PCIe PXH84x Transparent Adapter
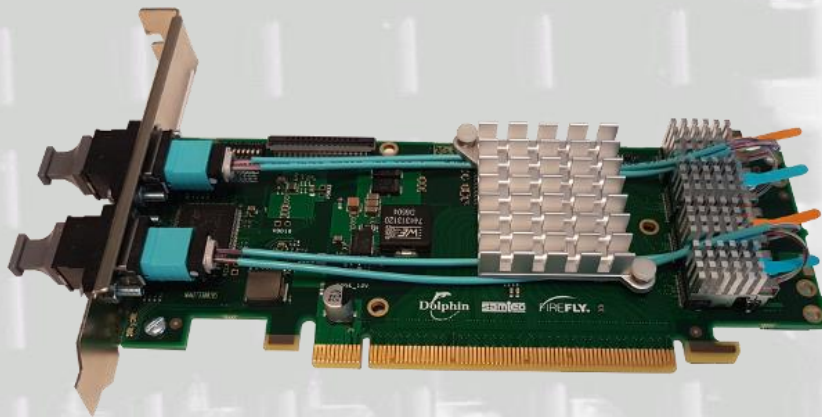

PXH84x Transparent PCIe Adapters users guide
Version 1.18

Date: 23th July 2021

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Terms and acronyms

Important terms and acronyms used in this manual

AOC	**A**ctive **O**ptical **C**able. PCIe fiber cable assembly.
eXpressWare	Dolphins software stack for PCIe clustering and IO. www.dolphinics.com for more information.
FireFly	Optical fiber solution for PCIe over cable from Samtec Inc
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.
Port	The PXH84x cards have one or two MPO (MTP) connectors providing up to four PCIe x4 ports, named L0, L1, L2 and L3. The physical ports are identified by text on the PCIe brackets. Each MPO connector carries two ports. The number of ports depend on the model number.
PXH84x	The term PXH84x is used to reference the family of cards, utilizing different number of FireFly modules and MPO cables. The family consists of both transparent and NTB enabled adapters.

Transparent PXH84x high level specification

The Transparent PXH84x is a family of PCI Express Gen3 Transparent Host and Target card for PCIe IO expansion applications. Dolphin offers various configurations of this board to support various installations of FireFly modules. The standard PXH842 product is a dual FireFly x8 configuration that supports a single x16 or dual x8 PCIe connectivity. The Transparent PXH84x variants are shown in the table below.

Product variants

The card can be ordered with different FireFly optical engines mounted depending on your use case and requirements:

SKU / Model	#FireFly	PCIe Configurations	Required Fiber cable
PXH842	2 x8	Transparent x16 / 2 x8	2 units 24 fiber MPO
PXH845	4 x4	Transparent x16 / 2 x8 / 4 x4	4 units 12 fiber MPO
PXH846	1 x8	Transparent x8	1 unit 24 fiber MPO
PXH847	2 x4	Transparent x8 / 2 x4	2 units 12 fiber MPO
PXH848	1 x4	Transparent x4	1 unit 12 fiber MPO

NOTE: Please note that cards utilizing 24 fiber MPO cannot be connected to cards utilizing 12 fiber MPO.

The PXH84x supports PCIe Gen1, Gen2 and Gen3 speeds and x4, x8 and x16 link-widths depending on the number of FireFly modules mounted. The card will operate at the highest common speed shared between the slot and the card (Gen3) and the widest common link-width (x16).

- PCI Express Base Specification, Rev. 3.0.
- PCI Express CEM Specification, Rev. 3.0.
- PCI Express Gen3 8.0 GT/s per lane signaling – up to 128 GT/s total signaling.
- PCI Express Gen3 x16 edge connector. The card installs in any PCI Express slot that has a physical x16 connector. The slot may have any electrical width x1 – x16.
- Compliant with PCI Express Gen1 through Gen3 computers and IO systems, auto detection.
- MPO cable connector
- PXH84x card variants supports connecting to 1 – 4 target devices
- Transparent Cable port configurations, up to
  - One x16
  - Two x8
  - Four x4 (Supported using PXH846 only)
- Broadcom / Avago / PLX PEX8733 PCI Express Gen3 chipset.
- 132 nanosecond cut-through latency port to port.
- Support for active optical fibers up to 100 meters.
- Low profile, Half-length form factor - Dimensions 167.8mm x 68.9 mm.
- Weight 140 Grams with 4 FireFly, heat sink and full-height bracket mounted.
- Comes with standard profile PCI Express bracket. Low profile bracket option available, please contact Dolphin for more information.
- 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.
- PCI Express power domain isolation.
- Power consumption (preliminary):
  - 12 Volt: Max 18 Watt, typical 14 Watts with 4 FireFlys attached.
  - Port power (per cable port): 3.3 Volt +/- 5%, 0.6 A
- Operational Environment
  - Operating Temperature: 0°C - 55°C (32°F - 131°F), Air Flow: 150 LFM
  - Relative Humidity: 5% - 95% (non- condensing)
- Regulatory
  - CE
  - Compliant to EN-55022 (2010), EN 55024 (2010), Class A.
  - RoHS
  - FCC Class A.

- o   WEEE
- Safety Standards
  - o   UL 62368-1 and CAN/CSA C22.2 No. 62368-1-14

MTBF by Temperature and Environment

The MTBF (in hours) for the PXH842 can be found in the table below. The numbers are calculated using the Telcordia SR-332 issue 2 (2006) standard.

Ambient Temp [°C]	Environment		
	Ground fixed, controlled	Ground fixed, uncontrolled	Ground mobile
0	2.502.014	1.251.007	417.002
5	1.997.375	998.688	332.896
10	1.594.418	797.209	265.736
15	1.274.114	637.057	212.352
20	1.020.169	510.084	170.028
25	819.034	409.517	136.506
30	659.679	329.839	109.946
35	533.255	266.628	88.876
40	432.743	216.372	72.124
45	352.611	176.306	58.769
50	288.522	144.261	48.087
55	237.081	118.540	39.513

Table 1: MTBF vs. Temperature and Environment

Packaging

The PXH84x includes the following components.

- PXH84x Adapter Board with a full height PCIe bracket mounted
- Anti-static bag
- Getting started guide with serial number for quick download of Transparent Board Management software with Dolphin's eXpressWare PCIe software.

Pre-Installation Questions

Certain steps should be taken prior to installing the PXH84x. You should determine the following configuration requirements.

- Which PCIe slot and system will the card be installed in?
- What is the speed and link width of the slot that the card will be installed in?
- What is the operating environment in which the card will be installed?
- What width and length of cables will be used?
- Proper operational conditions, temperature, airflow.

PCIe Slot determination

The PXH84x supports PCIe Gen1, Gen2 and Gen3 speeds and x1, x2, x4, x8 and x16 link-widths. The slot width and speed will affect the performance of the card. The card can be physically installed in an x4, x8 or x16 connector. The card will auto configure to the slot speed and width.

- Install the board in a slot connecting directly to the CPU for optimal shared memory performance.
- Install the board behind a PCIe switch in the IO system for optimal PCIe peer to peer performance (e.g. between GPUs, FPGAs)

PXH84x Configuration

The PXH84x 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 Transparent Host single link. Alternative configuration settings are depend on the model. All cards supports both Host and Target operation.

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. Special care should be considered when PXH84x is used in office type cabinets in combination with other high energy consuming PCIe devices, e.g. not active cooled GPUs (preliminary):

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 Transparent Board management software, you can use the tool dis_diag to determine the actual board temperatures.

Cable Connections

The PXH84x cards utilizes the PCIe FireFly optical transceivers from Samtec. The card supports any length up to 100 meters without any special PCIe tuning. The requirement for the fiber patch cable is:

The card can be ordered with different FireFly optical engines mounted depending on your use case and requirements:

SKU / Model	Max number of cables	Patch cable
PXH842	2	MPO female, 24 fibers, OM3 50/125, Key up - Key up (Type C) cables.
PXH846	1	
PXH845	4	MPO female, 12 fibers, OM3 50/125, Key up - Key up (Type B) cables.
PXH847	2	
PXH848	1	

NOTE: Please note that the 24 fiber and 12 fiber MPO patch cables cannot be interchanged.

Transparent Use Cases

The transparent PXH84x card may be used as both a Host card and a Target card. A Host and Target card can be used as a pair or the Host card can be used with a compliant Target device. The supported use cases and the DIP switch settings are summarized in section "Step 3 - Configure the board for proper operation" on page 10.

Transparent Use Case A - 1 Host – Single Expansion Configuration

The Host system has a PXH842 adapter configured for Transparent Host operation and a direct x4, x8 or x16 link to a PXH842 configured for Transparent Target operation.

Connecting the cables for single expansion, x16 link
To establish an x16 link, a given port number should be connected to the same port number on the other card.
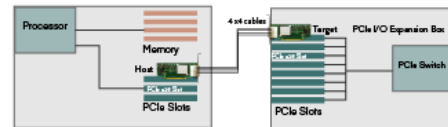
 Always connect a cable from Port Lx to Port Lx

Figure 1: Use Case C

Port Host A	Port Expansion
L0/L1	L0/L1
L2/L3	L2/L3

   Table 2: Required x16 cabling

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

Connecting the cables for single expansion, x8 link
To establish an x8 link, please connect a cable from port L0/L1 on the host card to port L0/L1 on the target card.

Transparent Use Case B – 1 Host - Dual Expansion Configuration

The host has a PXH842 adapter configured for Transparent Host operation and two x8 cable connection is used to connect two independent downstream target systems.

Connecting the cables for Single Node Dual expansion, x8 link
Connect a cable between any port (L0/L1 or L2/L3) on the host card to the selected expansion. The L0/L1 port should always be used on the target card.

Figure 2: Use Case D

Transparent Use Case C – 1 Host - Quad Expansion Configuration

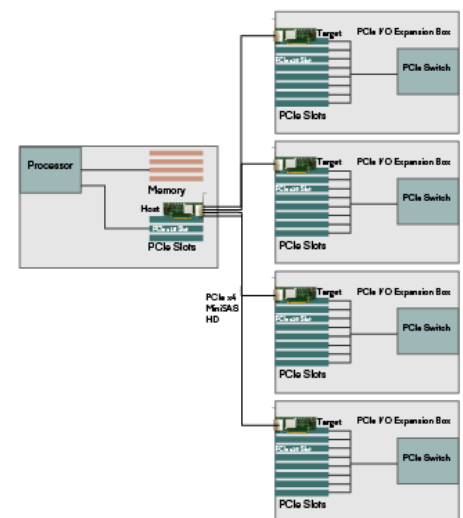This configuration is only available with the PXH845 adapter card.

Figure 3: Use Case E

Installation

Step 1 - Unpack board

The PXH84x 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 PXH84x card is removed from the anti-static bag. Not following these guidelines will void the warranty.

Step 3 - Configure the board for proper operation

The PXH84x board must be configured using the DIP Switch to meet your specific use case. Some of the configurations are only available with the latest firmware update, please consult the PXH842 Firmware Release Note for details.

DIP-Switch settings for Transparent Host operation
The following DIP-Switch settings used when configuring the PXH842 for Transparent Host operation:

Transparent Host Configuration PXH842	DIP switch view
Transparent Host (OPT1) One x16 port	
Transparent Host (OPT1) Two x8 ports (OPT3 set)	
Transparent Host (OPT1) Four x4 ports (OPT4 set)	

Table 3: PXH842 SW1 Transparent Host configuration settings

DIP-Switch settings for Transparent Target operation
The following DIP-Switch setting should be used for all Transparent Target configurations, supports all link widths:

Transparent Target Configuration PXH84x	DIP switch view
Standard Transparent target configurasjon Transparent (OPT1) Transparent Target (OPT2) (Supports all link widths)	
Hot Add Target with PXH840 Host operation Transparent (OPT1) Transparent Target (OPT2) Link Down Reset (OPT6) (Supports all link widths)	

Table 4: PXH84x SW1 Transparent Target configuration settings

Step 4 - 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 PXH84x. Please follow your computer's or expansion chassis manual on how to install a PCI Express card.

The PXH84x Adapter card can be installed into any PCI Express x16 slot. The PXH84x 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. The PXH842 is an x16 card, so maximum performance will only be attained if the slot provides full electrical x16 signaling.

The PXH84x supports hosts using either spread spectrum or constant frequency clocking. The card implements clock isolation.

Step 5 - Installing and Removing Cables

Installing and removing PCIe cables in Transparent mode must be done before powering on the systems, hot plugging and replacing cables are normally not supported. The fiber optic cable(s) are connected to the MPO connector(s) found on the PCIe bracket. The bracket will have one or two, single or dual MPO connectors depending on the board configuration.

Connecting Cables

Please carefully install the MPO fiber patch cable connector into the connector housing on the PXH84x adapter card. To install the cable, match the cable house color with the MPO connector on the PXH84x adapter card. Use even pressure to insert the connector until it is secure. 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.

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.

Figure 4 PCIe Bracket

Step 5 - Verify Installation

The PXH84x comes with a set of LEDs to verify proper configuration. Table 5: LED below is a chart of the LEDs and their corresponding meaning.

The card has four bi-color Link-LEDs visible through the PCI Express front bracket.

LED color	Function
Off	No cable installed
Yellow	Cable installed, no link
Green	Link up, PCIe Gen 3 speed
Green blinking	Link up, PCIe Gen 1 or 2 speed

Table 5: LED behavior
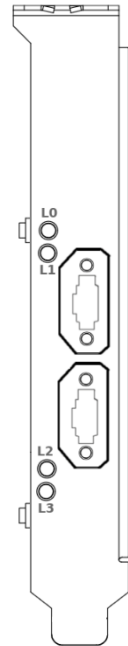
Operation and Maintenance

Configuration and DIP Switches

The PXH84x has one bank of 8 DIP switches. The default factory setting for the PXH842 is Transparent Host x16 mode. 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.
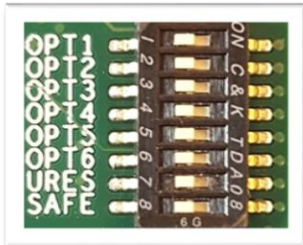
DIP Switch Bank – Configuration

Figure 5: DIP Switch shows the DIP switch for the PXH84x. It is used to configure the adapter card. Please leave all undocumented DIP switches in the default position. The table below shows all the various DIP switch settings for the PXH842.

Figure 5: DIP Switch

DIP no.	Name	Description	ON	OFF	Default
1	OPT1	Must be ON for Transparent Host and Transparent Target mode	Transparent mode	Not supported	ON
2	OPT2	Configures a Transparent card to Host or Target mode.	Enable Transparent Target operation.	Transparent Host (depends on DIP 1)	OFF
3	OPT3	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	OPT4	Enable quad link configuration for Transparent.	Quad x4 link on cable port 1,2,3,4		OFF
5	OPT5	Reserved for future use, must be off	Not supported	Normal operation	OFF
6	OPT6	Enable Link Down Reset for hot add, introduced in firmware 8.10 and newer.	Enable Link Down Reset for hot add operations	Normal FireFly reset	OFF
7	UTRES	Holds the management processors in reset	Board management is held in reset	Normal operation	OFF
8	SAFE	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.

Firmware upgrade

The PXH84x card uses a microcontroller to implement configuration, management and 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. More information can be found in the PXH84x Firmware Release Note.

Identifying the Card

The card has a label-sticker with the serial number in the format 'PXH84x-YY-ZZZZZZ', where YY denotes the card revision (e.g. CC) and ZZZZZZ denotes the serialized production number (e.g. 012345) – this whole string makes up the serial number of the card (i.e. PXH842-CC-012345).

You can also get this information using lspci in Linux:

First, identify the devices for the Dolphin Host card:

```
# lspci | grep "Device 8733"

01:00.0 PCI bridge: PLX Technology, Inc. Device 8733 (rev ca)
02:08.0 PCI bridge: PLX Technology, Inc. Device 8733 (rev ca)
```

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

```
# lspci -s 1:0.0 -v
01:00.0 PCI bridge: PLX Technology, Inc. Device 8733 (rev ca) (prog-if 00 [Normal decode])
Flags: bus master, fast devsel, latency 0, IRQ 25
Memory at f7d00000 (32-bit, non-prefetchable) [size=256K]
Bus: primary=01, secondary=02, subordinate=03, sec-latency=0
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 0832
Capabilities: [100] Device Serial Number 00-00-43-43-00-00-00-0a
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
```

Second, do

```
# lspci -s 1:0.0 -v | grep -E "Subsystem|Serial"
        Capabilities: [a4] Subsystem: Dolphin Interconnect Solutions AS Device 0832
        Capabilities: [100] Device Serial Number 00-00-43-43-00-00-00-0a
```

This shows the card as revision 0x4243 (hexadecimal values of the 'CC' letters in the ASCII table), with the production number 0x0000000A (0000010 in decimal).

Support

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

Technical Information

Please reference the FireFly PCUO manual available from Samtec for more information on the Samtec FireFly optical engines.

Compliance and Regulatory Testing

EMC Compliance

The PXH84x adapter is tested to comply to the following relevant test standards for PCI Express cards, telecommunication and industry equipment installed in a standard PC:

EN 55022 (2010), Class B
EN 55024 (2010), Class A

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 PXH84 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.

Laser Eye Safety

The PXH84x series is classified as a Class 1 laser.

Class 1 LASER PRODUCT
per IEC 60825-1 Ed. 2 (2007)

Complies with FDA performance standards for laser products except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007.
Caution – Use of controls or adjustment or performance of procedures other than those specified herein may result in hazardous radiation exposure.

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 result 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.