



NVIDIA BlueField BF1600 InfiniBand/Ethernet Controller Card User Manual

Table of Contents

- Introduction..... 9**
 - Product Overview 9
 - BlueField Multicore System-on-chip (SoC) 10
 - Features and Benefits 11
 - Operating Systems/Distributions 13
 - Package Contents 14
 - BF1600 Controller Card with Auxiliary Connection Card..... 14
 - BF1600 Controller Card without Auxiliary Connection Card..... 15
- Supported Interfaces 16**
 - Layout and Connector Information..... 16
 - BlueField BF1600 Controller Card 16
 - PCIe Auxiliary Connection Card 20
 - PCIe Auxiliary Connection Card - Print Side 22
 - Interfaces 23
 - BlueField System On Chip (SoC) 23
 - Ethernet QSFP56 Interfaces 23
 - QSFP28 Port Over-current Protection..... 23
 - PCI Express Interfaces..... 24
 - PCIe x16 Gen 3.0/4.0 Edge Connector..... 24

PCIe Gen 3.0 through Two CABLINE-CA II PLUS Connectors.....	24
NCSI Management Interface	25
USB Connector.....	26
UART0 Interface.....	26
I ² C0 Interface	27
JTAG CoreSight 10	27
External PCIe Power Supply Interfaces	28
External PCIe Power Supply Interface on the BF1600 Controller Card	28
External PCIe Power Supply Interface on the Auxiliary PCIe Connection Card	29
CPLD Interface	30
eMMC Interface.....	30
DDR4 SODIMM Memory.....	31
SPI Flash Memory	32
Networking LED Interfaces	32
CPLD Revision LEDs Interface	32
CABLINE-CA II PLUS Connector LED Interfaces	33
Power-Good Signal LED Interface.....	34
PCI Link Status LEDs	34
Pin Description	35
PCI Express Interface.....	35
PCIe x16 Gen 3.0/4.0 Edge Connector.....	35

PCIe x16 Edge Connector Pins Description - Print Side.....	35
PCIe x16 Edge Connector Pinouts Description - Component Side.....	41
PCIe Gen 3.0 through Two CABLINE-CA II PLUS Connectors.....	47
CABLINE-CA II PLUS Connector - Component Side	48
CABLINE-CA II PLUS Connector - Print Side.....	52
Power Sequencing.....	57
NCSI Management Interface	57
External Power Supply Interfaces	59
External +12V Mechanical Pinout Diagram	60
UART0 Interface.....	60
JTAG CoreSight 10 Interface	61
DDR4 DRAM Memory Interface	62
Cables and Cabling Configurations	64
UART Interface Cabling	64
USB Interface Cabling	65
Configuration Scenarios.....	67
Configuration 1: Direct Connectivity to 4-8 NVMe SSDs (No External PCIe Switch).....	67
Configuration 2: Direct Connectivity to 8-16 NVMe SSDs with (No External PCIe Switch)	69
Configuration 3: Connectivity to 8-16 NVMe SSDs (with External PCIe Switch)	70
Configuration 4: Connectivity to 24 NVMe SSDs (with External PCIe Switch).....	70
Clocks Distribution.....	71

Thermal Sensors.....	72
Hardware Installation	73
Installation Procedure Overview.....	73
System Requirements	74
Hardware Requirements	74
Airflow Requirements	74
Software Requirements	75
Pre-Installation Checklist.....	75
Bracket Replacement Instructions	76
Removing the Existing Bracket.....	76
Installing the New Bracket	76
Installation Instructions.....	76
BF1600 Controller Card Installation Instructions - PCIe x16.....	77
Connect the BF1600 Controller Card in an available PCI Express slot on the JBOF system.	77
Secure the BF1600 Controller Card to the JBOF system.	79
BF1600 Controller and Auxiliary Connection Cards Installation Instructions - PCIe x32	79
Connect the BF1600 Controller Card with the Auxiliary connection card using the supplied CABLINE-CAII PLUS harnesses.....	80
Connect the BF1600 Controller Card in an available PCI Express slot on the JBOF system.	81
Connect the PCIe Auxiliary Connection Card in an available PCI Express slot on the JBOF system.....	82
Secure the BF1600 Controller and PCIe Auxiliary Connection Cards to the JBOF system.....	83
Cables and Modules.....	84

Networking Cables	84
Bring-Up and Driver Installation	86
Troubleshooting	87
General Troubleshooting	87
Specifications.....	88
Dual-slot Controller Cards Specifications	88
Single-slot Controller Card Specifications.....	89
LED Interfaces	91
Networking LED Interfaces	91
CPLD Revision LEDs Interface	91
CABLINE-CA II PLUS Connector LED Interfaces	92
BF1600 Controller Card Cabline-CA II Plus Connector LED	93
PCIe Auxiliary Connection Card Cabline-CA II Plus Connector LED	93
Power-Good Signal LED Interface.....	93
Finding the MAC on the Controller Card.....	94
Document Revision History	99

About This Manual

This User Manual describes NVIDIA® BlueField® BF1600 Controller Card. It provides details as to the interfaces of the board, specifications, required software and firmware for operating the card, hardware installation, driver installation and bring-up instructions.

Overview of Document Content

Section	Section Description
Introduction	Provides a general overview of the BlueField BF1600 Controller Cards and discusses its benefits and features.
Supported Interfaces	Provides descriptions of all supported interfaces.
Pin Description	Provides interfaces' Pinouts description.
Configuration Scenarios	Provides examples of different configuration scenarios for NVMe SSD connectivity.
Cables and Cabling Configurations	Describes the required cables and cabling configurations.
Thermal Sensors	Describes the available thermal sensors on the BlueField SoC
Hardware Installation	Describes the procedures for installing and uninstalling the Controller Card.
Bring-Up and Driver Installation	Describes driver installation and bring-up instructions
Troubleshooting	Describes potential system problems - you can use this troubleshooting information to identify and resolve the problem.
Specifications	Lists the physical, electrical, operational and regulatory specifications of the BlueField

Intended Audience

This manual is intended for the installer and user of these cards. The manual assumes basic familiarity with 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: <https://www.nvidia.com> > Support

- E-mail: enterprisesupport@nvidia.com

Customers who purchased Mellanox M-1 Global Support Services, please see your contract for details regarding Technical Support. Customers who purchased Mellanox products through a Mellanox approved reseller should first seek assistance through their reseller.

Related Documentation

IEEE Std 802.3 Specification	IEEE Ethernet specification at http://standards.ieee.org
PCI Express Specifications	Industry Standard PCI Express Base and Card Electromechanical Specifications at https://pcisig.com/specifications
Mellanox LinkX Interconnect Solutions	Mellanox LinkX InfiniBand cables and transceivers are designed to maximize the performance of High-Performance Computing networks, requiring high-bandwidth, low-latency connections between compute nodes and switch nodes. Mellanox offers one of the industry’s broadest portfolio of QDR/FDR10 (40Gb/s), FDR (56Gb/s), EDR/HDR100 (100Gb/s), and HDR (200Gb/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, Mellanox tests every product in an end-to-end environment ensuring a Bit Error Rate of less than 1E-15. Read more at https://www.nvidia.com/en-us/networking/interconnect/

Document Conventions

When discussing memory sizes, MB and MBytes are used in this document to mean size in MegaBytes. The use of Mb or Mbits (small b) indicates size in MegaBits. 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

This is the User Manual for BlueField® BF1600 Controller Card. This document contains the complete installation instructions and specifications for the BF1600 Controller Cards listed in the below table.

Ordering Part Numbers

The below table provides the ordering part numbers (OPN) for the available BlueField BF1600 Controller Cards:

OPN	Marketing Description
MBF1M606A-CSNAT	BlueField® Controller card, Dual Port 100Gb/s QSFP28, PCIe Gen4.0 x16, BlueField® E-Series 16 cores, Crypto disabled, No Memory DIMM, FH $\frac{3}{4}$ L, Single Slot, Tall Bracket
MBF1M606A-ESNAT	BlueField® Controller card, Dual Port InfiniBand/Ethernet 100Gb/s QSFP28, PCIe Gen4.0 x16, BlueField® E-Series 16 cores, Crypto disabled, No Memory DIMM, FH $\frac{3}{4}$ L, Single Slot, Tall Bracket
MBF1M616A-CSNAT	BlueField® Controller card, Dual Port 100Gb/s QSFP28, PCIe Gen4.0 x16, BlueField® E-Series 16 cores, Crypto disabled, 2x 16GB Memory DIMM, FH $\frac{3}{4}$ L, Single Slot, Tall Bracket
MBF1M626A-CSNAT	BlueField® Controller card, Dual Port 100Gb/s QSFP28, BlueField E-Series 16 cores, PCIe Gen3.0 x16, Auxiliary Card PCIe Gen3.0 x16, CABLINE-CA II PLUS 350mm, Crypto disabled, No Memory DIMM, FH $\frac{3}{4}$ L, Single Slot width, Tall Bracket
MBF1M636A-CSNAT	BlueField® Controller card, Dual Port 100Gb/s QSFP28, BlueField E-Series 16 cores, PCIe Gen3.0 x16, Auxiliary Card PCIe Gen3.0 x16, CABLINE-CA II PLUS 350mm, QSFP28, 2x 16GB Memory DIMM, FH $\frac{3}{4}$ L, Single Slot width, Tall Bracket
MBF1M646A-CSNAT	BlueField® Controller card, Dual Port 100Gb/s, 100GbE dual-port QSFP28, PCIe Gen4.0 x16, Crypto disabled, 2x8GB Memory DIMM, FH $\frac{3}{4}$ L, Single Slot, Tall Bracket
MBF1M656A-CSNAT	BlueField® Controller card, Dual Port 100Gb/s QSFP28, BlueField® E-Series 16 cores, PCIe Gen3.0 x16, Auxiliary Card PCIe Gen3.0 x16, 2 x I-PEX 350mm Cable, Crypto disabled, 2x 8GB Memory DIMM, FH $\frac{3}{4}$ L, Single Slot, Tall Bracket

Product Overview

The BlueField BF1600 Dual Port 100Gb/s Controller Card is the perfect solution for managing NVMe storage drives in storage and hyper-converged systems. BlueField BF1600 Dual Port 100Gb/s Controller Card delivers the highest NVMe-oF target performance, reducing TCO and increasing ROI. The BlueField BF1600 Controller Cards can transform existing JBOF systems into NVMe-oF compliant solutions, simply by plugging the card into an existing PCIe slot. The card is available in two configurations: PCIe x16 and PCIe x32. This flexibility makes it easier to match different JBOF system configurations. The card's

small form factor allows customers to install multiple controller cards in a single system to support a larger number of SSDs and high-availability storage architecture.

⚠ The BlueField BF1600 Controller Card should be installed only in a JBOF System as it functions as a PCIe root-complex (RC) initiating PCIe bus operations. Installing it in a regular host system may damage the card.

BlueField Multicore System-on-chip (SoC)

BlueField SoC is a highly integrated and efficient controller, optimized for NVMe storage systems, Network Functions Virtualization (NFV), Cloud and AI workloads.

BlueField SoC integrates all the discrete components of a storage system appliance into a single chip (CPU, PCIe switch, and Network controller), making it the premier SoC solution for building Just-a-Bunch-Of-Flash (JBOF) systems, All-Flash-Array and storage appliances for NVMe over-Fabrics.

With an integrated NVMe-oF offload accelerator, the BlueField SoC gives the BlueField Dual Port 100Gb/s Controller Card a superior performance advantage over existing JBOF systems, significantly reducing storage transaction latency, while increasing IOPs (I/O operations per second).

BlueField SoC also offers cost-effective and integrative solutions for Machine Learning appliances, enabling efficient data delivery for real-time analytics and data insights based on superior RDMA and GPUDirect® RDMA technologies. Support for PCIe Gen4.0 helps future-proof the next generation of high-performance GPU cards.

BlueField Controller Cards

Part Number	MBF1M606A-CSNAT	MBF1M646A-CSNAT	MBF1M616A-CSNAT	MBF1M626A-CSNAT	MBF1M656A-CSNAT	MBF1M636A-CSNAT
Form Factor	PCIe Full Height, ¾ Length 9.13 in. x 4.37 in. (232.0 mm x 111.15mm)					
Heatsink Height	10.1mm					
Ethernet Data Rate	1/10/25/40/50/100 Gb/s Ethernet					
Network Connector Type	Dual-port QSFP28					
PCIe Gen 3.0/4.0 through x16 Edge Connector ^a	PCIe Gen 3.0 / 4.0 SERDES @ 8.0GT/s / 16.0GT/s					


PCIe Gen 3.0 through x16 Auxiliary Card	NA			PCIe Gen 3.0 SERDES @ 8.0GT/s		
On-board DDR4 Memory ^(a)	NA	2x 8GB	2x 16GB	NA	2x 8GB	2x 16GB
1GbE OOB Management	/	/	/	/		
RoHS	RoHS Compliant					
BlueField SoC	BlueField E-Series 16 cores					

a. Note: Refer to BlueField Software and Firmware release notes for the availability of PCIe Gen 4.0 capabilities.

For more detailed information see [Specifications](#).

Features and Benefits

This section describes hardware features and capabilities. Please refer to the software release notes for feature availability.

 It is recommended to upgrade your BlueField product to the latest software and firmware versions available in order to enjoy the latest features and bug fixes.

Feature	Description
PCI Express (PCIe) ^a	Uses the following PCIe connectors: <ul style="list-style-type: none"> • PCIe Gen 3.0 (8GT/s) and Gen 4.0 (16GT/s) through an x16 edge connector. Gen 1.1 and 2.0 compatible • Two PCIe Gen 3.0 (8GT/s) CABLINE-CA II PLUS connectors - available in MBF1M656A-CSNAT, MBF1M636A-CSNAT and MBF1M626A-CSNAT
Up to 100 Gigabit Ethernet	<ul style="list-style-type: none"> • 100GbE / 50GbE / 25GbE • IEEE 802.3bj, 802.3bm 100 Gigabit Ethernet • IEEE 802.3by, Ethernet Consortium25, 50 Gigabit Ethernet, supporting all FEC modes • IEEE 802.3az Energy Efficient Ethernet • IEEE 802.3ap based auto-negotiation and KR startup • Proprietary Ethernet protocols (50GBASE-R4) • IEEE 802.3ad, 802.1AX Link Aggregation

Feature	Description
	<ul style="list-style-type: none"> • IEEE 802.1Q, 802.1P VLAN tags and priority • IEEE 802.1Qau (QCN) • Congestion Notification • IEEE 802.1Qaz (ETS) • IEEE 802.1Qbb (PFC) • IEEE 802.1Qbg • IEEE 1588v2 • Jumbo frame support (9.6KB)
On-board Memory	<ul style="list-style-type: none"> • Two DDR4 SODIMM sockets - size is 16GB each (MBF1M636A-CSNAT and MBF1M616A-CSNAT) • Two DDR4 SODIMM sockets - size is 8GB each (MBF1M656A-CSNAT and MBF1M646A-CSNAT) • 2x 16GB eMMC NAND flash memory for software • SPI Flash for NIC firmware • SPI Flash for CPLD firmware • EEPROM - Size 128Kbit
BlueField SoC	The BlueField-2 SoC integrates eight 64-bit Armv8 A72 cores interconnected by a coherent mesh network, one DRAM controller, an RDMA intelligent network adapter supporting up to 200Gb/s, an embedded PCIe switch with endpoint and root complex functionality, and up to 16 lanes of PCIe Gen 3.0/4.0.
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. BlueField BF1600 Controller Card 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 Ethernet (RoCE)	The BlueField BF1600 Controller Cards, utilizing IBTA RDMA (Remote Data Memory Access) and RoCE (RDMA over Converged Ethernet) technology, deliver low-latency and high-performance over 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.
NVIDIA PeerDirect®	PeerDirect communication provides high-efficiency RDMA access by eliminating unnecessary internal data copies between components on the PCIe bus (for example, from GPU to CPU), and therefore significantly reduces application run time. BlueField BF1600 Controller Card advanced acceleration technology enables higher cluster efficiency and scalability to tens of thousands of nodes.
Quality of Service (QoS)	Support for port-based Quality of Service enabling various application requirements for latency and SLA.

Feature	Description
Storage Acceleration	<p>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.</p> <ul style="list-style-type: none"> • NVMe over Fabric offloads for the target machine • T10-DIF Signature Handover <p>BlueField-2 SmartNIC 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 BlueField-2 Arm cores. On the storage initiator side, BlueField-2 SmartNIC 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.</p>
High-Performance Accelerations	<ul style="list-style-type: none"> • Tag Matching and Rendezvous Offloads • Adaptive Routing on Reliable Transport • Burst Buffer Offloads for Background Checkpointing
GPU Direct	<p>The latest advancement in GPU-GPU communications is GPUDirect RDMA. This new technology 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. BlueField BF1600 Controller Card uses high-speed DMA transfers to copy data between P2P devices resulting in more efficient system applications.</p>
Security Accelerators	<p>A consolidated compute and network solution based on BlueField Controller Card achieves significant advantages over a centralized security server solution. Standard encryption protocols and security applications can leverage BlueField compute capabilities and network offloads for security application solutions such as:</p> <ul style="list-style-type: none"> • Connection Tracking • Statefull firewall

a. Refer to BlueField Software and Firmware release notes for availability of PCIe Gen 4.0 capabilities

Operating Systems/Distributions

The BlueField® BF1600 Controller Card supports the following operating systems:


- BlueField Software
- OpenFabrics Enterprise Distribution (OFED)

Connectivity


- Interoperable with 1/10/25/40/50/100 Gb/s Ethernet switches
- Passive copper cable with ESD protection
- Powered connectors for optical and active cable support

Package Contents

Before installing your new system, unpack it and check against the below tables that all the parts have been sent according to the OPN you purchased. Check the parts for visible damage that may have occurred during shipping.

 If anything is damaged or missing, contact your sales representative at support@NVIDIA.com.


BF1600 Controller Card with Auxiliary Connection Card

 Applies to MBF1M626A-CSNAT, MBF1M656A-CSNAT and MBF1M636A-CSNAT.

Category	Qty.	Item
Cards	1	BF1600 Controller Card
	1	PCIe Auxiliary Card
Cables	1	USB 2.0 Cable Type A to Type B
	1	USB 2.0 Cable to UART
	2	CABLINE-CAII PLUS 60 PIN harnesses (white and black) - 35cm
	1	Tall bracket for the BF1600 Controller Card (shipped assembled)

Category	Qty.	Item
Accessories	1	Tall bracket for the PCIe Auxiliary card (shipped assembled)
	1	Short bracket for the PCIe Auxiliary card

BF1600 Controller Card without Auxiliary Connection Card

 Applies to MBF1M606A-CSNAT, MBF1M646A-CSNAT and MBF1M616A-CSNAT.


Category	Qty.	Item
Cards	1	BF1600 Controller Card
Cables	1	USB 2.0 Cable Type A to Type B
	1	USB 2.0 Cable to UART
Accessories	1	Tall bracket for the PCIe Auxiliary card (shipped assembled)

Supported Interfaces

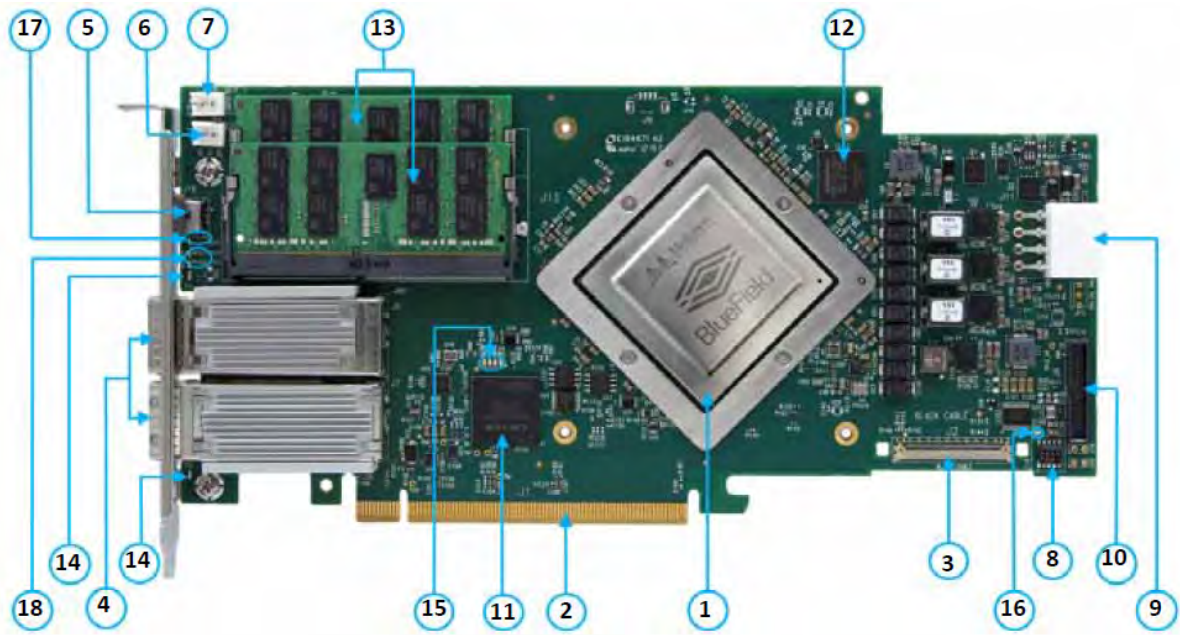
Layout and Connector Information

BlueField BF1600 Controller Card

The BF1600 Controller card is a 9.13 in. x 4.37 in. (232.0 mm x 111.15mm) card. The component height on the top and bottom of the card complies with the PCIe specification. The below figures show the connector and LED designations.

 The below figures are for illustration purposes only and might not reflect the current revision of the BF1600 card.

BF1600 Controller Card - Component Side




BF1600 Controller Card - Print Side




Callout	Interface	Description
1	BlueField System On Chip (SoC)	BlueField SoC with heatsink
2	PCIe x16 Gen 3.0/4.0 Edge Connector	The interface between the BlueField Controller and the JBOF system.
3	PCIe Gen 3.0 through Two CABLINE-CA II PLUS Connectors	The interface between the PCIe Auxiliary Card and the BlueField Controller Card.

4	Ethernet QSFP56 Interfaces	Ethernet traffic is transmitted through the controller's QSFP28 connectors. The QSFP28 connectors allow for the use of Optical modules and cable interconnect solutions.
5	USB Connector	USB Type-B Bracket mounted on card
6	I²C0 Interface	For ConnectX-5 Debug
7	UART0 Interface	BlueField UART0 (Console): connected to a transceiver and header
8	JTAG CoreSight 10	For Arm debugging
9	External PCIe Power Supply Interfaces	Along with the PCIe interface, this connector provides power to the board.
10	NCSI Management Interface	Connectivity channel between the BMC CPU and the BlueField Arm Array
11	CPLD Interface	CPLD for board periphery control and power sequencing
12	eMMC Interface	16GB eMMC Flash memory for software
13	DDR4 SODIMM Memory	2 Channel DDR4 SODIMMs, 64bit +ECC
	SPI Flash Memory	SPI Flash for NIC firmware
14	Networking LED Interfaces	One bi-color LED per port.
15	CPLD Revision LEDs Interface	Four green LEDs indicating CPLD revision
16	CABLIN-CA II PLUS Connector LED Interfaces	One green LED indicating a proper mating connection to cable
17	Power-Good Signal LED Interface	One green LED indicating power-good signal
18	PCI Link Status LEDs	2 bi-color LEDs that indicate proper link status of PCI0 and PCI1

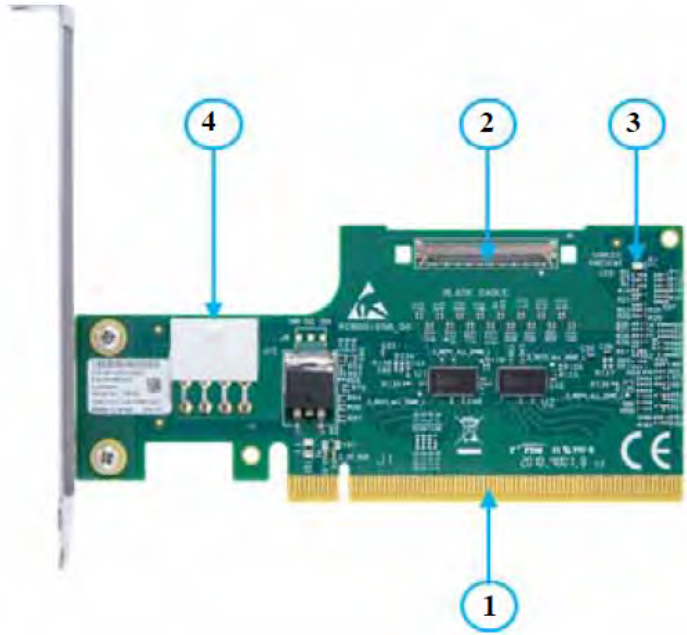
PCIe Auxiliary Connection Card

 The PCIe Auxiliary Connection card is supplied with the following OPNs: MBF1M626A-CSNAT, MBF1M656A-CSNAT and MBF1M636A-CSNAT.

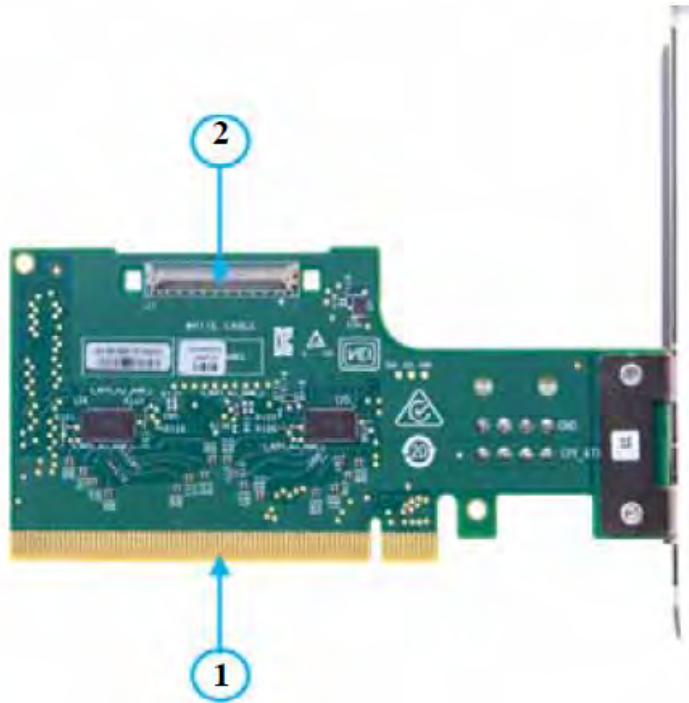
The PCIe Auxiliary Card is a 5.09in. x 2.32in. (129.30mm x 59.00mm) card. The below figures provide the connector designations.

 The below figures are for illustration purposes only and might not reflect the current revision of the BF1600 card.

PCIe Auxiliary Connection Card - Component Side



PCIe Auxiliary Connection Card - Print Side



Callout	Interface	Description
1	PCIe x16 Gen 3.0/4.0 Edge Connector	The interface between the PCIe Auxiliary Card and the JBOF system.
2	PCIe Gen 3.0 through Two CABLINE-CA II PLUS Connectors	The interface between the PCIe Auxiliary Card and the BlueField Controller Card.

3	CABLINA-CA II PLUS Connector LED Interfaces	One green LED indicating proper cable connection
4	External PCIe Power Supply Interface on the Auxiliary PCIe Connection Card	Connects to the +12V on the PCIe edge connector

Interfaces

BlueField System On Chip (SoC)

The BF1600 Controller Card is populated with a BlueField SoC. The BlueField IC is a highly integrated System-on-Chip (SoC) optimized for NVMe storage appliances, networking appliances, and programmable networking adapters. BlueField integrates a multicore Arm v8 processor subsystem (sixteen cores) together with a ConnectX®-5 dual-port Virtual Protocol Interconnect (VPI) network controller. The SoC includes two channels of DDR4 DRAM controllers, and 32 lanes of external PCIe lanes supporting Gen3 and Gen 4, along with an embedded PCIe switch.

Ethernet QSFP56 Interfaces

The network ports of the BlueField BF1600 Controller Card are compliant with the IEEE 802.3 Ethernet standards listed in Ethernet traffic is transmitted through the cards' QSFP28 connectors.

QSFP28 Port Over-current Protection

The power consumption for each QSFP28 modules is controlled by a 5W current limiting power distribution switch. Every power limiting switch is controlled by a signal, which is enabled by default. This signal is originated from the thermal shutdown mechanism. When the output load exceeds the current limit threshold, the power switch limits the current to a safe level.

PCI Express Interfaces

The PCI Express bus is a high-speed interface used to connect the Controller Card to other peripheral devices (the BMC, PCIe switch or directly to the NVMe SSDs backplane), and operates as a Root-Complex (RC) initiating PCIe bus operations. The BlueField BF1600 Controller Card supports PCI Express Gen 3.0/4.0 (1.1 and 2.0 compatible) through the following connectors:

PCIe x16 BF1600 Controller Cards:

- PCI Express Gen 3.0/4.0 through x16 edge connector

2x PCIe x16 BF1600 Controller Cards:

- PCI Express Gen 3.0/4.0 through x16 edge connector
- PCIe Express Gen 3.0 through two CABLINE-CA II PLUS x8 connectors - Although these connectors exist on all OPNs, they are functional on PCIe x32 cards used with an Auxiliary Connection Cards.


PCIe x16 Gen 3.0/4.0 Edge Connector

The BF1600 Controller Card supports PCI Express x16 Gen 3.0/4.0 (1.1 and 2.0 compatible) through golden fingers edge connector (separated into Connector A and Connector B) which serves as the main interface of the card. This connector enables the connectivity of the system to the BlueField PCIe interface.

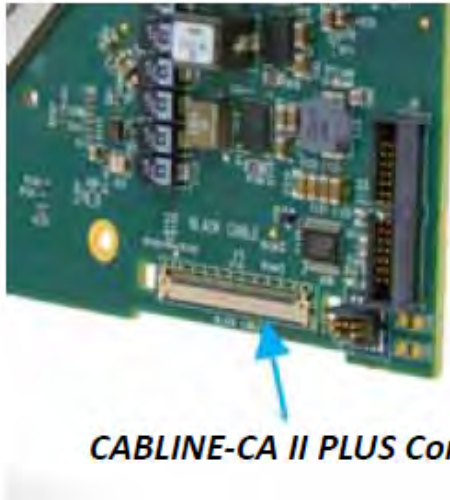
The following lists PCIe interface features:

- PCIe Gen 4.0 and 3.0 compliant, 2.0 and 1.1 compatible
- 2.5, 5.0, or 8.0, or 16.0 GT/s link rate x16
- Auto-negotiates to x8, x4, x2, or x1
- Support for MSI/MSI-X mechanisms

PCIe Gen 3.0 through Two CABLINE-CA II PLUS Connectors

 Applies to MBF1M626A-CSNAT, MBF1M656A-CSNAT and MBF1M636A-CSNAT.

The BlueField BF1600 Controller Card supports PCI Express Gen 3.0 (1.1 and 2.0 compatible) through two on-card x8 CABLINE-CA II PLUS connectors that together provide an additional x16 PCIe interface. The belly to belly CABLINE-CA II PLUS connectors are located on the component and print side of the card and they are connected to the BlueField SoC. The PCIe TX from the system platform (Transmit signals) are connected through the component side CABLINE-CA II PLUS connector, while the PCIe RX from the system platform (Receiving signals) are connected through the print side of the CABLINE-CA II PLUS connector. The connectivity to the NVMe SSDs is allowed through the two CABLINE-CA II PLUS harnesses that are combined to a second x16 PCIe Edge connector mounted on the Auxiliary card.



NCSI Management Interface

The Network Controller Sideband Interface (NCSI) enables the connection of a Baseboard Management Controller (BMC) to a card for the purpose of enabling out-of-band remote manageability. NCSI over the RMII interface is routed through the RMII connector with a flat cable.



NCSI Management Interface

USB Connector

The BlueField BF1600 Controller Card uses a USB 2.0 Type B device. The USB connector is mounted on the Controller Card bracket. The purpose of the USB connector is debugging and loading new versions of the operating systems and firmware.



USB Connector

UART0 Interface

The BlueField BF1600 Controller Card provides one Universal Asynchronous Receiver Transmitter (UART0). The UART0 Interface is populated for debugging and bring-up purposes.



UART0 Interface

I²C0 Interface

The BlueField BF1600 Controller Card provides one I²C0 interface. The I²C0 Interface is populated for ConnectX-5 debug and bring-up purposes.

JTAG CoreSight 10

The BlueField BF1600 Controller Card uses JTAG CoreSight 10-Pin Header. The purpose of the JTAG CoreSight 10 is for debugging the Arm with Arm DSTREAM debug tool. For JTAG CoreSight 10 pins, please refer [JTAG CoreSight 10 Interface](#).



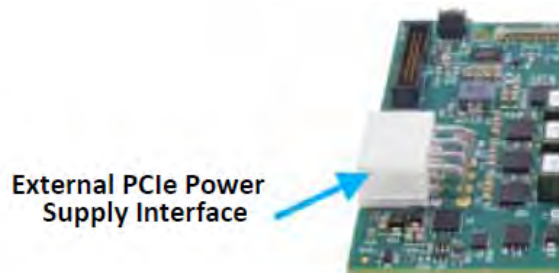
JTAG CoreSight 10 Interface

External PCIe Power Supply Interfaces

External PCIe Power Supply Interface on the BF1600 Controller Card

⚠ The BF1600 Controller Card requires the +3.3V AUX to come up prior to the +12V at the PCIe connector.

The BlueField BF1600 Controller Card consumes power from two power sources; an external +12V through an 8-pin ATX connector (reference #9) and an additional +12V through the PCIe x16 edge connector. The BF1600 Controller Card's special circuitry balances the power consumption between these two power sources. Each power source must be capable of supplying up to 75W of power. The delta between both +12V sources must be less than 0.6V for the power-sharing circuit to properly operate. The 3.3V AUX from the card's PCIe edge connector is used for logics on the BF1600 Controller Card. This logic includes power for buffering logic for signals to the card's edge connector, power for the FRU EEPROM, and miscellaneous items. The 3.3V from PCIe edge connector is floating on the board. For the external PCIe power supply pins, please refer to [External Power Supply Interfaces](#).



⚠ The use of an external power supply interface is restricted to the ATX 8-pin connector only, as shown in the above picture.

External PCIe Power Supply Interface on the Auxiliary PCIe Connection Card

⚠ The PCIe Auxiliary Connection card is supplied with the following OPNs: MBF1M626A-CSNAT, MBF1M656A-CSNAT and MBF1M636A-CSNAT

The Auxiliary PCIe card contains the same external +12V power connector as on the BF1600 Controller Card (reference #4). This external +12V connector on the Auxiliary PCIe card connects to the +12V on the PCIe edge connector. It is used for the case where an ATX 8-pin power supply connector is not available in the system. In that situation, it is possible to connect this external +12V connector on the Auxiliary PCIe card to the external +12V connector on the BF1600 Controller card. This allows the BF1600 Controller card to get up to 75W of +12V from its own PCIe edge connector plus up to 75W of +12V from the Auxiliary PCIe card's edge connector. The Auxiliary PCIe card does not directly use +12V. The Auxiliary PCIe card takes its +3.3V from the PCIe edge connector. The 3.3V AUX rail for the auxiliary card is connected to the EEPROM. For the external PCIe power supply pins, please refer to [External Power Supply Interfaces](#).

External PCIe Power Supply Interface



CPLD Interface

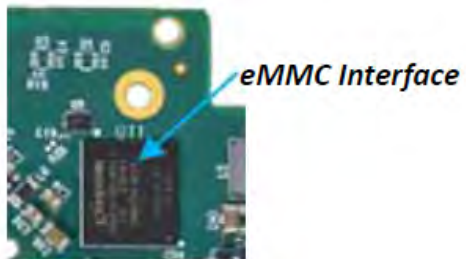
The BlueField BF1600 Controller Card incorporates a CPLD device. It drives all BlueField chip configuration pins, all system and device reset, miscellaneous board configuration setups, power monitoring, and power sequence control.



CPLD Interface

eMMC Interface

The BlueField BF1600 Controller Card incorporates one eMMC (embedded Multi-media Card) interface (eMMC0) which is utilized as a boot source for the Arm core. Arm Tile software (boot, POST, OS code) is stored in eMMC Flash for the boot-load function. The eMMC device size is 16GB.



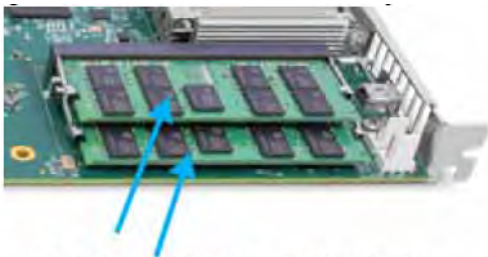
DDR4 SODIMM Memory

⚠ Applies to MBF1M616A-CSNAT, MBF1M636A-CSNAT, MBF1M646A-CSNAT, and MBF1M656A-CSNAT.

The BlueField BF1600 Controller Card incorporates two DDR4 small outline dual-inline memory modules (SODIMM) memory interfaces. Each interface is 16GB, 64-bit data and 8-bit Error Correcting Code (ECC) memory. The connections between the DDR4 SODIMMs and the BlueField SoC is listed in [DDR4 DRAM Memory Interface](#).

The following lists the supported DDR4 data rates:

- 1600 Mb/s
- 1866 Mb/s
- 2133 Mb/s
- 2400 Mb/s



SPI Flash Memory

The SPI Flash memory is used for storing the NIC firmware as of the ConnectX-5 Flash memory. The SPI Flash memory size is 128Mb.

Networking LED Interfaces

There is a one bi-color I/O LED per port to indicate link status. See the below figure for the networking LEDs locations on the BF1600 Controller Card bracket. For LED specifications, please refer to [Networking LED Interfaces](#).



CPLD Revision LEDs Interface

There are four green I/O LEDs to indicate CPLD revision located on the BlueField BF1600 Controller Card. See the below figure for the CPLD LEDs location on the card. For LEDs specifications, please refer to [CPLD Revision LEDs Interface](#).

CPLD Revision LEDs

CPLD Interface



CABLINE-CA II PLUS Connector LED Interfaces

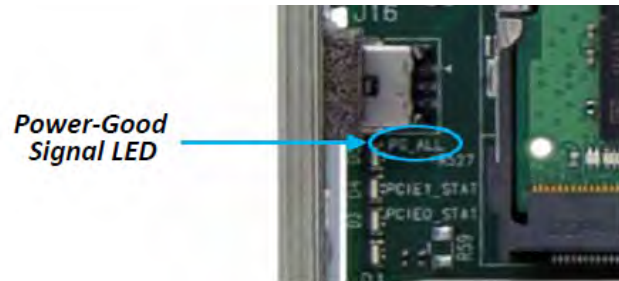
There is one green I/O LED near each CABLINE-CA II PLUS connector (four LEDs in total) on both on the Controller card and PCIe Auxiliary Connection card indicating the successful connection of the CABLINE-CA II PLUS cables. See the below figure for the green I/O LED location on the cards. For LED specifications, please refer to [CABLINE-CA II PLUS Connector LED Interfaces](#).



CABLINE-CA II PLUS
Connector LED

Power-Good Signal LED Interface

There is one green I/O LED to indicate power-good signal. See the below figure for LED locations on the card. For the power-good LED specifications, please refer to [Power-Good Signal LED Interface](#).



PCI Link Status LEDs

⚠ PCI link status LEDs will be activated in a future revision of the card.

There are two bi-color IO LEDs to indicate proper PCI link status. See the below figure for the location of the LED.




Pin Description

PCI Express Interface

PCIe x16 Gen 3.0/4.0 Edge Connector

The BF1600 Controller Card uses a PCI Express x16 connector (component and print sides) according to the PCI Express 3.0/4.0 specifications. The following two tables provide component side pins description and print side pins description. For further details, please refer to [PCIe x16 Gen 3.0/4.0 Edge Interface](#).

 HSOp(x) and HSON(x) stand for High Speed Output and HSIP(x) and HSI(x) stand for High Speed Input. The direction is relative to the motherboard or system board.

PCIe x16 Edge Connector Pins Description - Print Side

Pin#	Pin Name	Pin Direction ^a	Description
1	PRSNT#1	Input	The presence detects indication. Should be grounded on the carrier board.
2	+12v	Input	Power
3	+12v	Input	Power
4	GND		Ground
5	JTAG_HOST_TCK	Input	No connected
6	JTAG_HOST_TDI	Input	No connected

7	JTAG_HOST_TDO	Output	No connected
8	JTAG_HOST_TMS	Input	No connected
9	+3.3v	Input	Power
10	+3.3v	Input	Power
11	PERST#	Output	PCIe Interface Reset# For the PCIe interface via the card PCIe Edge connector For System NIC mode, it's direction will turn as input.
Mechanical Key			
12	GND	Ground	Ground
13	REFCLK+	NA	PCIe Reference Differential Clock. Not Connected (default) PCIe separated clocking default scheme Assembly option to support PCIe shared clocking scheme: 1. For BlueField Controller Card, REFCLK will be output 2. For SmartNIC mode, REFCLK will be input
14	REFCLK-		
15	GND		Ground
16	HSIp(0)	Output	BlueField Card PCIe TX to Carrier Board PCIe RX
17	HSIn(0)		
18	GND		Ground
19	RSVD	NA	NC optional on-board CPLD connectivity

20	GND		Ground
21	HSIp(1)	Output	BlueField Card PCIe TX to Carrier Board PCIe RX
22	HSIn(1)		
23	GND		Ground
24	GND		Ground
25	HSIp(2)	Output	BlueField Card PCIe TX to Carrier Board PCIe RX
26	HSIn(2)		
27	GND		Ground
28	GND		Ground
29	HSIp(3)	Output	BlueField Card PCIe TX to Carrier Board PCIe RX
30	HSIn(3)		
31	GND		Ground
32	RSVD	Input	UART0_RXD - Connected to BlueField SoC UART0 RX
33	RSVD	Output	UART0_TXD - Connected to BlueField SoC UART0 TX
34	GND		Ground

35	HSIp(4)	Output	BlueField Card PCIe TX to Carrier Board PCIe RX
36	HSIn(4)		
37	GND		Ground
38	GND		Ground
39	HSIp(5)	Output	BlueField Card PCIe TX to Carrier Board PCIe RX
40	HSIn(5)		
41	GND		Ground
42	GND		Ground
43	HSIp(6)	Output	BlueField Card PCIe TX to Carrier Board PCIe RX
44	HSIn(6)		
45	GND		Ground
46	GND		Ground
47	HSIp(7)	Output	BlueField Card PCIe TX to Carrier Board PCIe RX
48	HSIn(7)		
49	GND		Ground
50	RSVD	NA	Not connected
51	GND		Ground

52	HSIp(8)	Output	BlueField Card PCIe TX to Carrier Board PCIe RX
53	HSIn(8)		
54	GND		Ground
55	GND		Ground
56	HSIp(9)	Output	BlueField Card PCIe TX to Carrier Board PCIe RX
57	HSIn(9)		
58	GND		Ground
59	GND		Ground
60	HSIp(10)	Output	BlueField Card PCIe TX to Carrier Board PCIe RX
61	HSIn(10)		
62	GND		Ground
63	GND		Ground
64	HSIp(11)	Output	BlueField Card PCIe TX to Carrier Board PCIe RX
65	HSIn(11)		
66	GND		Ground
67	GND		Ground
68	HSIp(12)	Output	BlueField Card PCIe TX to Carrier Board PCIe RX

69	HSIn(12)		
70	GND		Ground
71	GND		Ground
72	HSIp(13)	Output	BlueField Card PCIe TX to Carrier Board PCIe RX
73	HSIn(13)		
74	GND		Ground
75	GND		Ground
76	HSIp(14)	Output	BlueField Card PCIe TX to Carrier Board PCIe RX
77	HSIn(14)		
78	GND		Ground
79	GND		Ground
80	HSIp(15)	Output	BlueField Card PCIe TX to Carrier Board PCIe RX
81	HSIn(15)		
82	GND		Ground

a. From BlueField BF1600 Controller Card Perspective.

PCIe x16 Edge Connector Pinouts Description - Component Side

Pin#	Name	PCIe Description	Description
1	+12v	Input	Power
2	+12v	Input	Power
3	+12v	Input	Power
4	GND		Ground
5	SMCLK	Input	SMBUS_SCL - connected to BlueField SoC SMB2 Inter- face SCL
6	SMDAT	bidirectional	SMBUS_SDA - connected to BlueField SoC SMB2 Inter- face SDA
7	GND		Ground
8	+3.3v	Input	Power
9	JTAG_TRS T#	Input	For testing purposes only. Keep it floating.
10	3.3Vaux	Input	3.3V_AUX
11	WAKE#	NA	Not Connected. Assembly option for on-board CPLD connectivity
Mechanical Key			
12	RSVD	NA	For testing purposes only. Keep it floating.
13	GND		Ground

14	HSOp(0)	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
15	HSOn(0)		
16	GND		Ground
17	PRSNT#2	NA	Not Connected. Assembly option for on-board CPLD connectivity
18	GND		Ground
19	HSOp(1)	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
20	HSOn(1)		
21	GND		Ground
22	GND		Ground
23	HSOp(2)	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
24	HSOn(2)		
25	GND		Ground
26	GND		Ground
27	HSOp(3)	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
28	HSOn(3)		
29	GND		Ground

30	RSVD	NA	For testing purposes only. Keep it floating.
31	PRSNT#2	NA	For testing purposes only. Keep it floating.
32	GND		Ground
33	HSOp(4)	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
34	HSOn(4)		
35	GND		Ground
36	GND		Ground
37	HSOp(5)	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
38	HSOn(5)		
39	GND		Ground
40	GND		Ground
41	HSOp(6)	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
42	HSOn(6)		
43	GND		Ground
44	GND		Ground

45	HSOp(7)	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
46	HSOn(7)		
47	GND		Ground
48	PRSNT#2	NA	Not Connected. Assembly option for on-board CPLD connectivity
49	GND		Ground
50	HSOp(8)	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
51	HSOn(8)		
52	GND		Ground
53	GND		Ground
54	HSOp(9)	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
55	HSOn(9)		
56	GND		Ground
57	GND		Ground

58	HSOp(10)	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
59	HSOn(10)		
60	GND		Ground
61	GND		Ground
62	HSOp(11)	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
63	HSOn(11)		
64	GND		Ground
65	GND		Ground
66	HSOp(12)	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
67	HSOn(12)		
68	GND		Ground
69	GND		Ground
70	HSOp(13)	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
71	HSOn(13)		

72	GND		Ground
73	GND		Ground
74	HSOp(14)	Input	BlueField Card PCIE RX to Carrier Board PCIE TX
75	HSOn(14)		
76	GND		Ground
77	GND		Ground
78	HSOp(15)	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
79	HSOn(15)		
80	GND		Ground
81	PRSNT#2	Output	PRSNT#2 - Hot plug present detect
82	RSVD	NA	For testing purposes only. Keep it floating.

PCIe Gen 3.0 through Two CABLINE-CA II PLUS Connectors

The BlueField BF1600 Controller Card uses two x8 CABLINE-CA II PLUS connectors (Component Side and Print Side Connectors) according to the PCI Express 3.0 specifications. The below two tables provide the component side pins description and the print side pins description. For further details, please refer to [PCIe Gen 3.0 through Two CABLINE-CA II PLUS Interfaces](#).

CABLINE-CA II PLUS Connector - Component Side

The below table provides pins description of the CABLINE-CA II PLUS connector mounted on the controller's component side.

Pin #	Pin Name	Pin Direction	Description
1	GND		Ground
2	PCIE_REF- CLK1_P	NA	PCIe Reference Differential Clock. Not Connected (default) PCIe separated clocking default scheme Assembly option to support PCIe shared clocking scheme, then: <ol style="list-style-type: none"> 1. For system Controller mode, REFCLK will be output 2. For system NIC mode, REFCLK will be input
3	PCIE_REF- CLK1_N		
4	GND		Ground
5	HSO_15N	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
6	HSO_15P		
7	GND		Ground
8	HSO_14N	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
9	HSO_14P		
10	GND		Ground
11	HSO_13N	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
12	HSO_13P		

13	GND		Ground
14	H5O_12N	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
15	H5O_12P		
16	GND		Ground
17	H5O_11N	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
18	H5O_11P		
19	GND		Ground
20	H5O_10N	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
21	H5O_10P		
22	GND		Ground
23	H5O_9N	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
24	H5O_9P		
25	GND		Ground
26	H5O_8N	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
27	H5O_8P		
28	GND		Ground

29	HSO_7N	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
30	HSO_7P		
31	GND		Ground
32	HSO_6N	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
33	HSO_6P		
34	GND		Ground
35	HSO_5N	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
36	HSO_5P		
37	GND		Ground
38	HSO_4N	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
39	HSO_4P		
40	GND		Ground
41	HSO_3N	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
42	HSO_3P		
43	GND		Ground
44	HSO_2N	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
45	HSO_2P		

46	GND		Ground
47	H5O_1N	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
48	H5O_1P		
49	GND		Ground
50	H5O_0N	Input	BlueField Card PCIe RX to Carrier Board PCIe TX
51	H5O_0P		
52	GND		Ground
53	I2C_SMDAT	NA	Not Connected. Optional assembly connectivity to BlueField SoC I2C GW4 interface
54	I2C_SMCLK	NA	Not Connected. Optional assembly connectivity to BlueField SoC I2C GW4 interface
55	RSVD	NA	Not Connected. Assembly option for on-board CPLD connectivity
56	S_WAKE1_- CONN_L	NA	Not Connected. Assembly option for on-board CPLD connectivity
57	RSVD	NA	Not Connected. Assembly option for on-board CPLD connectivity
58	RSVD	NA	Not Connected. Assembly option for on-board CPLD connectivity
59	S_PR5NT1_L	Input	Presence Indication. Should be grounded and shorted to IPEX component side pin #59

60	RSVD	NA	Not Connected. Keep it floating.
----	------	----	----------------------------------

CABLINE-CA II PLUS Connector - Print Side

The below table provides pins description of the CABLINE-CA II PLUS connector mounted on the controller's print side.

Pin #	Pin Name	Pin Direction	Description
1	RSVD	NA	Not Connected. Optional assembly connectivity to BlueField SoC UART1 TXD
2	RSVD	NA	Not Connected. Optional assembly connectivity to BlueField SoC UART1 RXD
3	RSVD	NA	Not Connected. Assembly option for on-board CPLD connectivity
4	RSVD	NA	Not Connected. Assembly option for on-board CPLD connectivity
5	RSVD	NA	Not Connected. Assembly option for on-board CPLD connectivity
6	RSVD	NA	Not Connected. Assembly option for on-board CPLD connectivity

7	RSVD	NA	Not Connected. Assembly option for on-board CPLD connectivity
8	RSVD	NA	Not Connected. Assembly option for on-board CPLD connectivity
9	GND		Ground
10	HSI_0P	Output	BlueField Card PCIE TX to Carrier Board PCIE RX
11	HSI_0N		
12	GND		Ground
13	HSI_1P	Output	BlueField Card PCIE TX to Carrier Board PCIE RX
14	HSI_1N		
15	GND		Ground
16	HSI_2P	Output	BlueField Card PCIE TX to Carrier Board PCIE RX
17	HSI_2N		
18	GND		Ground
19	HSI_3P	Output	BlueField Card PCIE TX to Carrier Board PCIE RX

20	HSI_3N		
21	GND		Ground
22	HSI_4P	Output	BlueField Card PCIE TX to Carrier Board PCIE RX
23	HSI_4N		
24	GND		Ground
25	HSI_5P	Output	BlueField Card PCIE TX to Carrier Board PCIE RX
26	HSI_5N		
27	GND		Ground
28	HSI_6P	Output	BlueField Card PCIE TX to Carrier Board PCIE RX
29	HSI_6N		
30	GND		Ground
31	HSI_7P	Output	BlueField Card PCIE TX to Carrier Board PCIE RX
32	HSI_7N		
33	GND		Ground

34	HSI_8P	Output	BlueField Card PCIE TX to Carrier Board PCIE RX
35	HSI_8N		
36	GND		Ground
37	HSI_9P	Output	BlueField Card PCIE TX to Carrier Board PCIE RX
38	HSI_9N		
39	GND		Ground
40	HSI_10P	Output	BlueField Card PCIE TX to Carrier Board PCIE RX
41	HSI_10N		
42	GND		Ground
43	HSI_11P	Output	BlueField Card PCIE TX to Carrier Board PCIE RX
44	HSI_11N		
45	GND		Ground
46	HSI_12P	Output	BlueField Card PCIE TX to Carrier Board PCIE RX

47	HSI_12N		
48	GND		Ground
49	HSI_13P	Output	BlueField Card PCIE TX to Carrier Board PCIE RX
50	HSI_13N		
51	GND		Ground
52	HSI_14P	Output	BlueField Card PCIE TX to Carrier Board PCIE RX
53	HSI_14N		
54	GND		Ground
55	HSI_15P	Output	BlueField Card PCIE TX to Carrier Board PCIE RX
56	HSI_15N		
57	GND		Ground
58	PERST#	Output	PCIe Interface Reset# for the PCIe interface via the card IPEX connectors For System NIC mode, its direction will turn as input.
59	RSVD	NA	Not Connected. Keep it floating.

60	S_PRSENT2_L	Input	Presence Indication Should be grounded and shorted to IPEX Component Side pin #58.
----	-------------	-------	---

Power Sequencing

The BF1600 Controller Card requires the +3.3V to come up prior to the +12V at the PCIe connector.

NCSI Management Interface

The below table lists the NCSI Management Interface pins description. For further details, please refer to [NCSI Management Interface](#).

Pin #	Pin Name	Description
1	REF_CLK	Clock reference for receive, transmit, and control interface
2	GND	Connected to Board Ground
3	ARB_IN	Network Controller hardware arbitration Input
4	GND	Connected to Board Ground
5	ARB_OUT	Network Controller hardware arbitration Output
6	GND	Connected to Board Ground
7	RXD0	Receive data
8	GND	Connected to Board Ground

9	RXD1	Receive data
10	GND	Connected to Board Ground
11	CRS_DV	Carrier Sense/Receive Data Valid
12	GND	Connected to Board Ground
13	TXD0	Transmit data
14	GND	Connected to Board Ground
15	TXD1	Transmit data
16	GND	Connected to Board Ground
17	TX_EN	Transmit enable
18	GND	Connected to Board Ground
19	RX_ER	Receive Error, keep float at system side
20	GND	Connected to Board Ground
21	I2C_SDA	Used for testing. Keep float at system side.
22	GND	Connected to Board Ground
23	I2C_SCL	Used for testing. Keep float at system side.
24	GND	Connected to Board Ground
25	GND	Connected to Board Ground

26	GND	Connected to Board Ground
27	3.3V_AUX	Used for testing. Keep float at system side.
28	3.3V_AUX	Used for testing. Keep float at system side.
29	3.3V_AUX	Used for testing. Keep float at system side.
30	3.3V_AUX	Used for testing. Keep float at system side.

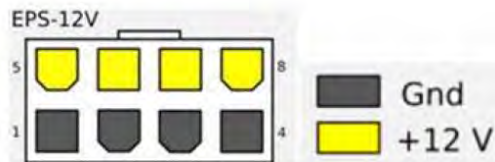
External Power Supply Interfaces

The below table lists the External Power Supply pins of the external power supply interfaces on the BF1600 Controller card and PCIe auxiliary card. For further details, please refer to [External PCIe Power Supply Interfaces](#).

Pin #	Signal Name	Description
1	GND	Power Return
2	GND	Power Return
3	GND	Power Return
4	GND	Power Return
5	+12V	ATX Supplied 12V
6	+12V	ATX Supplied 12V

7	+12V	ATX Supplied 12V
8	+12V	ATX Supplied 12V

External +12V Mechanical Pinout Diagram



UART0 Interface

The below table lists the UART0 interface pins from the BlueField Controller Card perspective. For further details, please refer to [UART0 Interface](#).

⚠ The electrical levels of the UART0 interface is CMOS (3.3V)

UART0 Pinouts Description

Pin #	Signal Name
1	Receive
2	Transmit
3	GND

JTAG CoreSight 10 Interface

The below table lists the JTAG CoreSight 10 pins description. For further details, please refer to [JTAG CoreSight 10 Interface](#).

Pin	Signal Name	Voltage Domain	Description
1	VTREF	A	The Voltage Target Reference pin supplies DSTREAM with the debug rail voltage of the target to match its I/O logic levels. VTREF can be tied HIGH on the target. If VTREF is pulled HIGH by a resistor, its value must be no greater than 100Ω.
2	TMS	A	The Test Mode Select pin sets the state of the Test Access Port (TAP) controller on the target. TMS can be pulled HIGH on the target to keep the TAP controller inactive when not in use.
3	GND	NA	Ground.
4	TCK	A	The Test Clock pin clocks data into the TDI and TMS inputs of the target. TCK is typically pulled HIGH on the target.
5	GND	NA	Ground.
6	TDO	A	The Test Data Out pin receives serial data from the target during debugging. You are advised to series terminate TDO close to the target processor. TDO is typically pulled HIGH on the target.
7	KEY (NC)	NA	This pin must not be present on the target connector.
8	TDI	A	The Test Data In pin provides serial data to the target during debugging. TDI can be pulled HIGH on the target.
9	GND	NA	Ground.
10	nSRST	A	The System Reset pin fully resets the target. This signal can be initiated by DSTREAM or by the target board (which is then detected by DSTREAM). nSRST is typically pulled HIGH on the target and pulled strong-LOW to initiate a reset. The polarity and strength of nSRST is configurable.

DDR4 DRAM Memory Interface

The below table lists the DDR4 DRAM pins description. For further details, please refer to [DDR4 SODIMM Memory](#).

Pin Name	Description	Pin Name	Description
A0-A16	SDRAM address bus	SCL	I2C serial bus clock for SPD/TS
BA0, BA1	SDRAM bank select	SDA	I2C serial bus data line for SPD/TS
BG0, BG1	SDRAM bank group select	SA0-SA2	I2C slave address select for SPD/TS
RAS_na	SDRAM row address strobe	PARITY	SDRAM parity input
CAS_nb	SDRAM column address strobe	VDD	SDRAM I/O & core power supply
WE_nc	SDRAM write enable	VPP	SDRAM activating power supply
CS0_n, CS1_n, CS2_n, CS3_n	Rank Select Lines	C0, C1	Chip ID lines for 3DS components
CKE0, CKE1	SDRAM clock enable lines	VREFOA	SDRAM command/address reference supply
ODT0, ODT1	SDRAM on-die termination control lines	VSS	Power supply return (ground)
ACT_n	SDRAM activate	VDDSPD	Serial SPD/TS positive power supply
DQ0-DQ63	DIMM memory data bus	ALERT_n	SDRAM ALERT_n
CB0-CB7	DIMM ECC check bits		

DQS0_t- DQS8_t	SDRAM data strobes (positive line of differential pair)	RESET_n	Set SDRAMs to a Known State
DQS0_c- DQS8_c	SDRAM data strobes (negative line of differential pair)	EVENT_ n	SPD signals a thermal event has occurred.
DM0_n-DM8_n, DBI0_n-DBI8_n	SDRAM data masks/data bus inversion (x8-based x72 DIMMs)	VTT	Termination supply for the Address, Command and Control bus
CK0_t, CK1_t	SDRAM clocks (positive line of differential pair)	NC	No connection
CK0_c, CK1_c	SDRAM clocks (negative line of differential pair)		

1. RAS_n is a multiplexed function with A16.
2. SDRAM column address strobe
3. WE_n is a multiplexed function with A14.

Cables and Cabling Configurations

UART Interface Cabling

Debugging or bringing up the card required the use of a USB-to-UART cable that is included in the package contents. Upon inspection, there is a USB connector with USB 2.0 full speed compatibility and 3 single pole 0.1m pitch header that connects to a serial port on the Controller Card. The following figure shows an example of a USB-to-UART Cable, and the table provides the cable signal description.



UART Cable Color Legend and Description

Color	Signal	Description
Black	GND	Device ground supply pin. Connects to the Controller Card ground pin
Yellow	RXD	Receive Asynchronous Data input. Connects to TXD output on Controller Card

Color	Signal	Description
Orange	TXD	Transmit Asynchronous Data output. Connects to RXD input on Controller Card

UART Cable Connected to BF1600 Card



USB Interface Cabling

Debugging and loading new versions of the operating systems and firmware requires the use of Type A to Type B USB 2.0 Cable. The following figure shows an example of Type A to Type V USB Cable.



Configuration Scenarios

Mellanox BlueField BF1600 Controller Cards offer a variety of options to serve the requirements of high-density and high-performance storage environments. The following section describes various connectivity options for NVMe SSDs. This list of scenarios is not exhaustive (represents the maximum utilization of PCIe connectivity), but it shows some different available options. Each scenario includes a view of the required cabling between the BF1600 Controller Card and the system platform.

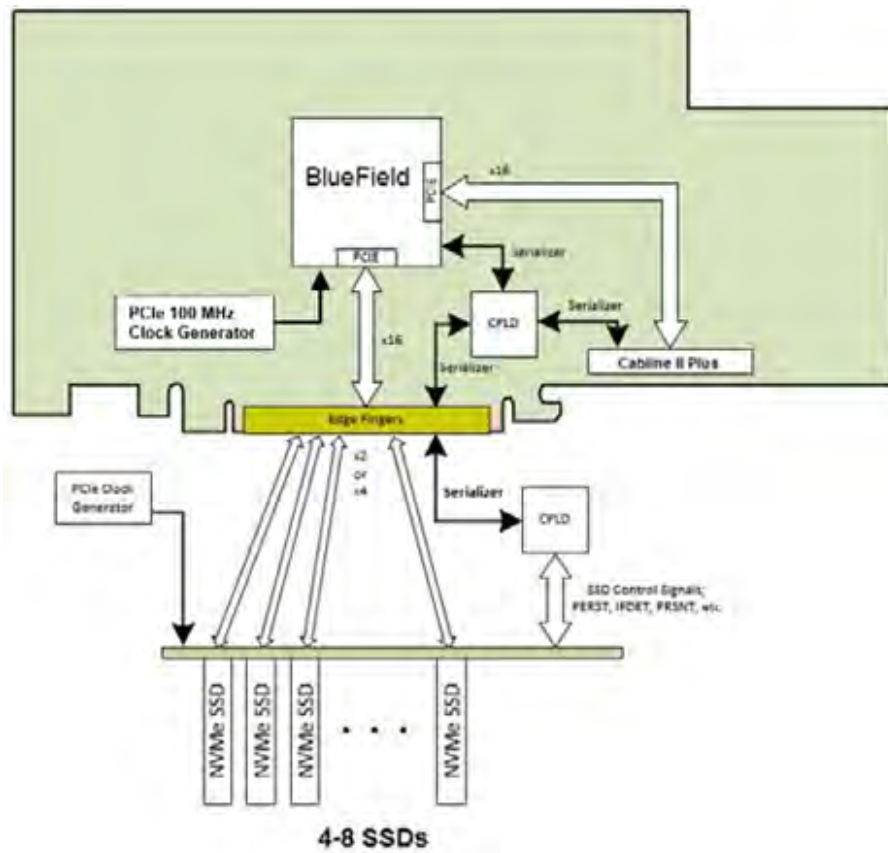
Configuration	PCIe Switch	No. SSDs	No. of Auxiliary Raisers	No. of Cabline- CA II PLUS Harnesses	BlueField PCIe Bifurcation, Speed PCIe Golden Fingers Connector	BlueField PCIe Bifurcation, Speed PCIe Auxiliary Connector
Configuration 1	No	4-8	0	0	4 x Gen 3.0/4.0 x4 8 x Gen 3.0/4.0 x2	0
Configuration 2	No	8-16	1	2	4 x Gen 3.0/4.0 x4 8 x Gen 3.0/4.0 x2	4 x Gen 3.0 x 4 8 x Gen 3.0 x 2
Configuration 3	Yes	8-16	1	2	1 x Gen 3.0/4.0 x16	1 x Gen 3.0 x16
Configuration 4	Yes	24	1	2	1 x Gen 3.0/4.0 x16	1 x Gen 3.0 x16

Configuration 1: Direct Connectivity to 4-8 NVMe SSDs (No External PCIe Switch)

For direct connectivity to 4-8 SSDs configuration, the first BlueField PCIe Gen **4.0** x16 interface is routed through the x16 PCIe Gen 3.0/4.0 Edge Connector towards the first group of four x4 SSDs or eight x2 SSDs. The control signals for each NVMe SSDs are routed through a serialized bus that is connected from the BlueField to the CPLD and further-on towards the PCIe edge connector. The user should implement a CPLD expander on its NVMe SSDs backplane and expand the various control signals towards each of the 4-8 SSDs.

The BlueField and the NVMe SSDs are implementing separate clock schemes, thus, the user should drive the 100Mhz reference clock for the SSDs from its own clock source.

See the below figure for an illustration of the 4-8 NVMe SSDs configuration.



Configuration 2: Direct Connectivity to 8-16 NVMe SSDs with (No External PCIe Switch)

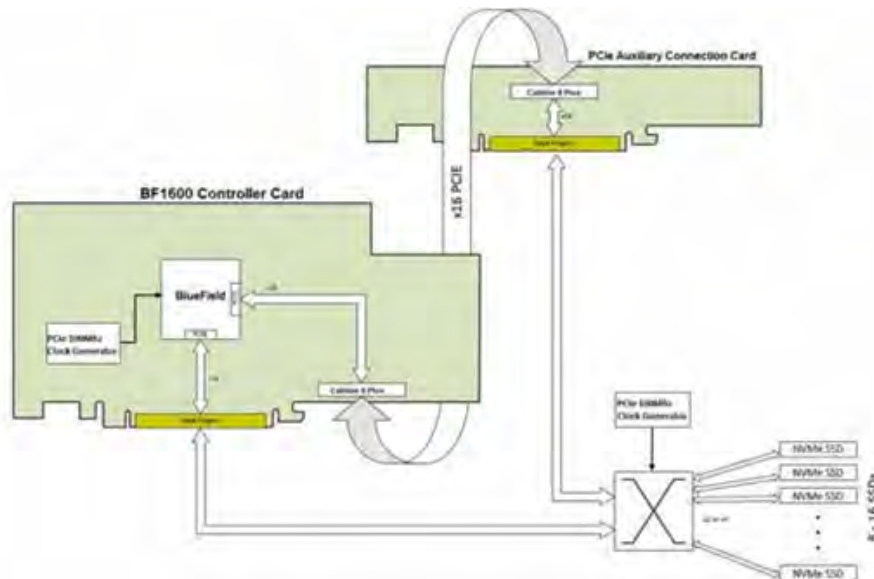
For direct connectivity to 8-16 SSDs configuration, the first BlueField PCIe Gen 4.0 x16 interface is routed through the x16 PCIe Gen 3.0/4.0 Edge Connector towards the first group of four x4 SSDs or eight x2 SSDs. The second BlueField PCIe Gen 4.0 x16 interface is routed through the x16 PCIe Gen 3.0 only CABLINE-CA II PLUS connector towards the second group of four x4 SSDs or eight x2 SSDs.

The control signals for the each NVMe SSDs is routed through a serialized bus that is connected from the BlueField to the CPLD and further-on towards the PCIe edge connector and the CABLINE-CA II Plus harness. The control signals are separated inside the CPLD to the appropriate groups to match each NVMe SSD backplane.

The user should implement a CPLD expander on each of its NVMe SSDs backplanes and expand the various control signals towards each of the 4-8 SSDs.

The BlueField and the NVMe SSDs are implementing separate clock schemes, thus the user should drive the 100Mhz reference clock for the SSDs from its own clock source.

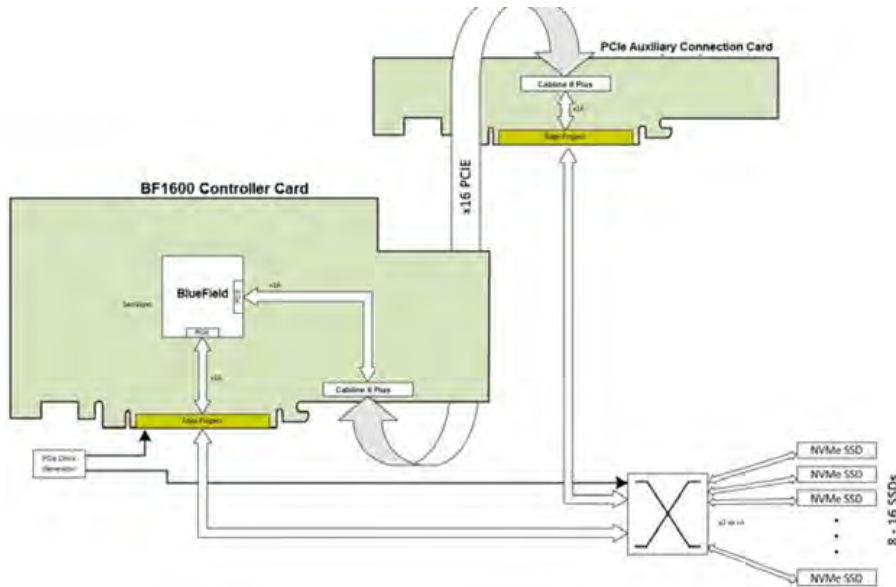
See the below figure for an illustration of the 8-16 NVMe SSDs configuration.



Configuration 3: Connectivity to 8-16 NVMe SSDs (with External PCIe Switch)

For 18-6 SSDs configuration with an external PCIe switch, the first BlueField PCIe Gen 3./4.0 x16 interface is routed through the x16 PCIe Gen 3.0/4.0 Edge Connector toward the first x16 port of the PCIe switch. The second BlueField PCIe Gen 3.0 x16 interface is routed through the PCIe Gen 3.0 CABLINE-CA II PLUS connector and the PCIe Auxiliary Card towards the second x16 port of the PCIe Switch.

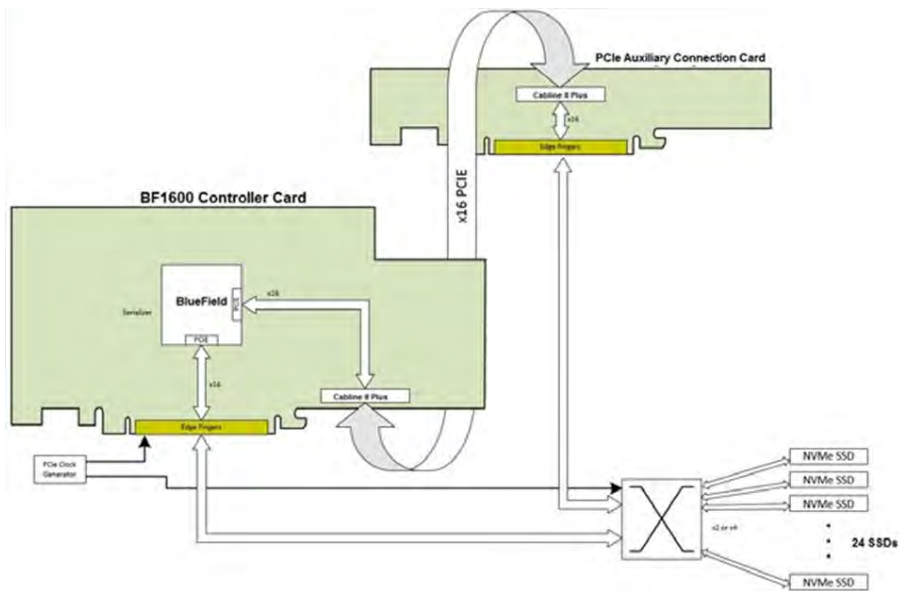
See the below figure for an illustration of the 16 NVMe SSDs configuration.



Configuration 4: Connectivity to 24 NVMe SSDs (with External PCIe Switch)

For connectivity to 24 SSDs configuration with an external PCIe switch, the first BlueField PCIe Gen 4.0 x16 interface is routed through the x16 PCIe Gen 3.0/4.0 Edge Connector toward the first port of the x16 external PCIe switch. The second BlueField PCIe Gen 4.0 x16 interface is routed through the PCIe Gen 3.0 CABLINE-CA II PLUS connector and the PCIe Auxiliary Card towards the second port of the x16 external PCIe switch.

See the below figure for an illustration of the 24 NVMe SSDs configuration.



Clocks Distribution

The BlueField BF1600 Controller Card implements a “separate clocking scheme”. The Controller Card has a dedicated 100MHz oscillator clock source for feeding its PCIe reference clock. This clock is not driven out of the card and it is expected that the downstream PCIe entities will have their own clock source.

Thermal Sensors

The BlueField BF1600 Controller Card incorporates the BlueField SoC which operates in the range of temperatures between 0C and 120C.

There are three thermal threshold definitions for the BlueField SoC which impact the overall system operation state:

- **Warning** - 105°C: On managed systems only: When the device crosses the 100°C threshold, a Warning Threshold message will be issued by the management SW, indicating to system administration that the Controller Card has crossed the Warning threshold. Note that this temperature threshold does not require nor lead to any action by hardware (such as BlueField Controller Card shutdown).
- **Critical** - 120°C: When the device crosses this temperature, the firmware will automatically shut down the device.
- **Emergency** - 130°C: In case the firmware fails to shut down the device upon crossing the Critical threshold, the device will auto-shutdown upon crossing the Emergency (130°C) threshold.

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

Hardware Installation

Installation and initialization of the BlueField BF1600 Controller Card require attention to the mechanical, power, and precautions for rack-mounted equipment.

Safety Warnings

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

Unable to render include or excerpt-include. Could not retrieve page.

Installation Procedure Overview

The installation procedure of BlueField Controller Card involves the following steps:

Step	Procedure	Direct Link
1	Unpack the package and confirm that you have received all the required components	Refer to “Package Contents”
2	Check the system’s hardware and software requirements.	Refer to System Requirements
3	Pay attention to the air flow consideration within the JBOF system	Refer to AirFlow Requirements
4	Follow the pre-installation check list	Refer to Pre-Installation Checklist
5	Install the BF1600 Controller Card in the JBOF system	Refer to “BF1600 Controller Card Installation Instructions - PCIe x16”
	Install the BF1600 Controller and Auxiliary Connection cards in the JBOF system	Refer to “BF1600 Controller and Auxiliary Connection Cards Installation Instructions”
7	Configure the NVMe SSD devices in the JBOF system	Refer to the devices’ documentation for any pre-installation configuration requirements.

8	Connect the ATX power supply to the BF1600 Controller Card	
9	Power on the system	
10	Perform initial system bring-up	

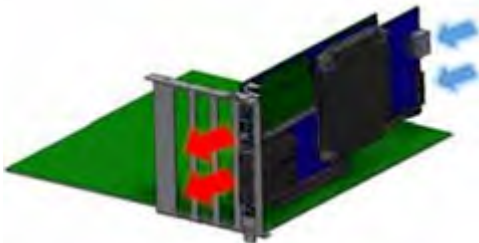
System Requirements

Hardware Requirements

- ⚠ Unless otherwise specified, NVIDIA 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.

Airflow Requirements

BlueField 1600 Controller Card is offered with one airflow pattern: from the BlueField SoC to the QSFP28 ports.



⚠ All systems in the same rack should be planned with the same airflow direction. All components need to have the same airflow direction.

Please refer to the [Specifications](#) section for airflow numbers for each specific card model.

Software Requirements

- See [Operating Systems/Distributions](#) section under the Introduction section.
- Software Stacks - The BF1600 Controller Card is shipped with Linux based Operating System burned on it which includes all needed drivers. For more information, please refer to the BlueField Software User Manual.

Pre-Installation Checklist

1. Unpack the BF1600 Controller Card

Unpack and remove the BF1600 Controller Card. 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 cards must be placed on an antistatic surface. For package contents please refer to [Package Contents](#).

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

1. Turn off the power to the JBOF system.

Turn off the power to the JBOF system, and disconnect the power cord and remove the cover. Refer to the JBOF system documentation for instructions. Before you install the BF1600 Controller card, make sure that the system is disconnected from power and any networks.

2. (Optional) Check the mounting bracket on the PCIe Auxiliary Connection Card.

If required for your JBOF system, replace the full-height mounting bracket that is shipped mounted on the PCIe Auxiliary Card with the supplied low-profile bracket. Refer to [Bracket Replacement Instructions](#).

Bracket Replacement Instructions

The BF1600 Controller Card and auxiliary connection card are shipped with assembled high-profile brackets. If this form factor is suitable for your requirements, you can skip the remainder of this section and move to [Installation Instructions](#). If you need to replace the Auxiliary Connection Card with the short bracket that is included in the shipping box, please follow the instructions in this section.

 Due to risk of damaging the EMI gasket, it is not recommended to replace the bracket more than three times.

To replace the brackets you will need the following parts:


- The new bracket of the proper height
- The 2 screws saved from the removal of the brackets

Removing the Existing Bracket

1. Using a torque driver, remove the two screws holding the bracket in place.
2. Separate the bracket from the Auxiliary Connection card.
3. Save the two screws.


Installing the New Bracket


1. Place the bracket onto the card until the screw holes line up.
2. Screw on the bracket using the screws saved from the bracket removal procedure above.

 Use a torque driver to apply up to 4.4 lbs-in torque on the screws.

Installation Instructions

This section provides detailed instructions on how to install your BlueField 1600 Controller Card in a JBOF system.


 The BlueField BF1600 Controller Card should be installed only in a JBOF System as it functions as a PCIe root-complex (RC) initiating PCIe bus operations. Installing it in a regular host system may damage the card.

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

See below direct links to the installation instructions depending on the part number you have purchased.

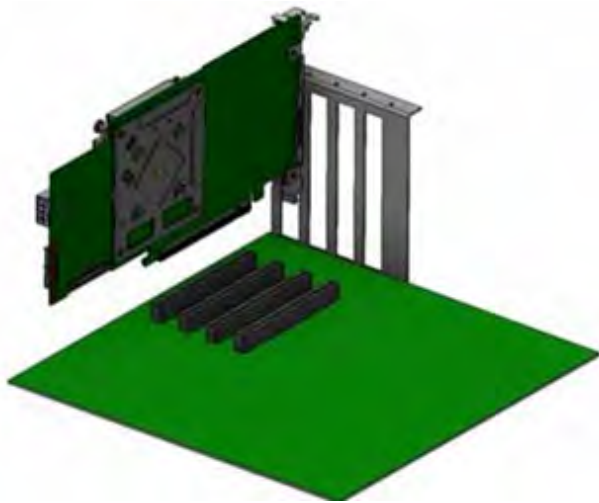
Form Factor	Direct Link to Installation Instructions
PCIe x16 BF1600 Controller Cards: MBF1M606A-CSNAT MBF1M616A-CSNAT MBF1M646A-CSNAT	“BF1600 Controller Card Installation Instructions - PCIe x16”
2x PCIe x16 BF1600 Controller Cards: MBF1M626A-CSNAT MBF1M636A-CSNAT MBF1M656A-CSNAT	“BF1600 Controller and Auxiliary Connection Cards Installation Instructions”

BF1600 Controller Card Installation Instructions - PCIe x16

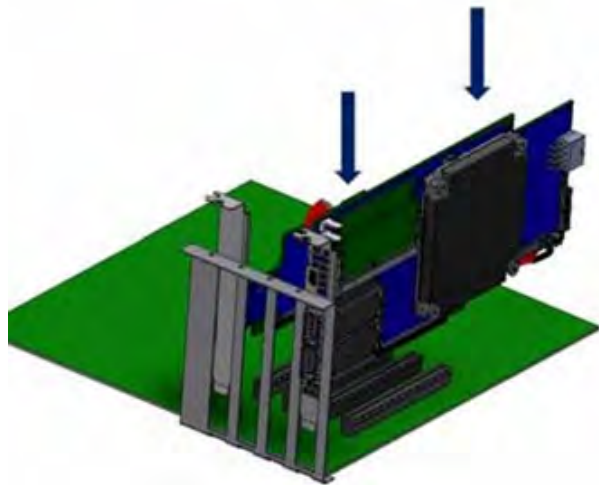
 Applies to MBF1M606A-CSNAT, MBF1M616A-CSNAT and MBF1M646A-CSNAT.

➤ **Connect the BF1600 Controller Card in an available PCI Express slot on the JBOF system.**

Step 1. Locate an available PCI Express x16 slot.



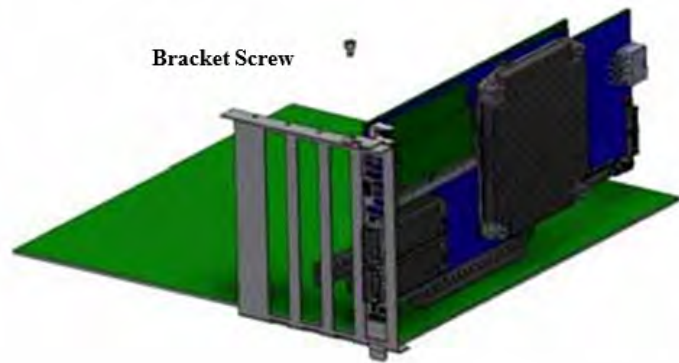
Step 2. Applying even pressure at both corners of the card, insert the BF1600 Controller Card in a PCI Express slot until firmly seated.



⚠ Do not use excessive force when seating the card, as this may damage the system or the auxiliary PCIe connection card.

➤ **Secure the BF1600 Controller Card to the JBOF system.**

Step 1. Secure the bracket to the JBOF system with the bracket screw.



BF1600 Controller and Auxiliary Connection Cards Installation Instructions - PCIe x32

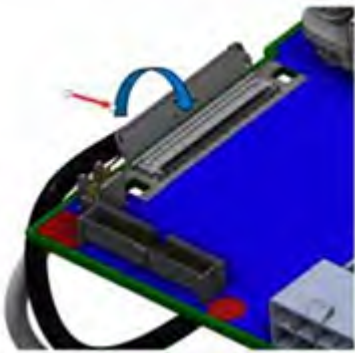
⚠ Applies to MBF1M626A-CSNAT, MBF1M636A-CSNAT and MBF1M656A-CSNAT.

➤ *Connect the BF1600 Controller Card with the Auxiliary connection card using the supplied CABLINE-CAII PLUS harnesses.*

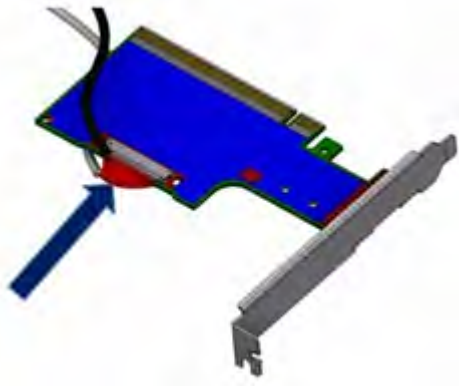
Step 1. Plug the CABLINE-CAII PLUS harness on the BF1600 Controller Card while paying attention to the color-coding. As indicated on both sides of the card; plug the black harness to the component side and the white harness to the print side.



Step 2. Verify the plugs are locked.



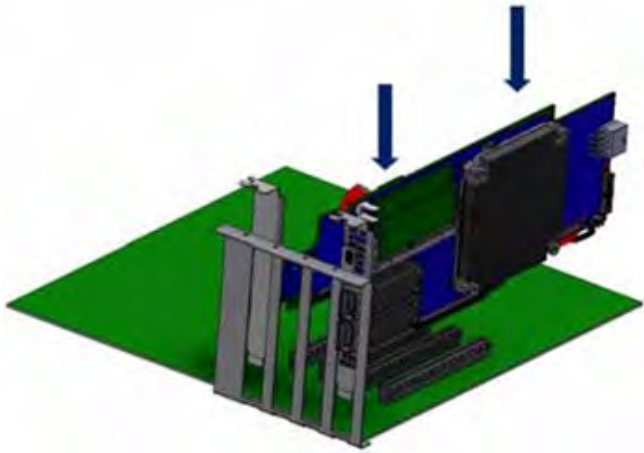
Step 3. Plug the CABLINE-CAII PLUS harness on the PCIe Auxiliary Card. As indicated on both sides of the Auxiliary connection card; plug the black harness to the component side and the white harness to the print side.



➤ **Connect the BF1600 Controller Card in an available PCI Express slot on the JBOF system.**

Step 1. Locate an available PCI Express x16 slot.

Step 2. Applying even pressure at both corners of the card, insert the BF1600 Controller Card in a PCI Express slot until firmly seated.



⚠ Do not use excessive force when seating the card, as this may damage the system or the auxiliary PCIe connection card.

➤ **Connect the PCIe Auxiliary Connection Card in an available PCI Express slot on the JBOF system.**

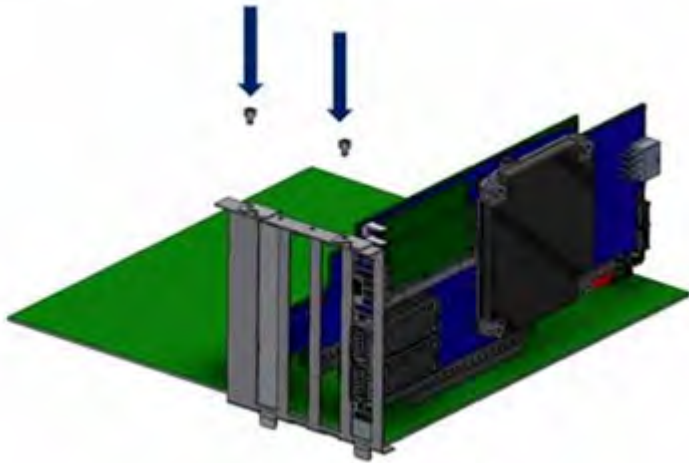
Step 1. Locate an available PCI Express x16 slot.

Step 2. Applying even pressure at both corners of the card, insert the card in a PCI Express slot until firmly seated.



➤ Secure the BF1600 Controller and PCIe Auxiliary Connection Cards to the JBOF system.

Step 1. Secure the bracket to the JBOF system with the bracket screw.



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


Cables and Modules

Networking Cables

1. All networking 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 adapter card. Do this by using a cable holder or tying the cable to the rack.
 - b. Determine the correct orientation of the connector to the card before inserting the connector. Do not try and insert the connector upside down. This may damage the adapter card.
 - c. Insert the connector into the adapter card. Be careful to insert the connector straight into the cage. Do not apply any torque, up or down, to the connector cage in the adapter card.


d. Verify 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 card.

3. After inserting a cable into a port, the Amber 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).
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. See [Networking LED Interfaces](#).
5. Care should be taken as 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. The LED indicator will turn off when the cable is unseated.

Bring-Up and Driver Installation

 It is recommended to upgrade your BlueField product to the latest software and firmware versions in order to enjoy the latest features and bug fixes.

Instructions for the BlueField Controller card bring-up and driver installation are located in the BlueField Software documentation at [Controller Card Bring-Up and Driver Installation](#).

Troubleshooting

General Troubleshooting

Server unable to find the BlueField BF1600 Controller Card	<ul style="list-style-type: none">• Ensure that the BlueField BF1600 Controller Card is placed correctly• Make sure the BlueField BF1600 Controller Card slot and the BF1600 Controller Card are compatible<ul style="list-style-type: none">• Install the BlueField BF1600 Controller Card in a different PCI Express slot• Use the drivers that came with the BlueField BF1600 Controller Card or download the latest• Make sure your motherboard has the latest BIOS• Try to reboot the server
The BlueField BF1600 Controller Card no longer works	<ul style="list-style-type: none">• Reseat the BlueField BF1600 Controller Card 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<ul style="list-style-type: none">• Reboot the server
BlueField BF1600 Controller Card stopped working after installing another BlueField BF1600 Controller Card	<ul style="list-style-type: none">• Try removing and re-installing all BlueField BF1600 Controller Cards• Check that cables are connected properly• Make sure your motherboard has the latest BIOS
Link indicator light is off	<ul style="list-style-type: none">• Try another port on the switch<ul style="list-style-type: none">• 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 BlueField BF1600 Controller Card port are compatible
Link light is on, but with no communication established	<ul style="list-style-type: none">• Check that the latest driver is loaded• Check that both the BlueField BF1600 Controller Card and its link are set to the same speed and duplex settings

Specifications

Dual-slot Controller Cards Specifications

Physical	Size: 9.13 in. x 4.37 in. (232.0 mm x 111.15mm)				
	Connector: Dual Ethernet QSFP28 (copper and optical)				
Protocol Support	Ethernet: 100GBASE-CR4, 100GBASE-KR4, 100GBASE-SR4, 56GBASE-R4, 550G Ethernet Consortium, 40GBASE-CR4, 40GBASE-SR4, 40GBASE-LR4, 40GBASE-ER4, 25GBASE-CR/CR-S, 25GBASE-SR, 25GBASE-LR, 25G Ethernet Consortium, 10GBASE-SR, 10GBASE-LR, 10GBASE-ER, 10GBASE-CX4, SGMII, 1000BASE-X				
	Data Rate	Ethernet	1/10/25/40/50/100 Gb/s		
	PCI Express Gen 3.0 / 4.0: SERDES @ 8.0GT/s / 16GT/s, 32 lanes (2.0 and 1.1 compatible)				
Power	Voltage: 12V				
	Power			Airflow (LFM)	
				@40° C	@45° C
	Typical Power	Passive Cables	84W	800LFM	900LFM
	Maximum Power	Passive Cables	106W	800LFM	900LFM
		1.5W Active Cables	109W	800LFM	900LFM
2.5W Active Cables		111W	800LFM	900LFM	

		3.5W Active Cables	114W	800LFM	900LFM
	Maximum power available through QSFP28 port: 3.5W				
Environmental	Temperature	Operational	0 °C to 55 °C		
		Non-operational	-40 °C to 70 °C ^a		
	Humidity	Operational	10% to 85% relative humidity		
		Non-operational	10% to 90% relative humidity		
Regulatory	Safety: CB / cTUVus / CE				
	EMC: CE / FCC / VCCI / ICES / RCM				
	RoHS: RoHS Compliant				

a. The non-operational storage temperature specifications apply to the product without its package.

Single-slot Controller Card Specifications

Physical	Size: 9.13 in. x 4.37 in. (232.0 mm x 111.15mm)	
	Connector: Dual Ethernet QSFP28 (copper and optical)	
Protocol Support	Ethernet: 100GBASE-CR4, 100GBASE-KR4, 100GBASE-SR4, 56GBASE-R4, 550G Ethernet Consortium, 40GBASE-CR4, 40GBASE-SR4, 40GBASE-LR4, 40GBASE-ER4, 25GBASE-CR/CR-S, 25GBASE-SR, 25GBASE-LR, 25G Ethernet Consortium, 10GBASE-SR, 10GBASE-LR, 10GBASE-ER, 10GBASE-CX4, SGMII, 1000BASE-X	
	Data Rate	Ethernet 1/10/25/40/50/100 Gb/s

	PCI Express Gen 3.0 / 4.0: SERDES @ 8.0GT/s / 16GT/s, 32 lanes (2.0 and 1.1 compatible)				
Power	Voltage: 12V				
	Power			Airflow (LFM)	
				@40°C	@45°C
	Typical Power	Passive Cables	77W	700LFM	800LFM
	Maximum Power	Passive Cables	98W	700LFM	800LFM
		1.5W Active Cables	101W	700LFM	800LFM
		2.5W Active Cables	103W	700LFM	800LFM
3.5W Active Cables		106W	700LFM	800LFM	
Maximum power available through QSFP28 port: 3.5W					
Environmental	Temperature	Operational	0°C to 55°C		
		Non-operational	-40°C to 70°C ^a		
	Humidity	Operational	10% to 85% relative humidity		
		Non-operational	10% to 90% relative humidity		
Regulatory	Safety: CB / cTUVus / CE				
	EMC: CE / FCC / VCCI / ICES / RCM				
	RoHS: RoHS Compliant				

a. The non-operational storage temperature specifications apply to the product without its package.

LED Interfaces

Networking LED Interfaces

There is a one bi-color I/O LED per port to indicate link status. See the below table for physical and logical link indications in Ethernet Mode.

LED Color and State	Description
Off	A link has not been established
Blinking Amber ^a	6Hz blinking Amber indicates a problem with the physical link
Solid Green	Indicates a valid link with no active traffic
Blinking Green	Indicates a valid logical link with active traffic

a. 1Hz Blinking Amber occurs due to running a beacon command for locating the BF1600 Controller Card

CPLD Revision LEDs Interface

There are four green I/O LEDs to indicate the CPLD revision. The LEDs are located on the BlueField BF1600 Controller Card. See the below table for Revision LEDs.

LED Number				CPLD Revision
D6	D7	D8	D9	
Off	Off	Off	Off	Rev 0
Off	Off	Off	Solid Green	Rev 1
Off	Off	Solid Green	Off	Rev 2
Off	Off	Solid Green	Solid Green	Rev 3
Off	Solid Green	Off	Off	Rev 4
Off	Solid Green	Off	Solid Green	Rev 5
Off	Solid Green	Solid Green	Off	Rev 6
Off	Solid Green	Solid Green	Solid Green	Rev 7
Solid Green	Off	Off	Off	Rev 8

CABLINE-CA II PLUS Connector LED Interfaces

There is one green I/O LED near each CABLINE-CA II PLUS connector indicating the proper connection of the CABLINE-CA II PLUS cable to the card's connector. See the below two tables for the BF1600 Controller and Auxiliary cards LED specifications.

BF1600 Controller Card Cabline-CA II Plus Connector LED

LED Number	LED state	Description
D10	ON	The CABLINE-CA II PLUS cable is properly connected
	OFF	The CABLINE-CA II PLUS cable is not properly connected

PCIe Auxiliary Connection Card Cabline-CA II Plus Connector LED

LED Number	LED state	Description
D1	ON	The CABLINE-CA II PLUS cable is properly connected
	OFF	The CABLINE-CA II PLUS cable is not properly connected


Power-Good Signal LED Interface

There is one green I/O LED to indicate power-good signal. See the below table for LED specifications.

LED Number	LED state	Description
D5	ON	Indicates that all rails are valid and board power is up and running
	OFF	Power Failure

Finding the MAC on the Controller Card

Each BF1600 Controller Card has a different identifier printed on the label: serial number and the card MAC for the Ethernet protocol.

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

MBF1M606A-CSNAT Board Label (Example)



MBF1M616A-CSNAT Board Label (Example)

Model No: BF1M616	
BlueField Controller card	
P/N: MBF1M616A-CSNAT	
	2009-04-22
S/N: MT0806X01504	
MAC: 00 02 C9 27 05 1C	
Made in Israel Rev: A1	

MBF1M626A-CSNAT Board Label (Example)

Model No: BF1M626	
BlueField Controller card	
P/N: MBF1M626A-CSNAT	
	2009-04-22
S/N: MT0806X01504	
MAC: 00 02 C9 27 05 1C	
Made in Israel Rev: A1	

MBF1M636A-CSNAT Board Label (Example)

Model No: BF1M626	
BlueField Controller card	
P/N: MBF1M636A-CSNAT	
	2009-04-22
S/N: MT0806X01504	
MAC: 00 02 C9 27 05 1C	
Made in Israel Rev: A1	

MBF1M646A-CSNAT Board Label (Example)

Model No: BF1M646	
BlueField Controller card No Crypto	
P/N: MBF1M646A-CSNAT	
	2009-04-22
S/N: MT0806X01504	
MAC: 00 02 C9 27 05 1C	
Made in Israel Rev: C1	

MBF1M656A-CSNAT Board Label (Example)



PCIe Auxiliary Card Board Label



S/N: MT1210X00011

P/N: SA001577

ConnectX

Model No: TMK00



CAN ICES-3 (A)/NMB-3(A)

Made in COO

Rev: A1

Document Revision History

Date	Comments/Changes
May. 2023	Updated Specifications - added non-operational storage temperature specifications
Apr. 2021	Added MBF1M606A-ESNAT
Nov. 2019	Added a note to Introduction
Nov. 2019	Updated the list of OPNs. Updated Specifications
Aug. 2019	Updated Configuration Scenarios
Jul. 2019	Mellanox BlueField was modified from trademark to registered trademark. Updated the following s due to re-spin of the cards: <ul style="list-style-type: none"> • Introduction • Interfaces • Pin Description • Hardware Installation
Jan. 2019	Updated Specifications
Dec. 2018	Updated Specifications
Sep. 2018	Updated Pin Description
Aug. 2018	Updated Interfaces
Jul. 2018	Updated the following sections: <ul style="list-style-type: none"> • Introduction • Interfaces • Pin Description • Hardware Installation

Date	Comments/Changes
	<ul style="list-style-type: none">• Bring-Up and Driver Installation
May. 2018	Updated the following sections: <ul style="list-style-type: none">• Introduction• Interfaces• Pin Description• Hardware Installation• Bring-Up and Driver Installation
Jan. 2018	First release

Notice

This document is provided for information purposes only and shall not be regarded as a warranty of a certain functionality, condition, or quality of a product. Neither NVIDIA Corporation nor any of its direct or indirect subsidiaries and affiliates (collectively: "NVIDIA") make any representations or warranties, expressed or implied, as to the accuracy or completeness of the information contained in this document and assumes no responsibility for any errors contained herein. NVIDIA shall have no liability for the consequences or use of such information or for any infringement of patents or other rights of third parties that may result from its use. This document is not a commitment to develop, release, or deliver any Material (defined below), code, or functionality.

NVIDIA reserves the right to make corrections, modifications, enhancements, improvements, and any other changes to this document, at any time without notice. Customer should obtain the latest relevant information before placing orders and should verify that such information is current and complete. NVIDIA products are sold subject to the NVIDIA standard terms and conditions of sale supplied at the time of order acknowledgement, unless otherwise agreed in an individual sales agreement signed by authorized representatives of NVIDIA and customer ("Terms of Sale"). NVIDIA hereby expressly objects to applying any customer general terms and conditions with regards to the purchase of the NVIDIA product referenced in this document. No contractual obligations are formed either directly or indirectly by this document.

NVIDIA products are not designed, authorized, or warranted to be suitable for use in medical, military, aircraft, space, or life support equipment, nor in applications where failure or malfunction of the NVIDIA product can reasonably be expected to result in personal injury, death, or property or environmental damage. NVIDIA accepts no liability for inclusion and/or use of NVIDIA products in such equipment or applications and therefore such inclusion and/or use is at customer's own risk.

NVIDIA makes no representation or warranty that products based on this document will be suitable for any specified use. Testing of all parameters of each product is not necessarily performed by NVIDIA. It is customer's sole responsibility to evaluate and determine the applicability of any information contained in this document, ensure the product is suitable and fit for the application planned by customer, and perform the necessary testing for the application in order to avoid a default of the application or the product. Weaknesses in customer's product designs may affect the quality and reliability of the NVIDIA product and may result in additional or different conditions and/or requirements beyond those contained in this document. NVIDIA accepts no liability related to any default, damage, costs, or problem which may be based on or attributable to: (i) the use of the NVIDIA product in any manner that is contrary to this document or (ii) customer product designs.

No license, either expressed or implied, is granted under any NVIDIA patent right, copyright, or other NVIDIA intellectual property right under this document. Information published by NVIDIA regarding third-party products or services does not constitute a license from NVIDIA to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property rights of the third party, or a license from NVIDIA under the patents or other intellectual property rights of NVIDIA.

Reproduction of information in this document is permissible only if approved in advance by NVIDIA in writing, reproduced without alteration and in full compliance with all applicable export laws and regulations, and accompanied by all associated conditions, limitations, and notices.

THIS DOCUMENT AND ALL NVIDIA DESIGN SPECIFICATIONS, REFERENCE BOARDS, FILES, DRAWINGS, DIAGNOSTICS, LISTS, AND OTHER DOCUMENTS (TOGETHER AND SEPARATELY, "MATERIALS") ARE BEING PROVIDED "AS IS." NVIDIA MAKES NO WARRANTIES, EXPRESSED, IMPLIED, STATUTORY, OR OTHERWISE WITH RESPECT TO THE MATERIALS, AND EXPRESSLY DISCLAIMS ALL IMPLIED WARRANTIES OF NONINFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE. TO THE EXTENT NOT PROHIBITED BY LAW, IN NO EVENT WILL NVIDIA BE LIABLE FOR ANY DAMAGES, INCLUDING WITHOUT LIMITATION ANY DIRECT,



INDIRECT, SPECIAL, INCIDENTAL, PUNITIVE, OR CONSEQUENTIAL DAMAGES, HOWEVER CAUSED AND REGARDLESS OF THE THEORY OF LIABILITY, ARISING OUT OF ANY USE OF THIS DOCUMENT, EVEN IF NVIDIA HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. Notwithstanding any damages that customer might incur for any reason whatsoever, NVIDIA's aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Terms of Sale for the product.

Trademarks

NVIDIA, the NVIDIA logo, and Mellanox are trademarks and/or registered trademarks of NVIDIA Corporation and/or Mellanox Technologies Ltd. in the U.S. and in other countries. Other company and product names may be trademarks of the respective companies with which they are associated.

Copyright

© 2023 NVIDIA Corporation & affiliates. All Rights Reserved.

