step 6: Plug the Cabline CA-II Plus harnesses on the PCIe Auxiliary Card. As indicated on both sides of the Auxiliary connection card; plug the black harness to the component side and the white harness to the print side.

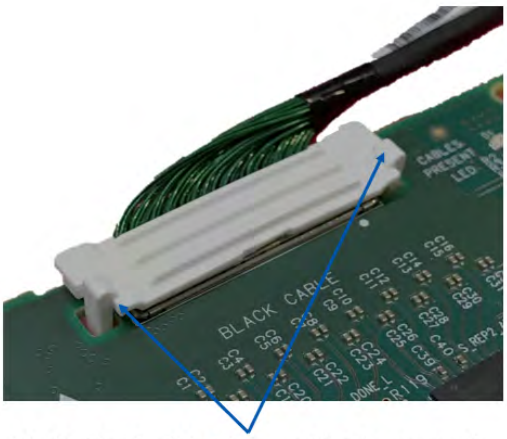


Step 7: Verify the plugs are locked.



Step 8: Slide the retention clip through the cutouts on the PCB. Make sure latches are facing "Black Cable" annotation as seen in the below picture.

Step 9: Clamp the retention clip. Verify both latches are firmly locked.



Verify that both latches are firmly snapped

➢ Connect the DPU and PCIe Auxiliary Connection cards in available PCI Express x16 slots in the chassis.

Step 1: Locate two available PCI Express x16 slots.

Step 2: Applying even pressure at both corners of the cards, insert the DPU in the PCI Express slots until firmly seated.

> Do not use excessive force when seating the cards, as this may damage the system or the cards.

Step 3: Applying even pressure at both corners of the cards, insert the Auxiliary Connection card in the PCI Express slots until firmly seated.

➢ Secure the DPU and PCIe Auxiliary Connection Cards to the chassis.

Secure the brackets to the chassis with the bracket screws.

Uninstalling the Cards

Safety Precautions

The DPU is installed in a system that operates with voltages that can be lethal. Before uninstalling the DPU, please observe the following precautions to avoid injury and prevent damage to system components.

1. Remove any metallic objects from your hands and wrists.
2. It is strongly recommended to use an ESD strap or other antistatic devices.
3. Turn off the system and disconnect the power cord from the server.

Card Removal

1. Verify that the system is powered off and unplugged.
2. Wait 30 seconds.
3. To remove the card, disengage the retention mechanisms on the brackets (clips or screws).

4. Holding the DPU from its center, gently pull the DPU and Auxiliary Connections card out of the PCI Express slot.

Setting High-Speed-Port Link Type

The following table lists the BlueField-3 supported speeds and the default networking port link type per OPN.

OPN	Data Transmission Rate	Default Protocol and Rate
900-9D3B4-00EN-EA0 900-9D3B4-00PN-EA0 900-9D3B6-00CN-AB0 900-9D3B6-00SN-AB0	InfiniBand: NDR 400Gb/s Ethernet: 400GbE	InfiniBand NDR 400Gb/s
900-9D3B6-00CV-AA0 900-9D3B6-00SV-AA0	InfiniBand: NDR200 200Gb/s Ethernet: 200GbE	Ethernet 200GbE
900-9D3B6-00CC-AA0 900-9D3B6-00SC-AA0 900-9D3B6-00CC-EA0 900-9D3B6-00SC-EA0	InfiniBand: HDR100 100Gb/s Ethernet: 100GbE	Ethernet 100GbE

To configure the high-speed networking port mode, you can either use the mlxconfig or the UEFI tools.

UEFI can configure the DPU device before the operating system is up, while mlxconfig configures the card once the operating system is up. According to your preference, use one of the below tools:

mlxconfig

The mlxconfig tool allows users to change device configurations without burning the firmware. The configuration is also kept after reset. By default, mlxconfig shows the configurations that will be loaded in the next boot. For more information and instructions, refer to Using mlxconfig to Set IB/ETH Parameters.

UEFI

PreBoot drivers initialize the adapter device, check the port protocol type – Ethernet or InfiniBand - and bring up the port. Then it connects to a DHCP server to obtain its assigned IP address and network parameters and obtain the source location of the kernel/OS to boot from. The DHCP server instructs the PreBoot drivers to access the kernel/OS through a TFTP server, an iSCSI target, or some other service. For more information and instructions, refer to UEFI.

Troubleshooting

Server unable to find the DPU	• Ensure that the DPU is placed correctly • Make sure the DPU slot and the DPU are compatible Install the DPU in a different PCI Express slot • Use the drivers that came with the DPU or download the latest • Make sure your motherboard has the latest BIOS • Try to reboot the server
The DPU no longer works	• Reseat the DPU in its slot or a different slot, if necessary • Try using another cable • Reinstall the drivers for the network driver files may be damaged or deleted • Reboot the server
DPUs stopped working after installing another DPU	• Try removing and re-installing all DPUs • Check that cables are connected properly • Make sure your motherboard has the latest BIOS
Link indicator light is off	• Try another port on the switch • Make sure the cable is securely attached • Check you are using the proper cables that do not exceed the recommended lengths • Verify that your switch and DPU port are compatible
Link light is on, but with no communication established	• Check that the latest driver is loaded • Check that both the DPU and its link are set to the same speed and duplex settings
Forgot password needed to install/upgrade the DPU image	Refer to the latest version of BlueField DPU SW Manual and follow instructions under "Upgrading NVIDIA BlueField DPU Software" section.

Specifications

Ensure your system supports the following system hardware and power supply requirements prior to installing your card.

FHHL	**E-Series DPUs:** A maximum of 75W system power supply through the PCIe x16 interface.
	P-Series DPUs: A minimum of 75W or greater system power supply through the PCIe x16 interface, **and** a supplementary 8-pin ATX power supply connectivity available through the external power supply connector

900-9D3B4-00EN-EA0 / 900-9D3B4-00PN-EA0 Specifications

BlueField-3 SoC	**BlueField-3 E-Series** - 8 Arm-Cores - 505MHz/2000MHz		
	• 900-9D3B4-00EN-EA0: Crypto Enabled with integrated BMC • 900-9D3B4-00PN-EA0: Crypto Disabled with integrated BMC		
Physical	**Single-Slot FHHL Card Dimensions:** 111.15mm x 167.65mm **Tall Bracket Dimensions:** 121.0mm x 21.6mm **Heatsink Dimensions (Length, Width, Height):** 139.6mm x 92.7mm x 10.2mm		
Interfaces	See Supported Interfaces		
	On-board Memory	• Single-channel with 10 DDR5 + ECC (64bit + 8bit ECC) for a total of **16GB**@ 5200MT/s • 40GB pSLC eMMC memory + 128GB SSD	
	PCI Express Interface	Gen 5.0 SERDES @ 32.0GT/s, 16 lanes (4.0, 3.0, 2.0 and 1.1 compatible)	
	Networking Connector	Single-port QSFP112 (copper and optical)	
Data Rate	**InfiniBand (Default Speed)**	NDR/NDR200/HDR/HDR100/EDR/FDR/SDR	
	Ethernet	400/200/100/50/25/10 Gb/s	
Protocol Support	**InfiniBand:** IBTA v1.5[a] Auto-Negotiation: NDR (4 lanes x 100Gb/s per lane) port, NDR200 (2 lanes x 100Gb/s per lane) port, HDR (50Gb/s per lane) port, HDR100 (2 lane x 50Gb/s per lane), EDR (25Gb/s per lane) port, FDR (14.0625Gb/s per lane), 1X/2X/4X SDR (2.5Gb/s per lane)		
	Ethernet: 400GAUI-4 C2M, 400GBASE-CR4, 200GAUI-2 C2M, 200GAUI-4 C2M, 200GBASE-CR4, 100GAUI-2 C2M, 100GAUI-1 C2M, 100GBASE-CR4, 100GBASE-CR2, 100GBASE-CR1, 50GAUI-2 C2M, 50GAUI-1 C2M, 50GBASE-CR, 50GBASE-R2 , 40GBASE-CR4, 40GBASE-R2, 25GBASE-R, 10GBASE-R, 10GBASE-CX4, 1000BASE-CX, CAUI-4 C2M, 25GAUI C2M, XLAUI C2M , XLPPI, SFI		
Electrical and Thermal Specifications	**Voltage**	12V	
	Electrical and thermal specifications are provided in "***NVIDIA BlueField-3 DPUs Electrical and Thermal Specifications***" document. You can access the document either by logging into NVOnline or by contacting your NVIDIA representative.		
Environmental	**Temperature**	**Operational**	0°C to 55°C
		Non-operational	-40°C to 70°C[b]

	Humidity	**Operational**	10% to 85% relative humidity
		Non-operational	10% to 90% relative humidity
	Altitude (Operational)	3050m	
Regulatory	**Safety**	CB / cTUVus / CE	
	EMC	CE / FCC / VCCI / ICES / RCM	
	RoHS	RoHS compliant	

Notes:
[a] The BlueField-3 DPU supplement the IBTA auto-negotiation specification to get better bit error rates and longer cable reaches. This supplemental feature only initiates when connected to another NVIDIA InfiniBand product.
[b] The non-operational storage temperature specifications apply to the product without its package.

900-9D3B6-00CV-AA0 / 900-9D3B6-00SV-AA0 Specifications

BlueField-3 SoC	**BlueField-3 P-Series** - 16 Arm-Cores - 560MHz/2133MHz	
	• 900-9D3B6-00CV-AA0: Crypto Enabled with integrated BMC • 900-9D3B6-00SV-AA0: Crypto Disabled with integrated BMC	
Physical	**Single-Slot FHHL Card Dimensions:** 111.15mm x 167.65mm **Tall Bracket Dimensions:** 121.0mm x 21.6mm **Heatsink Dimensions (Length, Width, Height):** 139.6mm x 92.7mm x 10.2mm	
Interfaces	See Supported Interfaces	
	PCI Express Interface	Gen 5.0 SERDES @ 32.0GT/s, 16 lanes (4.0, 3.0, 2.0 and 1.1 compatible)
		Optional: Additional PCIe x16 Gen 5.0 @ SERDES 32GT/s through the PCIe auxiliary passive card and Cabline SA-II Plus harnesses
	On-Board Memory	• Dual-channel with **20** DDR5 + ECC (128bit + 16bit ECC) for a total of **32GB** @ 5600MT/s • 40GB pSLC eMMC memory + 128GB SSD
	Networking Connector	Dual-port QSFP112 (copper and optical)
Data Rate	**InfiniBand**	NDR200/HDR/HDR100/EDR/FDR/SDR
	Ethernet (Default Speed)	200/100/50/25/10 Gb/s
Protocol Support	**InfiniBand:** IBTA v1.5[a] Auto-Negotiation: NDR200 (2 lanes x 100Gb/s per lane) port, HDR (50Gb/s per lane) port, HDR100 (2 lane x 50Gb/s per lane), EDR (25Gb/s per lane) port, FDR (14.0625Gb/s per lane), 1X/2X/4X SDR (2.5Gb/s per lane).	
	Ethernet: 200GAUI-2 C2M, 200GAUI-4 C2M, 200GBASE-CR4, 100GAUI-2 C2M, 100GAUI-1 C2M, 100GBASE-CR4, 100GBASE-CR2, 100GBASE-CR1, 50GAUI-2 C2M, 50GAUI-1 C2M, 50GBASE-CR, 50GBASE-R2 , 40GBASE-CR4, 40GBASE-R2, 25GBASE-R, 10GBASE-R, 10GBASE-CX4, 1000BASE-CX, CAUI-4 C2M, 25GAUI C2M, XLAUI C2M , XLPPI, SFI	
Electrical and Thermal Specifications	**Voltage**: 12V	
	Electrical and thermal specifications are provided in "***NVIDIA BlueField-3 DPUs Electrical and Thermal Specifications***" document. You can access the document either by logging into NVOnline or by contacting your NVIDIA representative.	

Environmental	**Temperature**	**Operational**	0°C to 55°C
		Non-operational	-40°C to 70°C[b]
	Humidity	**Operational**	10% to 85% relative humidity
		Non-operational	10% to 90% relative humidity
	Altitude (Operational)	3050m	
Regulatory	**Safety**	CB / cTUVus / CE	
	EMC	CE / FCC / VCCI / ICES / RCM	
	RoHS	RoHS compliant	

Notes:
[a] The BlueField-3 DPU supplement the IBTA auto-negotiation specification to get better bit error rates and longer cable reaches. This supplemental feature only initiates when connected to another NVIDIA InfiniBand product.
[b] The non-operational storage temperature specifications apply to the product without its package.

900-9D3B6-00CC-EA0 / 900-9D3B6-00SC-EA0 Specifications

⚠ Requires a supplementary 8-pin ATX power supply connectivity available through the external power supply connector.

BlueField-3 SoC	**BlueField-3 E-Series** - 16 Arm-Cores - 505MHz/2000MHz	
	• 900-9D3B6-00CC-EA0: Crypto Enabled with integrated BMC • 900-9D3B6-00SC-EA0: Crypto Disabled with integrated BMC	
Physical	**Single-Slot FHHL Card Dimensions:** 111.15mm x 167.65mm **Tall Bracket Dimensions:** 121.0mm x 21.6mm **Heatsink Dimensions (Length, Width, Height):** 139.6mm x 92.7mm x 10.2mm	
Interfaces	See Supported Interfaces	
	PCI Express Interface	Gen 5.0 SERDES @ 32.0GT/s, 16 lanes (4.0, 3.0, 2.0 and 1.1 compatible)
		Optional: Additional PCIe x16 Gen 5.0 @ SERDES 32GT/s through the PCIe auxiliary passive card and Cabline SA-II Plus harnesses
	On-board Memory	• Dual-channel with **20** DDR5 + ECC (128bit + 16bit ECC) for a total of **32GB** @ 5200MT/s • 40GB pSLC eMMC memory + 128GB SSD
	Networking Connector	Dual-port QSFP112 (copper and optical)
Data Rate	**InfiniBand**	HDR100/EDR/FDR/SDR
	Ethernet (Default Speed)	100/50/25/10 Gb/s

Protocol Support	**InfiniBand:** IBTA v1.5[a] Auto-Negotiation: HDR100 (2 lane x 50Gb/s per lane), EDR (25Gb/s per lane) port, FDR (14.0625Gb/s per lane), 1X/2X/4X SDR (2.5Gb/s per lane).		
	Ethernet: 100GAUI-2 C2M, 100GAUI-1 C2M, 100GBASE-CR4, 100GBASE-CR2, 100GBASE-CR1, 50GAUI-2 C2M, 50GAUI-1 C2M, 50GBASE-CR, 50GBASE-R2 , 40GBASE-CR4, 40GBASE-R2, 25GBASE-R, 10GBASE-R, 10GBASE-CX4, 1000BASE-CX, CAUI-4 C2M, 25GAUI C2M, XLAUI C2M , XLPPI, SFI		
Electrical and Thermal Specifications	**Voltage**: 12V		
	Electrical and thermal specifications are provided in "***NVIDIA BlueField-3 DPUs Electrical and Thermal Specifications***" document. You can access the document either by logging into NVOnline or by contacting your NVIDIA representative.		
Environmental	**Temperature**	**Operational**	0°C to 55°C
		Non-operational	-40°C to 70°C[b]
	Humidity	**Operational**	10% to 85% relative humidity
		Non-operational	10% to 90% relative humidity
	Altitude (Operational)	3050m	
Regulatory	**Safety**	CB / cTUVus / CE	
	EMC	CE / FCC / VCCI / ICES / RCM	
	RoHS	RoHS compliant	

Notes:
[a] The BlueField-3 DPU supplement the IBTA auto-negotiation specification to get better bit error rates and longer cable reaches. This supplemental feature only initiates when connected to another NVIDIA InfiniBand product.
[b] The non-operational storage temperature specifications apply to the product without its package.

900-9D3B6-00CC-AA0 / 900-9D3B6-00SC-AA0 Specifications

BlueField-3 SoC	**BlueField-3 P-Series** - 16 Arm-Cores - 560MHz/2133MHz	
	• 900-9D3B6-00CC-AA0: Crypto Enabled with integrated BMC • 900-9D3B6-00SC-AA0: Crypto Disabled with integrated BMC	
Physical	**Single-Slot FHHL Card Dimensions:** 111.15mm x 167.65mm **Tall Bracket Dimensions:** 121.0mm x 21.6mm **Heatsink Dimensions (Length, Width, Height):** 139.6mm x 92.7mm x 10.2mm	
Interfaces	See Supported Interfaces	
	PCI Express Interface	Gen 5.0 SERDES @ 32.0GT/s, 16 lanes (4.0, 3.0, 2.0 and 1.1 compatible)
		Optional: Additional PCIe x16 Gen 5.0 @ SERDES 32GT/s through the PCIe auxiliary passive card and Cabline SA-II Plus harnesses
	On-board Memory	• Dual-channel with **20** DDR5 + ECC (128bit + 16bit ECC) for a total of **32GB** @ 5600MT/s • 40GB pSLC eMMC memory + 128GB SSD
	Networking Connector	Dual-port QSFP112 (copper and optical)
Data Rate	**InfiniBand**	HDR100/EDR/FDR/SDR

	Ethernet (Default Speed)	100/50/25/10 Gb/s	
Protocol Support	**InfiniBand:** IBTA v1.5[a] Auto-Negotiation: HDR100 (2 lane x 50Gb/s per lane), EDR (25Gb/s per lane) port, FDR (14.0625Gb/s per lane), 1X/2X/4X SDR (2.5Gb/s per lane).		
	Ethernet: 100GAUI-2 C2M, 100GAUI-1 C2M, 100GBASE-CR4, 100GBASE-CR2, 100GBASE-CR1, 50GAUI-2 C2M, 50GAUI-1 C2M, 50GBASE-CR, 50GBASE-R2 , 40GBASE-CR4, 40GBASE-R2, 25GBASE-R, 10GBASE-R, 10GBASE-CX4, 1000BASE-CX, CAUI-4 C2M, 25GAUI C2M, XLAUI C2M , XLPPI, SFI		
Electrical and Thermal Specifications	**Voltage**: 12V		
	Electrical and thermal specifications are provided in "***NVIDIA BlueField-3 DPUs Electrical and Thermal Specifications***" document. You can access the document either by logging into NVOnline or by contacting your NVIDIA representative.		
Environmental	**Temperature**	**Operational**	0°C to 55°C
		Non-operational	-40°C to 70°C[b]
	Humidity	**Operational**	10% to 85% relative humidity
		Non-operational	10% to 90% relative humidity
	Altitude (Operational)	3050m	
Regulatory	**Safety**	CB / cTUVus / CE	
	EMC	CE / FCC / VCCI / ICES / RCM	
	RoHS	RoHS compliant	

Notes:
[a] The BlueField-3 DPU supplement the IBTA auto-negotiation specification to get better bit error rates and longer cable reaches. This supplemental feature only initiates when connected to another NVIDIA InfiniBand product.
[b] The non-operational storage temperature specifications apply to the product without its package.

900-9D3B6-00CN-AB0 / 900-9D3B6-00SN-AB0 Specifications

BlueField-3 IC	**BlueField-3 P-Series** - 16 Arm-Cores - 560MHz/2133MHz	
	• 900-9D3B6-00CN-AB0: Crypto Enabled with integrated BMC • 900-9D3B6-00SN-AB0: Crypto Disabled with integrated BMC	
Physical	**Dual-Slot FHHL Card Dimensions:** 111.15mm x 167.65mm **Tall Bracket Dimensions:** 121.0mm x 21.6mm **Heatsink Dimensions (Length, Width, Height):** 139.6mm x 92.7mm x 29.3mm	
Interfaces	See Supported Interfaces	
	PCI Express Interface	Gen 5.0 SERDES @ 32.0GT/s, 16 lanes (4.0, 3.0, 2.0 and 1.1 compatible)
		Optional: Additional PCIe x16 Gen 5.0 @ SERDES 32GT/s through the PCIe auxiliary passive card and Cabline SA-II Plus harnesses
	On-board Memory	• Dual-channel with **20** DDR5 + ECC (128bit + 16bit ECC) for a total of **32GB** @ 5600MT/s • 40GB pSLC eMMC memory + 128GB SSD

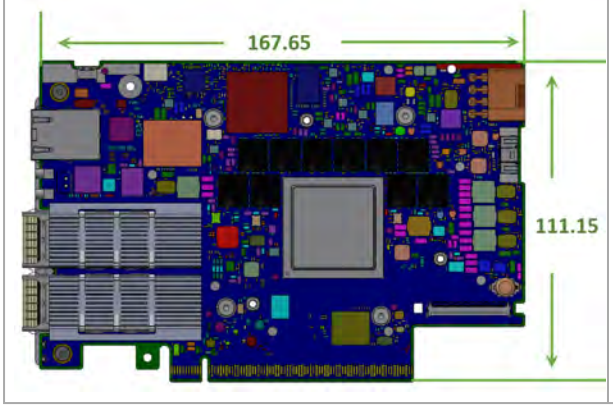
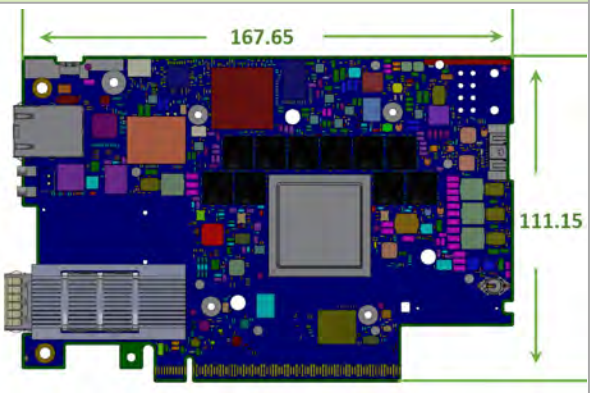
	Networking Connector	Dual QSFP112 (copper and optical)	
Data Rate	**InfiniBand (Default Speed)**	NDR/NDR200/HDR/HDR100/EDR/FDR/SDR	
	Ethernet	400/200/100/50/25/10 Gb/s	
Protocol Support	**InfiniBand:** IBTA v1.5[(a)] Auto-Negotiation: NDR (4 lanes x 100Gb/s per lane) port, NDR200 (2 lanes x 100Gb/s per lane) port, HDR (50Gb/s per lane) port, HDR100 (2 lane x 50Gb/s per lane), EDR (25Gb/s per lane) port, FDR (14.0625Gb/s per lane), 1X/2X/4X SDR (2.5Gb/s per lane)		
	Ethernet: 400GAUI-4 C2M, 400GBASE-CR4, 200GAUI-2 C2M, 200GAUI-4 C2M, 200GBASE-CR4, 100GAUI-2 C2M, 100GAUI-1 C2M, 100GBASE-CR4, 100GBASE-CR2, 100GBASE-CR1, 50GAUI-2 C2M, 50GAUI-1 C2M, 50GBASE-CR, 50GBASE-R2 , 40GBASE-CR4, 40GBASE-R2, 25GBASE-R, 10GBASE-R, 10GBASE-CX4, 1000BASE-CX, CAUI-4 C2M, 25GAUI C2M, XLAUI C2M , XLPPI, SFI		
	PCI Express 5.0: SERDES @ 32.0GT/s, 16 lanes (4.0, 3.0, 2.0 and 1.1 compatible)		
Electrical and Thermal Specifications	**Voltage**: 12V		
	Electrical and thermal specifications are provided in "***NVIDIA BlueField-3 DPUs Electrical and Thermal Specifications***" document. You can access the document either by logging into NVOnline or by contacting your NVIDIA representative.		
Environmental	**Temperature**	**Operational**	0°C to 55°C
		Non-operational	-40°C to 70°C[(b)]
	Humidity	**Operational**	10% to 85% relative humidity
		Non-operational	10% to 90% relative humidity
	Altitude (Operational)	3050m	
Regulatory	**Safety**	CB / cTUVus / CE	
	EMC	CE / FCC / VCCI / ICES / RCM	
	RoHS	RoHS compliant	

Notes:
[(a)] The BlueField-3 DPU supplement the IBTA auto-negotiation specification to get better bit error rates and longer cable reaches. This supplemental feature only initiates when connected to another NVIDIA InfiniBand product.
[(b)] The non-operational storage temperature specifications apply to the product without its package.

DPU Mechanical Drawing and Dimensions

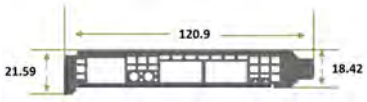
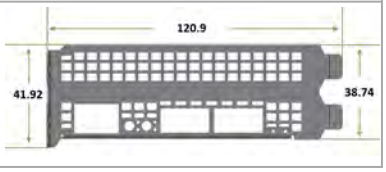
All dimensions are in millimeters. The PCB mechanical tolerance is +/- 0.13mm.

The diagrams may differ for different cards and are provided here for illustration purposes only.

Dual-port DPUs	Single-port DPUs
	

Bracket Mechanical Drawings

All dimensions are in millimeters.

DPU Configuration		Tall Bracket
Single-slot DPUs	Dual-port DPU	
	Single-port DPU	
Dual-slot DPUs	Dual-port DPU	

Monitoring

Thermal Sensors

The DPU incorporates the DPU SoC, which operates in the range of temperatures between 0°C and 105°C.

Three thermal threshold definitions impact the overall system operation state:

- Warning – 105°C: On managed systems only: When the device crosses the 105°C threshold, a Warning Threshold message is issued by the management SW, indicating to system administration that the card has crossed the warning threshold. Note that this temperature threshold does not require nor lead to any action by hardware (such as DPU shutdown).
- Critical – 115°C: When the device crosses this temperature, the firmware automatically shuts down the device.
- Emergency – 130°C: If the firmware fails to shutdown the device upon crossing the critical threshold, the device automatically shuts down upon crossing the emergency (130°C) threshold.

The DPU's thermal sensors can be read through the system's SMBus. The user can read these thermal sensors and adapt the system airflow following the readouts and the needs of the above-mentioned SoC thermal requirements.

Heatsink

The heatsink is attached to the DPU by three screws to dissipate the heat from the SoC.
The DPU SoC has a thermal shutdown safety mechanism that automatically shuts down the DPU in cases of high-temperature events, improper thermal coupling, or heatsink removal.

Refer to the below table for heatsink details per card configuration. For the required airflow (LFM) per OPN, please refer to Specifications.

Card Configuration	OPN	Maximum Dimensions
Single-slot DPUs	900-9D3B4-00EN-EA0, 900-9D3B4-00PN-EA0, 900-9D3B6-00CV-AA0, 900-9D3B6-00SV-AA0, 900-9D3B6-00CC-AA0, 900-9D3B6-00SC-AA0, 900-9D3B6-00CC-EA0, 900-9D3B6-00SC-EA0	Length, Width, Height: 139.6mm x 92.7mm x 10.2mm
Dual-slot DPUs	900-9D3B6-00CN-AB0, 900-9D3B6-00SN-AB0	Length, Width, Height: 139.6mm x 92.7mm x 29.3mm

Finding the GUID/MAC on the DPU

Each DPU has a different identifier printed on the label: serial number and the card MAC (for the Ethernet protocol) and the card GUID (for the InfiniBand protocol). VPI cards have both a GUID and a MAC (derived from the GUID).

The product revisions indicated on the labels in the following figures do not necessarily represent the latest revisions of the cards.

The board label contains the base GUID.

The DPU labels contain five MAC addresses (Host, ECPF, BMC, MPF, and OOB).

- Host (Base MAC)
- ECPF: Embedded CPU Function (the embedded Arm system controls the NIC resources and datapath)
- DPU BMC: Connection of a Baseboard Management Controller (BMC)
- MPF: Multi/Management Physical Function
- OOB: Out-of-Band Management (Management Port)

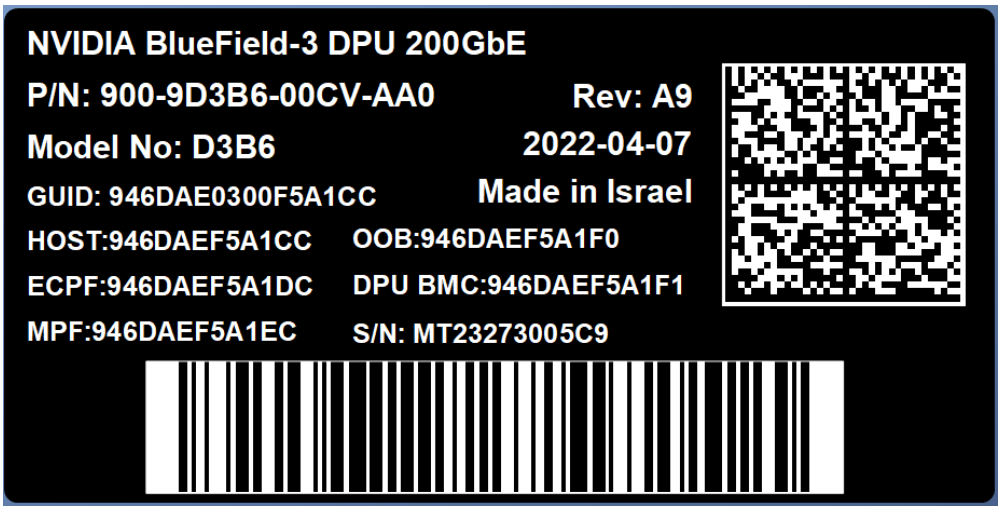
The barcode supports all of the available MAC addresses.

The HOST MAC in the board label is the product's base MAC.
In dual-port cards, the HOST MAC belongs to the first port, and the HOST MAC of the second port increases by 1 (in HEX).
For example:
The HOST MAC address of the second port is HOST: 00 02 C9 27 05 01.

The allocation of MAC addresses to the embedded CPU is derived from a few configuration factors which set some variables.

The gap between the MAC addresses is set by constant numbers in HEX.
The OOB, ECPF, and MPF MAC addresses depend on the BASE MAC address.

DPU Board Label (Example)


NVIDIA BlueField-3 DPU 200GbE
P/N: 900-9D3B6-00CV-AA0
Rev: A9
Model No: D3B6
2022-04-07
GUID: 946DAE0300F5A1CC
Made in Israel
HOST:946DAEF5A1CC
OOB:946DAEF5A1F0
ECPF:946DAEF5A1DC
DPU BMC:946DAEF5A1F1
MPF:946DAEF5A1EC
S/N: MT23273005C9

PCIe Auxiliary Card Kit

This section applies to the following DPUs when used as Socket Direct cards in dual-socket servers.

- 900-9D3B6-00CN-AB0
- 900-9D3B6-00SN-AB0
- 900-9D3B6-00CV-AA0
- 900-9D3B6-00SV-AA0

Socket Direct network cards, which cost-effectively integrate a single network adapter silicon on a primary board, and an auxiliary PCIe connection card and Cabline SA-II Plus Harness connecting the two. Socket Direct enables direct access from each CPU to the network through its dedicated PCIe interface as the card's 32-lane PCIe bus is split into two 16-lane buses, with one bus accessible through a PCIe x16 edge connector and the other bus through an x16 Auxiliary PCIe Connection card. The two cards should be installed into two PCIe x16 slots and connected using two Cabline SA-II Plus harnesses.

The PCIe auxiliary kit can be purchased separately to operate in a dual-socket server. The below table lists the available PCIe auxiliary kit ordering part numbers, depending on the desired length of the Cabline SA-II Plus harnesses and the PCI Express interface, Gen 4.0 or Gen 5.0.

Ordering Part Number	Passive Auxiliary Connection	Cabline SA-II Plus Harnesses Length
MTMK9100-T15	PCIe Gen **4.0/5.0** x16 connection card	2x 150mm harnesses
MTMK9100-T25	PCIe Gen **4.0 x16** connection card	2x 250mm harnesses
MTMK9100-T35	PCIe Gen **4.0 x16** connection card	2x 350mm harnesses

The two Cabline SA-II Plus harnesses in the PCIe auxiliary kit have different routings. To distinguish between these two harnesses, one black harness is marked with a “WHITE” label while the harness is marked with a “BLACK” label.

The Cabline harness marked with the "WHITE" label should be connected to the connector on the networking card and PCIe Auxiliary card engraved with “White Cable” while the one marked with the "BLACK" label should be connected to the connector on the networking card and the PCIe Auxiliary card engraved with “Black Cable”. The Cabline SA-II Plus harness mates with two 60-pin connectors (P/N 20790-060E-01), on both sides. The black Cabline SA-II Plus harness mates with the connector on the component side (top side) of the network card, while the White Cabline SA-II Plus harnesses mates with the pint side (bottom side) of the main network card. For hardware installation, please refer to PCIe Extension Option (2x PCIe x16) Installation Instructions.

PCIe Auxiliary Card Package Contents

Category	Qty	Item
Cards	1	MTMK9100-T15: PCIe x16 Gen **5.0/4.0** Auxiliary Connection Card MTMK9100-T25 and MTMK9100-T35: PCIe x16 Gen 4.0 Auxiliary Connection Card
Harnesses	1	Cabline CA-II Plus harness (white) - Length according to kit OPN (15, 25 or 35cm)
	1	Cabline CA-II Plus harness (black) - Length according to kit OPN (15, 25 or 35cm)
Accessories	2	Retention Clip for Cabeline harness (shipped assembled on the harnesses - optional)
	1	PCIe Auxiliary card short bracket
	1	PCIe Auxiliary card tall bracket (shipped assembled on the Auxiliary card)

Channel Insertion Loss

Channel insertion loss is the signal power loss resulting from a device's insertion in a transmission line or optical fiber and is usually expressed in decibels (dB).

The following table describes the NVIDIA® BlueField®-3 channel insertion loss budget for PCIe Gen 5.0 architecture (32 GT/s).

The total PCIe channel insertion loss approved by PCI-SIG Gen5.0 spec is 36dB @16GHz.

The total BlueField-3 DPU board insertion loss of the PCIe lanes (PCORE1) routed to the Cabline CA-II Plus is 6dB (@16GHz).

The Passive Socket Direct PCIe Auxiliary Card Loss is 1.5dB (@16Ghz).

The Cabline CA-II Plus harness loss at 16GHz:

Harness Length	Channel Loss at Gen 5.0
15cm	3.8dB
35cm	7.6dB
55cm	11.4dB

The above is measured data; it is recommended to add 0.5dB margins for your system (some loss variations are possible).

The Cabline CA-II Plus harnesses loss = 0.24dB/cm for Gen 5.0.

The above loss includes the Cabline CA-II Plus harnesses and connectors on both sides.

The PCI-SIG Gen5 SPEC also defines the total loss for AIC (bump to GF) to be 9.5dB @16Ghz.

The BlueField-3 AIC, together with a 15cm Cabline CA-II Plus harnesses and the Passive PCIe Auxiliary Card loss is: 3dB+2dB+3.8dB+1.5dB=10.3dB > 9.5dB

Cabline CA-II Plus Harness Pinouts

Cabline CA-II Plus Harness - Component Side

Pin#	Signal Name	Wire Type	Detailed Description	AWG#	Pin# on the other end
1	GND	GND BAR			1
2	PCIE_REFCLK1_P	Micro coax	Primary PCIe clock from the motherboard to the BlueField DPU Main card, to be used for the x16 Cabline harness PCIe interface. This clock must meet all the PCIe SIG spec requirements. It should be driven from the motherboard side.	38	2
3	PCIE_REFCLK1_N	Micro coax	Primary PCIe clock from the motherboard to the BlueField DPU Main card, to be used for the x16 Cabline harness PCIe interface. This clock must meet all the PCIe SIG spec requirements. It should be driven from the motherboard side.	38	3
4	GND	GND BAR			4
5	PCIE_CPU_CX_15N	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	5
6	PCIE_CPU_CX_15P	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	6
7	GND	GND BAR			7

Pin#	Signal Name	Wire Type	Detailed Description	AWG#	Pin# on the other end
8	PCIE_CPU_CX_14N	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	8
9	PCIE_CPU_CX_14P	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	9
10	GND	GND BAR			10
11	PCIE_CPU_CX_13N	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	11
12	PCIE_CPU_CX_13P	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	12
13	GND	GND BAR			13
14	PCIE_CPU_CX_12N	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	14
15	PCIE_CPU_CX_12P	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	15
16	GND	GND BAR			16
17	PCIE_CPU_CX_11N	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	17

Pin#	Signal Name	Wire Type	Detailed Description	AWG#	Pin# on the other end
18	PCIE_CPU_CX_11P	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	18
19	GND	GND BAR			19
20	PCIE_CPU_CX_10N	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	20
21	PCIE_CPU_CX_10P	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	21
22	GND	GND BAR			22
23	PCIE_CPU_CX_9N	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	23
24	PCIE_CPU_CX_9P	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	24
25	GND	GND BAR			25
26	PCIE_CPU_CX_8N	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	26
27	PCIE_CPU_CX_8P	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	27
28	GND	GND BAR			28

Pin#	Signal Name	Wire Type	Detailed Description	AWG#	Pin# on the other end
29	PCIE_CPU_CX_7N	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	29
30	PCIE_CPU_CX_7P	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	30
31	GND	GND BAR			31
32	PCIE_CPU_CX_6N	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	32
33	PCIE_CPU_CX_6P	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	33
34	GND	GND BAR			34
35	PCIE_CPU_CX_5N	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	35
36	PCIE_CPU_CX_5P	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	36
37	GND	GND BAR			37
38	PCIE_CPU_CX_4N	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	38

Pin#	Signal Name	Wire Type	Detailed Description	AWG#	Pin# on the other end
39	PCIE_CPU_CX_4P	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	39
40	GND	GND BAR			40
41	PCIE_CPU_CX_3N	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	41
42	PCIE_CPU_CX_3P	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	42
43	GND	GND BAR			43
44	PCIE_CPU_CX_2N	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	44
45	PCIE_CPU_CX_2P	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	45
46	GND	GND BAR			46
47	PCIE_CPU_CX_1N	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	47
48	PCIE_CPU_CX_1P	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	48
49	GND	GND BAR			49

Pin#	Signal Name	Wire Type	Detailed Description	AWG#	Pin# on the other end
50	PCIE_CPU_CX_0N	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	50
51	PCIE_CPU_CX_0P	Micro coax	Connect from the Black Cabline CA-II Plus cable through 220nF capacitors to the x16 PCIe Tx lanes of the CPU/GPU/End-Point	38	51
52	GND	GND BAR			52
53	I2C_DPU_BMC_SDA	Micro coax		38	53
54	I2C_DPU_BMC_SCL	Micro coax		38	54
55	AUX_PGOOD	Micro coax		38	55
56	No wire	Micro coax		38	56
57	I2C_AUX_SCL	Micro coax	The BlueField silicon serves as the I2C bus master on this bus. An I2C EEPROM at I2C address 0x57 needs to be mounted on the motherboard side to report to the Cabline CA-II Plus interface parameters to the main-card BlueField DPU silicon, like Cabline CA-II Plus cables length (contact NVIDIA for the format of this EEPROM). If additional optional I2C slave devices need to be managed by the main-card BlueField DPU silicon, they need to be included on this I2C bus as well.	38	57

Pin#	Signal Name	Wire Type	Detailed Description	AWG#	Pin# on the other end
58	I2C_AUX_SDA	Micro coax	The BlueField silicon serves as the I2C bus master on this bus. An I2C EEPROM at I2C address 0x57 needs to be mounted on the motherboard side to report to the Cabline CA-II Plus interface parameters to the main-card BlueField DPU silicon, like Cabline CA-II Plus cables length (contact NVIDIA for the format of this EEPROM). If additional optional I2C slave devices need to be managed by the main-card BlueField DPU silicon, they need to be included on this I2C bus as well.	38	58
59	S_PRSNT1_L	Micro coax	Connect this pin to GND No wires are connected to these pins to ensure they do not interfere with the operation of S_PRSNT2_L for the detection when the two Cabline harnesses are installed.	38	59
60		No Wire			60

Cabline CA-II Plus Harness - Print Side

Pin#	Signal Name	Wire Type	AWG#	Detailed Description	Pin# on the other end
1	SER_CLK	Micro coax	38	This pin is used as the serializer clock (SER_CLK) from the DPU to the device/s located on the motherboard.	1
2	SER_CAPTURE	Micro coax	38	This pin is used as the serializer capture (SER_CAPTURE).	2

Pin#	Signal Name	Wire Type	AWG#	Detailed Description	Pin# on the other end
3	SER_DO	Micro coax	38	This pin is used as the serializer data out from the BlueField DPU to the device/s located on the motherboard.	3
4	S_PERST2_CONN_L	Micro coax	38	Optional: PCIe compliant PERST_L (active low PCI Reset) signal for the Cabline CA-II Plus PCIe interface. To be used as the PERST_L signal for the control of PCIe lane 15:8, when a bifurcation of the Cabline CA-II Plus PCIe x16 interface to two x8 interfaces is needed (and in specific main board assemblies which support such bifurcation). The direction of this optional PERST_L signal depends on the implementation: When connecting a CPU root complex to the Cabline CA-II Plus PCIe interface, this signal is driven from the motherboard side (from the CPU), to the BlueField DPU; When connecting a GPU or an end point to the Cabline CA-II Plus PCIe interface, this signal is driven from the BlueField DPU (which operates as a PCIe switch in this case), to the GPU or end-point on the motherboard side.	4
5	SER_DI	Micro coax	38	This pin is used as the serializer data in from the device/s located on the motherboard.	5
6	Reserved_06	Micro coax	38		6
7	Reserved_07	Micro coax	38	Reserved for future expansion	7

Pin#	Signal Name	Wire Type	AWG#	Detailed Description	Pin# on the other end
8	Reserved_08	Micro coax	38	Reserved for future expansion	8
9	GND	GND BAR			9
10	PCIE_CX_CPU_0P	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	10
11	PCIE_CX_CPU_0N	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	11
12	GND	GND BAR			12
13	PCIE_CX_CPU_1P	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	13
14	PCIE_CX_CPU_1N	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	14
15	GND	GND BAR			15
16	PCIE_CX_CPU_2P	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	16

Pin#	Signal Name	Wire Type	AWG#	Detailed Description	Pin# on the other end
17	PCIE_CX_CPU_2N	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	17
18	GND	GND BAR			18
19	PCIE_CX_CPU_3P	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	19
20	PCIE_CX_CPU_3N	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	20
21	GND	GND BAR			21
22	PCIE_CX_CPU_4P	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	22
23	PCIE_CX_CPU_4N	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	23
24	GND	GND BAR			24

Pin#	Signal Name	Wire Type	AWG#	Detailed Description	Pin# on the other end
25	PCIE_CX_CPU_5P	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	25
26	PCIE_CX_CPU_5N	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	26
27	GND	GND BAR			27
28	PCIE_CX_CPU_6P	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	28
29	PCIE_CX_CPU_6N	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	29
30	GND	GND BAR			30
31	PCIE_X_CPU_7P	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	31

Pin#	Signal Name	Wire Type	AWG#	Detailed Description	Pin# on the other end
32	PCIE_CX_CPU_7N	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	32
33	GND	GND BAR			33
34	PCIE_CX_CPU_8P	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	34
35	PCIE_CX_CPU_8N	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	35
36	GND	GND BAR			36
37	PCIE_CX_CPU_9P	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	37
38	PCIE_CX_CPU_9N	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	38
39	GND	GND BAR			39

Pin#	Signal Name	Wire Type	AWG#	Detailed Description	Pin# on the other end
40	PCIE_CX_CPU_10P	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	40
41	PCIE_CX_CPU_10N	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	41
42	GND	GND BAR			42
43	PCIE_CX_CPU_11P	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	43
44	PCIE_CX_CPU_11N	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	44
45	GND	GND BAR			45
46	PCIE_CX_CPU_12P	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	46

Pin#	Signal Name	Wire Type	AWG#	Detailed Description	Pin# on the other end
47	PCIE_CX_CPU_12N	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	47
48	GND	GND BAR			48
49	PCIE_CX_CPU_13P	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	49
50	PCIE_CX_CPU_13N	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	50
51	GND	GND BAR			51
52	PCIE_CX_CPU_14P	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	52
53	PCIE_CX_CPU_14N	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	53
54	GND	GND BAR			54

Pin#	Signal Name	Wire Type	AWG#	Detailed Description	Pin# on the other end
55	PCIE_CX_CPU_15P	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	55
56	PCIE_CX_CPU_15N	Micro coax	38	Connect from the White Cabline CA-II Plus harness to the PCIe x16 Rx lanes of the CPU/GPU/End-Point. 220nF caps are required on this signal on the BlueField DPU.	56
57	GND	GND BAR			57
58	S_PERST1_CONN_L	Micro coax	38	PCIe compliant PERST_L (active low PCI Reset) signal for the PCIe Cabline CA-II Plus Connectors. The direction of this PERST_L signal depends on the implementation: When connecting a CPU root complex to the PCIe Cabline CA-II Plus interface, this signal is driven from the motherboard side (from the CPU), to the BlueField DPU. When connecting a GPU or an end point to the PCIe Cabline CA-II Plus interface, this signal is driven from the BlueField DPU side (which operates as a PCIe switch in this case), to the GPU or end-point on the motherboard side.	58
59		No Wire			59

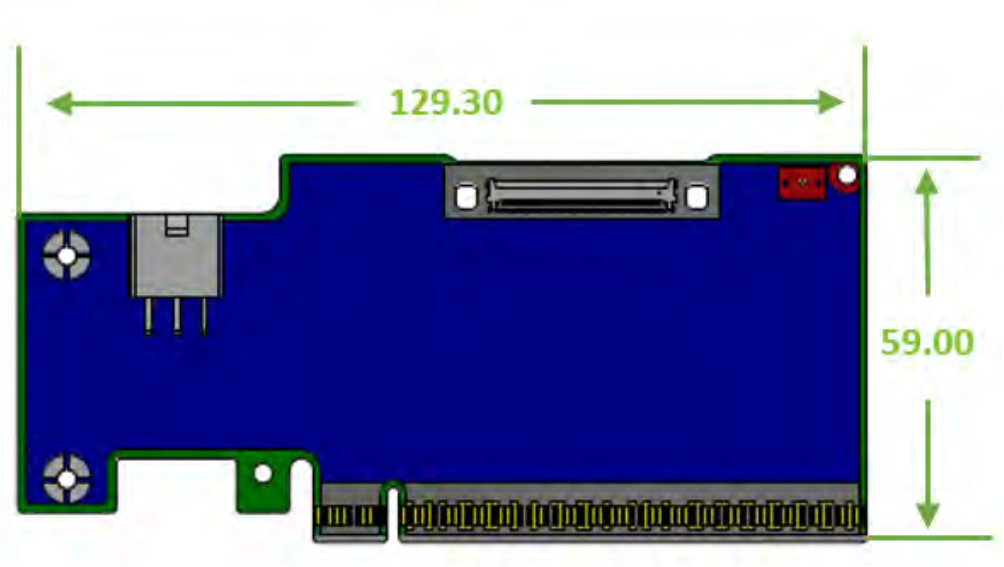
Pin#	Signal Name	Wire Type	AWG#	Detailed Description	Pin# on the other end
60	S_PRSNT2_L	Micro coax	38	Connect to a 4.7K pull-up resistor to 3.3V on the motherboard side, to detect if both the Cabline harnesses are connected or not. This signal is connected to S_PRSNT1_L on the BlueField DPU. In the motherboard side, read logic low if both Cabline harnesses are connected. Read logic 1 (3.3V) if one or both the Cabline harnesses are not connected. No wires are connected to these pins to ensure they do not interfere with the operation of S_PRSNT1_L for the detection when the two Cabline harnesses are installed.	60

Technical Specifications

Physical	PCIe Auxiliary Card Size: 5.09 in. x 2.32 in. (129.30mm x 59.00mm) Two Cabline CA-II Plus harnesses (white and black) Length: 15, 25 or 35cm		
Power Consumption	**Voltage**: 12V, 3.3V_AUX **Maximum current:** 100mA for the 3.3V_AUX voltage rail		
PCIe Connectivity	MTMK9100-T15	PCI Express Gen 5.0/4.0: SERDES @ 16/32 GT/s, x16 lanes (Gen 3.0 compatible)	
	MTMK9100-T25 / MTMK9100-T35	PCI Express Gen 4.0: SERDES @ 16GT/s, x16 lanes (Gen 3.0 compatible)	
Environmental	**Temperature**	**Operational**	0°C to 55°C
		Non-operational	-40°C to 70°C
	Humidity	**Operational**	10% to 85% relative humidity
		Non-operational	10% to 90% relative humidity
	Altitude (Operational)	3050m	
Regulatory	**Safety**: CB / cTUVus / CE		
	EMC: CE / FCC / VCCI / ICES / RCM / KC		
	RoHS: RoHS Compliant		

PCIe Auxiliary Card Mechanical Drawings and Dimensions

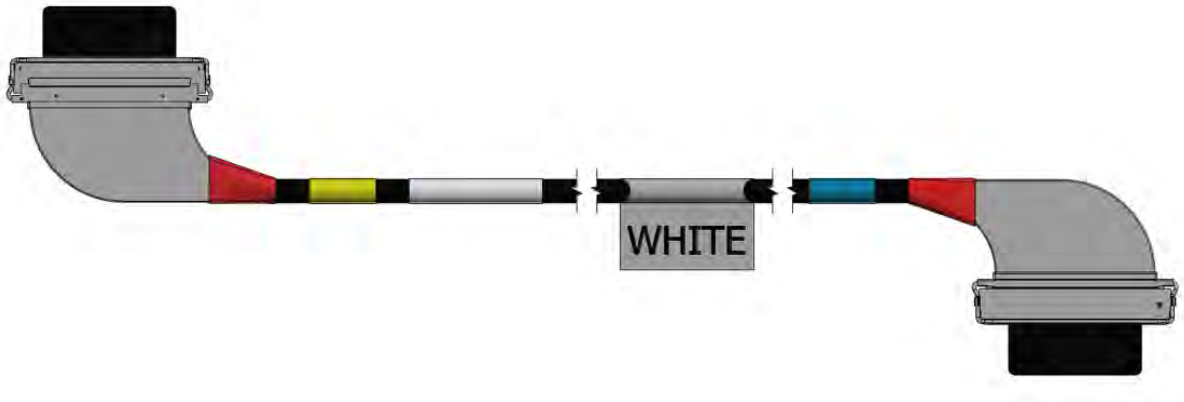
All dimensions are in millimeters. The PCB mechanical tolerance is +/- 0.13mm.



Bracket Mechanical Drawings and Dimensions

Auxiliary PCIe Connection Card Tall Bracket	Auxiliary PCIe Connection Card Short Bracket
	

Cabline CA-II Plus Harnesses Mechanical Drawing



Supported Servers and Power Cords

To be updated in a furture revision of this document.

Document Revision History

Date	Description
Aug 2023	• Added step 3 to section Verifying DPU Connection and Setting Up Host Environment • Fixed typo in Bracket Mechanical Drawings
Aug 2023	• Updated the lifecycle tag of 900-9D3B6-00CV-AA0 and 900-9D3B6-00SV-AA0 to indicate "Mass Production". • Updated Cabline CA-II Plus Connectors Pinouts. • Updated Cabline CA-II Plus Harness Pinouts. • Added a note to NVMe SSD Interface.
July 2023	Amended a note on airflow direction in Hardware Installation.
June 2023	• Added `sudo` to step 2 in section Verifying DPU Connection and Setting Up Host Environment. • Updated list of identified devices in section Verifying DPU Connection and Setting Up Host Environment. • Added section Connecting to BlueField and Verifying Version. • Updated step 2.c. in section Updating BlueField BFB Image. • Added `sudo` to step 3.b. in section Updating BlueField BFB Image. • Marked 900-9D3B6-00CC-AA0 and 900-9D3B6-00SC-AA0 as EOL (End of Life) products. • Added new DPUs to the user manual: 900-9D3B6-00CC-EA0 and 900-9D3B6-00SC-EA0. • Updated Cabline CA-II Plus Harness Pinouts. • Updated SoC frequency for E-Series DPUs in Specifications
May 2023	• Updated Specifications - added non-operational storage temperature specifications. • Updated Ethernet protocols in Specifications.
Apr 2023	Added PSID and device ID information in NVIDIA BlueField-3 DPU User Guide.
Mar 2023	Updated DDR5 SDRAM On-Board Memory.
Feb 2023	Updated External PCIe Power Supply Connector.
Feb 2022	• Updated list of SKUs across the document • Added BlueField DPU Administrator Quick Start Guide • Added Setting High-Speed-Port Link Type • Added an important note on the External PCIe Power Supply Connector
Jan 2023	Added PCIe Auxiliary Card Kit
Nov 2022	Updated the following sections: • NC-SI Interface Pinouts
Jul 2022	Updated the following sections: • Cabline CA-II Plus Connectors with additional information. • Added Cabline CA-II Connector pins in Pinouts Description. • Finding the GUID/MAC on the DPU with board label examples. • PCI Express Interface pinouts to reflect changes in pins BB81 and B882. • Added heatsink dimensions in Introduction and Specifications.
Jun 2022	Renamed the document from "NVIDIA BleuField-3 InfiniBand/VPI DPU User Guide" to "NVIDIA BlueField-3 DPU User Guide"
May 2022	First release

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