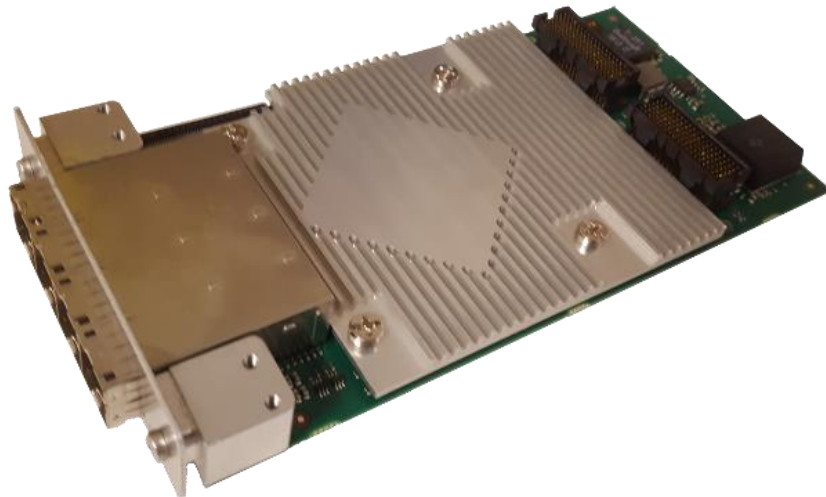




Dolphin PCI Express PXH820 XMC Adapter



PXH820 NTB Adapter Users Guide
Version 1.1

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Do not use information in this guide to design your own card, always reference the original PCI-SIG or VITA Specification for details.

LIFE SUPPORT POLICY

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Dolphin is minimizing the amount of printed documentation and software CDs in its shipments; please download additional documentation and software from www.dolphinics.com.

Terms and Acronyms

Important terms and acronyms used in this manual

AOC	Active Optical Cable. PCIe fiber cable assembly with SFF-8644 connector. Available from Dolphin, orderable part number MSFCxxxM (where xxx is the length in meters).
CMI	Cable Management Interface. The 2-wire management interface for communication between subsystems connected by a PCIe 3.0 cable. Details can be found in the PCI-SIG External Cabling Specification 3.0. The CMI functionality is optional with the PXH820 card.
BMC	Microcontroller on the PXH820 used to manage card functionality and CMI communications.
eXpressWare	Dolphin's software stack for PCIe clustering and IO. www.dolphinics.com for more information.
Lane	One PCI Express Lane contains a differential pair for transmission and a differential pair for reception.
Link	A collection of one or more PCI Express Lanes providing the communication path between an Upstream and Downstream Port.
MiniSAS-HD	Standard MiniSAS-HD cable with SFF-8644 connectors.
PCIe 3.0 cable	PCIe 3.0 cable with SFF-8644 connectors. Compliant to the new PCI-SIG External Cabling Specification 3.0. Support for CMI.
Port	The PXH820 has four x4 ports, named P1, P2, P3, P4. The physical ports are identified by text on the PCIe brackets. The PCIe switch chip only supports 2 concurrent NTB connections.

PXH820 High Level Specification

The PXH820 is a PCI Express Gen3 x8 NTB XMC adapter card available from Dolphin providing an easy-to-use, multi-functional PCI Express networking solution.

The PXH820 supports PCIe Gen1, Gen2 and Gen3 speeds and x1, x2, x4, x8 and x16 link-widths both at the XMC connector side and cable link side. The card will operate at the highest common speed shared between the XMC Carrier card and the PXH820 (up to Gen3) and the widest common link-width (up to x16 using both P15 and P16 XMC connectors). The PXH820 is link compliant to the PXH830 card. These two products can be mixed in any supported combination to create a PCIe fabric consisting of standard servers with a standard PCIe slot and embedded systems supporting the XMC form factor. Scale out solutions can be implemented using the 24 port MXS824 PCIe switch.

Specifications

- ANSI/VITA 42.3-2006 (R2014) Single Width Mezzanine Card
- ANSI/VITA 42.0-2016
- PCI Express Base Specification, Rev. 3.0.
- PCI Express CEM Specification, Rev. 3.0.
- PCI Express External Cabling Specification Rev 3.0, version 0.9
- PCI Express Gen3 8.0 GT/s per lane signaling – 128 GT/s total signaling.
- XMC 1.0 Connectors
 - XMC P15 PCI Express Gen3 x8, x4, x2 or x1 host connection.
 - XMC P16 PCI Express Gen3 x8, support x16 Host merged with P15. Can be configured for REAR-IO.
- Compliant with PCI Express Gen1 through Gen3 computers and IO systems, auto detection.
- The PXH820 supports direct NTB connections to two or three other nodes. Scale out with MXS824 PCIe switch.
- Quad SFF-8644 cable connector
 - Durability max total 250 mating cycles
- Cable port configurations
 - One x16 NTB port
 - Two x8 NTB ports
- Broadcom / Avago / PLX PEX8733 PCI Express Gen3 chipset with DMA.
- 132 nanosecond cut-through latency port to port.
- Support for MiniSAS-HD copper cables up to 9 meters (between PXH820 cards, room temperature).
- Support for PCI Express 3.0 copper cables with CMI.
- Support for active optical fibers up to 100 meters.
- Host clock isolation. Automatic support for host running CFC or SSC mode.
- VAUX powered board management controllers for flexible configuration and cable management.
- EEPROM recovery option.
- No PCI Express power domain isolation.
- Supports both 5- and 12-Volt XMC VPWR power supply.
- Power consumption:
 - 12- or 5-Volt supply: Max 14 Watt, typical 10 Watts without AOC attached.
 - +3.3 Volt AUX: Max 1 Watt
- Port power supply (per cable port): 3.3 Volt +/- 5%, 0.6 A
- Operating Temperature: 0°C - 55°C (32°F - 131°F), Air Flow: 150 LFM
- Operating Temperature with AOC: 0°C - 45°C (32°F - 113°F), Air Flow: 150 LFM
- Relative Humidity: 5% - 95% (non- condensing)
- Regulatory compliance
 - CE
 - RoHS
 - FCC Class A.
 - WEEE

Packaging

The PXH820 includes the following components.

- PXH320 Adapter Board.
- Face plate for SFF-8644 connector.
- 6 screws for fixing the XMC and face plate.
- Anti-static bag.
- Getting started guide with serial number for quick download of Dolphins eXpressWare PCIe software.

Pre-Installation Questions

Certain steps should be taken prior to installing the PXH820. You should determine the following configuration requirements.

- Which XMC slot and system will the card be installed in?
- What is the speed and link width of the XMC carrier that the card will be installed in?
- What is the operating environment for the Host computer?
- What type and length of cables will be used?
- How to ensure proper operational conditions, temperature and air-flow.

PCIe Slot Determination

The PXH820 supports PCIe Gen1, Gen2 and Gen3 speeds and x1, x2, x4, x8 using XMC connector P15 and x16 link-widths using XMC connector P15+P16. The slot width and speed will affect the performance of the card. The card will auto configure to the slot speed and width.

TIP: After installing the eXpressWare software, run the “sisci_benchmarks” benchmark suite to verify the expected performance. Please contact Dolphin support if you need assistance to reach the expected performance.

PXH820 NTB Configuration

The PXH820 has a DIP switch bank to control the main configuration of the card. The DIP switch labeled SW1 can be found close to the upper edge of the board. The default DIP switch setting is single link x16 operations. Alternative configuration settings are two x8 links, or long cable tuning.

Operating Environment

To maximize lifetime for the product and maintain the warranty, please honor the specified operating temperature and make sure the specified air flow is present.

Operating Temperature: 0°C - 55°C (32°F - 131°F), Air Flow: 150 LFM

Operating Temperature with AOC: 0°C - 45°C (32°F - 113°F), Air Flow: 150 LFM

Relative Humidity: 5% - 95% (non- condensing)

TIP: After installing the Dolphin eXpressWare software, you can use the tool dis_diag to determine the actual board temperatures.

Cable Ports and Connections

The PXH820 is designed to support both long and short cables and comes with two types of PCIe link tuning parameters. The default configuration supports cables between 0.5 and 3 meters or fiber cables (AOC). To use cables longer than 3 meters, please use DIP-Switch DIP4 to enable the long cable tuning.

Cable ports

The PXH820 has a quad SFF-8644 connector. Each port implements 4 PCIe lanes. The ports are numbered as shown in Figure 1 Front panel below. The black thick line indicates the position of the PCB.

The PXH820 cable connector is compliant to the SFF-8644 industry specification and supports x4/x8 Mini-SAS HD cables or x4/x8 PCI Express 3.0 cables (PCIe 3.0 cable) compliant to the PCIe External Cabling Specification 3.0. Four x4 or two x8 cables are needed for full PCIe x16 connectivity. Currently, the PXH820 card does not benefit from the new PCIe 3.0 cable, a future firmware release may add support for optional, advanced PCIe networking management if PCIe 3.0 cables are installed.

Active Optical Cables (AOC)

The PXH820 card is compliant with active fiber optic cables available from Dolphin (Part no: MSFCxxx). No special configuration is required. Up to 100-meter fiber cable is supported.

REAR-IO

The PXH820 card is designed to support REAR-IO. Please contact Dolphin for more information.

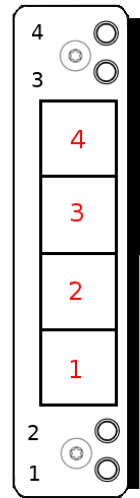


Figure 1 Front panel face plate

Installation

Step 1 - Unpack board

The PXH820 card is shipped in an anti-static bag to prevent static electricity damage. The card should only be removed from the bag after ensuring that anti-static precautions are taken. Static electricity from your clothes or work environment can damage your PCI Express adapter card or your PC. Always wear a grounded anti-static wrist strap while opening the PC and when the PXH820 is removed from the anti-static bag.



Unpack the PXH820 from the anti-static bag using proper anti-static procedures.

Step 2 - Configure the Board for Proper Operation

The PXH820 has one bank of 8 DIP switches. Set the DIP switch settings for the required NTB use case. The default factory setting for the PXH820 is NTB mode, short cable, single (up to x16) link connection.




Configuration PXH820	DIP switch view
1 x16 port (Shipping Default)	
2 x8 ports DIP3 set	
Long cable tuning DIP4 set	

Table 1: PXH820 SW1 configuration settings. DIP3 and DIP4 can be combined.

Step 3 - Install the Adapter Card

Before installing the adapter card, make sure you are properly grounded to avoid static discharges that may destroy your computer or the adapter card. Ensure you are properly grounded before opening your computer or the anti-static bag containing the PXH820. Please follow your computer's or expansion chassis manual on how to install a PCI Express card.



The PXH820 Adapter card can be installed into any XMC 1.0 compliant carrier card. The PXH820 supports PCI Express Gen1, Gen2 and Gen3 signaling. NOTE: A Gen3 slot is recommended as it typically doubles the performance compared to a Gen2 slot. Using the XMC P15 connector, the host link will be up to x8. The PXH820 card supports x16 host connections using both P15 and P16.

The PXH820 supports hosts using either spread spectrum or constant frequency clocking. The card implements clock isolation.

To install the card:

1. Ensure the PXH820 face plate is removed from the SFF8644 connector block.
2. Carefully slide the connector side of the PXH820 card through the carrier card front panel cut out.
3. Carefully align the XMC connectors to the connectors on the carrier card and push the PXH820 and the carrier card together.
4. Mount the 4 screws to fix the PXH820 card to the carrier card.
5. Mount the PXH820 front panel face plate around the SFF-8644 connector block – align the LEDs and the holes in the face plate. Fix the two screws.

Step 4 - Installing and Removing Cables

Installing and removing cables can be done while the systems are running. Hot plugging / removing cables are fully supported.

Connecting Cables

Please carefully install the cable connector into the connector housing on the PXH820 adapter card. To install the cable, match the cable house with the connector on the PXH820 adapter card. Use even pressure to insert the connector until it is secure. Adhere to ESD guidelines when installing the cables to ensure you don't damage the board. Computer cables should always use strain relief to protect the connected equipment from excessive force on the cable. This is especially important for cables between racks. Note that for wider than x4 connections, the same cable-ports (ie port 1 through 4) should be used on both hosts to ensure that the cards properly link up as x8 or x16.

The PXH820 supports both copper and active optical cables (AOC). Specifications can be found in Table 1. The max distance may change if connecting to other PCIe products.

Cable	Speed	Distance
Copper MiniSAS-HD	Gen3	9 meters
Copper PCIe 3.0 cable	Gen3	TBD
Dolphin MSFC Fiber optic cable (AOC)	Gen3	100 meters

Table 1: Cable Specifications

Disconnecting Cables

Please carefully pull the release tab to release the cable from the locking latches and gently pull the cable out of the connector guides.

Step 5 – Installing the Dolphin eXpressWare Software

The PXH820 adapter card is compliant with Dolphin's eXpressWare software package for the PX product line. Please visit

<http://www.dolphinics.com/px.html>

to register and download the latest documentation and software. It is recommended to follow the quick installation guide found on the web page above to install the software for your operating system.

TIP: Dolphin provides software and documentation for several product families; **please remember to select the PX product family before downloading.** The PXH820 requires Dolphin software version DIS 5.14.0 or higher to operate.

The software download requires a password to log in. **The password will automatically be emailed to you if you follow the instructions found on the getting started document bundled with the adapter card.** If you fail to provide the correct serial number found on the getting started document, your request will be managed manually.

Step 6 - Verify Installation & LEDs

The PXH820 comes with 4 bi-color LEDs which show the corresponding cable port status according to Table 2: LED below. Please note that the eXpressWare software must be installed and configured properly to ensure the LEDs are lit correctly.

The LEDs are visible through cut-outs in the PCIe bracket on each side of the cable connector block.

LED color	Function
Off	No cable installed
Yellow	Cable installed, no link
Green	Cable installed, link gen 3
Green blinking	Cable installed, link gen ½

Table 2: LED behavior

Please install the Dolphin eXpressWare software and run the included verification tests as suggested by the software installation procedure and documentation.

Operation and Maintenance

Configuration and DIP Switches

The PXH820 has one bank of 8 DIP switches controlling the operation of the card. The default factory setting for the PXH820 is NTB mode, short cable, and single (up to x16) link connection. Please carefully read the documentation before modifying any DIP switch settings. Please pay close attention to ON and OFF positions written on the DIP switch.

DIP Switch Bank – Configuration

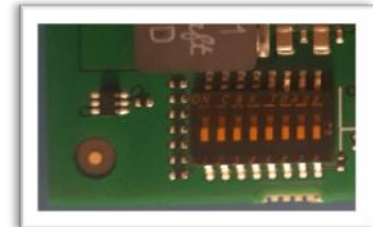


Figure 2: DIP Switch show the bank of DIP switches for the PXH820. It is used to configure the adapter card. Please leave all undocumented DIP switches in the default position. The table below lists all options and DIP switch settings for the card

Figure 2: DIP Switch

DIP no.	Description	ON	OFF	Default
1	Leave in default position	Not used	NTB mode, Normal operation	OFF
2	Leave in default position	Not used	Normal operation	OFF
3	Enable dual x8 link configuration	Dual x8 link on cable ports 1-2 and 3-4	Single x16 link, cable ports 1-4	OFF
4	Enable long-cable configuration	Support cables of 4-9m length	Supports cables of 0.4-3m length or fiber optic cables	OFF
5	TBD	TBD	Normal operation	OFF
6	CMI Disable	Will disable the CMI interface.	CMI will be used if a PCIe 3.0 cable is detected	OFF
7	Holds the management processors in reset	Board management is held in reset	Normal operation	OFF
8	Enables the card to boot if the EEPROM has been corrupted	Safe EEPROM	Normal operation	OFF

Note: Some DIP switch configuration options may be changed in the future versions. Please always consult the latest user guide for details.

Use Cases Summary and Settings

The PXH820 card may be used in the following use cases as summarized in Table 3: Use Case DIP switch settings below.

Use case	Description	DIP switch setting
A	Two node NTB configuration. Both systems have PXH820 or PXH830 installed.	DIP4 on if long cables All other off
B	Three node NTB configuration. All systems have a PXH820 or PXH830 installed	DIP3 on to enable two x8 links DIP4 on if long cables All other off
C	Multi node with MXS824 switch	All DIP Switches off

Table 3: Use Case DIP switch settings

Use Case A - 2 Node Configuration – NTB Mode

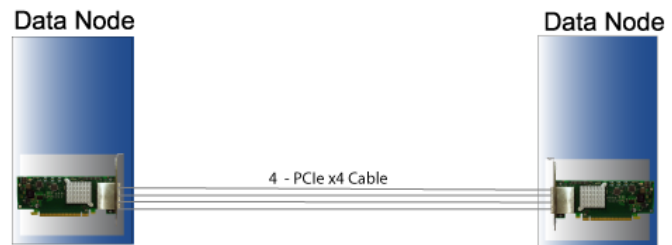
Each node has a PXH820 adapter and a direct x4, x8 or x16 cable connection to the other system having a PXH820 or PXH830 card. Both adapter cards operate in NTB mode. The DIP-Switch is set to all off, except if a long cable is used.

Connecting the cables for 2 Node Configurations, x16 link

To establish an x16 link, a given port number should be connected to the same port number on the other card.

Table 4: Required x16 cabling. Always connect a cable from Port #x to Port #x

Port, Host A	Port, Host B
P1	P1
P2	P2
P3	P3
P4	P4



A failure connecting any of the cables will cause the link to re-train to x8 or x4.

Connecting the cables for 2 Node Configurations, x8 link

To establish an x8 link, please select one of the alternatives below.

Table 5: Alternative x8 cabling, select alternative 1, 2, 3 or 4.

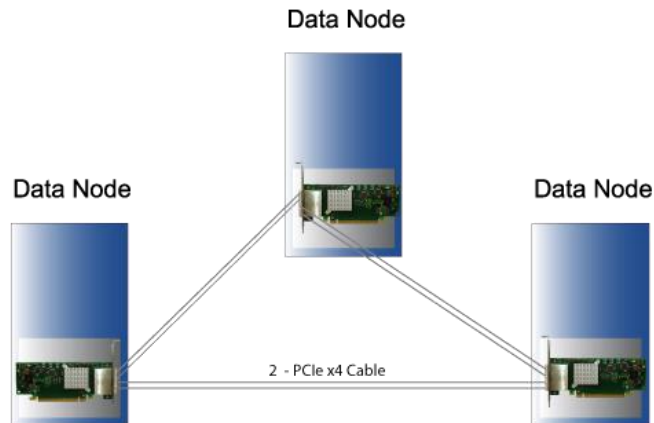
Alternatives	Host A	Host B
1	P1	P1
	P2	P2
2	P1	P3
	P2	P4
3	P3	P1
	P4	P2
4	P3	P3
	P4	P4

Connecting the cables for 2 Node Configurations, x4 link

To establish an x4 link when in dual port mode, please connect any port to any port on the other card.

Use Case B - 3 Node Configuration – NTB Mode

Each node has a PXH820 or PXH830 adapter and a direct x4 or x8 cable connection is used between all systems. All adapter cards operate in NTB mode. The DIP-Switch DIP3 is ON to enable dual port mode.

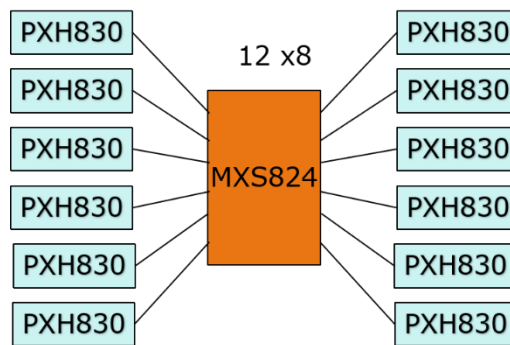


Connecting the cables for 3 Node Configurations, x8 link

Connect the cables between two nodes as described above, connecting two nodes x8. Connect the third node to the two other cards using similar rules. Always connect P1 + P2 to P1 + P2 or P3 + P4

Use Case C - Multi node with MXS824 switch – NTB Mode

Each node has a PXH820 adapter and a direct x4, x8 or x16 cable connection to the MXS824 switch. All PXH820 adapter cards operate in NTB mode. All DIP-Switches are off. The drawing below shows a 12-node cluster using PXH830 cards. Any mix of PXH820 and PXH830 can be used.



Please consult the MXS824 Users Guide for information how to configure the MXS824 switch for x4, x8 or x16 links and how to build larger configurations. Currently, up to 60 systems are supported in one PCIe fabric. Please contact Dolphin for more information.

Firmware Upgrade

The PXH820 design uses a microcontroller (BMC) to implement the PCIe CMI protocol and other maintenance functions. Dolphin may from time to time publish updated firmware for the microcontroller or EEPROM data for the card. Please note that standard PLX firmware tools cannot be used to upgrade the firmware. Please contact Dolphin for more information.

Identifying the Card

The card has a label-sticker with the serial number in the format 'PXH820-YY-ZZZZZ', where YY denotes the card revision (e.g. CC) and ZZZZZ denotes the serialized production number (e.g. 012345) – this whole string makes up the serial number of the card (i.e. PXH820-BB-012345).

You can also get this information using `lspci` in Linux:

First, identify the devices for the Dolphin Host card:

```
#lspci

0a:00.0 PCI bridge: PLX Technology, Inc. Device 8733 (rev ca)
0a:00.1 System peripheral: PLX Technology, Inc. Device 87d0 (rev ca)
0a:00.2 System peripheral: PLX Technology, Inc. Device 87d0 (rev ca)
0b:08.0 PCI bridge: PLX Technology, Inc. Device 8733 (rev ca)
0c:00.0 Bridge: PLX Technology, Inc. PEX 8732 32-lane, 8-Port PCI Express Gen 3 (8.0 GT/s) Switch (rev ca)
```

Then run `lspci`, and identify the card. It will show up as something like

```
[root@metty ~]# lspci -s a:0.0 -v
0a:00.0 PCI bridge: PLX Technology, Inc. Device 8733 (rev ca) (prog-if 00 [Normal decode])
    Flags: bus master, fast devsel, latency 0, IRQ 37, NUMA node 0
    Memory at f4900000 (32-bit, non-prefetchable) [size=256K]
    Bus: primary=0a, secondary=0b, subordinate=0c, sec-latency=0
    Memory behind bridge: f0000000-f48fffff
    Prefetchable memory behind bridge: 0000000040000000-000000007ffffff
    Capabilities: [40] Power Management version 3
    Capabilities: [48] MSI: Enable+ Count=1/8 Maskable+ 64bit+
    Capabilities: [68] Express Upstream Port, MSI 00
    Capabilities: [a4] Subsystem: Dolphin Interconnect Solutions AS Device 0820
    Capabilities: [100] Device Serial Number 00-00-42-42-00-00-00-67
    Capabilities: [fb4] Advanced Error Reporting
    Capabilities: [138] Power Budgeting <?>
    Capabilities: [10c] #19
    Capabilities: [148] Virtual Channel
    Capabilities: [e00] #12
    Capabilities: [b00] Latency Tolerance Reporting
    Capabilities: [b70] Vendor Specific Information: ID=0001 Rev=0 Len=010 <?>
    Kernel driver in use: pcieport
    Kernel modules: shpchp
```

This

shows the card as revision 0x4242 (hexadecimal values of the 'BB' letters in the ASCII table), with the production number 0x00000067 (0000103 in decimal).

Technical Information

PCIe Cable Signals

The external PCI Express cable connector (SFF-8644) and cabling support the following signals:

- PEPn/PETnN: PCI Express Transmitter pairs, labeled where N is the Lane number (starting with 0); “p” is the true signal while “n” is the complement signal.
- PERpN/PERnN: PCI Express Receiver pairs, labeled where N is the Lane number (starting with 0); “p” is the true signal while “n” is the complement signal.
- PWR: Power to support AOC and signal conditioning components within the cable assembly.
- MGTPWR: Power supplied to the connector for cable management components that are needed while the link is not active. This needs to be active if the subsystem has power.
- CBLPRSNT#: Cable present detect, an active-low signal pulled-down by the cable when it is inserted into the PXH820 connector.
- CADDR: Signal used to configure the upstream cable management device address.
- CINT#: Signal asserted by the cable assembly to indicate a need for service via the CMI controller.
- CMISDA: Management interface data line. Used for both initial link setup and sideband messages when used with CMI compliant cables.
- CMISCL: Management interface clock line. Used for both initial link setup and sideband messages when used with CMI compliant cables.

External PCIe x4 Cable Connector Pin-Out

	Column								
Row	9	8	7	6	5	4	3	2	1
D	GND	PETn2	PETp2	GND	PETn1	PETp1	GND	MGTPWR	PWR
C	GND	PETn3	PETp3	GND	PETn0	PETp0	GND	CMISDA	CMISCL
B	GND	PERn2	PERp2	GND	PERn1	PERp1	GND	CBLPRSNT#	PWR
A	GND	PERn3	PERp3	GND	PERn0	PERp0	GND	CINT#	CADDR

Table 6; External PCIe x4 cable Pin-Out

Compliance and Regulatory Testing

EMC Compliance

The Dolphin PCI Express PXH820 adapter has been tested to the following relevant test standards for PCI Express cards, telecommunication and industry equipment installed in a standard PC:

EN 55032:2012,
EN 55035:2017,
EN 61000-3-2:2014,
EN 61000-3-3:2013
CISPR 32:2012 First Edition
CISPR 35:2016 Edition 1.0 (CISPR/I/412/CDV)
47 CFR Part 15, Subpart B (Clause 15.107 and 15.109)



This does not ensure that it will comply with these standards in any random PC. It is the responsibility of the integrator to ensure that their products are compliant with all regulations where their product will be used.

RoHS Compliance

The Dolphin PXH820 is RoHS compliant. A Compliance certificate issued by the manufacturer is available upon request.



FCC Class A

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.



Limited Warranty

Dolphin Interconnect Solutions warrants this product to be free from manufacturing defects under the following terms:

Warranty Period

Dolphin warrants the product for one (1) year from the date of purchase. Extended warranties are available.

Coverage

To the extent permitted by applicable law, this warranty does not apply to:

- Damages caused by operator error or non-compliance with instructions available for the product.
- Use or attempt to use or program firmware not approved by Dolphin.
- Damage which results from accident, abuse, misuse, neglected improper handling or improper installation; moisture, corrosive environments, high voltage surges, shipping or abnormal working conditions.
- Damages which results from violating the specified operating or storage temperatures and airflow.
- Damages caused by acts of nature, e.g. floods, storms, fire, or earthquakes.
- Damage caused by any power source out of range or not provided with the product.
- Normal wear and tear.
- Attempts to repair, modify, open or upgrade the product by personnel or agents not authorized by Dolphin.
- Products that have had the product serial number tampered with or removed.
- Damage to the product caused by products not supplied by Dolphin.

Service Procedure

If the product proves defective during the Warranty Period, you should contact the seller that supplied you with the product, or if you purchased it directly from Dolphin, email returnrequests@dolphinics.com to obtain a valid RMA number and instructions.

Products returned to Dolphin without a proper RMA number will not be serviced under this warranty.

Product Revision history

The following tables gives a general overview of the hardware and firmware capabilities and changes. Please contact Dolphin if you have any questions.

Adapter revision

The adapter revision covers the PCB and BOM changes. The revision can be found on the serial number label located on the card.

Adapter revision	Capabilities / Changes
PXH820-AA	<ul style="list-style-type: none">• Internal version. Early users should return the card to Dolphin.
PXH820-BB	<ul style="list-style-type: none">• Initial production version

BMC Firmware versions

The BMC Firmware version is covering the BMC firmware changes. The current firmware version can be found by running the dis_diag utility. The BMC firmware is field upgradeable.

BMC Firmware version	Capabilities / Changes
8.10	<ul style="list-style-type: none">• Initial production version

EEPROM Versions

The EEPROM Versions is covering the PCIe Switch configuration data. The current EEPROM version can be found by running the dis_diag utility. The EEPROM data is field upgradable.

EEPROM version	Capabilities / Changes
2	<ul style="list-style-type: none">• Initial production version

Support

More information about the product, support and software download can be found at <http://www.dolphinics.com/px.html>. Please email pci-support@dolphinics.com if you have any questions.