ConnectX®-2 Dual Port QSFP and SFP+ Adapter Card User Manual

P/N:
MHZH29-XTR, MHZH29-XSR, MHZH29B-XTR, MHZH29B-XSR

Rev 1.4

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ConnectX-2 VPI Card User Manual

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Revision History

This document was printed on 2/14/11.

Table 1 - Revision History Table

Date	Rev	Comments/Changes
Feb. 14th, 2011	1.4	Added the MHZH29B small form factor cards. Updated Set up section
July 22nd, 2010	1.3.4	Replaced Figure 1 photo of card with graphic
July 21st, 2010	1.3.3	Fixed TOC Fixed Table 5
June 23rd, 2010	1.3.2	Minor formatting
May 13th, 2010	1.3.1	Minor formatting
April 2010	1.3	Replaced power numbers with the latest power numbers
Feb. 2010	1.2	Replaced power numbers with the latest power numbers
December 2009	1.1	Modified format Added information to sections 5.4 Cables and Modules and 5.5 Cable Lengths
October 2009	1.0	Initial Release

About this Manual

This *User Manual* describes Mellanox Technologies ConnectX®-2 Dual Port VPI InfiniBand and Ethernet PCI Express x8 adapter cards. It provides details as to the interfaces of the board, specifications, required software and firmware for operating the board, and relevant documentation.

Intended Audience

This manual is intended for the installer and user of these cards.

The manual assumes basic familiarity with InfiniBand® and Ethernet networks and architecture specifications.

Related Documentation

Table 2 - Documents List

Mellanox Firmware Tools (MFT) User Manual Document no. 2204UG	User Manual describing the set of MFT firmware management tools for a single node. See http://www.mellanox.com => Firmware & Downloads => Download Firmware Tools Or http://www.mellanox.com => Support => Download Firmware Tools
IBTA Specification Release 1.2.1	InfiniBand Architecture Specification
IEEE Std 802.3 Specification	This is the IEEE Ethernet specification http://standards.ieee.org/getieee802
PCI Express 2.0 Specifications	Industry Standard PCI Express 2.0 Card Electromechanical Specification, Rev 1.3.

Online Resources

- Mellanox Technologies Web pages: http://www.mellanox.com
- Mellanox Technologies Firmware download Web page: http://www.mellanox.com => Support > Download Center

Document Conventions

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

Technical Support

Customers who purchased Mellanox products directly from Mellanox are invited to contact us through the following methods.

- URL: http://www.mellanox.com => Support
- E-mail: support@mellanox.com
- Tel: +1.408.916.0055

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

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Firmware and Software Updates

The Mellanox support downloader contains software, firmware and knowledge database information for Mellanox products. Access the data base from the Mellanox Support Web page,

http://www.mellanox.com=>Support

or use the following link to go directly to the Mellanox Support Download Assistant page,

http://www.mellanox.com/supportdownloader/.

1 Overview

This document is a *User Manual* for Mellanox Technologies network VPI adapter cards based on MT25408 the ConnectX®-2 VPI integrated circuit device. The cards described in this manual have the following main features:

- IEEE Std 802.3 compliant
- Virtual Protocol Interconnect IBTA v1.2.1 compliant
- SFP+ port for connecting Ethernet traffic
- Autosense for the running protocol and speed
  - InfiniBand speeds: 10Gb/s (SDR), 20Gb/s (DDR), 40Gb/s (QDR)
  - Ethernet speeds: 1Gb/s, 10 Gb/s
- Compliant with QSFP MSA spec Rev. 1.0
- Compatible with copper cables and optical cables with the use of QSFP connectors. Support for SFP+ cables is available through QSA (Quad to Serial) adapters.
- CPU offload of transport operations
- CORE-Direct application offload
- GPU-Direct application offload
- End-to-end QoS and congestion control
- Hardware-based I/O virtualization
- TCP/UDP/IP stateless offload
- Fibre Channel encapsulation (FCoIB or FCoE)
- RoHS-R6
- PCI Express 2.0 (1.1 compatible) through an x8 edge connector up to 5GT/s
- Two bracket heights: short and tall

1.1 Adapter Cards Covered in this Manual

The MHZH29 card is a VPI adapter card with a 40Gb/s InfiniBand QSFP connector and a 10GigE SFP+ connector.

The QSFP connector is compatible with InfiniBand Architecture Specifications

The SFP+ connector is compatible with 10GigE.

Table 3 lists the Single port VPI adapter cards described in this manual.

Table 3 - Adapter Cards List

Ordering Part Number (OPN)	IB QSFP Port Speed	ETH SFP+ Port Speed	Short / Tall Bracket	RoHS	Adapter IC Part Number
MHZH29-XTR	40Gb/s (QDR)	10Gb/s	Tall	RoHS-R6	MT25408B0-FCCR-QI
MHZH29-XSR	40Gb/s (QDR)	10Gb/s	Short	RoHS-R6	MT25408B0-FCCR-QI
MHZH29B-XTR	40Gb/s (QDR)	10Gb/s	Tall	RoHS-R6	MT25408B0-FCCR-QI
MHZH29B-XSR	40Gb/s (QDR)	10Gb/s	Short	RoHS-R6	MT25408B0-FCCR-QI

Figure 1: Full Sized Component Side

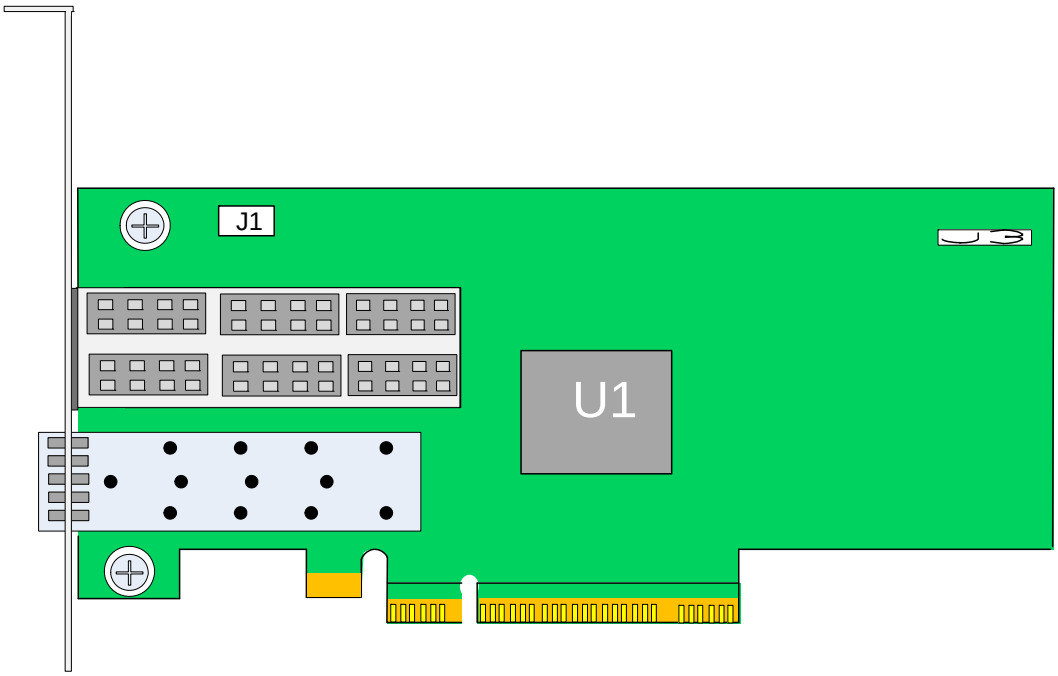
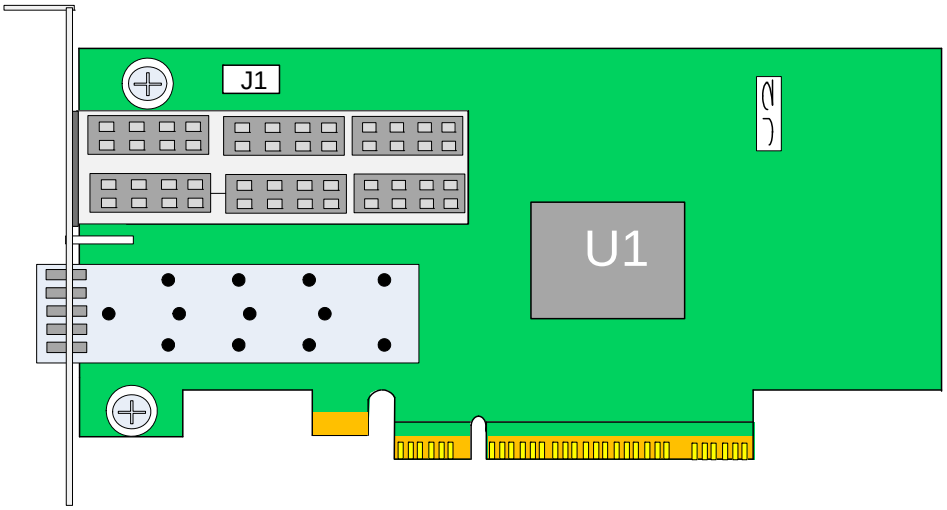


Figure 2: Small Form Factor Component Side



1.2 Mellanox Part Numbering Legend

Table 4 describes the Mellanox Technologies adapter cards part numbering legend.

Table 4 - Mellanox Cards Part Numbering Key

Adapter Card OPN MHTS#I-XBR	Field	Decoder
M	Mellanox Technologies	
H	Adapter Type	H = InfiniBand Host Channel Adapter, N = Ethernet Network Interface Card
T	Media	Z = one SFP+ connector and one QSFP connector
S	Adapter Architecture	H = ConnectX®or ConnectX-2
#	# ports	1 = 1, 2 = 2
I	Host Interface	X = PCI-X, 4 = PCIe x4, 8 = PCIe Gen1 x8, 9 = PCIe (Gen2 x8),
G	Generation	<blank> = Initial product generation, B= generation B, C= generation C
-	Separator	
X	Memory Size	X = MemFree, 1=128MB, 2=256MB, 3=512MB
B	Bracket	S = Short, T = Tall, N = None
R	RoHS	<blank> = non RoHS, C = RoHS R-5 w/ Exemption, R = RoHS R-6 Lead-Free

For example, the part number MHZH29-XTR describes Mellanox Technologies' ConnectX-2 card with dual ports one SFP+ and one QSFP, a PCIe2.0 x8 5.0GT/s interface, no on-board memory (mem-free), a tall PCI bracket, and RoHS R6 compliance. Using the legend,

- field M = M to indicate a Mellanox Technologies product,
- field H = H to indicate an InfiniBand Adapter Card,
- field T = Z to indicate 1 QSFP (IB QDR) port and 1 SFP+ (10GigE) port,
- field S = H to indicate the ConnectX family,
- field # = 2 to indicate two ports,
- field I = 9 to indicate PCI Express 2.0 x8 running at 5.0GT/s,
- field X = X to indicate no on-board memory,
- field B = T to indicate a tall bracket, and
- field R = R to indicate RoHS R6 (lead free) compliance

1.3 Finding the GUID/MAC and Serial Number on the Adapter Cards

All Mellanox adapter cards have a label on the printed side of the adapter card that has the card serial number, the card MAC for Ethernet protocol, and the card GUID for InfiniBand protocol VPI Cards have both a MAC and a GUID. For VPI cards the MAC is derived from the GUID.

Figure 3: Card Product Label

Port 1 uses the GUID or MAC ID described on the label, for port 2 GUID or MAC add 1 to port 1's description.

1.4 Safety Warnings

For safety warnings in French see “Avertissements de sécurité d’installation (Warnings in French)” on page 51. For safety warnings in German see “Sicherheitshinweise (Warnings in German)” on page 52. For safety warnings in Spanish see “Advertencias de seguridad para la instalación (Warnings in Spanish)” on page 53.

1. **Installation Instructions**

Read all installation instructions before connecting the equipment to the power source.

2. **Over-temperature**

This equipment should not be operated in an area with an ambient temperature exceeding the maximum recommended: 55°C (131°F).
To guarantee proper air flow, allow at least 8cm (3 inches) of clearance around the ventilation openings.

3. During Lightning - Electrical Hazard

During periods of lightning activity, do not work on the equipment or connect or disconnect cables.

4. Copper Cable Connecting/Disconnecting

Some copper cables are heavy and not flexible, as such they should be carefully attached to or detached from the connectors. Refer to the cable manufacturer for special warnings and instructions.

5. Equipment Installation

This equipment should be installed, replaced, or serviced only by trained and qualified personnel.

6. Equipment Disposal

Disposal of this equipment should be in accordance to all national laws and regulations.

7. Local and National Electrical Codes

This equipment should be installed in compliance with local and national electrical codes.

2 Adapter Card Interfaces

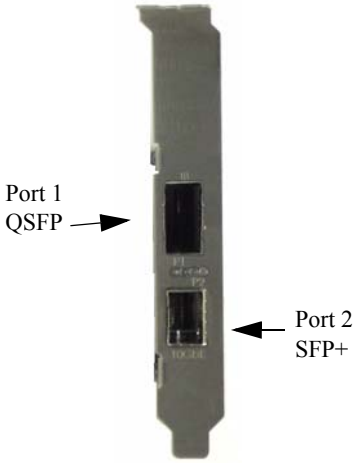
2.1 I/O Interfaces

Each adapter card includes the following interfaces:

- QSFP port
- SFP+ port
- PCI Express x8 edge connector
- I/O panel LEDs
- I^2C compatible connector (for debug)

Port 1 connects to the InfiniBand port of the device, while port 2 connects to the Ethernet port of the device.

Figure 4: Port Numbering



2.1.1 InfiniBand Interface

The ConnectX®-2 device is compliant with the *InfiniBand Architecture Specification, Release 1.2.1*. VPI adapter cards (listed in Table 3) based on this device provide access to its ports by means of QSFP connectors.

2.1.2 Ethernet SFP+ Interface

The ConnectX®-2 device is compliant with the *IEEE Std 802.3*. The SFP+ port has one Tx/Rx pair of SerDes. VPI adapter cards listed in Table 3 on page 11 based on this device provide access to the Ethernet ports by means of SFP+ and QSFP connectors. The Mellanox QSA (QSFP to SFP +) adapter modules can be ordered through Mellanox Technologies authorized dealers.

2.1.3 VPI Port Configuration

VPI ports are auto-sensing but can be manually configured using a script.

Port type management:

By default ConnectX® -2 ports are initialized as Infiniband ports. If you wish to change the port type use the connectx_port_config script after the driver is loaded.

The script is installed as part of the Mellanox OFED for Linux package (under /sbin). See the Mellanox OFED for Linux User's Manual available at http://www.mellanox.com =>Support > InfiniBand Software and Drivers > Mellanox OFED.

Running "/sbin/connectx_port_config -s" will show the current port configuration for all ConnectX® -2 devices.

Port configuration is saved in the file: /etc/infiniband/connectx.conf. This saved configuration is restored at driver restart only if done via "/etc/init.d/openibd restart".

Possible port types are:

- "eth" - Always Ethernet
- "ib" - Always Infiniband
- "auto" - Link sensing mode - detect port type based on the attached network type. If no link is detected, the driver retries link sensing every few seconds.

The port link type can be configured for each device in the system at run time using the "/sbin/connectx_port_config" script. This utility will prompt for the PCI device to be modified (if there is only one it will be selected automatically). At the next stage the user will be prompted for the desired mode for each port.

The desired port configuration will then be set for the selected device. Note: This utility also has a non interactive mode:

"/sbin/connectx_port_config [[-d|--device <PCI device ID>] -c|--conf <port1,port2>]".

The following configurations are supported by dual port VPI:

Table 5 - Supported Port Configurations

Port 1	Port 2
Ethernet	Ethernet
IB	IB
auto-sensing	auto-sensing
IB	Ethernet
IB	auto-sensing
auto-sensing	Ethernet

The following options are not supported by dual port VPI:

Table 6 - Unsupported Port Configurations

Port 1	Port 2
Ethernet	IB
Ethernet	auto-sensing
auto-sensing	IB

2.1.4 PCI Express Interface

The ConnectX®-2 adapter cards support PCI Express 2.0 (1.1 compatible) through an x8 edge connector. The device can be either a master initiating the PCI Express bus operations or a slave responding to PCI bus operations.

2.1.5 LED Assignment

The board has I/O LEDs located on the I/O panel. The green LED, when lit, indicates that the driver is running and a valid physical connection between nodes exists. If the green LED is blinking, it indicates a problem with the physical link. The yellow LED when lit, indicates a valid data activity link, this is the logical link. The yellow LED lights up when the network is discovered over the physical link. A valid data activity link without data transfer is designated by a constant yellow LED indication. A valid data activity link with data transfer is designated by a blinking yellow LED indication. If the LEDs are not active, either the physical link or the logical link (or both) connections have not been established.

Figure 5: LED - Port Association

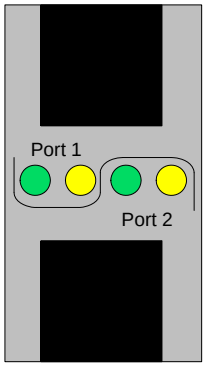


Figure 6: Physical and Logical Link Indications

Table 7 - LEDs

Port Number	LED Name
Port 1	Physical Link - Green Constant on indicates a good physical link Blinking indicates a problem with the Physical link
	Data Activity - Yellow Blinking indicates Data Transfer Constant on indicates no Data Transfer
Port 2	Physical Link - Green Constant on indicates a good physical link Blinking indicates a problem with the Physical link
	Data Activity - Yellow Blinking indicates Data Transfer Constant on indicates no Data Transfer

Port 1

Port 2

The short bracket has the same port and LED footprint as the tall bracket.

2.1.6 I²C Compatible Interface

A three-pin header on the adapter card is provided as the I²C compatible interface. See Appendix A,"Specifications," on page 38 for the location on the board.

Figure 7: I²C Connector

2.2 Power

All adapter cards receive 12V and 3.3V power from the PCI Express Edge connector. All other required power voltages are generated by on-board switch mode regulators. See "Specifications" on page 38.

2.3 QSFP Power Level

The card supports power level 3, according to SFF Committee SFF-8436 Specification for QSFP (Quad Small Formfactor Pluggable) Transceiver.

2.4 Memory

The adapter cards support multiple memory devices through the PCI Flash, and I2C.

2.4.1 System Memory

The adapter card utilizes the PCI Express interface to store and access IB fabric and/or Ethernet fabric connection information and packet data on the system memory.

2.4.2 Flash

Each of the adapter cards include one 16MB SPI Flash device M25P16-VME6G device by ST Microelectronics) accessible via the Flash interface of the MT25408B0 ConnectX®-2 VPI device.

There is a jumper on each adapter card that indicates to the device whether an on-board Flash device is to be used. Table 8 provides information on this jumper. See the schematic in Appendix A,"Specifications," on page 38 for the jumper location.

Table 8 - Jumper Configuration

Description	Option	Card Default Configuration	Comments
Flash present/ not present	connection open – Flash present connection shorted – Flash not present ***Figure 8: Flash Jumper*** 	connection open – Flash present	Header 1x2

2.4.3 EEPROM

Each board incorporates an EEPROM that is accessible through the I2C. The EEPROM is used for storing the Vital Product Data (VPD). The EEPROM capacity is 4Kb.

2.5 VPD Layout

The PCI VPD (Vital Product Data) layout, for each of the described Mellanox Technologies ConnectX®-2 VPI adapter cards complies with the format defined in the *PCI 2.3 Specification, Appendix I*. All ConnectX-2® adapter cards have the same PCI VPD layout.

2.5.1 PCI VPD Layout

Table 9 - VPD Layout for MHZH29-X[ST]R

Offset (Decimal)	Item	Value	Format	Description
0	Large Resource Type ID String Tag (0x02)	0x82		
1	Length [7:0] LSB	0x6		
2	Length [15:8] MSB	0x0		
3	Data	RAPTOR	STR	
9	Large Resource Type VPD-R Tag (0x10)	0x90		
10	Length [7:0] LSB	0x4F		
11	Length [15:8] MSB	0x00		
12	VPD Keyword	PN	STR	Add in Card Part Number
14	Length	0x15		
15	PN	PN	%STR_SPC	
36	VPD Keyword	EC	STR	Engineering Change Level of the card (rev)
38	Length	0x2		
39	Revision	RV	%STR	PCB revision
41	VPD Keyword	SN	STR	Serial Number
43	Length	0x18		
44	SerialNumber		%STR_SPC	“00..00XXXX..XX”
68	VPD Keyword	V0	STR	Misc Information
70	Length	0x10		
71	Data	PCIe Gen2 x8	STR_SPC	
87	VPD Keyword	RV	STR	
89	Length	0x1		
90	Data	0,89	%CS0	
91	Large Resource Type VPD-W Tag (0x11)	0x91		
92	Length [7:0] LSB	0xA1		
93	Length [15:8] MSB	0x00		
94	VPD Keyword	V1	STR	EFI Driver version
96	Length	0x6		
97	Data	N/A	STR_SPC	
103	VPD Keyword	YA	STR	Asset Tag
105	Length	0x20		
106	Data	N/A	STR_SPC	“N/A”
138	VPD Keyword	RW	STR	Remaining read/write area
140	Length	0x72		
141	Data		STR_ZERO	Reserved (0x00)
255	Small Resource Type END Tag (0x11)	0x78		

Table 10 - VPD Layout for MHZH29B-X[ST]R

Offset (Decimal)	Item	Value	Format	Description
0	Large Resource Type ID String Tag (0x02)	0x82		
1	Length [7:0] LSB	0x6		
2	Length [15:8] MSB	0x0		
3	Data	RAPTOR	STR	
9	Large Resource Type VPD-R Tag (0x10)	0x90		
10	Length [7:0] LSB	0x4F		
11	Length [15:8] MSB	0x00		
12	VPD Keyword	PN	STR	Add in Card Part Number
14	Length	0x15		
15	PN	PN	%STR_SPC	
36	VPD Keyword	EC	STR	Engineering Change Level of the card (rev)
38	Length	0x2		
39	Revision	RV	%STR	PCB revision
41	VPD Keyword	SN	STR	Serial Number
43	Length	0x18		
44	SerialNumber		%STR_SPC	“00..00XXXX..XX”
68	VPD Keyword	V0	STR	Misc Information
70	Length	0x10		
71	Data	PCIe Gen2 x8	STR_SPC	
87	VPD Keyword	RV	STR	
89	Length	0x1		
90	Data	0,89	%CS0	
91	Large Resource Type VPD-W Tag (0x11)	0x91		
92	Length [7:0] LSB	0xA1		
93	Length [15:8] MSB	0x00		
94	VPD Keyword	V1	STR	EFI Driver version
96	Length	0x6		
97	Data	N/A	STR_SPC	
103	VPD Keyword	YA	STR	Asset Tag
105	Length	0x20		
106	Data	N/A	STR_SPC	“N/A”
138	VPD Keyword	RW	STR	Remaining read/write area
140	Length	0x72		
141	Data		STR_ZERO	Reserved (0x00)
255	Small Resource Type END Tag (0x11)	0x78		

3 Driver Software and Firmware

3.1 Driver Software

3.1.1 Linux

For Linux, download and install the latest OpenFabrics Enterprise Distribution (OFED) software package available via the Mellanox Web site at:
http://www.mellanox.com => Support > Download Center. Follow the installation instructions included in the download package.

3.1.2 Windows

Support > Download Center.For Windows, there are currently two distinct packages:

- MLNX EN – Ethernet driver
- MLNX WinOF – IB driver

These packages cannot co-exist (you need to uninstall one of them before installing the other).

Soon we will release a VPI package that will support both IB and Ethernet.

- Download these two packages from the Mellanox Web site at:
  For IB: http://www.mellanox.com => Downloads => InfiniBand/VPI SW/Drivers
- For Eth: http://www.mellanox.com => Downloads => Ethernet SW/Drivers

Follow the installation instructions included in the download package.

3.2 FlexBoot

FlexBoot enables remote boot over Ethernet or InfiniBand using Boot over InfiniBand (BoIB), Boot over Ethernet (BoE), or Boot over iSCSI (Bo-iSCSI). This technology is based on the Pre-boot Execution Environment (PXE) standard specification, and FlexBoot software is based on the open source EtherBoot/gPXE project (see www.etherboot.org). For more information go to
http://www.mellanox.com => Support > Download Center.

3.3 NVIDIA GPUDirect Support

Utilizing the high computational power of the Graphics Processing Unit (GPU), the GPU-to-GPU method has proven valuable in various areas of science and technology. Mellanox ConnectX-2 based HCA provides the required high throughput and low latency for GPU-to-GPU communications.

3.3.1 Hardware and Software Requirements

Software:

Operating Systems:

- RHEL5.4 2.6.18-164.el5 x86_64 or later
- Mellanox OFED with GPUDirect support
- NVIDIA Development Driver for Linux version 195.36.15 or later

Hardware:

- Mellanox ConnectX-2 HCA card
- NVIDIA Tesla series

3.3.2 Installation

For installation instructions visit: www.mellanox.com => Support => VPI SW/Driver.

3.3.2.1 Kernel Installation:

Use Red Hat Package Manager (RPM) to install the Kernel RPM files:

```
- Install the required RPMs, for example, run:
  # rpm --force -ivh *.rpm
- Modify the boot loader configuration file if needed
  (e.g., edit /etc/grub.conf)
- Reboot the machine with the new kernel
  # reboot
```

3.3.2.2 MLNX OFED Drivers Installation:

The MLNX driver is called MLNX_OFED_LINUX-Nvidia-1.5.1.

- Mount the ISO file:

```
  # mount -o ro, loop MLNX_OFED_<version>.iso /mnt
- Run the installation script:
  # /mnt/mlnxofed install
- Restart the driver:
  # /etc/init.d/openibd restart
- To make sure that GPUDirect is enabled, run:
  # cat /sys/module/ib_core/parameters/gpu_direct_enable => 1
```

The number of shared pages by GPUDirect is reported under:

```
  # cat /sys/module/ib_core/parameters/gpu_direct_shares
```

3.3.2.3 NVIDIA Driver Installation:

Install NVIDIA Development Driver for Linux x86_64, available under:

```
http://developer.nvidia.com/object/cuda_3_0_downloads.html
```

For example:

```
- Run: devdriver_3.0_linux_64_195.36.15.run
- Follow the installation wizard instructions
```

To make sure that the NVIDIA driver was installed successfully:

```
- Load nvidia driver:
  # modprobe nvidia
```

```
- Check the driver version, for example:
  # cat /proc/driver/nvidia/version =>  version 195.36.15 (or later)
```

3.4 CORE-Direct (Collectives Offload Resource Engine)

CORE-Direct (Collectives Offload Resource Engine) provides the most advanced solution for handling collectives operations, ensures maximum scalability, minimizes the CPU overhead and provides the capability for overlapping communications with computations. Mellanox ConnectX®-2 adapters address the collectives communication scalability problems by offloading the communications to the adapters and switches.

3.4.1 Hardware and Software Requirements

Software:

Operating system

- RHEL 5.4 or later
- Mellanox OFED 1.5.1 or later

Hardware:

- Mellanox ConnectX®-2 HCA card
- Disk Space for Installation 400 MB

3.4.2 Installation

For installation instructions visit: www.mellanox.com => Support => VPI SW/Driver

3.5 RDMA over Converged Ethernet (RoCE)

ConnectX-2 with RoCE utilizes advances in Data Center Bridging (DCB) to enable efficient and low cost implementations of RDMA over Ethernet, supporting the entire breadth of RDMA and low latency features. This includes reliable connected service, datagram service, RDMA and send/receive semantics, atomic operations, user level multicast, user level I/O access, kernel bypass, and zero copy.

ConnectX-2 with RoCE based network management is the same as that for any Ethernet and DCB-based network management, eliminating the need for IT managers to learn new technologies.

3.5.1 Hardware and Software Requirements

Software:

Operating System

- Mellanox OFED 1.5.1 or later

Hardware:

- ConnectX-2 Adapter Card

To use RoCE you will need the following versions of firmware and software:

- OFED 1.5.1 or later
- firmware version 2.7.700 or later

3.5.2 Installation

For installation instructions visit: www.mellanox.com => Support => Ethernet SW/Driver

3.6 Updating Adapter Card Firmware

Each card is shipped with the latest version of qualified firmware at the time of manufacturing. Firmware is updated occasionally, and the most recent firmware can be obtained from: http://www.mellanox.com =>Support > Download Center. Check that the firmware on your card is the latest found on the Mellanox site, if not update to the latest version found on the Mellanox website.

Firmware can be updated on the stand alone single card using the **flint** tool of the *Mellanox Firmware Tools (MFT)* package. This package is available for download, along with its user manual, from the Mellanox Firmware Tools page. See http://www.mellanox.com => Support > Download Center.

A firmware binaries table lists a binary file per adapter card. The file name of each such binary is composed by combining the firmware name, the firmware release version, and the card part number. Please contact Mellanox sysem support if you cannot find the firmware binary for your adapter card.

To check the latest firmware:

1. Go to Mellanox web site to check current firmware version.
   Go to: http://www.mellanox.com/supportdownloader
2. Enter your card PSID and compare the firmware versions.

Figure 9: Support Download Assistant

4 VPI Adapter Card Installation

4.1 Hardware and Software Requirements

Before installing the adapter card, please make sure that the system meets the hardware and software requirements listed in Table 11. Refer to Chapter 3,“Driver Software and Firmware” on page 24 for download and installation instructions.

Table 11 - Hardware and Software Requirements

Requirement	Description
Hardware	• PCI Express x8 or x16 slots
Software Operating Systems/Distributions	• For Windows, both the InfiniBand and Ethernet drivers are in the Mellanox WinOF for Windows software package available via Mellanox Web site http://www.mellanox.com => Downloads > Mellanox WinOF VPI for Windows • For Linux, both the InfiniBand and Ethernet drivers are in the Mellanox OpenFabrics Enterprise Distribution (OFED) software package available via the Mellanox Web site http://www.mellanox.com => Downloads > InfiniBand/VPI SW/ Linux Drivers

4.2 Installation Instructions

To change a tall bracket to a short bracket see Replacing a Tall Bracket With a Short Bracket on page 49.

Read all installation instructions before connecting the equipment to the power source.

The adapter cards listed in Table 3 on page 11 are standard PCI Express cards, each with a standard x8 edge connector. Please consult the host machine documentation for instructions on how to install a PCI Express card.

When more than one PCI slot is available make sure to use the PCI slot with the proper configuration.

Any PCI slot with the proper configuration is acceptable for connection. If the card is installed in a PCI slot with less lanes than the card requires then the adapter card will not provide the optimum data transfer.

4.3 Set Up

This section is valid for InfiniBand, Ethernet and VPI cards. Disregard sections that are not relevant to your card.

The basic steps to embed Mellanox cards in your computer are:

1. Identify the card in your system.
2. Verify the computer is recognizing the new adapter.
3. Install the adapter drivers.
4. Update the adapter firmware if needed.

The configuration of the card is dependant upon your choice to use InfiniBand or Ethernet.

4.3.1 Identify the Card in Your System

For instructions to identify your adapter card using specific tools see http://www.mellanox.com/content/pages.php?pg=firmware_HCA_FW_identification

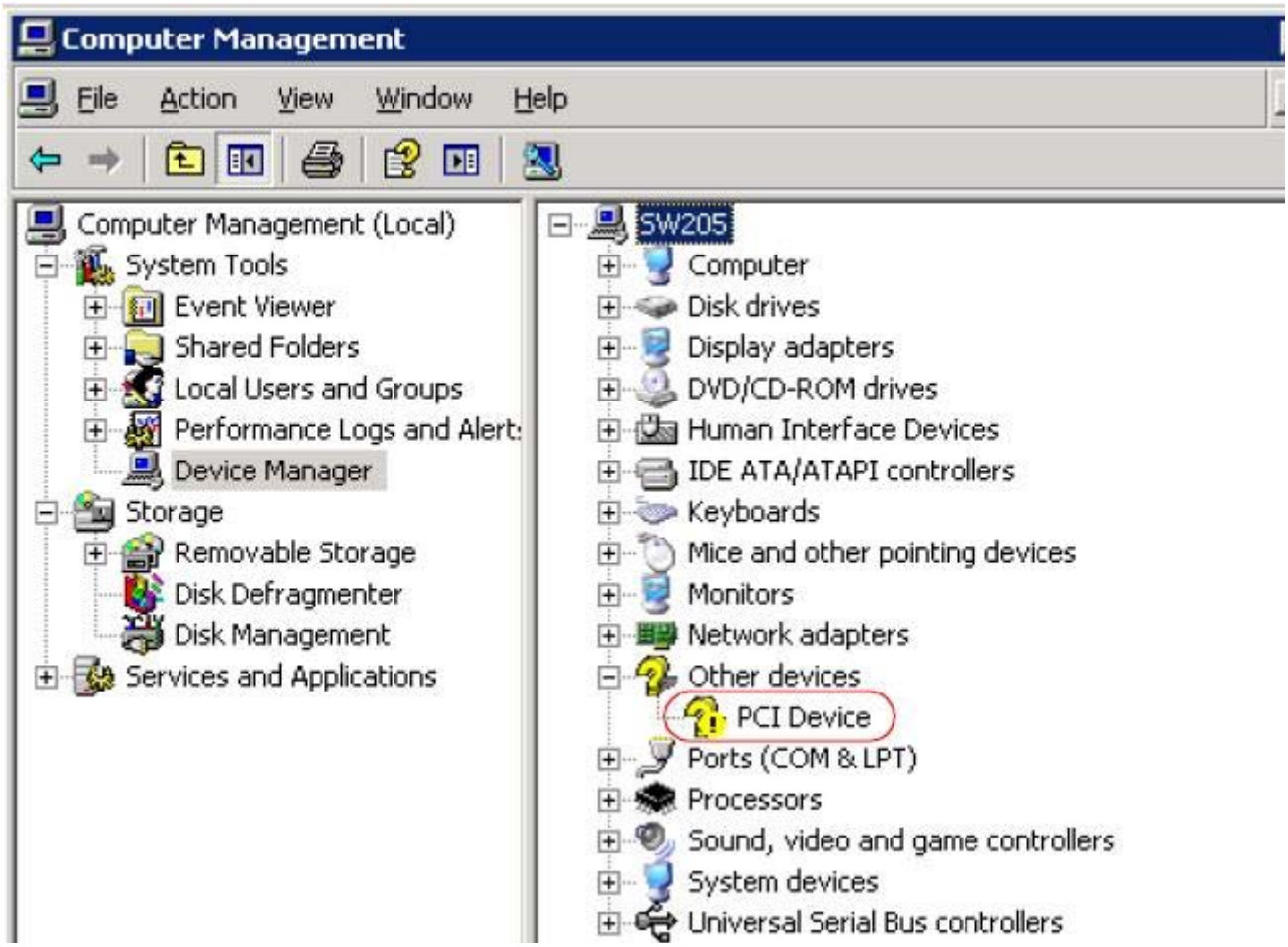
Otherwise, use the instructions below relevant to your particular card and OS.

4.3.1.1 Windows

1. Open Device Manager. Click start--> Run, and then enter “devmgmt.msc”.
2. Check the Device Manager under “Other devices” for “PCI Device” (Windows 2003) or “InfiniBand Controller” (Windows 2008/R2).

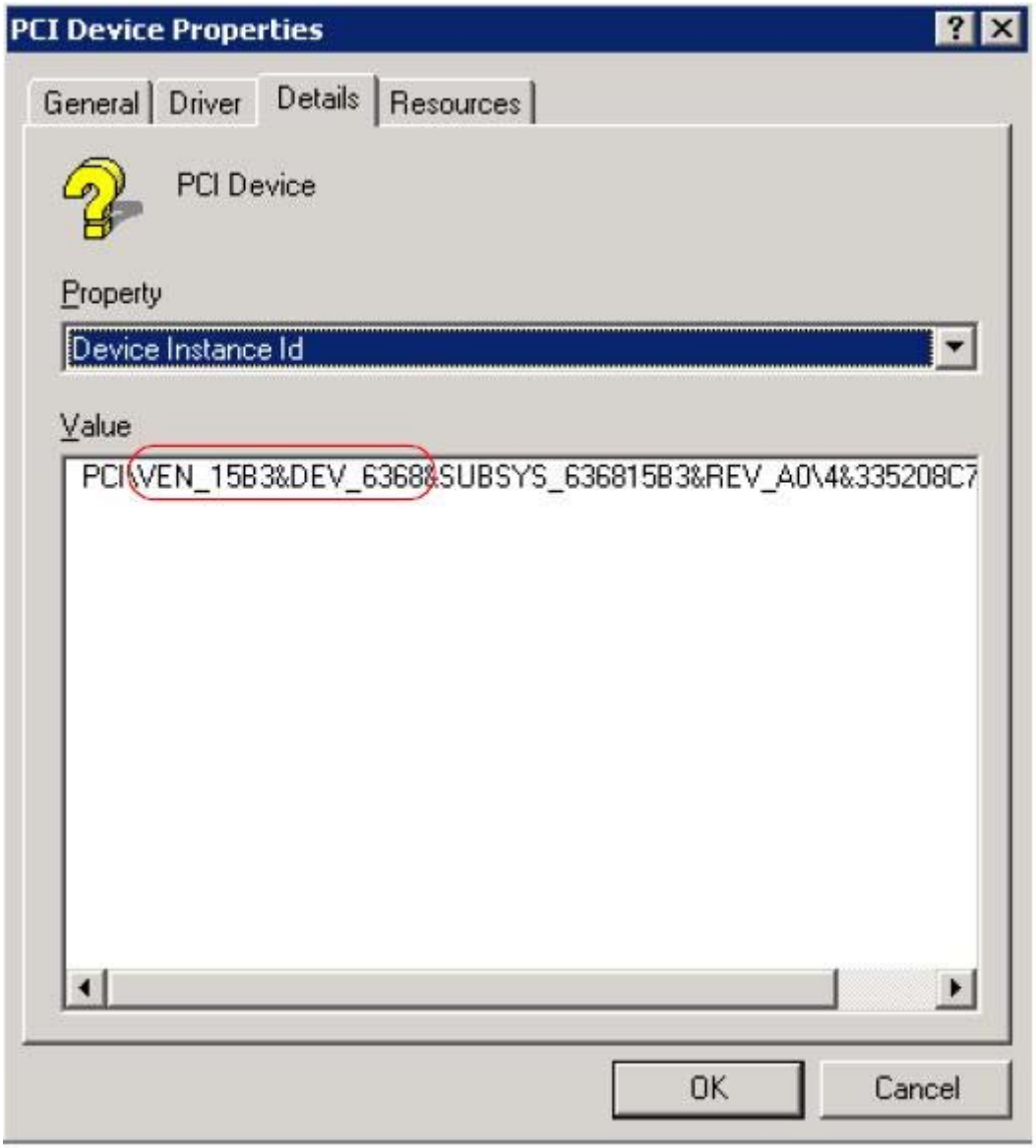
If you cannot find any PCI device, click Action --> Scan for hardware changes. If no PCI devices are detected, check that the network adapter card(s) is correctly installed in the PCI slot or try installing the adapter card into a different PCI slot.

Figure 10: Hardware Devices



3. Select a PCI Device / InfiniBand Controller entry.
4. Right-click.
5. Select "**Properties to display the PCI Device Properties**" window.
6. Click the Details tab and select **Device Instance Id** (Windows 2003) or **Hardware Ids** (Windows 2008/R2) from the Property pull-down menu.

Figure 11: PCI Device



7. In the Value display box, check the fields VEN and DEV (fields are separated by '&'). In the display example above, notice the sub-string "PCI\VEN_15B3&DEV_6368": VEN is equal to 0x15B3 – this is the Vendor ID of Mellanox Technologies; and DEV is equal to 0x6368 – this is a valid Mellanox Technologies PCI Device ID.

The list of Mellanox Technologies PCI Device IDs can be found in the PCI ID repository at http://pci-ids.ucw.cz/read/PC/15b3.

8. If the PCI device does not have a Mellanox adapter ID, return to Step 3 to check another device.

4.3.1.2 Linux

Get the device location on the PCI bus by running lspci and locating lines with the string "Mellanox Technologies":

```
> lspci  | grep Mellanox

                      2:00.0 InfiniBand: Mellanox Technologies MT26428 [ConnectX VPI PCIe
2.0 5GT/s - IB QDR / 10GigE] (rev b0)
```

Make sure that either the MLNX_OFED driver or the MLNX_EN driver is loaded and configured.

Check the link status

First check the network interface name by running the "`ifconfig -a`" command.

To check the Ethernet link status, for EN only and VPI cards, run: `ethtool <interface>`

```
Host# ethtool  eth1
        Supported ports: [ TP ]
        Supported link modes:   10baseT/Half 10baseT/Full
                                100baseT/Half 100baseT/Full
                                1000baseT/Half 1000baseT/Full
        Supports auto-negotiation: Yes
        Advertised link modes:  10baseT/Half 10baseT/Full
                                100baseT/Half 100baseT/Full
                                1000baseT/Half 1000baseT/Full
        Advertised auto-negotiation: Yes
        Speed: Unknown! (0)
        Duplex: Half
        Port: Twisted Pair
        PHYAD: 1
        Transceiver: internal
        Auto-negotiation: on
        Supports Wake-on: g
        Wake-on: d
        Current message level: 0x000000ff (255)
        Link detected: yes
```

To check the IB link status, for IB anad VPI cards, run "`ibstat`" and focus on the Physical state attributes.

Example:

```
Host# ibstat
CA 'mlx4_0'
        CA type: MT26428
        Number of ports: 1
        Firmware version: 2.7.616
        Hardware version: b0
        Node GUID: 0x0002c903000c8710
        System image GUID: 0x0002c903000c8713
        Port 1:
                State: Down
                Physical state: Polling
```

```
Rate: 10
Base lid: 6
LMC: 0
SM lid: 3
Capability mask: 0x0251086a
Port GUID: 0x0002c903000c8711
Link layer: IB
```

Check the OFED version

To get the version of the running Mellanox OFED/BXOFED, run the following command:

```
Host# ofed_info | head -1
BXOFED-1.5.1-1.3.7-rc19:
```

Troubleshooting MLNX_OFED Installation

For troubleshooting driver installation, please check Mellanox OFED driver user manual: http://www.mellanox.com => Support > Adapter IB/VPI SW.

If you need to update your card firmware, download the new firmware.

Unzip the downloaded file and run flint/mstflint command:

```
flint -d <device> -i <fw-file> [-guid <GUID> | -guids <4 GUIDS> | -mac <MAC> | -macs <2 MACs>] burn
```

Check VPI setup – Ethernet / InfiniBand configuration

For Example:

```
flint  -d /dev/mst/mt26428_pci_cr0 –i fw-25408-2_7_000-MNPH28B-XTC_A1-A2.bin burn
```

Loading the Ethernet Driver

By default, the Mellanox OFED stack loads mlx4_en. Run ‘lsmod’ to verify that the module is listed.

Example:

```
Host# lsmod | grep mlx4_en
mlx4_en               109708  0
mlx4_core             136804  2 mlx4_en,mlx4_ib
```

If you don’t see the mlx4_en driver, run: ’ modprobe mlx4_en’

Another option is to use the command below to see which modules are active.

```
Edit ”/etc/infiniband/openib.conf” which modules needs to loaded from a service.
```

For example:

```
# Load MLX4_EN module
MLX4_EN_LOAD=yes
```

The “Usage: openibd {start|stop|restart|status}” command to modify this file and thereby control the drivers.

Ethernet Driver Usage and Configuration

To assign an IP address to the interface run:

```
#> ifconfig eth<n> <ip>
```

where 'n' is the OS assigned interface number.

- To check driver and device information run:

```
#> ethtool -i eth<n>
```

Example:

```
#> ethtool -i eth2
driver: mlx4_en (MT_04A0140005)
version: 1.5.1 (March 2010)
firmware-version: 2.7.000
bus-info: 0000:13:00.0
```

- The mlx4_en parameters can be found under /sys/module/mlx4_en (or /sys/module/mlx4_en/parameters, depending on the OS) and can be listed using the command:

```
#> modinfo mlx4_en
```

To set non-default values to module parameters, the following line should be added to the file/etc/modprobe.conf:

```
"options mlx4_en <param_name>=<value> <param_name>=<value> ..."
```

Ethernet Network Tuning

To improve network perfomance by tuning your network see the Mellanox Performance Tuning Guide located at:

http://www.mellanox.com/related-docs/prod_software/Performance_Tuning_Guide_for_Mellanox_Network_Adapters_rev_1_0.pdf

4.4 Cables and Modules

Mellanox QSFP ports can connect to InfiniBand passive copper cables, active copper cables and optical cables using direct attach cables and through QSFP modules. These ports can connect to hybrid QSFP to SFP+ cables.

The SFP+ port can connect to the Ethernet through both direct attach cables and stand alone transceivers with optical cables. SFP+ transceiver modules are available for both SR and LR protocols.

See www.mellanox.com => Products => Cables for certified and approved cable recommendations.

4.4.1 Optical modules for SFP+

SFP+ transceiver modules can be used to connect fiber optic cables to the cards greatly increasing the cable reach.

The adapter cards are shipped without optical modules. Mellanox 10GBASE-SR (MFM1T02A-SR) and 10GBASE-LR (MFM1T02A-LR) optical modules are recommended. The figure below shows the Mellanox SFP+ module.

Inserting the Optical Transceiver Module

To insert the module into the cage:

1. Open the module's locking mechanism – see Figure 12 and Figure 13.
2. Make sure that the male connector on the module will align with the female connector inside of the cage. Also check that there is no dirt or foreign matter in the module or in the cage.

Figure 12: Module With Locking Mechanism Closed

Figure 13: Module With Locking Mechanism Open

3. Insert the module into the adapter card module cage.
4. Close the locking Mechanism.

To remove the module from the cage:

1. Unlock the locking mechanism by opening the handle.
2. Pull the module out of the cage.

4.4.2 Optical Modules for QSFP

These cards support optical modules for active fiber optical cables. The part ordering number for this module is MFM4R12C-QDR.

4.4.3 Modules for QSFP to SFP+

These cards support modules for SFP+ cables. The Quad to Single Small Form Factor Pluggable adapter (QSFP to SFP+ adapter or QSA) is built in QSFP form factor with a receptacle for SFP+ cable connector. The part ordering number for this module is MAM1Q00A-QSA.

4.4.4 Cable Installation

All cables can be inserted or removed with the unit powered on. To insert a cable, press the connector into the port receptacle until the connector is firmly seated. 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). After plugging in a cable, lock the connector using the latching mechanism particular to the cable vendor. When a logical connection is made the YELLOW LED will come on. When data is being transferred the yellow led will blink.

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.

Care should be taken not to impede the air exhaust flow through the ventilation holes. Cable lengths should be used which allow for routing horizontally around to the side of the chassis before bending upward or downward in the rack.

To remove a cable, disengage the locks and slowly pull the connector away from the port receptacle. Both LED indicators will turn off when the cable is unseated.

Cables, especially long copper cables, can weigh a substantial amount. Make sure that the weight of the cable is supported on its own and is not hanging from the adapter card.

Mellanox Cards support up to 40 Gb/s IB over the QSFP port, and up to 10Gb/s on the SFP+ connector.

4.4.5 InfiniBand Connectivity

These Mellanox Cards support QSFP passive and active copper and active optical cables.

Appendix A: Specifications

A.1 MHZH29B-X[ST]R Specifications

Table 12 - Specifications for MHZH29-X[ST]R

Physical		**Power and Environmental**	
Size:	2.71in. x6.60in. (68.90mm x 167.65mm)	Voltage:	12V, 3.3V
Air Flow:	200LFM[a]	Typ Power:	8.01W for passive cables only 10.71W for active optic modules
QSFP40Gb/s Connector:	InfiniBand (Copper and optical) Max power per port 2.0 W. Cable power budget class 2	Maximum Power:	8.66W for passive cables only 11.36W for active optic modules
SFP+ Connector:	Ethernet (Copper and optical) Max power per port 0.7W	Temperature:	0°C to 55°C
Protocol Support		**Regulatory**	
InfiniBand:	IBTA v1.2.1, Auto-Negotiation[b] (40Gb/s, 10Gb/s per lane), (20Gb/s, 5Gb/s per lane) or (10Gb/s, 2.5Gb/s per lane)	EMC:	FCC 47 CFR part 15:2006, subpart B, class A ICES-003:2004 Issue 4, class A VCCI V-3/2007.04, class A EN 55022:1998+A1: 2000+A2:2003 class A, EN 61000-3-2:2000+A2:2005, EN61000-3-3:1995+A2:2005, EN 55024:1998 + A1:2001+A2:2003 standards, harmonized under EMC Directive 2004/108/EC Article 6(2); AS/NZS 3548
Ethernet:	IEEE Std 802.3ae 10 Gigabit Ethernet IEEE Std 802.3ad Link Aggregation and Failover IEEE Std 802.3x Pause IEEE Std 802.1Q VLAN tags IEEE Std 802.1p Priorities Multicast Jumbo frame support (10KB) 128 MAC/VLAN addresses per port	Environmental:	IEC/EN 60950-1:2006 ETSI EN 300 019-2-2 IEC 60068-2- 64, 29, 32
QoS:	8 Virtual Lanes for InfiniBand 8 Priority Queues for Ethernet	RoHS:	RoHS-R6
RDMA Support:	Yes, All Ports		
Data Rate SFP+ Ethernet:	10 Gb/s		
QSFP InfiniBand:	40 Gb/s		
PCI Express:	2.0 SERDES @ 5.0 GT/s		

a. Air flow is measured ~1" from the heat sink between the heat sink and the cooling air inlet.
b. The auto-negotiation protocol is proprietary of Mellanox Technologies and compliant with the *InfiniBand Architecture Specification, Release 1.2*.

A.2 MHZH29-X[ST]R Specifications

Table 13 - Specifications for MHZH29-X[ST]R

Physical		**Power and Environmental**	
Size:	2.71in. x6.60in. (68.90mm x 167.65mm)	Voltage:	12V, 3.3V
Air Flow:	200LFM[a]	Typ Power:	8.01W for passive cables only 10.71W for active optic modules
QSFP40Gb/s Connector:	InfiniBand (Copper and optical) Max power per port 2.0 W. Cable power budget class 2	Maximum Power:	8.66W for passive cables only 11.36W for active optic modules
SFP+ Connector	Ethernet (Copper and optical) Max power per port 0.7W	Temperature:	0°C to 55°C
Protocol Support		**Regulatory**	
InfiniBand:	IBTA v1.2.1, Auto-Negotiation[b] (40Gb/s, 10Gb/s per lane), (20Gb/s, 5Gb/s per lane) or (10Gb/s, 2.5Gb/s per lane)	EMC:	FCC 47 CFR part 15:2006, subpart B, class A ICES-003:2004 Issue 4, class A VCCI V-3/2007.04, class A EN 55022:1998+A1: 2000+A2:2003 class A, EN 61000-3-2:2000+A2:2005, EN61000-3-3:1995+A2:2005, EN 55024:1998 + A1:2001+A2:2003 standards, harmonized under EMC Directive 2004/108/EC Article 6(2); AS/NZS 3548
Ethernet:	IEEE Std 802.3ae 10 Gigabit Ethernet IEEE Std 802.3ad Link Aggregation and Failover IEEE Std 802.3x Pause IEEE Std 802.1Q VLAN tags IEEE Std 802.1p Priorities Multicast Jumbo frame support (10KB) 128 MAC/VLAN addresses per port	Environmental:	IEC/EN 60950-1:2006 ETSI EN 300 019-2-2 IEC 60068-2- 64, 29, 32
QoS:	8 Virtual Lanes for InfiniBand 8 Priority Queues for Ethernet	RoHS:	RoHS-R6
RDMA Support:	Yes, All Ports		
Data Rate SFP+ Ethernet:	10 Gb/s		
QSFP InfiniBand:	40 Gb/s		
PCI Express:	2.0 SERDES @ 5.0 GT/s		

a. Air flow is measured ~1" from the heat sink between the heat sink and the cooling air inlet.
b. The auto-negotiation protocol is proprietary of Mellanox Technologies and compliant with the *InfiniBand Architecture Specification, Release 1.2*.

A.3 Board Mechanical Drawing and Dimensions

All of the cards covered in this *User Manual* have the same mechanical drawing and share the same dimensions as depicted in Figure 14 or Figure 15(SFF card).

All dimensions are in millimeters.
All the mechanical tolerances are +/-0.1mm

Figure 14: Schematic of the ConnectX-2 MHZH29B Adapter Card

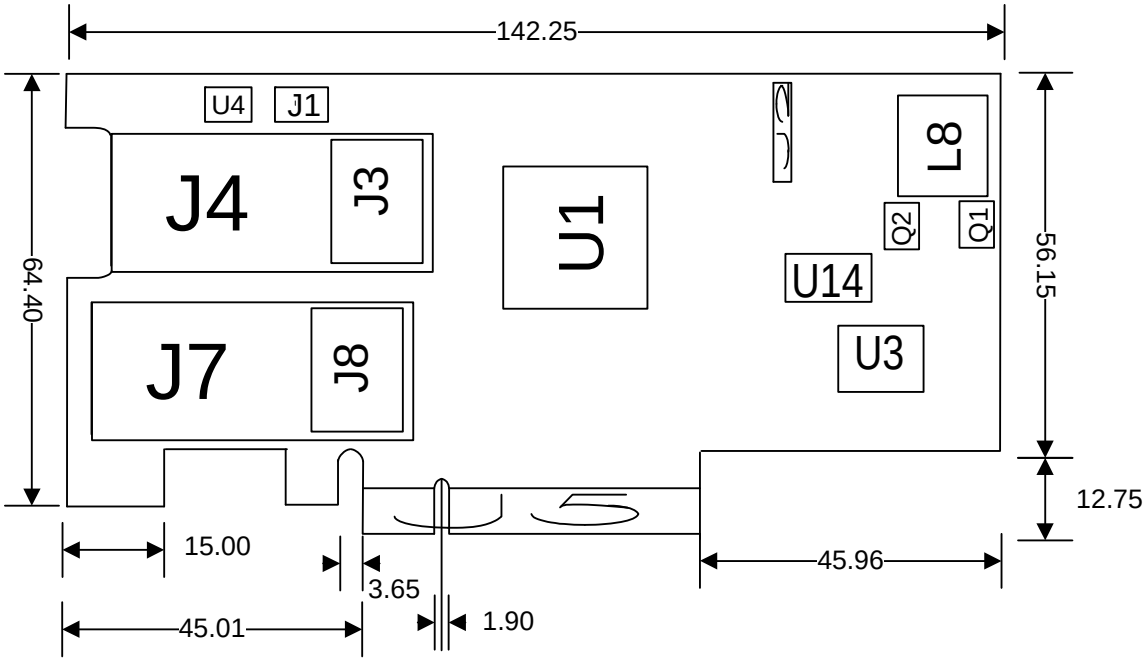
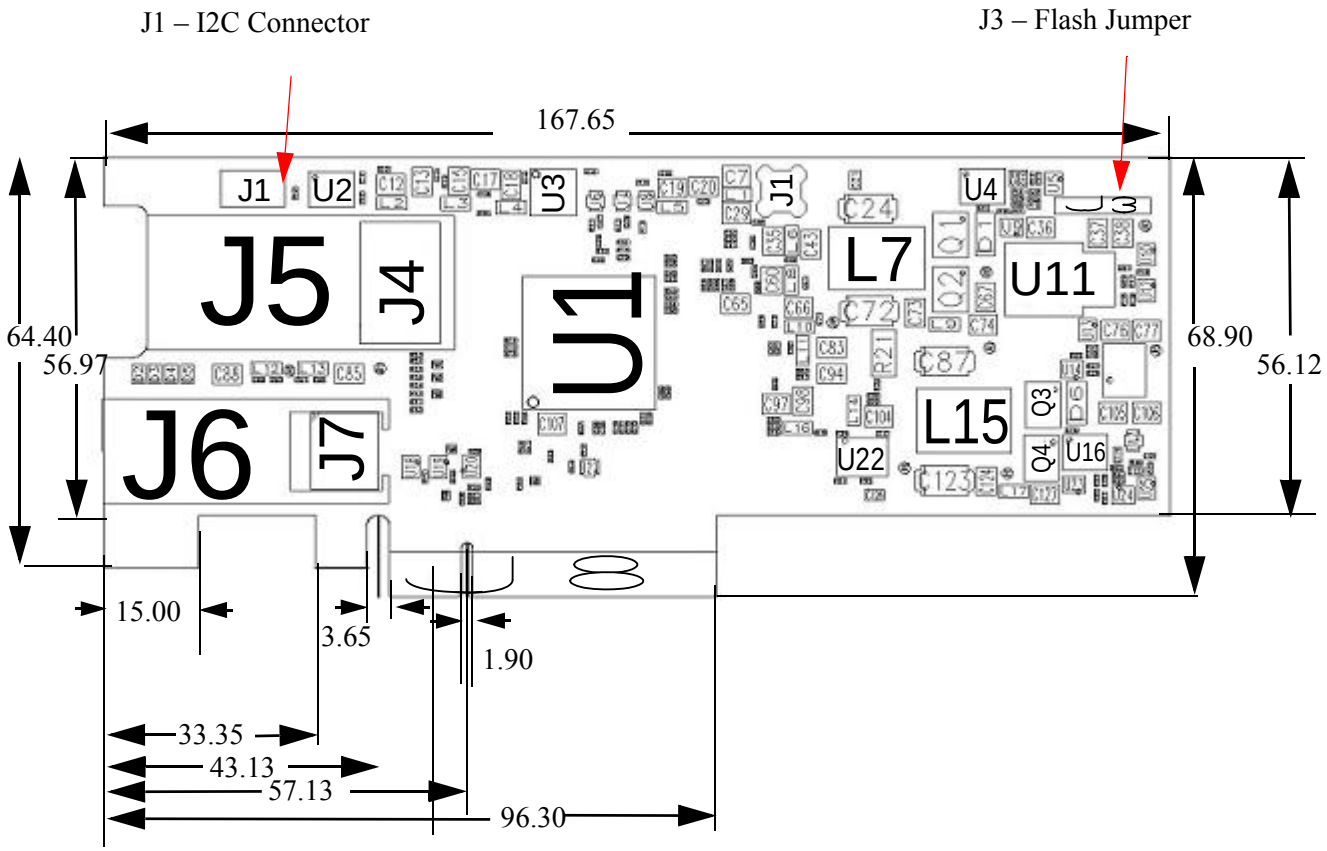


Figure 15: Schematic of the ConnectX-2 MHZH29 Adapter Card



A.4 EMC Certification Statements

the approved certification status per adapter card in different regions of the world.

Table 14 - Adapter Cards Certification Status

Adapter Card P/N	FCC	VCCI	EN	ICES	CE	CB	cTUVus	KCC
MHZH29-XSR	YES	YES	YES	YES	YES	YES	YES	YES
MHZH29-XTR	YES	YES	YES	YES	YES	YES	YES	YES
MHZH29B-XSR	YES	YES	YES	YES	YES	YES	YES	YES
MHZH29B-XTR	YES	YES	YES	YES	YES	YES	YES	YES

A.4.1 FCC Statements (USA)

Class A Statements:

§ 15.19(a)(4)

This device complies with Part 15 of the FCC Rules.

Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

§ 15.21

Statement

Warning!

Changes or modifications to this equipment not expressly approved by the party responsible for compliance (Mellanox Technologies) could void the user's authority to operate the equipment.

§15.105(a)

Statement

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

A.4.2 EN Statements (Europe)

EN55022 Class A Statement:

Warning

This is a class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

A.4.3 ICES Statements (Canada)

Class A Statement:

“This Class A digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.”

A.4.4 VCCI Statements (Japan)

Class A Statement:

この装置は、情報処理装置等電波障害自主規制協議会（ＶＣＣＩ）の基準に基づくクラスＡ情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。

(Translation - "This is a Class A product based on the standard of the Voluntary Control Council for Interference by Information Technology Equipment (VCCI). If this equipment is used in a domestic environment, radio interference may occur, in which case the user may be required to take corrective actions.")

A.4.5 KCC Certification (Korea)

English Translation

Device	User's information
A급 기기 (업무용 방송통신기기)	이 기기는 업무용(A급)으로 전자파적합등록을 한 기기이오니 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.
CLASS A device (commercial broadcasting and communication equipment)	This device has been approved by EMC registration. Distributors or users pay attention to this point . This device is usually aimed to be used in other area except at home .

- Remark

Class A device: operated in a commercial area.

Appendix B: Interface Connectors Pinout

B.1 I²C-Compatible Connector Pinout

Figure 16: Compatible Connector Plug and Pinout

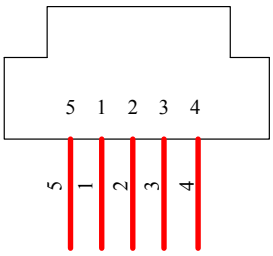


Table 15 - I2C-Compatible Connector

Connector Pin Number	Signal Name
1	SPSDA
2	SPSCL
3	GND
4	NC
5	NC

B.2 PCI Express x8 Connector Pinout

The adapter cards use a standard PCI Express x8 edge connector and the PCI Express x8 standard pinout according to the PCI Express 2.0 specification.

B.3 PCI Express Connector Pinout

B.4 QSFP Connector Pinout

Figure 17: Connector and Cage Views

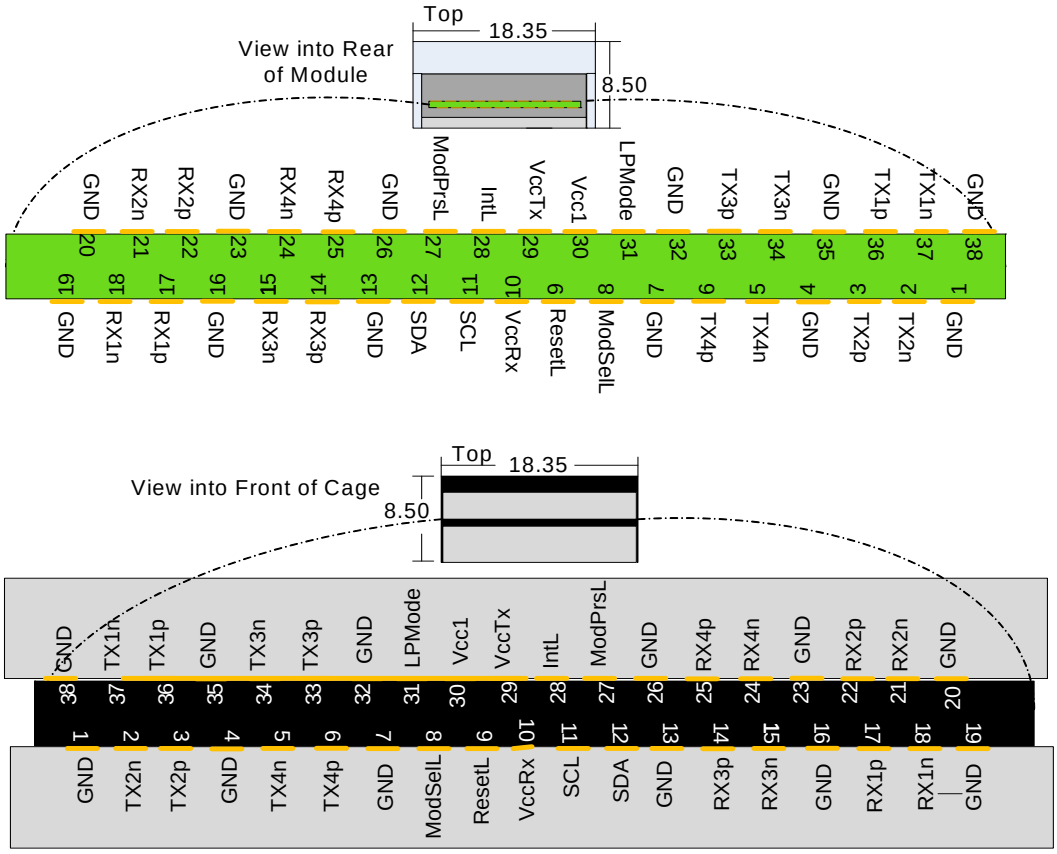


Table 16 - Connector Pin Name and Number to Signal Name Correspondence

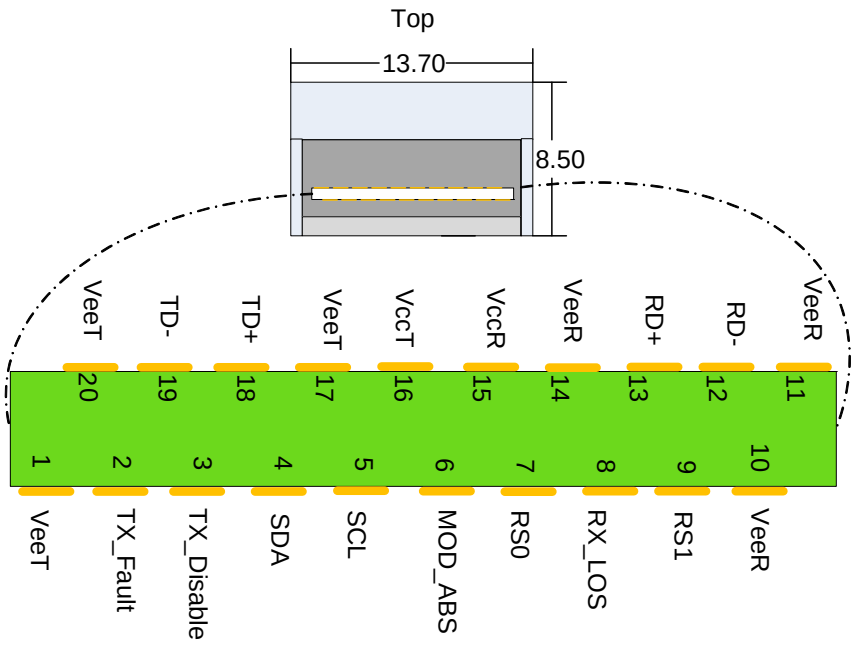
Connector Pin Number	Connector Pin Name	Port A Signal Name
1	GND	GND
2	TXN_2	Tx2n
3	TXP_2	Tx2p
4	GND	GND
5	TXN_4	Tx4n
6	TXP_4	Tx4p
7	GND	GND
8	ModSelL_Port0	ModSelL
9	ResetL_Port0	ResetL
10		VccRx
11	SCL	SCL
12	SDA	SDA

Table 16 - Connector Pin Name and Number to Signal Name Correspondence

Connector Pin Number	Connector Pin Name	Port A Signal Name
13	GND	GND
14	RXP_3	Rx3p
15	RXN_3	Rx3n
16	GND	GND
17	RXP_1	Rx1p
18	RXN_1	Rx1n
19	GND	GND
20	GND	GND
21	RXN_2	Rx2n
22	RXP_2	Rx2p
23	GND	GND
24	RXN_4	Rx4n
25	RXP_4	Rx4p
26	GND	GND
27	ModPrsl_Port0	Mod PrsL
28	IntL	IntL
29		VccTx
30		Vcc1
31	LPMode_Port0	LPMode
32	GND	GND
33	TXP_3	Tx3p
34	TXN_3	Tx3n
35	GND	GND
36	TXP_1	Tx1p
37	TXN_1	Tx1n
38	GND	GND

B.5 SFP+ Connector Pinout

Figure 18: Rear View of Module With Pin Placement



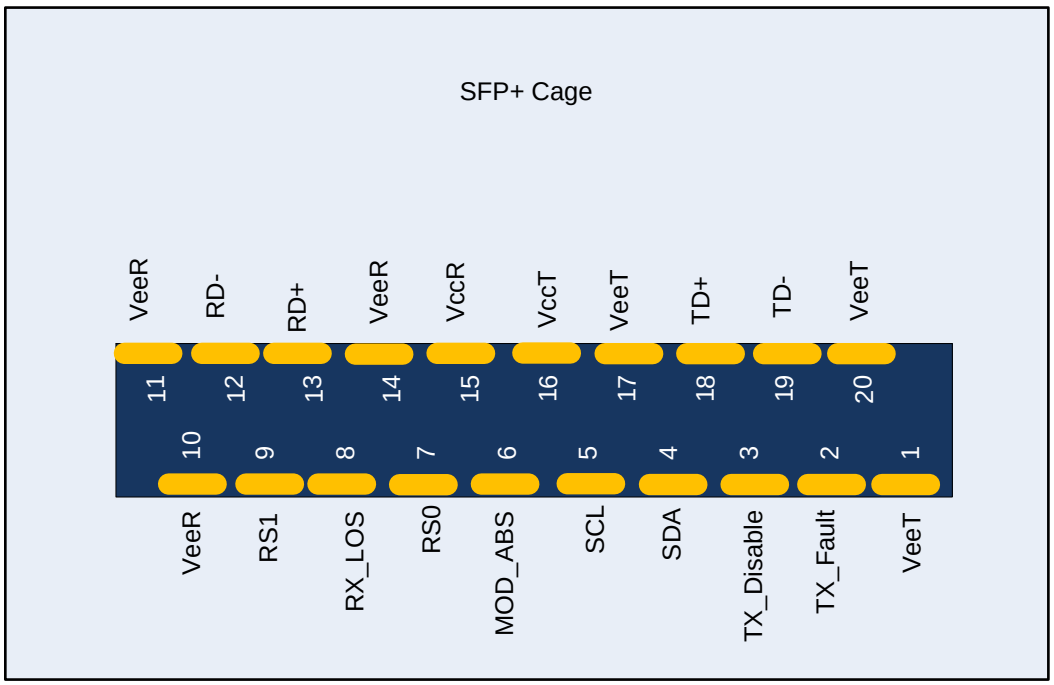


Table 17 - SFP+ Connector Pinout

Pin	Symbol Name	Description
1	VeeT	Transmitter Ground (Common with Receiver Ground) [a]
2	TX_Fault	Transmitter Fault.[b]
3	TX_Disable	Transmitter Disable. Laser output disabled on high or open. [c]
4	SDA	2-wire Serial Interface Data Line [d]
5	SCL	2-wire Serial Interface Clock Line [d]
6	MOD_ABS	Module Absent. Grounded within the module [d]
7	RS0	No connection required
8	RX_LOS	Loss of Signal indication. Logic 0 indicates normal operation. [e]
9	RS1	No connection required
10	VeeR	Receiver Ground (Common with Transmitter Ground) [a]
11	VeeR	Receiver Ground (Common with Transmitter Ground)[a]
12	RD-	Receiver Inverted DATA out. AC Coupled
13	RD+	Receiver Non-inverted DATA out. AC Coupled
14	VeeR	Receiver Ground (Common with Transmitter Ground) [a]
15	VccR	Receiver Power Supply
16	VccT	Transmitter Power Supply
17	VeeT	Transmitter Ground (Common with Receiver Ground) [a]
18	TD+	Transmitter Non-Inverted DATA in. AC Coupled.
19	TD-	Transmitter Inverted DATA in. AC Coupled.
20	VeeT	Transmitter Ground (Common with Receiver Ground)[a]

a. Circuit ground is internally isolated from chassis ground.
b. T_{FAULT} is an open collector/drain output, which should be pulled up with a 4.7k – 10k Ohms resistor on the host board if intended for use. Pull up voltage should be between 2.0V to Vcc + 0.3V. A high output indicates a transmitter fault caused by either the TX bias current or the TX output power exceeding the preset alarm thresholds. A low output indicates normal operation. In the low state, the output is pulled to <0.8V.
c. Laser output disabled on TDIS >2.0V or open, enabled on TDIS <0.8V
d. Should be pulled up with 4.7kΩ – 10kΩ on host board to a voltage between 2.0V and 3.6V. MOD_ABS pulls line low to indicate module is plugged in.
e. LOS is open collector output. Should be pulled up with 4.7kΩ – 10kΩ on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.

Appendix C: Replacing a Tall Bracket With a Short Bracket

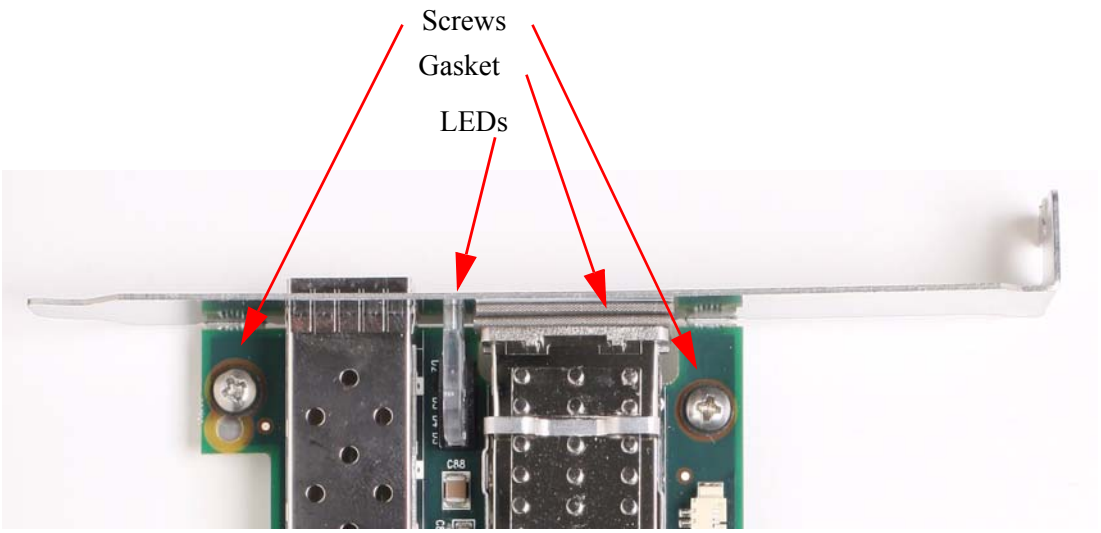
This section provides instructions on how to remove the tall bracket of a standard Mellanox Technologies adapter card and replace it with a short one.

To replace the bracket you will need the following parts:

- the new bracket of the proper height
- one new QSFP EMI gasket
- the 2 screws saved from the removal of the bracket
- the 2 fiber washers saved from the removal of the bracket

C.1 Remove the Existing Bracket from the Adapter Card

Figure 19: Remove the Bracket



1. Remove the two screws holding the bracket in place.
2. Push the bracket off using equal pressure at the top and bottom of the bracket. See Figure 19

Be careful not to put stress on the LEDs.

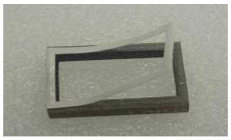
3. Save the two screws and the two fiber washers.

C.2 Installing the New Bracket

1. Remove the paper to expose the adhesive on the gasket.

2. Place the gasket onto the new bracket. Make sure to correctly align the gasket with the hole in the bracket.
3. If the old gasket is still on the card, remove it before installing the new bracket. Make sure that only one gasket is used.

Figure 20: Gasket Installation

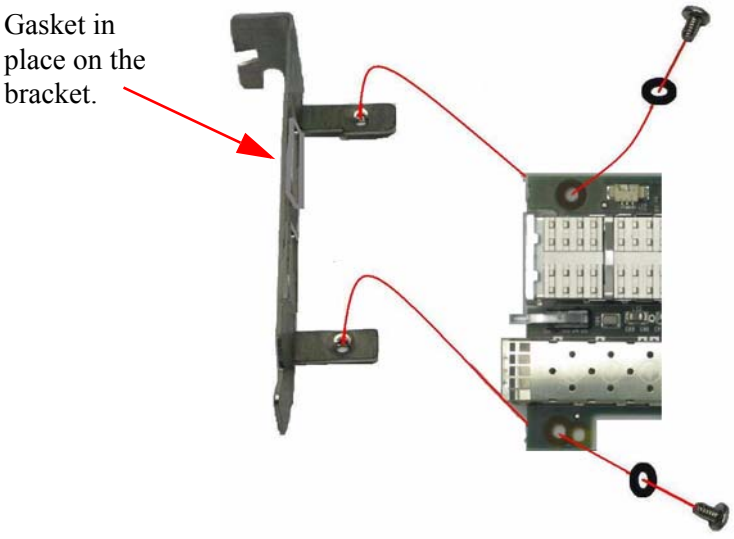


4. Place the bracket onto the card until the screw holes line up.

Do not force the bracket onto the card. You may have to gently push the LEDs using a small screwdriver to align the LEDs with the holes in the bracket.

5. Screw on the bracket using the screws and washers saved from the procedure above step 1.

Figure 21: Placing the Bracket on the Card



6. Make sure that the LEDs are aligned onto the bracket holes.
7. Use a torque driver to apply up to 2 lbs-in torque on the screws.

Appendix D: Avertissements de sécurité d'installation (Warnings in French)

1. Instructions d'installation

Lisez toutes les instructions d'installation avant de brancher le matériel à la source d'alimentation électrique.

2. Température excessive

Ce matériel ne doit pas fonctionner dans une zone avec une température ambiante dépassant le maximum recommandé de 55°C (131°F). Un flux d'air de 200LFM à cette température ambiante maximale est nécessaire. En outre, pour garantir un bon écoulement de l'air, laissez au moins 8 cm (3 pouces) d'espace libre autour des ouvertures de ventilation.

3. Orages – dangers électriques

Pendant un orage, il ne faut pas utiliser le matériel et il ne faut pas brancher ou débrancher les câbles.

4. Branchement/débranchement des câbles InfiniBand en cuivre

Les câbles InfiniBand en cuivre sont lourds et ne sont pas flexibles, il faut donc faire très attention en les branchant et en les débranchant des connecteurs. Consultez le fabricant des câbles pour connaître les mises en garde et les instructions spéciales.

5. Installation du matériel

Ce matériel ne doit être installé, remplacé ou entretenu que par du personnel formé et qualifié.

6. Elimination du matériel

L'élimination de ce matériel doit s'effectuer dans le respect de toutes les législations et réglementations nationales en vigueur.

7. Codes électriques locaux et nationaux

Ce matériel doit être installé dans le respect des codes électriques locaux et nationaux.

Appendix E: Sicherheitshinweise (Warnings in German)

1. Installationsanleitungen

Lesen Sie alle Installationsanleitungen, bevor Sie das Gerät an die Stromversorgung anschließen.

2. Übertemperatur

Dieses Gerät sollte nicht in einem Bereich mit einer Umgebungstemperatur über der maximal empfohlenen Temperatur von 55°C (131°F) betrieben werden. Es ist ein Luftstrom von 200 LFM bei maximaler Umgebungstemperatur erforderlich. Außerdem sollten mindestens 8 cm (3 in.) Freiraum um die Belüftungsöffnungen sein, um einen einwandfreien Luftstrom zu gewährleisten.

3. Bei Gewitter - Elektrische Gefahr

Arbeiten Sie während eines Gewitters und Blitzschlag nicht am Gerät, schließen Sie keine Kabel an oder ab.

4. Anschließen/Trennen von InfiniBand-Kupferkabel

InfiniBand-Kupferkabel sind schwer und nicht flexible. Deshalb müssen sie vorsichtig an die Anschlüsse angebracht bzw. davon getrennt werden. Lesen Sie die speziellen Warnungen und Anleitungen des Kabelherstellers.

5. Geräteinstallation

Diese Gerät sollte nur von geschultem und qualifiziertem Personal installiert, ausgetauscht oder gewartet werden.

6. Geräteentsorgung

Die Entsorgung dieses Geräts sollte unter Beachtung aller nationalen Gesetze Bestimmungen erfolgen.

7. Regionale und nationale elektrische Bestimmungen

Dieses Gerät sollte unter Beachtung der regionalen und nationalen elektrischen Bestimmungen installiert werden.

Appendix F: Advertencias de seguridad para la instalación (Warnings in Spanish)

1. Instrucciones de instalación

Antes de conectar el equipo a la fuente de alimentación, leer todas las instrucciones de instalación.

2. Sobrecalentamiento

No se debe utilizar el equipo en un área con una temperatura ambiente superior a la máxima recomendada: 55°C(131°F). Además, para garantizar una circulación de aire adecuada, se debe dejar como mínimo un espacio de 8 cm (3 pulgadas) alrededor de las aberturas de ventilación.

3. Cuando hay rayos: peligro de descarga eléctrica

No utilizar el equipo ni conectar o desconectar cables durante períodos de actividad de rayos.

4. Conexión y desconexión del cable Copper InfiniBand

Dado que los cables de cobre InfiniBand son pesados y no son flexibles, su conexión a los conectores y su desconexión se deben efectuar con mucho cuidado. Para ver advertencias o instrucciones especiales, consultar al fabricante del cable.

5. Instalación de equipos

La instalación, el reemplazo y el mantenimiento de este equipo estarán a cargo únicamente de personal capacitado y competente.

6. Eliminación de equipos

La eliminación definitiva de este equipo se debe efectuar conforme a todas las leyes y reglamentaciones nacionales.

Códigos eléctricos locales y nacionales

Este equipo se debe instalar conforme a los códigos eléctricos locales y nacionales.