



Dolphin PCI Express MXS824 Switch



MXS824 24 ports PCI Express Gen3 switch users guide

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ENVIRONMENTAL POLICY

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Terms and Acronyms

Important terms and acronyms used in this manual

AOC	Active Optical Cable. PCIe fiber cable assembly.
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 MXS824 switch.
CMI Controller	Microcontroller on the MXS824 used to manage and implement the 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. The MXS824 support links of x4, x8 or x16 width.
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 MXS824 has 24 x4 Gen3 ports, named 1, 2, 3 ..., 24. The port number is printed below the connectors.

Overview

This document describes the Dolphin MXS824 PCI Express Gen3 switch used in combination with other Dolphin PCI Express products. Dolphin is currently providing the following compliant PCI Express products:

- PXH830 PCI Express Gen3 x16 NTB MiniSAS-HD / SFF-8644 cable adapter card
- PXH832 PCI Express Gen3 x16 Transparent Host and Target MiniSAS-HD / SFF-8644 cable adapter card
- MXH830 PCI Express Gen3 x16 NTB MiniSAS-HD / SFF-8644 cable adapter card
- MXH832 PCI Express Gen3 x16 Transparent Host and Target MiniSAS-HD / SFF-8644 cable adapter card
- PXH820 PCI Express Gen3 x8 XMC NTB MiniSAS-HD / SFF-8644 cable adapter card
- PXH822 PCI Express Gen3 x8 XMC Transparent Host and Target MiniSAS-HD / SFF-8644 cable adapter card

The MXS824 switch can be used to create a PCIe fabric or PCIe expansion using the above products or to any product compliant to the PCI-SIG External Cabling Specification 3.0.

Software support

All Dolphin PXH and MXH PCI Express NTB adapter cards support the complete eXpressWare suite of Dolphin PCI Express Software including Dolphin SuperSockets™, optimized TCP/IP drivers, SmartIO and SISI Embedded software.

Dolphin SuperSockets is a Berkeley Sockets compliant library that provides a socket latency below 1 microsecond, and close to the wire speed streaming bandwidth for networked applications. SuperSockets™ is currently available on Linux and Windows. It is a 100% transparent plug-and-play solution for commercial and embedded applications.

Dolphin's optimized TCP/IP driver enables PCI Express to be used as a traditional 10G Ethernet / 40G Ethernet replacement such as for NFS sharing and legacy networking that does not need the low latency provided by SuperSockets. The TCP/IP driver supports gateway functionality.

The SISI software provides a well-defined, easy to use shared memory / reflective memory programming API for PCI Express over cable.

The SmartIO software enables dynamic sharing of and access to PCIe devices through a PCIe fabric. More on SmartIO

More information about eXpressWare at http://www.dolphinics.com/products/dolphin_pci_express_software.html.

Revision history

Hardware revisions

The following table gives a general overview of the hardware capabilities.

Switch revision	Capabilities
MXS824-BC	<ul style="list-style-type: none">• Initial product version
	<ul style="list-style-type: none">•

Management firmware revisions

The following table gives a general overview of the management software capabilities. All versions contain various bug fixes, security patches, and stability improvements.

Revision	Capabilities
1.0.0	<ul style="list-style-type: none">• Initial functionality
	<ul style="list-style-type: none">•

PCI Express Gen3 Switch - MXS824

The MXS824 is a 24 port PCI Express Gen3 x4 switch available from Dolphin providing an easy to use, multi-functional solution.

MXS824 high level specification

- PCI Express Gen1 2.5 Gbps / Gen2 5.0 Gbps / Gen3 8.0 Gbps per lane signaling – 4 lanes – up to 32 Gbps total signaling per port.
- Compliant with PCI Express Gen1, Gen2, and Gen3 computers and IO systems, auto detection. Each port operates independently at Gen1, Gen2, or Gen3 speeds.
- Lane width auto-training to connected cable width (x16, x8, x4, x2, x1)
- 19-Inch 1U rack mountable chassis.
- Physical dimensions 440mm x 357mm x 45mm (17" x 14" x 1.75") (WxDxH).
- Supports NTB connections to other hosts and transparent connections to IO systems as a transparent P2P device.
- Based on Microsemi PFX chipset
- PCI Express Base Specification Rev 3.1
- PCI Express External Cabling Specification, Rev. 3.0
- Twenty-four PCI Express Gen3 x4 SFF-8644 Cable connection.
- Link clock isolation. Automatic support for hosts running CFC or SSC mode.
- Support for hot plugging of the PCI Express cable (NTB mode, SISI and SuperSockets)
- Built in management processor for monitoring and firmware upgrade and management
- RJ45 Ethernet (10/100) connector (optional use)
- USB port for firmware upgrade
- Front operational status and alert LEDs
- No PCI Express power domain isolation.
- Partitioning
- 4 Redundant fans
- Operating systems supported:
 - NTB mode: Linux, Windows, RTX and VxWorks.
 - Transparent mode: All (No drivers required)
- Power supply input 110 - 240VAC 50/60 Hz – 2.8A
- Power Consumption: Max 80 Watt (including active optical transceivers).
- Operating temperature 0°C to 55°C, Relative Humidity 5% - 95% non-condensing
- Storage temperature -25°C to 70°C, Relative Humidity 10% - 90% non-condensing
- Weight: 4.6 Kilo (10 lbs)
- RoHS compliant
- FCC & CE Mark



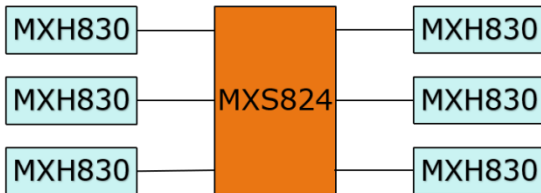
Picture 1: MXS824 front view

Configuration examples

The MXS824 switch can be used as a standalone PCI Express switch, or several switches can be cascaded to build larger PCIe expansion systems or PCIe fabrics. It can be combined with compliant PCIe cards available from Dolphin or compliant customer designs. Some examples can be found below. Please consult the chapter Configuring the MXS824 switch on page 14 for more details.

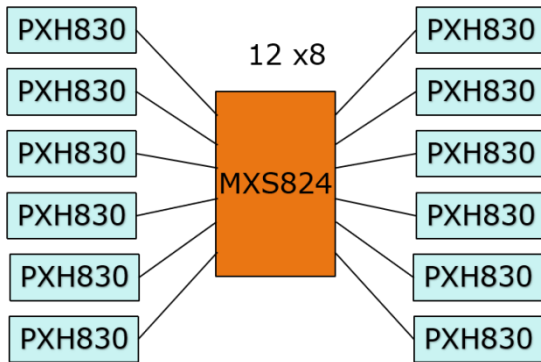
6 node PCIe x16 Gen3 NTB Cluster

Each node has a Dolphin Express MXH830, PXH30 or PXH820 adapter. Up to six systems can be connected to the Dolphin MXS824 switch using the default firmware configuration. All nodes connect directly to the switch using up to 4 x4 MiniSAS-HD or PCIe 3.0 cables. This is the switch default configuration.



Please note that the Dolphin eXpressWare currently doesn't support mixing MXH830 and PXH8x0 in a single cluster.

12 node PCIe x8 Gen3 NTB Cluster



Each node has a Dolphin Express MXH830, PXH30 or PXH820 adapter. Up to twelve systems can be connected to the Dolphin MXS824 switch. All nodes connect directly to the switch using up to 2 x4 MiniSAS-HD or PCIe 3.0 cables.

Please note that the Dolphin eXpressWare currently doesn't support mixing MXH830 and PXH8x0 in a single cluster.

Larger NTB Cluster configurations

Firmware and software to support larger configurations are being developed and tested. Scalability up to 64/128 nodes is planned, please contact Dolphin to learn about the latest test results and release plans.

Transparent PCIe IO expansion – Multiple expansion chassis connected to one server

The MXS824 can be used for regular PCIe IO expansion. An adapter card in host transparent mode is connected to the switch upstream port (port 1,2,3,4 for a full x16). Transparent target adapters are connected to the other downstream ports. Figure 1: Transparent PCIe IO Expansion below shows 5 expansion chassis connected to a single host.

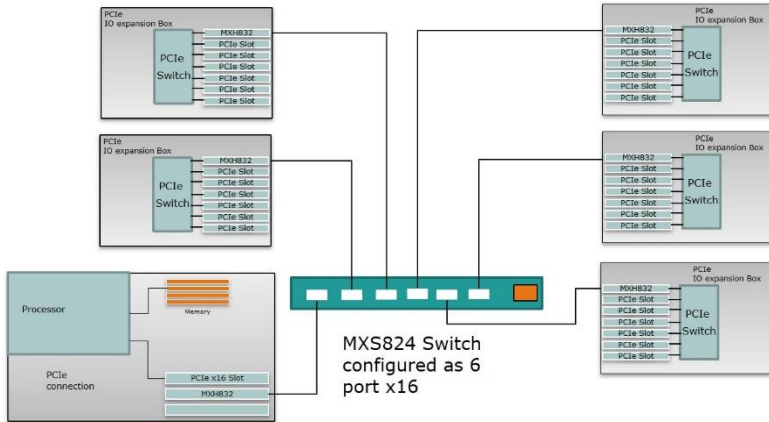


Figure 1: Transparent PCIe IO Expansion

No special device driver is required for the transparent adapter card or the MXS824 switch.

Any device in the PCI Express IO system will operate using its standard device driver.

The IO devices can be connected using x16, x8 or x4 links depending on the required scale out and performance requirements.

NOTE: Please note that large scale PCIe IO expansion may be limited by your BIOS. Please consult your system vendor before buying the system.

Cables

The MXS824 switch supports x4 copper or fiber cables. The maximum cable distance will depend on the actual cable quality, the device at the other end of the cable, and the cable link speed (Gen1, Gen2 or Gen3). Cables compliant to the PCI-SIG External Cabling Specification 3.0 (PCIe 3.0 cables) are recommended for transparent use. NTB use cases can use PCIe 3.0 cables or approved MiniSAS-HD cables available from Dolphin.

Speed and medium, card	Max cable length
Gen3, PXH830, PXH832	Copper 5 meters tested, longer TBD Fiber 100 meters
Gen3, MXH830, MXH832	TBD
Between MXS824 switches (Gen3)	TBD

Management processor

The actual configuration of the switch is controlled by the onboard firmware loaded from onboard FLASH memory and will be enabled immediately after power is applied to the switch. The built-in management processor has no active role in normal operations except for firmware updates, switch configuration and monitoring.

Use cases summary and settings

The table below gives an overview of the default configuration settings and limitations.

Use Case	Description	Cable Hot Plug	Power Sequence Requirements	Software/ Driver
Transparent	Transparent – Dolphin adapter card connects to downstream PCI Express devices or PCI Express expansion systems through the MXS824 switch	Not supported by legacy device drivers	IO system and MXS824 must power on before PC	No driver required for host card or MXS824 switch. Legacy drivers for IO Devices
NTB	NTB configuration. All connected hosts have Dolphin adapter card	Fully supported	No limitations	Dolphin SISI, SuperSockets, TCP/IP, SmartIO
Mixed	Switch is portioned. Behavior depends on configuration data. May combine use case A and B			

Table 3: Switch use cases

LEDs

The switch has several LEDs on the front side to signal various operating modes and status.

MXS824 Switch Status LEDs

The MXS824 has two LEDs next to the RJ45 Ethernet connector.

Marking	Description
PWR	Dark: Power off or failure. Green: Power on.
ST	Dark: Normal Blinking: Firmware upgrade in progress

Table 1 MXS824 Switch status LED overview

Port and Link status LEDs

The switch has 24 x4 PCI Express ports organized in six quad port blocks. Depending on the software configuration of the switch each x4 port can be combined with its neighboring ports to form either a x8 or a x16 port within the same quad port block

Each of the 24 PCI Express ports has two bi-color LEDs status visible through the cabinet. The LEDs are located just above the connector for each port. The Link status LED provides information on the current PCIe link status. The Port status LED provides information on the configuration. The table below provides a summary of the LED behavior. Refer to the sections below for more information on each LED.

Mark	Function	Dark	Yellow	Green
L	Link status	Cable not connected	Cable connected locally	PCIe Link up and running
S	Port status		Port starts here	Indicates upstream port capabilities

Table 2: Link LED overview

Port status LEDs

The port status LED is used to indicate port width and if it's upstream or downstream.

Each port status LED lit denotes the start of a port. The other ports part of this aggregated port will be dark.

If the switch is configured as a 24 * x4 switch every port status LED will light up:

0000 0000 0000 0000 0000 0000

If the switch is configured as $12 * x8$ every second port status led will be on:

O-O- O-O- O-O- O-O- O-O- O-O-

And if it's configured as $6 * x16$ every fourth status led will be on:

O--- O--- O--- O--- O--- O---

It is also possible to have more complex configurations. Let's say $2 * x16 + 8 * x8$:

O--- O--- O-O- O-O- O-O- O-O-

In the examples above the port status LED color is orange which denotes that it is a NTB port or a downstream transparent port. If the LED is green it indicates that the port is a transparent upstream port.

When the cables are connected, and you have a valid link the port status LED will in both cases turn yellow.

Link status LEDs

Each port has also a separate link status LED. It reflects the cable and link status:

- it will remain dark if no valid cable has been detected in the port
- it will light up orange if the cable is inserted and ok, but there is no valid link established.
- it will be green if the cable is ok and the link is valid.

Installation

Safety instructions

Always use caution when working with computers, IO Devices and electrical components.



High voltages are present inside the MXS824 cabinet that may cause severe harm to your body if opened. Never open the switch cabinet, no user serviceable parts are available inside the cabinet. Opening the cabinet will void your warranty.

Static electricity from your clothes or work environment can damage your PCI Express adapter card or your PC. Always wear a grounded antistatic wrist strap while opening the PC and when Dolphin PCI Express adapter is removed from the anti-static bag. The MXS824 switch requires no special anti-static protection and should be handled in line with other electronic equipment.

Special National notes:

Norway: "Apparatet må tilkoples jordet stikkontakt"

Sweden: "Apparaten skall anslutas till jordat uttag"

Finland: "Laitte on liitettävä suojamaadoituskoskettimilla varustettuun pistorasiaan"

Installing the Switch in a rack

The MXS824 shipping box includes rack mount ears that can be used to fix the MXS824 into a 19-inch standard rack. The rack mount ears can be mounted on the front or rear of the switch depending on user requirements.

Switch desktop use

Rubber feet are included and should be applied beneath the switch to avoid scratches in desktop use.

Ethernet

The MXS824 switch supports Ethernet management and monitoring. Please connect an Ethernet cable from the switch RJ45 plug to a 10/100 Ethernet network. The switch supports both static and DHCP configurations. The switch defaults to DHCP, the MAC address is available next to the Ethernet port.

Installing and removing PCIe cables

The MXS824 supports approved PCI Express x4 MiniSAS-HD or PCIe 3.0 cables. Installing and removing cables should be done with both upstream and downstream device powered off. The Dolphin SuperSockets, TCP/IP drivers and SISI fully supports hot plugging (*Note: installation and removal of cables while the system is running*). Standard PCI Express cables are not designed for a high number of installation and removals; the gold applied to the connector head may wear out and cause loss of communication. Please contact your Dolphin representative if you intend to continuously connect and disconnect the PCI Express cables.

1, 2, or 4 cables can be used to create a x4, x8 or x16 connection to other compliant devices. If more than one cable is used to create a wide link, the first cable must be connected to a width aligned port number.

Connecting a cable

Please carefully install the PCI Express cable connector into the connector housing on the adapter card or MXS824 Switch box. Computer cables should always use strain relief to protect the connected equipment from excessive force via the cable. This is especially important for cables between racks.

Disconnecting a cable

Carefully pull the thumb tab in the direction of the cable to release the cable from the connector house and eject the cable.

MXS824 operating modes

The Dolphin PCI Express MXS824 switch has two main operational modes: *Transparent* and *Non-Transparent Bridge* (NTB) mode. The switch operating mode is controlled by the MXS824 switch management software. The shipping default configuration is support for 6 ports x16 NTB mode. Please consult the chapter Configuring the MXS824 switch on page 14 for more details.

Transparent mode port usage

In standard transparent mode, Ports 1, 2, 3 and 4 are always configured as a x16 upstream port. Port 1 should always be used. If you want to create a x8 link, you should use port 1 & 2. To create a x16 link, you should use port 1,2,3 and 4. All other ports are configured as downstream ports. Separate configuration settings exist for creating 10 x8 or 20 x4 transparent downstream ports.

NTB mode port usage

Any port can be used in any order for all NTB configurations. If more than one cable is used to create a wide link, the first cable must be connected to a width aligned port number. Separate configuration settings exist and must be enabled for twelve x8 mode or 24 x4 mode. The six x16 mode is the shipping default.

Dolphins eXpressWare software and adapter cards will auto detect ports and automatically connect at the highest speed possible. Customers writing their own low-level drivers need to contact Dolphin for further technical information.

Cascading switches

The MXS824 supports cascading multiple switches into larger PCI Express networks. Please contact Dolphin for more information.

Partitioning – mixed transparent and NTB usage

The switch supports partitioning into separate switch domains, enabling a single switch to be used as two or more independent logical switch domains. The switch hardware prevents unintended data communication and reset / configuration cycles to propagate between separate domains. This configuration requires custom firmware, please contact Dolphin for more information.

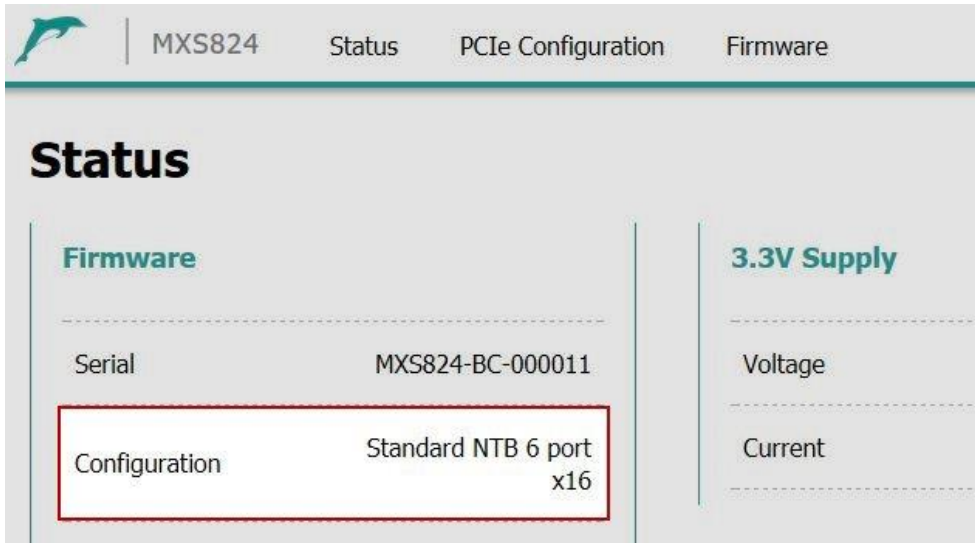
Configuring the MXS824 switch

The MXS824 comes with a Web GUI for monitoring temperature, fan speed, port monitoring and switch configuration management. This documentation covers the 1.0.0 version of the management firmware.

The GUI currently consist of three sections, all easily accessible by the top menu or by scrolling down the page.

Status section

The status section provide real-time data from the Firmware, fans, temperature sensors and power modules. Please note that there are only 4 fans connected to the switch, so if 6 fans are displayed it is expected that 2 fans show 0 RPM. The other four should be close to 8000 RPM.



New switches are delivered with the standard NTB 6 port x16 link width configuration active, unless you have a specialized order with a different configuration pre-programmed. The switch' active configuration is shown under «Firmware» below the «Status» section of the Web GUI as highlighted in the picture above.

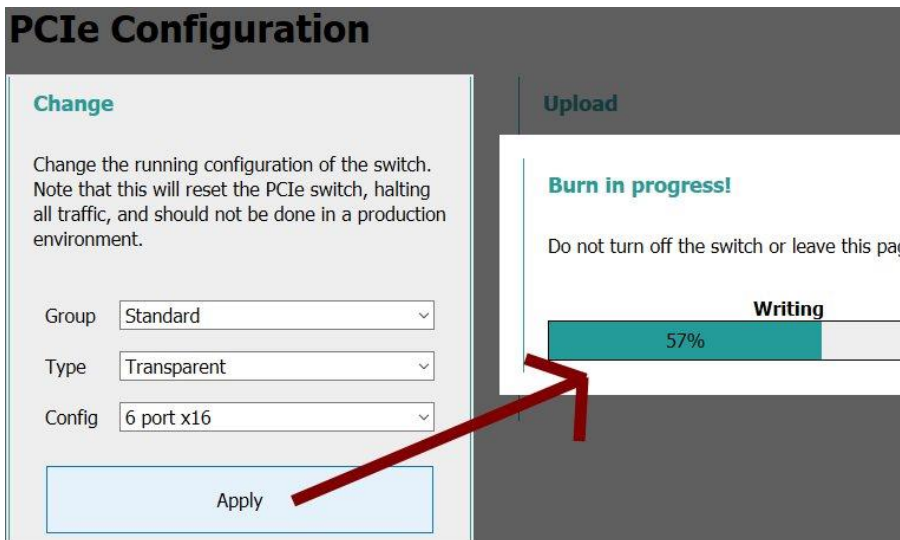
PCIe Configuration section

The PCIe Configuration section enables the user to change the active configuration, upload new Dolphin provided configurations, erase uploaded configurations and to perform a reset of the PFX switch.

Unless otherwise specified, the switch is delivered with a standard set of configurations for NTB and Transparent operation. The available selections will appear in the menu.

Change configuration

This section allow you to change the active configuration of the PCIe switch. The section works like a filter for the available configurations.



Start by selecting a «Group» (Standard, Custom, ...), then «Type» (NTB, Transparent, Uploaded, ...), and eventually the configuration. You can then press [Apply] where you will be met with a warning message; « Changing the config will reset the PCIe switch, halting all traffic, and should not be done in a production environment. You must NOT turn off the switch or leave this page during the burn operation. Are you sure you want to continue?». Pressing [OK] initiates an erase, write and verification step, all with individual progress bars.

Upload configuration

Additional configurations and special customizations may be provided by Dolphin. Press the [Browse] button to locate the binary on your disk and press the [Upload] button to perform the upload. You will be provided with the new file name on successful upload, which will afterwards be present under the «Custom» group and «Uploaded» type in the «Change» field set.

Uploading and applying configurations not provided by Dolphin may break your hardware and will void your warranty.

Delete configuration group

The «Delete» field set enable the user to clean up the list of uploaded configurations by deleting the entire «Custom» group if present. This will only erase the available configurations on the switch and will not affect the PCIe switch and its active configuration.

Reset switch

Press the «Reset Switch» to initiate a hardware reset of the PCIe switch chip. You will be prompted for confirmation.

Firmware section

The Firmware section is currently reserved for firmware upgrades containing only an «Upgrade» fieldset. Dolphin's MXS824 switch is pre-configured during manufacturing and a firmware upgrade is normally not required for default operations. Please contact Dolphin support before trying to upgrade any firmware. Warranty is void if unauthorized firmware upgrades are attempted.

Software installation, PXH830, PXH820

No special software is required for the switch, but Dolphin Express PXH adapters need to install eXpressWare 5.7.0 or newer software releases to enable seamless integration with the MXS824 switch. More information on installing Dolphins SuperSockets, SISI or TCP/IP driver software can be found at <http://www.dolphinics.com/px.html>

Software installation, MXH830

No special software is required for the switch, but Dolphin Express MXH adapters need to install eXpressWare 5.8.0 or newer software releases to enable seamless integration with the MXS824 switch. More information on installing Dolphins SuperSockets, SISI or TCP/IP driver software can be found at <http://www.dolphinics.com/mx.html>

Support

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

Compliance



EMC compliance

The Dolphin PCI Express MXS824 switch has been tested to comply with the following relevant test standards for PCI Express equipment, Telecommunication and Industry equipment:

- EN 55032:2012
- EN 55024:2010
- EN 61000-3-2:2014
- EN 61000-3-3:2013

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

Safety compliance

The MXS824 PCI Express switch is tested and found to comply with the following safety standards:

- IEC 60950-1:2005 (Second Edition), Am 1: 2009
- EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011

A CB test certificate is available upon request.

RoHS compliance

The Dolphin MXS824 is RoHS compliant. A compliance certificate issued by the Manufacturer is available upon request.



Flammability standard

The Dolphin MXS824 PWB is UL94V-0 compliant. The board has the 94V-0 mark in its silk screen.

WEEE Notice

This MXS824 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 various 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

Dolphin warrants the Product for one (1) year from the date of purchase. Extended warranty may be purchased with the equipment.

Coverage

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

- Damages caused by operator error or non-compliance with usage and programming 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 caused by acts of nature, e.g. floods, storms, fire, or earthquakes.
- Damage caused by any power source out of range.
- Normal wear and tear.
- Attempts to open, repair, modify, or upgrade the product by personnel or agents not authorized by Dolphin.
- Products for which the products serial number 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, 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.

Limitations

TO THE FULLEST EXTENT PERMITTED BY LAW, DOLPHIN WILL NOT BE LIABLE FOR ANY INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES (INCLUDING LOST PROFITS, LOST DATA, OR LOSS OF USE) ARISING OUT OF ANY USE DOLPHINS PRODUCTS, SOFTWARE OR SERVICE PROVIDED. DOLPHINS MAXIMUM LIABILITY WILL NOT EXCEED THE TOTAL AMOUNT PAID FOR THE PRODUCT BY PURCHASER.