Dolphin PCI Express IXH620 XMC Adapter

Adapter card users guide

Version 2.07

Date: 30th November 2023

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DOCUMENT VALIDITY

This document is valid for IXH620 cards shipped from Dolphin starting 1st January 2013. Cards shipped before that
date do not include the firmware needed to operate in transparent TARGET mode. Older IXH620 cards can be re-
flashed to also include the TARGET functionality. The special IXH622 TARGET card/firmware is discontinued. Please
contact Dolphin for more information and assistance with upgrading.

Quick install guide

The IXH620 XMC is a multi-functional PCI Express cable adapter that supports both regular PCIe transparent operations (HOST and TARGET functions) as well as software managed NTB mode. The IXH620 XMC cards can be installed in any VITA 42.3 Short PCI Express x4 or x8 XMC Gen1, Gen2 or Gen3 position.

Note: *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 when the card is removed from the anti-static bag.*

Configuring the IXH620
The factory default setting is standard NTB mode.

The operating modes are controlled by two DIP switch banks on the adapter card, and you need to modify the setting to operate the card in Transparent Host or Target mode. Detailed configuration settings can be found on page 11 and 12 in this document.

Copper cable connections
The IXH620 requires a single x8 iPass™ or PCI Express standard cable to connect to other devices including transparent I/O devices, another PC with an IXH610, IXH611or an IXS600 8 port switch.

The IXH620 can also be connected to other x4 PCI Express devices using a x8 to x4 PCI Express Transition cable.

To install the cable, match the male portion on the x8 cable with the female connector on the IXH620 board. Use even pressure to insert the connector until it is secure. Adhere to ESD guidelines when installing the cable ensure not to damage the board.

Fiber optic cable connections
Fiber cables need special attention when installing. Each end of the fiber is marked HOST or TARGET. When installing in Transparent mode, just make sure to connect the TARGET side to the downstream device and the HOST side to the upstream IXH620. When used in NTB mode, there are no defined HOST or TARGET, but the IXH620 in NTB mode can simulate a TARGET side if the DIP SW2 Upstream cable select is OFF. Please consult section Configuration and DIP-switches on page 10 in this document for more details.

The Dolphin Express IXH620 adapter card is compliant with Dolphins extensive software packages for the IXH adapter card and the IDT Demo software available from IDT. Please visit http://www.dolphinics.com/support to download the latest documentation and software. Dolphin provides software and documentation for several product families; please remember to select the IX product family before downloading.

Dolphin PCI Express IX product family overview

This document describes the Dolphin PCI Express IX architecture and the IXH620 PCI Express Gen2 adapter card. The card is based on the PES24NT6G2 PCI Express Gen2 chipset from IDT. The IX product family consists of the following products:

- IXH610   PCI Express Gen2 x8 NTB, Host adapter card
- IXH611   PCI Express Gen2 x8 NTB, Host and Target adapter card
- IXS620   XMC PCI Express Gen2 NTB, Host and Target adapter card
- IXS600   8 port PCI Express Gen2 rack mount switch
- IXE60X   PCI Express expansion products (contact Dolphin for details)
- IXC1M   1 Meter PCIe Gen2 Copper Cable
- IXC2M   2 Meter PCIe Gen2 Copper Cable
- IXC5M   5 Meter PCIe Gen2 Copper Cable
- IXC1M-844   1 meter PCIe x8 to x4 transition cable
- IXFC10M-848   10 Meter x4 Gen2 Fiber Optic Cable, x8 Housing
- IXFCXMX Meter x4 Gen2 Fiber Optic Cable, x8 Housing (Contact Dolphin for details)

The IXH620 adapter can be used to connect to any of the above products or to any compliant existing PCI Express downstream device having a standard PCI Express x8 connector (PCI Express Gen 1 or Gen2, auto detect).

All Dolphin PCI Express IXH adapters support the complete suite of Dolphin NTB Software including Dolphin SuperSockets™, optimized TCP/IP drivers, and SISCI Embedded software. It is also compliant with the PXImc software specification.

Dolphin SuperSockets is a Berkeley compliant Sockets library which provides socket latency below 2 microseconds 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. More on SuperSockets can be found at http://www.dolphinics.com/products/dolphin-supersockets.html

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

The SISCI software provides well defined, easy to use shared memory programming API for PCI Express over cable. More on SISCI can be found at http://www.dolphinics.com/products/embedded-sisci-developers-kit.html

More information about the software provided for the Dolphin IXH620 adapter card can be found on http://www.dolphinics.com/products.

PCI Express Adapter card - IXH620 XMC

The IXH620 PCI Express Gen2 x8 adapter XMC card available from Dolphin provides an easy to use, multi-functional PCI Express over cable solution.

IXH620 high level specification

- VITA 42.3 Short PCI Express XMC.

- PCI Express Gen2 5.0 Gbps pr lane signaling.

- One XMC P15 PCI Express Gen2 x8 host connection.

- One PCI Express Gen2 x8 Cable connection.

- Support for both NTB connection to other hosts and transparent connections to IO systems as a transparent P2P device.

- PCI Express Base Specification Rev 2.1

- PCI Express External Cabling Specification, Rev. 1.0

- PIO and Direct DMA capabilities.

- Host clock isolation. Automatic support for host running CFC or SSC mode.

- Support for hot plugging of the PCI Express cable (NTB mode, SISCI, TCP/IP driver and SuperSockets).

- Dual 128 KB EEPROM for configuration data.

- Boot up configuration from EEPROM. Optional Software utility for reprogramming of EEPROM content.

- No PCI Express power domain isolation.

- Full SISCI, TCP/IP driver and SuperSockets compliance. Linux and Windows support.

- Power Consumption: 3,3 Volt - Max 7 Watt.

- Operating temperature: -10C - +60C

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

- JTAG programming and test

- RoHS compliant

- CE Mark, FCC Class A compliant

- EN 55022,EN 55024-A1&A2, EN 61000-6-2

- UL94V-0 compliant

LEDs

The card has two bi-color LEDs visible through the XMC front bracket.

Name	Dark	Yellow	Green	Green – blinking
Link	Power off or failure	Power on, Link down	Power on, Link Up	Power on, Link active, data transmitted
NTB	Transparent HOST mode	Transparent TARGET mode	NTB mode enabled (PXImc/SISCI/SuperSockets/TCP/IP mode)	NA

Table 2: LED overview

The NTB link LED is controlled by software. Both LEDs depend on GPIO registers initialized by EEPROM. An incorrect EEPROM can cause dark LEDs. DIP-switch SWMODE set to 0000b will cause all LEDs to be dark. More details on DIP-switch settings can be found below.

Use cases

The IXH610 and IXH620 adapter card may be used in the following use cases. The use cases are summarized in Table 3 Adapter use cases on page 10.

Use case A - Transparent IO - Upstream Host

The Dolphin IXH610, IXH611 or IXH620 XMC adapter card connects to any standardized PCI Express x8 downstream device in transparent mode. No special device driver is required for the IXH card. Any device in the PCI Express IO system will operate using its standard device driver. Please also note that the IXS600 PCI Express switch can be used in this configuration – to fan out PCI Express – connecting one host to several PCI Express IO devices.

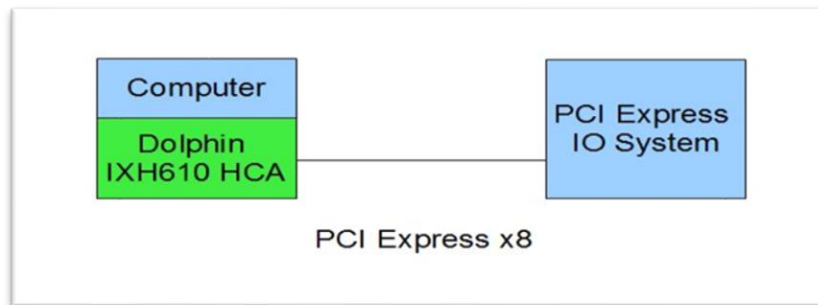Illustration 1: IXH adapter used to connect to a remote PCI Express IO System

Use case B - 2 node configuration – NTB Mode

Each node has an IXH610, IXH611 or IXH620 XMC adapter card and is directly connection to a remote host using a PCI Express Gen2 x8 cable. This configuration is fully supported by all Dolphin NTB software.
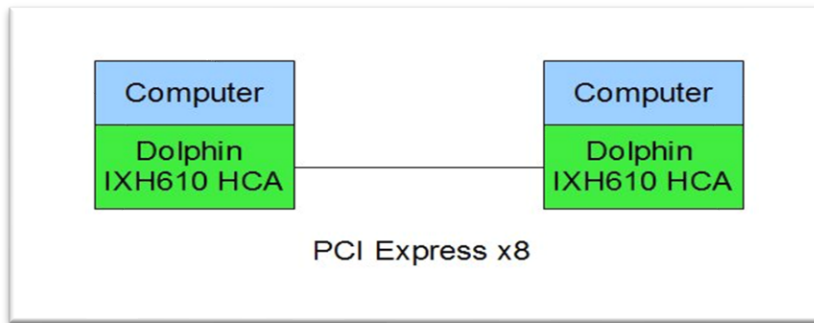
Illustration 4: Two IXH adapter cards used to build a two node configuration.

Use case C - Switch configuration

Each node has a Dolphin Express IXH610, IXH611 or Dolphin Express IXH620 XMC adapter card. Up to 8 systems can be connected to the Dolphin IXS600 8 port PCI Express Gen2 switch. More switches can be cascaded, please contact Dolphin for details.
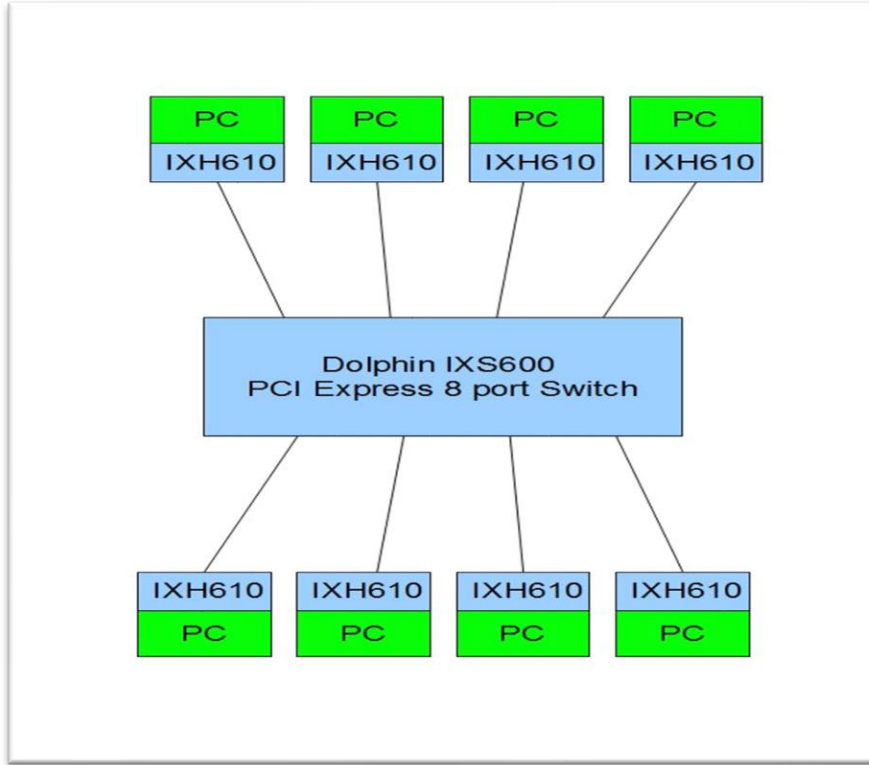
Illustration 3: Switch use

Use case D – Transparent IO Downstream TARGET

The IXH611 and IXH620 XMC adapter cards can be used as a downstream target adapter. Both IXH610 and IXH620 can be used as Host upstream adapters.
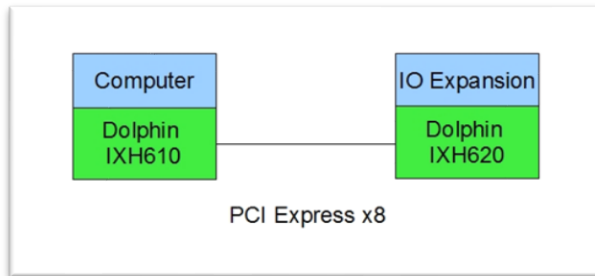
Illustration 4: IXH620 as target mode
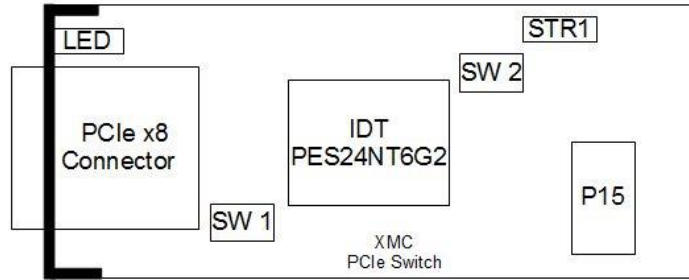
Illustration 5 : IXH620 overview

Configuration and DIP-switches

The IXH620 has two banks of DIP switches for setting modes of operations. The location of the DIP switches on the card is shown as SW1 and SW2 in figure 5 below. Please carefully read the documentation before modifying any DIP-switch settings. Please carefully pay attention to ON and OFF positions written on the DIP switch.

DIP switch bank SW 1 - SWMODE

This DIP should normally be kept in factory default mode. These DIP switches are used to directly control the PES24NT6G2 Software MODE. Please refer to the PES24NT6G2 data sheet for details. The most useful options are documented in the table below.

| Binary value – SWMODE [3:0]	Description
0000b	Single partition, no EEPROM configuration. Supports default transparent configuration – non optimized settings. No LEDs operational. This setting can be used as an emergency setting if an incorrect or corrupted EEPORM content prevents the system from booting. Supports reprogramming of the EEPORM.
0010b	**Transparent TARGET configuration**. DIP-SW 2 must be set to TRANSPARENT. Configuration data loaded from EEPROM.
1100b	**Supports transparent HOST and NTB modus.** DIP-SW 2 must be set to the desired operational mode. Configuration data loaded from EEPROM. This is the factory default setting.

Illustration 6: SW1 – SWMODE - Default setting

DIP switch bank SW 2 – configuration

This DIP Switch is used to configure transparent and non-transparent modes and manipulate clock source and reset functionality. Please note that the Transparent Target functionality requires a non-default setting of DIP SW 1 described on the previous page.

DIP no	Name	Description	ON	OFF	Transparent HOST	Transparent TARGET	NTB (Default)
1	Boot EEPROM Select	Used to select EEPROM 1 or 2 as boot image.	Load configuration from EEPROM 2 – Transparent mode	Load configuration from EEPROM 1 – NTB mode	on	on	off
2		Not used			off	off	off
3	MRSTI_TO_CHIP	Reset coming from XMC carrier will reset IXH620 card	Normal reset of IXH620	Do not reset IXH620 on system reset	on	off	on
4	CPERST_TO_CHIP	CPERST on PCI Express cable will reset IDT chip on XMC620	Reset chip on CPERST	No chip reset from cable	off	on	off
5	MRSTO_ENABLE	IDT chip reset will trigger MRSTO on P15 connector. Gated by ROOT signal	Reset of XMC carrier system if XMC is upstream.	No carrier system reset	on	on	on
6	Upstream cable select	Used to select clock source. Should be on in all use cases except transparent TARGET	Adapter card drives CREFCLK and CPERST on cable if CPRESNT from downstream	Card will issue CPRESNT	on	off	On When using a fiber – one of the cards need to have this off

Note: Some DIP switch configuration options may be removed in the future versions. Please always consult the user guide for details. Please note special setting for fiber optics in NTB mode.

Use cases summary and settings

The table below gives an overview of the various use cases, settings, and limitations.

Use case	Description	NTB	Clock source	Cable pull	Power Sequence requirements	Software/Driver
A	IXH620 operates in Transparent HOST mode	no	Adapter card drives CREFCLK	Not supported by legacy device drivers	IO system must power on first	No driver required for IXH620 card. Legacy drivers for IO Devices
B	Dolphin Host – Host NTB mode. Both connected systems have Dolphin adapter card installed.	yes	Both cards run on local clock	Fully supported	No limitations	Dolphin SISCI, SuperSockets, TCP/IP, PXImc
C	Dolphin Switch configuration. All connected hosts have Dolphin adapter cards installed	yes	Adapter card transmits clock on PCI Express cable	Fully supported	No limitations	Dolphin SISCI, SuperSockets, TCP/IP, PXImc
D	IXS620 operates in transparent TARGET mode.	no	Adapter cards receive clock on PCI Express cable. Carrier provides REFLOCK		Downstream must power on first	No driver required for IXH620 card

Table 3: Adapter use cases

Technical information

IXH620 PCIe iPass Cable Connector pinout

PIN#	Row A Signal Name	Row B Signal Name
1	GND	GND
2	PETp(0)	PERp(0)
3	PETn(0)	PERn(0)
4	GND	GND
5	PETp(1)	PERp(1)
6	PETn(1)	PERn(1)
7	GND	GND
8	PETp(2)	PERp(2)
9	PETn(2)	PERn(2)
10	GND	GND
11	PETp(3)	PERp(3)
12	PETn(3)	PERn(3)
13	GND	GND
14	CREFCLOCK+	+3,3V POWER
15	CREFCLOCK-	+3,3V POWER
16	GND	+3,3V POWER
17	RESERVED	POWER RET
18	RESERVED	POWER RET
19	SIDEBAND RETURN	POWER RET
20	CPRESNT#	CWAKE#[1]
21	CPWRON	CPERST#
22	GND	GND
23	PET(p4)	PERp(4)
24	PET(n4)	PERn(4)
25	GND	GND
26	PET(p5)	PERp(5)
27	PET(n5)	PERn(5)
28	GND	GND
29	PETp(6)	PERp(6)
30	PETn(6)	PERn(6)
31	GND	GND
32	PETp(7)	PERp(7)
33	PETn(7)	PERn(7)
34	GND	GND

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[1] CWAKE is optional and not used on IXH620

IXH620 XMC P15 Connector pinout

Column	Row A	Row B	Row C	Row D	Row E	Row F
1	PET0p(0)	PET0n(0)	3.3V	PET0p(1)	PET0n(1)	VPWR
2	GND	GND	TRST#	GND	GND	MRSTI#
3	PET0p(2)	PET0n(2)	3.3V	PET0p(3)	PET0n(3)	VPWR
4	GND	GND	TCK	GND	GND	MRSTO#
5	PET0p(4)	PET0n(4)	3.3V	PET0p(5)	PET0n(5)	VPWR
6	GND	GND	TMS	GND	GND	+12V
7	PET0p(6)	PET0n(6)	3.3V	PET0p(7)	PET0n(7)	VPWR
8	GND	GND	TDI	GND	GND	-12V
9	RFU	RFU	RFU	RFU	RFU	VPWR
10	GND	GND	TDO	GND	GND	GA0
11	PER0p(0)	PER0n(0)	MBIST#	PER0p(1)	PER0n(1)	VPWR
12	GND	GND	GA1	GND	GND	MPRESENT#
13	PER0p(2)	PER0n(2)	3.3V AUX	PER0p(3)	PER0n(3)	VPWR
14	GND	GND	GA2	GND	GND	MSDA
15	PER0p(4)	PER0n(4)	RFU	PER0p(5)	PER0n(5)	VPWR
16	GND	GND	MVMRO	GND	GND	MSCL
17	PER0p(6)	PER0n(6)	RFU	PER0p(7)	PER0n(7)	RFU
18	GND	GND	RFU	GND	GND	RFU
19	REFCLK0+	REFCLK0-	RFU	WAKE#	ROOT0#	RFU

Installation

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 the adapter card is removed from the anti- static bag.

Installing 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 IXH620.Please follow your computer's manual on how to install an XMC PCI Express card.

The IXH620 supports both PCI Express Gen2 and Gen1 signaling. *NOTE: A Gen2 position is recommended as it typically doubles the performance compared to a Gen1 slot.* The IXH620 can be installed in a PCI Express Gen3 position but will operate at Gen2 speed.

The IXH620 supports both hosts using spread spectrum and constant frequency clocking. The card implements clock isolation and will provide a high quality CREFCLK signal on the cable. Refer to the DIP switch settings for configuration information.

Installing and removing the cable

The IXH620 adapter card supports standard PCI Express x8 Gen2 cables. Installing and removing cables should be done with both upstream and downstream devices powered off. The Dolphin SuperSockets, TCP/IP drivers and SISCI fully support 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 installations and removals; the gold applied to the connector head may wear out and cause loss of communication. Please contact your Dolphin if you intend to continuously connect and disconnect the PCI Express cables.

 The IXH620 can a be connected to other x4 PCI Express devices using a x8 to x4 PCI Express Transition cable.

Fiber optic cable connections

Fiber cables need special attention when installing. Each end of the fiber is marked HOST or TARGET. When installing in Transparent mode, just make sure to connect the TARGET side to the downstream device and the HOST side to the upstream IXH620. When used in NTB mode, there are no defined HOST or TARGET, but the IXH620 in NTB mode can simulate a TARGET side if the DIP SW2 Upstream cable select is OFF. Please consult section Configuration and DIP-switches on page 10 in this document for more details.

Connecting the cable

Please carefully install the PCI Express cable connector into the connector housing on the IXH adapter card or IXS600 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 the cable

Please carefully pull back the thumb tab to release the cable from the connector house and pull back the cable.

EEPROM programming

Dolphin may from time to time publish updated firmware. Current firmware is normally included in the Dolphin software distribution and published on www.dolphinics.com/support. Please consult the software documentation for information on firmware upgrades or Dolphin support if assistance is required.

Software installation

More information on installing Dolphins SuperSockets, SISCI or TCP/IP driver software can be found at http://www.dolphinics.com/support/installation-ix.html

Identifying the card

The card has a label-sticker with the serial-number in the format 'IXHXXX-YY-ZZZZZZ', where XXX denotes the card-type (*eg 620*), YY denotes the card revision (*eg BC*) and ZZZZZZ denotes the serialized production number (*eg 012345*) – this whole string makes up the serial number of the card (*ie IXH620-BC-012345*).

With the DIS software installed and loaded, you can get this serial-number with the ixdiag command.

The top of this output will show information about the card (here from an IXH610-card):

```
Adapter 0 > Type                     : IXH610
            NodeId                    : 4
            Serial number            : IXH610-DE-001352
            IXH chipId                : 0x8091111d
            IXH chip revision         : 0x00000002 (ZC)
            EEPROM version NTB mode   : 0024
            EEPROM version transp mode : 0009
            EEPROM swmode[3:0]        : 1100
            EEPROM images             : 0001
            Card revision             : DE
```

Here you will see both the whole serial-number string, as well as the decoded card-type and card-revision identifiers. The 'EEPROM version NTB mode' may be of interest – this shows the firmware-version of the card.

You can also get this information without ixdiag (for instance when the drivers are not loaded or the card is in transparent mode), using lspci in Linux.

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

```
02:00.0 PCI bridge: Integrated Device Technology, Inc. Device 8091 (rev 02)
02:00.1 Bridge: Integrated Device Technology, Inc. Device 8091 (rev 02)
02:00.2 System peripheral: Integrated Device Technology, Inc. Device 8091 (rev 02)
```

Second, do an lspci –vvvv –s <device>, and look for the 'Serial' –string

```
# lspci -s 02:00.0 -vvv | grep Serial
        Capabilities: [180 v1] Device Serial Number 00-00-44-45-00-00-05-48
```

This shows the card as revision 0x4445 (*hexadecimal values of the 'DE' letters in the ASCII table*), with the production number 0x00000548 (*001352 in decimal*).

In Windows, we export the serial-number through the event-log through the transparent-mode driver is loaded (v 1.0.1 or later required). This driver is available through the download-section at http://www.dolphinics.com/support/index_support_ix.html

PS C:\> Get-EventLog System -Source IXH_T -Newest 1

```
  Index Time          EntryType   Source InstanceID Message
  ----- ----          ---------   ------ ---------- -------
  34206 Oct 25 23:02  Information IXH_T 1074069505 Serial number is IXH610-CC-000101.
```

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 and regulatory testing

EMC compliance

The Dolphin PCI Express IXH620 adapter has been tested and found to comply with the following relevant test standards for PCI Express cards, Telecommunication and Industry equipments installed in a standard PC:

EN 55022 (2010)
EN 55024 (1998) + A1 (2001) + A2 (2003)
EN 61000-6-2 (2005)

This does not ensure that it will comply with these standards in any random PC or embedded computer. 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 IXH620 is RoHS compliant. A compliance certificate issued by the Manufacturer is available upon request.

Flammability standard

The Dolphin IXH620 PWB is UL94V-0 compliant. The board has the 94V-0 mark in its silk screen.

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 https://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.

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.