Dolphin cPCI-s System Switch Module MXC960

MXC960 Users Guide

Version 1.2

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PCI Express External Cabling specification 4.0 is, as of the release of MXC960, not completed and ratified by the PCI-SIG. The MXC960 is designed to the new specification, but Dolphin cannot guarantee the card will be compliant to the final 3.0 version. Dolphin firmware tools can update the CMI implementation.

LIFE SUPPORT POLICY

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ENVIRONMENTAL POLICY

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

Scope

This version of the MXC960 Users Guide is valid for BMC firmware version 3.5 and newer.

Terms and Acronyms

Important terms and acronyms used in this manual

AOC	**A**ctive **O**ptical **C**able. PCIe fiber cable assembly available from Dolphin. SFF-8644 connectors.
CMI	**C**able **M**anagement **I**nterface. The 2-wire management interface for communication between subsystems connected by a PCIe 4.0 cable. Details can be found in the PCI-SIG External Cabling Specification 4.0.
BMC	Board Management Controller - Microcontroller on the MXC960 used to manage and implement CMI communications.
eXpressWare	Dolphin's software stack for PCIe clustering and IO. Please visit www.dolphinics.com/software 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.
PCIe 4.0 cable	Cable compliant to the PCI-SIG External Cabling Specification 4.0. Support for CMI. SFF-8644 connector.
Port	PCIe Cable port. The MXC960 has four x4 ports, named P1, P2, P3, P4. These ports can be merged into two x8 ports, or one x16 port. The physical ports are identified by text on the PCIe brackets.
Wake	A mechanism used by a downstream device to request the reapplication of PC main power when in the L2 Link state / Power mode.

Introduction

This user's guide covers Dolphin's MXC960 cPCI-S module. The MXC960 is fully supported by Dolphins eXpressWare software. Please consult the www.dolphinics.com/software for details.

MXC960 High Level Specification

The MXC960 is CPCI-s system switch module and supports the following configurations

- PCIe 4.0 uplink to a standard PC for CPCI-s software control
- Connectivity between two or more MXC960 based systems
- Connectivity from cPCI-s based systems to PXIe and other industry standards

MXC960 Detailed Specification

- Single System Slot 3U
- PICMG® CPCI-S.0 Specification R2.0
- PCI Express Base Specification, Rev. 4.0
- PCI Express External Cabling specification 4.0
- Microchip Switchtec PM40084 PFX PCIe 4.0 switch
  - 120 nanosecond cut-through latency port to port
  - Support for Common clocking, SRNS and SRIS
- 1G Ethernet switch
  - Broadcom BCM53158
  - 8 backplane ports 1 Gb/s Auto negotiation
  - 2 RJ45 Front Panel Ports 1 Gb/s Fixed speed, 1Gb/s Only
- PCIe Cable ports:
  - Quad SFF-8644 cable connector
  - PCIe 4.0 16.0 GT/s per lane signaling – 256 GT/s total signaling.
  - Compliant with PCI Express 1.0 through PCIe 4.0 - auto detection
  - Support for PCIe4L copper cables 0.5-5 meters
  - Support for MSF4C and MSP4M fiber cables (AOC) up to 100 meters
  - Durability max total 250 mating cycles
- Backplane ports:
  - PCIe 3.0 using Airmax VS connector, total 40 lanes, up to 8 ports
  - Compliant to PCI Express 1.0 through PCIe 3.0 - auto detection
  - 8 Ethernet 1G, Auto negotiation
- Onboard M.2 Slot
  - Support for 2280 Key M M.2
  - PCIe 4.0 x4
- Support for PCIe Wake functionality
- Automatic Thermal Shutdown to avoid hardware damages (can be disabled)
- VAUX powered board management controllers for flexible configuration and cable management
- Flash recovery option. PFX Multi configuration support
- Relative Humidity: 5% - 95% (non- condensing)
- CE and FCC markings

Packaging

The MXC960 product is delivered in a retail box including the following components.

- MXC960 module
- Anti-static bag
- Getting started guide

CPCI-s System Switch Slot

The MXC960 must be placed in the CPCI-s system switch slot. The MXC960 supports PCIe 1.0, 2.0, and 3.0 speeds. The module will auto-configure the slot speed and width to match the connected equipment. Alternative backplane configuration can be supported, please contact Dolphin for more information.

MXC960 Configuration

The MXC960 cable ports can either be configured as a single x4 / x8 / x16 PCIe target for connecting to a MXH932 configured for host opeation or in daisy-chanin mode for connecting x4 / x8 to the host and a single x4 / x8 to a downstream MXC960.
The default DIP switch setting is transparent target x4 / x8 / x16 operations.

Thermal Shutdown

The MXC960 module includes over-temperature overheat protection. The BMC will automatically shut down the MXC960 if a PCIe switch temperature beyond 105°C (221°F) is detected. Similarly, if an AOC is plugged in, the MXC960 module will automatically shut down if the max operating temperature announced by the connected AOC is reached. Please consult the AOC data sheet for details.

NOTE: The MXC960 link LEDs will start flashing yellow when a PCIe switch temperature of 95°C (203°F) is reached or when the AOC reports a temperature 5°C (41°F) lower than the max operating temperature.

NOTE: The automatic shutdown can be disabled by setting DIP switch SW2-4. Prior to disabling the automatic shutdown, please ensure you have established proper airflow.

PCIe Wake

The MXC960 supports PCIe Wake functionality. To utilize this functionality, you need to set the PXH924 DIP-SW2-2 / Enable Wake to ON position and use PCIe 4.0 cables to connect to the MXH932. PCIe Wake must also be enabled in the System BIOS.

Airflow - 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.

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

Cable Connections

The MXC960 is designed to support both long and short PCIe copper cables as well as PCIe active optical cables (AOC).

The MXC960 cable ports are compliant to the PCIe External Cabling Specification 4.0. Four x4 cables are needed for full PCIe x16 connectivity.

PCI Express 4.0 Cables

When used with cables compliant to the new PCIe External Cable standard 4.0, the MXC960 module will transmit a CMI Reset message downstream. The module can be connected to a MXC960 in Target mode or any PCIe device compliant to the new cable standard.

CMI Functionality

The MXC960 BMC firmware release 2.4 and newer supports the following CMI operations when used with PCIe 4.0 cables:

- Publishes card and CMI status information in readable memory map
- Supports sending and receiving CMI reset, wake and power status messages
- Supports receiving indicators (LED/messages).

Active Optical PCIe Cables (AOC)

Dolphin offers active optical PCIe fiber cables up to 100 meters for the MXC960 module. PCIe AOC cables do not support CWAKE and CPOWERON functionality.

Installation

Step 1 - Unpack board

The MXC960 module is shipped in an anti-static bag to prevent static electricity damage. The module 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 MXH924 module or your CPCI-s components. Always wear a grounded anti-static wrist strap while the MXC960 is removed from the anti-static bag until it is properly installed in the CPCI-s chassis.

Unpack the MXC960 from the anti-static bag using proper anti-static procedures.

Step 2 - Configure the Board for Proper Operation

Set the DIP switch to enable the desired functionality and configuration. Please refer to the section Configuration and DIP Switches on page 10 for details.

Step 3 - Ensure proper Airflow

Please pay proper attention to ensure the selected chassis provides the minimum required airflow.

TIP: Immediately after installing the software, please use the dis_diag tool to verify the temperature. If the chip temperature reported by dis_diag exceeds 95°C, it is strongly recommended to improve the airflow.

Step 4 - Install the MXC960

Before installing the module, make sure you are properly grounded to avoid static discharges that may destroy your computer or the CPCI-s module. Ensure you are properly grounded before opening your CPCI-s chassis or the anti-static bag containing the MXC960. Please follow your CPCI-s chassis manual on how to install a CPCI-s System switch module.

Please review the list of supported and approved CPCI-s chassis.

Step 5 - Installing and Removing the Cable

Installing and removing cables should be done with the CPCI-s chassis powered off.

Connecting the Cable

Please carefully install the cable connector into the connector housing on the MXC960 module. Cable port 1 is located at the top of the face plate bracket. To install the cable, match the cable house with the connector on the MXC960. 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.

Cable stain relief

Strain-relief on the PCIe cables are important to protect the PCIe card from fatigue loading and damage. The cable should be mechanically connected to the rack or cabinet. This is especially important for long heavy cables and cables going between cabinets and racks.

Supported cable lengths

The MXC960 supports both copper and active optical PCIe cables (AOC). Maximum lengths between two MXC960 modules can be found in Table 1 below. The maximum distance may change when connecting to other PCIe products.

Cable	Dolphin SKU	Speed	Max Distance
PCIe 4.0 copper cables	PCIe4L-xM	PCIe 4.0	5 meters
PCIe Active Optical cables (AOC)	MSF4C-xM	PCIe 4.0	100 meters
PCIe Active Optical cables (AOC) Pigtail + Patch cable	MSP4M-1M + MTFCFF-xM	PCIe 4.0	102 meters

Table 1: Cable Specifications

Disconnecting the Cable

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 7 - Verify Installation & LEDs

The MXC960 comes with 4 LEDs, which show the corresponding cable port status according to Table 2: LED below.
The LEDs are visible through cut-outs in the front panel below each port.

LED color	Function
Off	No cable installed, or CPCI-s not powered
Yellow	Cable installed, no link
Yellow blinking	Temperature overheat warning, please immediately improve cooling to avoid thermal damage or system shutdown.
Green blinking	Cable installed, link operational at lower than PCIe 4.0 speed
Green	Cable installed, link operational at PCIe 4.0 speed
Red blink	Link Reset

Table 2: LED behavior

Operation

Configuration and DIP Switches

The MXC960 has one bank of 8 DIP switches. The default factory setting for the MXC960 is Transparent Target mode, single (up to x16) link connection.

The MXC960 has DIP switches for setting special modes or operations, the meaning of each DIP switch depends on the loaded firmware. Please carefully read this section before modifying any DIP switch settings. Please pay close attention to ON and OFF positions written on the DIP switch.

DIP Switches

Figure 1: DIP Switch shows the DIP switch for the MXC960. It is used to configure the CPCI-s module. Please leave all undocumented DIP switches in the default position. Error! Reference source not found. **Table 3: DIP SW1 settings**

3 shows all the various DIP switch settings for the MXC960.

Note: DIP switch configuration options may be changed in the future versions. Please always consult the latest user guide for details. The table above is valid for BMC version 3.5.

Figure 1: DIP Switch

DIP no.	Description	ON	OFF	Default
1-5	Configuration selector, details below			OFF
6	Thermal Shutdown Disable	Will disable thermal shutdown	The card will shut down on thermal overload.	OFF
7	Holds the management processors in reset. Do NOT ACTIVATE without instructions from Dolphin.	Board management is held in reset	Normal operation	OFF
8	Do NOT ACTIVATE without instructions from Dolphin.	Do not activate without instructions from Dolphin	Normal operation	OFF

Table 3: DIP SW1 settings

3

Configuration Selection

The DIP Switch settings below should be considered when configuring the **MXC960. The configuration that fits best in your use case depends on several factors including backplane configuration, hot plug support, and daisy chaining. If none of these configurations matches your use case, please contact Dolphin support.**

Config	Use Case	Configuration MXC960	DIP SW1	DIP switch view
1	D	• D-Switch NTB • 256MB BAR • 2 CPUs in chassis • 1 CPU connected via cable ports	**1:ON**	
2	D	• D-Switch NTB • 256MB BAR • 2 CPUs in chassis • Downstream cable ports	**2:ON**	
3	D	• D-Switch NTB • 32GB BAR • 2 CPUs in chassis • Downstream cable ports	**1:ON** **2:ON**	
8	A+B+C	• NTB x16 cable ports • NTB x8 link to CPU in system slot • 256MB BAR	**4:ON**	
9	A+B+C	• NTB x16 cable ports • NTB x8 link to CPU in system slot • 32GB BAR	**1:ON** **4:ON**	

Use Cases

The MXC960 module can be used to connect the CPCI-s chassis to a PC utilizing a MXH930 or to another CPCI-s chassis utilizing another MXC960. The Dolphin PCIe 4.0 MXS924 rack-mount switch can be used to create larger systems. The supported use cases and the DIP switch settings are summarized in section Configuration and DIP Switches on page 10. DIP-Switch settings for the MXH932 card can be found in the MXH932 Users Guide available from www.dolphinics.com.

Use Case A – Two node – Single cPCI-s Configuration - PCIe x16

The server has an MXH930 NTB adapter and is directly connected to the MXC960. If you are not using all four ports, please always start connecting the lower port numbers.

MXC960 is placed in the first slot. Slot 2-3 is x8, Slot 4-8 is x4. The MXC960 will provide the clock and reset to slot 2-8

The MXC960 DIP Switch should be set to Config 8 (DIP #4 ON): NTB with 256MB BAR.

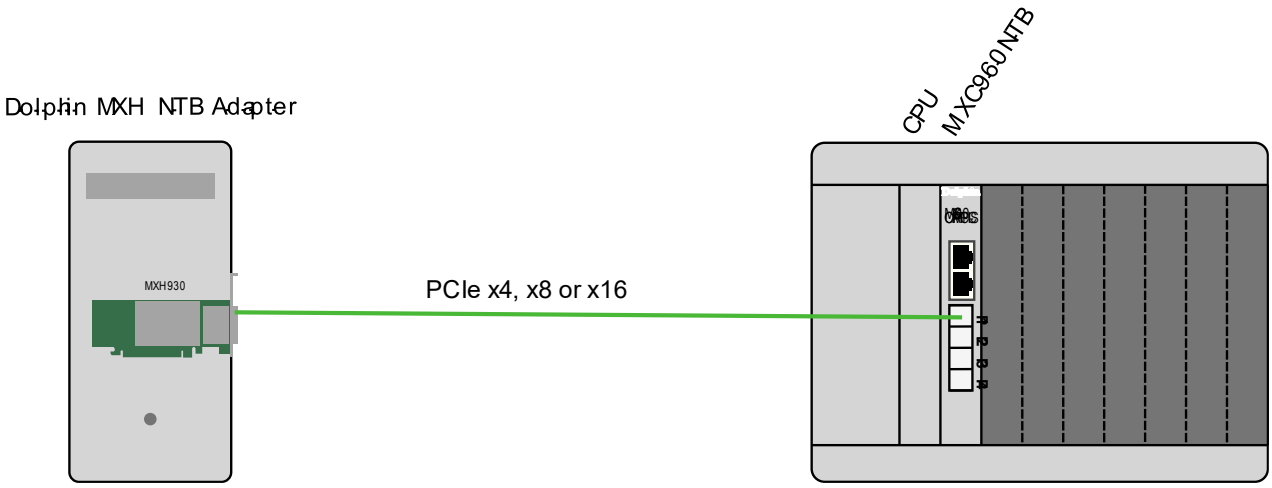


Figure 2: Use Case A

MXH930 ports	MXC960 ports
P1	P1
P2	P2
P3	P3
P4	P4

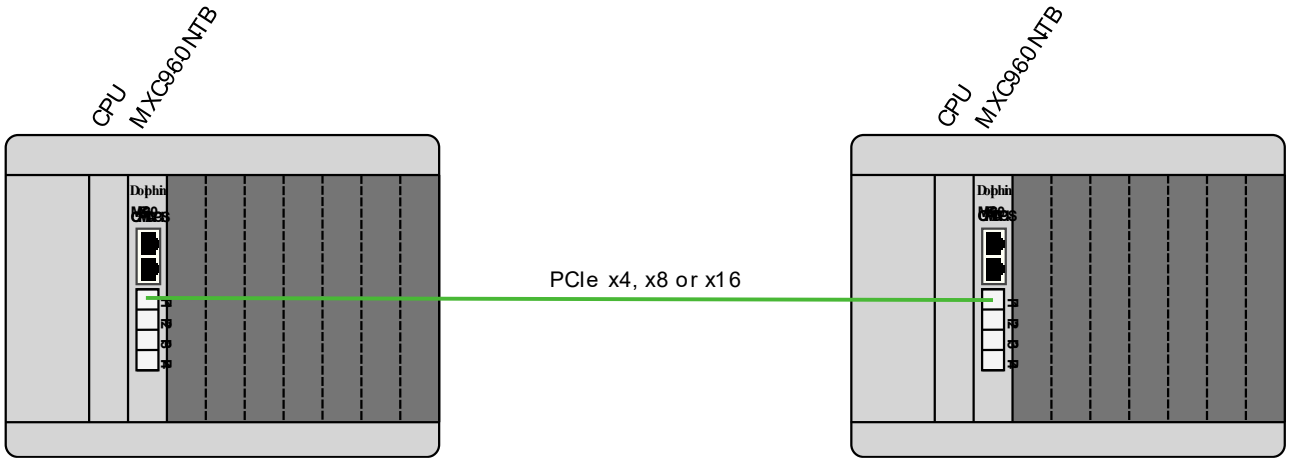
Table 4: Required x16 cabling

Always connect a cable from Port #x to Port #x
A failure connecting any of the cables will cause the link to re-train to x8 or x4.

Use Case B – Two node - PCIe x16

The MXC960 is connected directly to another MXC960. Supports x4, x8 or x16 connectivity.

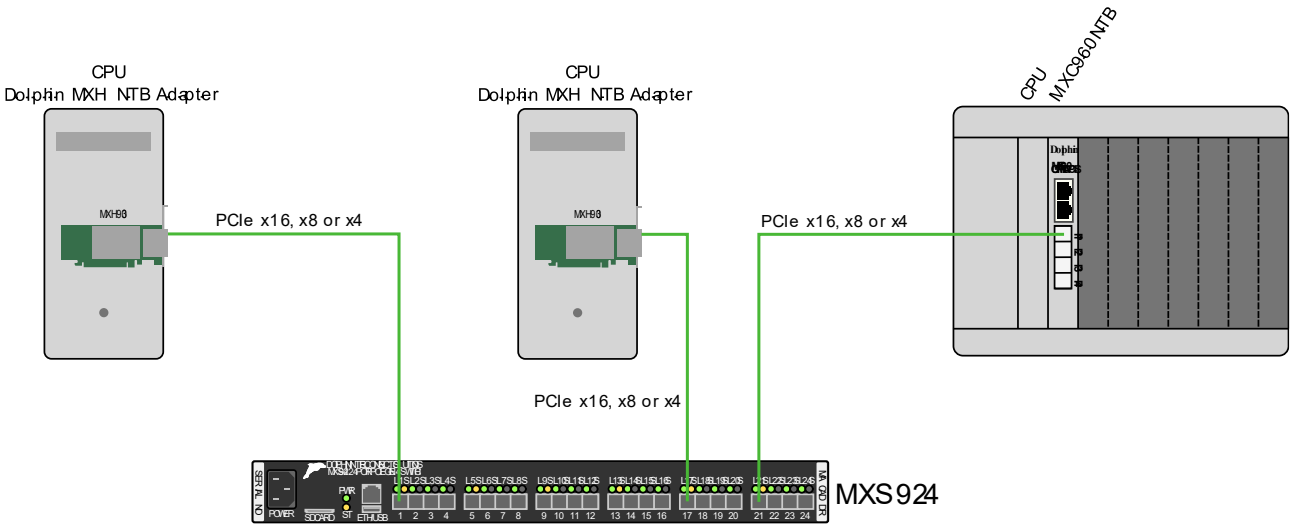
Both MXC960s should use Config #8 (DIP #4 ON). Config #9 (DIP #1 & #4 ON) is identical to config #8 with an increased BAR size of 32GB.

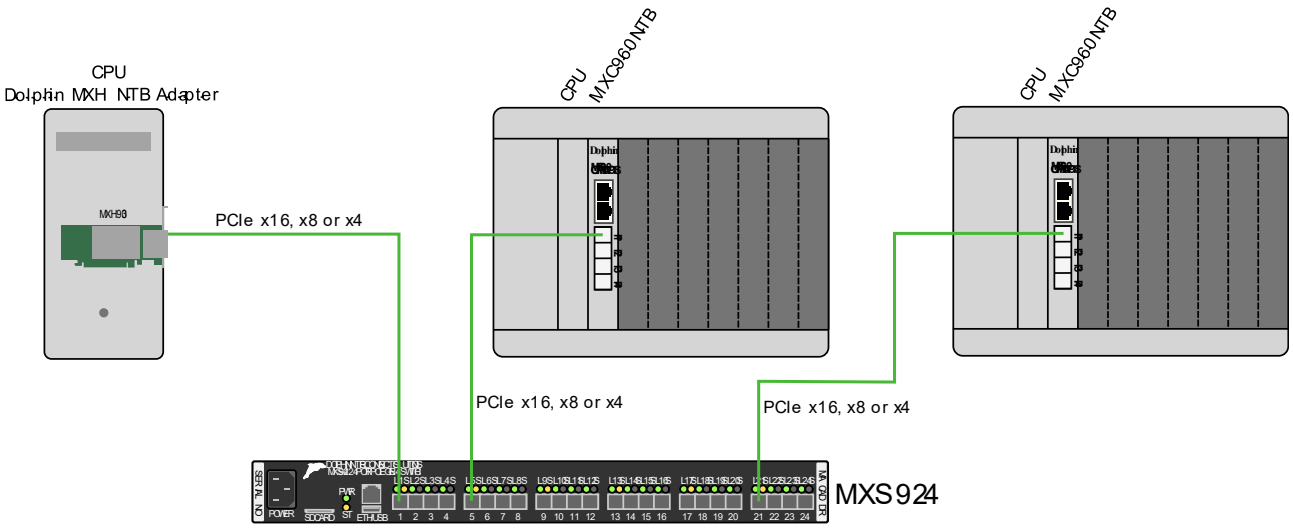


Use Case C – Multiple nodes – MXS924 - PCIe x16

The MXC960 is connected to a Dolphin PCIe 4.0 MXS924 rack-mount switch. Through the switch, the MXC960 can be connected to other Dolphin MX NTB adapter cards, such as the MXH930, or additional MXC960 adapters. Multiple MXS924 switches can be connected to create larger clusters.

The MXC960 adapter should use Config #8 (DIP #4 ON): NTB with 256MB BAR or Config #9 (DIP #1 & #4 ON): NTB with 32GB BAR.





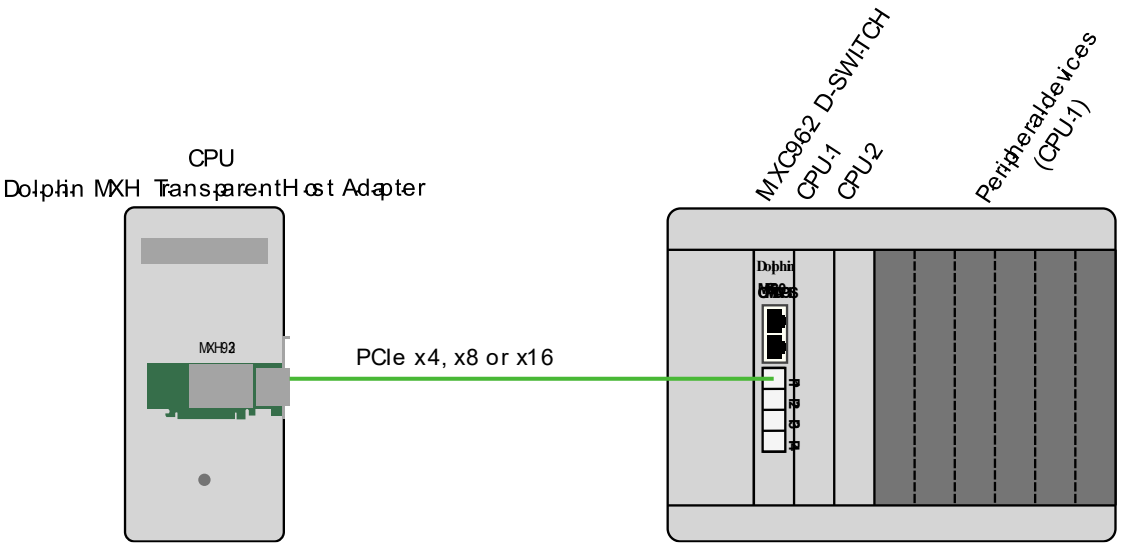
Use Case D – D-Switch

D-Switch mode is used to connect multiple CPUs to a single MXC960 adapter card. The current set of configurations supports up to three CPUs connected to the switch.

Config #1 (DIP #1 ON) supports two CPUs in the cPCI chassis, as well as an additional CPU connected via the cable ports to a Dolphin MX transparent host adapter card, such as the MXH932. The BAR size for this configuration is 256MB.

Config #2 (DIP #2 ON) supports two CPUs in the cPCI chassis. In this configuration, the cable ports act as downstream ports that can be used to add additional peripheral devices. This can be achieved using a Dolphin transparent target adapter, such as the MXH932, or an additional cPCI chassis with an MXC962. The BAR size for this configuration is 256MB.

Config #3 (DIP #1 & #2 ON) is identical to config #2, but with an increased BAR size of 32GB.



EEPROM and Firmware Upgrade

The MXC960 design uses a Board Management Controller (BMC) to implement the PCIe CMI protocol, reset, and other maintenance functions. Dolphin may, from time to time publish updated firmware for the BMC, PCIe switch, or EEPROM data for the card.

WARNING: Please note that standard Microchip tools (ChipLink) cannot be used to upgrade the firmware, as this will violate the warranty. Please contact Dolphin for instructions on upgrading the MXC960 firmware.

Note: Please consult the MXC960 Firmware Release Note for details on supported configurations.

Identifying the CPCI-s module

The module has a label-sticker with the serial number in the format 'MXC960-YY-ZZZZZZ', where YY denotes the revision (e.g. BB) and ZZZZZZ denotes the serialized production number (e.g. 012345) – this whole string makes up the serial number of the module (i.e. MXC960-CC-012345).

You can also get this information using lspci in Linux:

First, identify the devices for the Dolphin Host card:

```
# lspci | grep "Device 4084"

01:00.0 PCI bridge: PMC-Sierra Inc. Device 4084
01:00.1 Bridge: PMC-Sierra Inc. Device 4084
02:00.0 PCI bridge: PMC-Sierra Inc. Device 4084
```

Then run lspci and identify the module. It will show up as something like

```
# lspci -s 1:0.0 -v
01:00.0 PCI bridge: PMC-Sierra Inc. Device 4084 (prog-if 00 [Normal decode])
        Flags: bus master, fast devsel, latency 0, IRQ 122
        Bus: primary=01, secondary=02, subordinate=03, sec-latency=0
        I/O behind bridge: 00002000-00002fff
        Prefetchable memory behind bridge: 00000000c8000000-00000000c81fffff
        Capabilities: [40] Express Upstream Port, MSI 00
        Capabilities: [7c] MSI: Enable+ Count=1/8 Maskable- 64bit+
        Capabilities: [8c] Power Management version 3
        Capabilities: [94] Subsystem: Dolphin Interconnect Solutions AS Device 0960
        Capabilities: [100] Advanced Error Reporting
        Capabilities: [148] Power Budgeting <?>
        Capabilities: [158] #12
        Capabilities: [188] #19
        Capabilities: [1b4] Device Serial Number 00-00-43-43-00-00-00-24
        Capabilities: [1c0] Latency Tolerance Reporting
        Capabilities: [1c8] Access Control Services
        Capabilities: [1f0] #25
        Capabilities: [1fc] #26
        Capabilities: [23c] #27
        Capabilities: [7f8] Vendor Specific Information: ID=ffff Rev=1 Len=808 <?>
        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 0960
        Capabilities: [100] Device Serial Number 00-00-42-42-00-00-00-ff
```

This shows the module as revision 0x4242 (hexadecimal values of the 'BB' letters in the ASCII table), with the production number 0x000000ff (00000255 in decimal).

Support

More information about the product, support and software download can be found at www.dolphinics.com/mx.
For general support questions, please contact Dolphin via the Jira Service Management portal: www.dolphinics.com/csp.

Technical Information

Board revision history

The following table gives a general overview of the hardware revision history.

MXC960 revision	Capabilities
MXC960-CC	• Initial production version

PCIe Cable Port Signals

The external PCI Express SFF-8644 cable connector supports the following signals:

- PETpN/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 MXC960 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 5; External PCIe x4 cable Pin-Out

PCIe Cable Port Mapping

The MXC960 module has a quad SFF-8644 connector. The table below shows the signal / port map.

Cable Port	x16	Dual x8	Quad x4	PCIe 3.0 Cable Pin
1	L0 L1 L2 L3	L0 L1 L2 L3	L0 L1 L2 L3	TX0/RX0 TX1/RX1 TX2/RX2 TX3/RX3
2	L4 L5 L6 L7	L4 L5 L6 L7	L0 L1 L2 L3	TX0/RX0 TX1/RX1 TX2/RX2 TX3/RX3
3	L8 L9 L10 L11	L0 L1 L2 L3	L0 L1 L2 L3	TX0/RX0 TX1/RX1 TX2/RX2 TX3/RX3
4	L12 L13 L14 L15	L4 L5 L6 L7	L0 L1 L2 L3	TX0/RX0 TX1/RX1 TX2/RX2 TX3/RX3
Lx – PCIe lane X, Cable port is ref PCIe bracket marking				

Table 6 : PCIe Cable Port Mapping

Compliance and Regulatory Testing

EMC Compliance

The Dolphin CPCI-s MXC960 system switch has been tested to comply with the following standards

- EN 55032:2015 + A11:2020
- EN 55035:2017 + A11:2020
- EN 61000-3-2:2014
- EN 61000-3-3:2013
- CISPR 35:2016
- KS C 9835:201
- CISPR 11:2015 (6th Edition) + A1:2016 + A2:2019
- IEC 61326-1:2021
- 47 CFR Part 15, Subpart B last amended 2025-09-17 excluding clause 15.105, in conjunction with ANSI C63.4:2014
- ICES-003, issue 7 excluding clause 4.2 in conjunction with ICES-Gen, Issue 2 and ANSI C63.4-2014 amended as per ANSI C63.4a-2017

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

FCC Class A

This equipment is tested to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules.

RoHS Compliance

The Dolphin MXC960 is RoHS compliant. A Compliance certificate issued by the manufacturer is available upon request.

WEEE Notice

The CPCI-s module is labelled in accordance with European Directive 2002/96/EC concerning waste electrical and electronic equipment (WEEE). The Directive determines the framework for the return and recycling of used appliances as applicable throughout the European Union. This label is applied to products to indicate that the product is not to be thrown away but returned to your local approved WEEE waste collector.

Limited Warranty

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

Warranty Period

The warranty applies for one (1) year from the date of purchase. Extended warranty is available.

Coverage

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

- Damage 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 due to accidents, abuse, misuse, improper handling or installation, moisture, corrosive environments, high voltage surges, shipping, or abnormal working conditions.
- Damage 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 for which the serial number label has been tampered with or removed.
- Damage to the product caused by products not supplied by Dolphin.

Service Procedure

In the event that 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, visit www.dolphinics.com/csp to obtain a valid RMA number and instructions. Products returned to Dolphin without a proper RMA number will not be serviced under this warranty.