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System connectivity beyond imagination

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Adnaco-S5 20 Gb/s
PCI Express Over Fiber Optic System

User's Guide

Contents

1 Terminology

Table 1-1 Common terms used in the user's guide

Term	Description
Add-in card	A card that is plugged into a connector and mounted in a chassis
ATX	A system board form factor. Refer to the ATX Specification
xN	A Link with "N" Lanes.
Downstream	The Ports on a Switch that are not the Upstream Port are *Downstream* Ports.
EMI	Electromagnetic Interference
ESD	Electrostatic Discharge
Gb/s	Gigabit per second
GT/s	Gigatransfers per second
Gen 1	PCIe 2.5 GT/s
Gen 2	PCIe 5 GT/s, backward compatible with Gen1
H2	Adnaco-H2 adapter card
Lane	A set of differential signal pairs, one pair for transmission and one pair for reception. A by-N Link is composed of N *Lanes*
Link	The collection of two Ports and their interconnecting Lanes. A *Link* is a dual-simplex communications path between two components.
microATX	A system board form factor. Refer to the microATX Specification
NC	Not connected
OS	Operating system
PCIe	Interconnect standard for PCI Express cards
Port	Logically, an interface between a component and a PCI Express Link
RT4	Adnaco-RT4 backplane
S5	Adnaco-S5 system
SFP	Small Form-Factor Pluggable Transceiver
Switch	A device that connects two or more Ports to allow PCIe packets to be routed from one Port to another
RMA	Return Material Authorization
Root Complex	A device which connects the processor and memory subsystem to the PCI Express switches and devices
Upstream	The Port on a Switch that is closest topologically to the Root Complex is the *Upstream* Port

2 Read This First

SAFETY INSTRUCTIONS

The precautions noted within this User's Guide are intended to instruct you in the safe and correct use of the system in order to prevent bodily injuries and equipment failure. Please read and ensure that you understand them before proceeding to other sections of the guide.

Warning This symbol indicates topics that could lead to equipment malfunctioning if ignored or handled incorrectly.

3 System Description

3.1 Overview

Adnaco S5 is a multilane PCI Express Gen 2 system based on Adnaco PCI Express over fiber optic technology. The system can be configured to operate with a x4, x2 and x1 duplex fiber optic cable supporting total throughput of 20 Gb/s, 10 Gb/s and 5 Gb/s respectively. The system operates with single-mode or multi-mode cable and transceivers, with the system able to function with cables up to a few hundred meters in length. The system consists of two Adnaco-H2 PCIe x4 host/remote adapters, a x1, x2 and x4 fiber optic cable and an Adnaco-RT4 PCIe x16 backplane. The rated temperature range is from 0° C to +70° C.

The S5 allows system integrators to operate one PCIe Gen 2 or Gen 1 add-in card at long distances from the location of the computer system via a fiber optic cable with a maximum throughput of 20 Gb/s. No additional host software drivers are required during installation or operation. Any type of PCI Express cards can be used including audio, video, USB, FireWire, SATA, data-acquisition, network and others. The supported add-in card PCIe link widths are x1, x2 and x4.

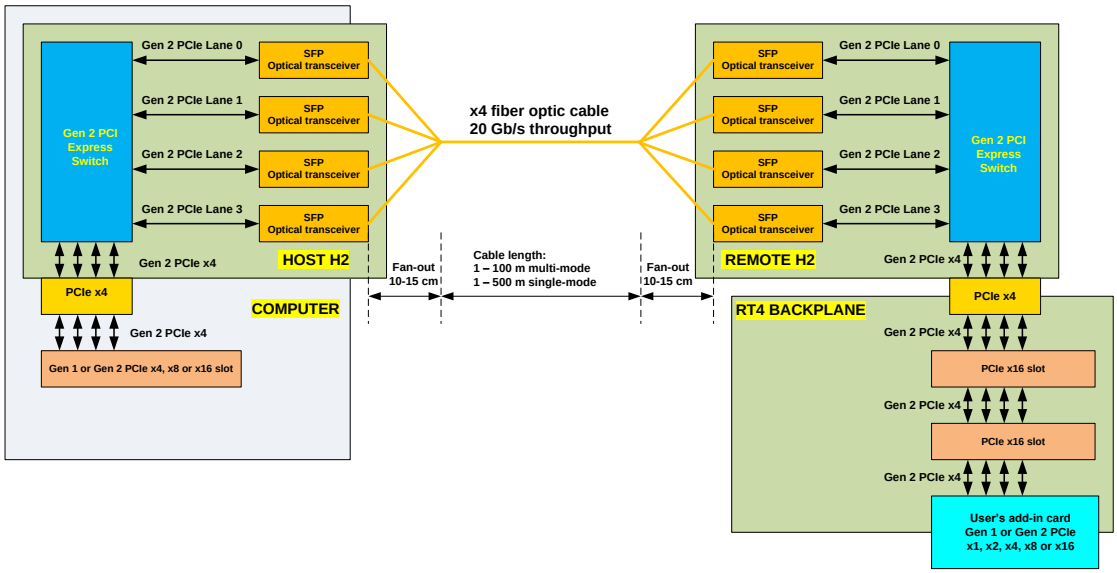
The use of fiber optics provides electrical isolation and also an ability to use long cables. This allows the system integrator to use the system in applications where equipment must operate under harsh environmental conditions or must be isolated from the host computer. The unique feature of the Adnaco PCI Express over fiber optic technology is its transparent access to remote devices without compromising performance due to long cable length. The Adnaco expansion system is transparent to software applications and drivers, so industry standard desktop computers and servers can communicate with remote devices with no additional programming.

3.2 Optical transceivers and fiber optic cable

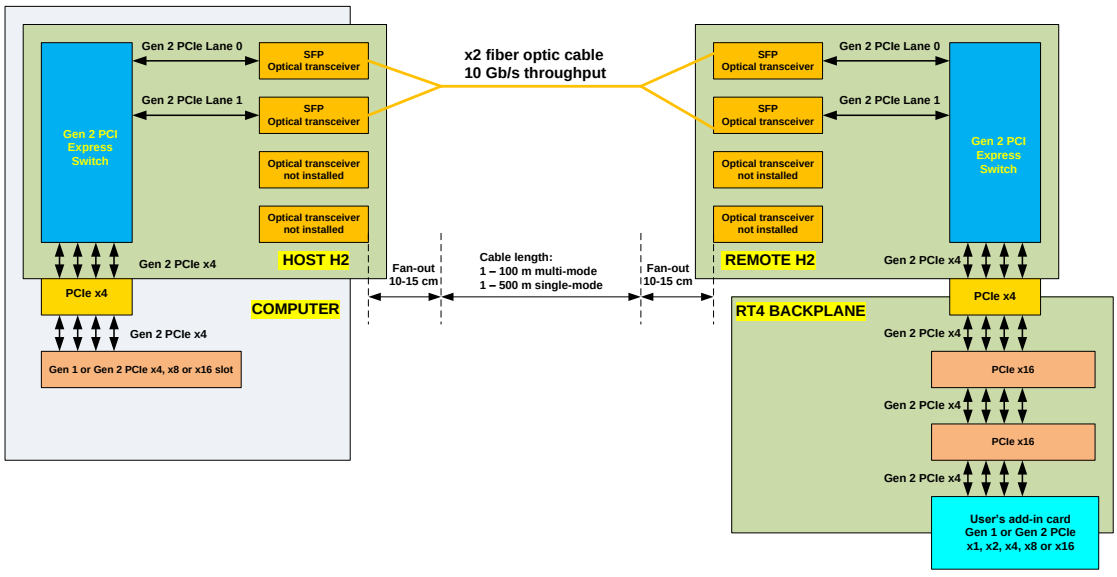
The S5 system operates with multi-mode or single mode LC-LC fiber optic cable and transceivers. The type of cable used should match the optical transceivers type used in the system. Multi-mode transceivers and cable are intended for applications where required cable length is up to 100 meters. Multi-mode transceivers are significantly less expensive compared to single-mode transceivers. However, single-mode transceivers and cable can cover longer distances up to a few hundred meters. Information on the recommended optical transceivers can be found in section 10.7 H2 optical transceivers. Information on fiber optic cable can be found in section 12 Multicore Fiber Optic Cable

3.3 System diagram

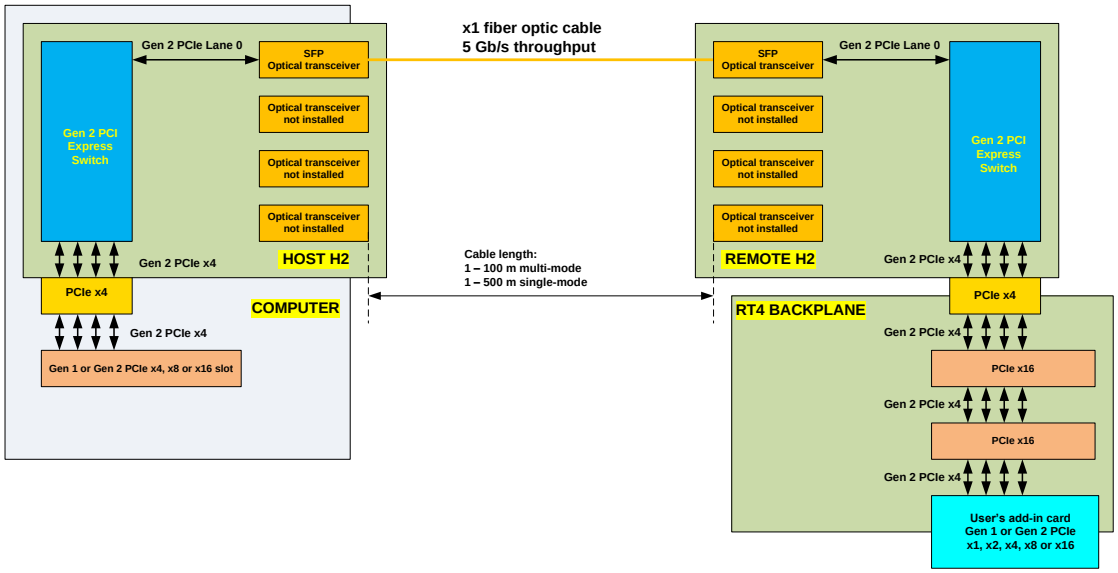
3.3.1 x4 configuration



3.3.2 x2 configuration



3.3.3 x1 configuration



3.4 Measured performance

The system performance depends on the cable length, the add-in card and its driver. The performance is higher for short cables and if the data are transferred in big blocks using a direct memory access (DMA). Beyond 500 m distance, the S5 performance drops and becomes comparable with the S1B single lane system. In x1 configuration the S5 performance is the same as the S1B system. Click here to download the latest Performance Benchmarking Results

3.5 Datasheet and ordering information

Click here to download the latest datasheet with ordering information

4 System Operation

4.1 S5 Power-ON/OFF Modes

The remote H2 and RT4 can turn on and off a standard computer power supply. The system can operate in one of 3 power control modes.

Table 4-1 S5 Power Control Modes

Mode	Remote H2 S1 switch	Description
1	S1.4 = OFF, S1.5 = OFF	Power ON and OFF is controlled by the momentary button SW1 or an external momentary switch connected to the J4 pins 8 and 10
2	S1.4 = ON, S1.5 = OFF	Power supply and the RT4 are always ON This mode should be used with a custom power supply
3	S1.4 = OFF, S1.5 = ON	Power is turned ON and OFF automatically when the computer is turned ON and OFF

Note: Disconnection of the fiber optic cable with the system powered on will require a Power-OFF/ON sequence to resume operation.

4.2 Manual Power-ON/OFF Sequence (modes 1 and 2)

Power-On Sequence

- Power-on the Adnaco-RT4.
- Power-on the host computer.

Power-On Sequence Rationale: The host computer BIOS and OS assume all PCI/PCIe cards are available for first code execution following power-up.

Power-Off Sequence

- Power-off the host computer.
- Power-off the Adnaco-RT4.

Power-Off Sequence Rationale: OS and Drivers assume all PCI/PCIe cards are always available from power-on to power-off.

4.3 Automatic Power-ON/OFF Sequence (mode 3)

Mode 3 can be used only with a standard computer power supply or a power supply with a 5V stand-by voltage and a PS_ON# signal compliant with the Power Supply Design Guide for Desktop Platforms. After installing the system connect the power cord and switch ON the power switch on the RT4 power supply in order to provide stand-by power to the RT4. In this mode power sequence is controlled automatically. When the computer is turned ON and OFF the RT4 is turned ON and OFF automatically.

5 System Installation

5.1 Installation recommendations

It is highly recommended to update your computer's BIOS and OS. If the BIOS is more than 2-3 years old, the extension may not operate properly if PCI recourses for multiple PCI-PCI bridges are not allocated. A number of system vendors have released updates that fix many issues related to the PCI Express expansion systems. The latest BIOS update and its installation instructions can be downloaded from the computer or motherboard manufacturer's web site. If a BIOS update does not solve installation issues, try a different computer.

Overclocking is not supported. The PCI Express clock frequency must be set to either the default value or 100MHz in the BIOS.

The S5 system is supplied with two H2 cards preconfigured as host and remote adapters. The cards are identical so their configuration can be changed if needed.

The number of fiber optic cables must match the H2 configuration described section 10.6 H2 supported optical configurations, otherwise the fiber optic link will not work.

Table 5-1 Default H2 configuration

Mode	S1.3	S1.8	Other S1.x	J2	J3-J8
Host	ON	OFF	OFF	1-2	Set for ordered configuration
Remote	ON	ON	OFF	2-3	Set for ordered configuration

Table 5-2 Default RT4 configuration for a standard computer power supply

J5	J6	J7
1-2	2-3	2-3

If RT4 is intended to be used with a custom power supply see the section 9 Using RT4 with Custom Power Supply

If you experience any problems, please review 13 Troubleshooting

ESD Warning The electronic parts are sensitive to electrostatic discharges. Please use an electrostatic wrist strap and/or conductive mat when executing the steps below.

5.2 Preparing your computer

- **The system does not support overclocking. Please make sure that the PCI Express clock frequency is set to either the default value or 100MHz in the BIOS.**

- **The optical transceivers used in the system do not support PCI Express link power management. Therefore, it is recommended to disable all power management features on the computer. The step-by-step instructions for Windows 7 and 8 can be**

found in Appendix A. For other operating systems, please consult your OS documentation, or if you need additional assistance please contact the OS vendor.

5.3 Power supply minimum load requirements

- **The RT4 backplane is designed to be powered by a standard computer power supply. Many computer power supplies will require a minimum load in order to provide a stable output voltage and in some cases may not even turn on. If installed add-in card does not consume enough power for stable power supply operation, an additional load can be added by connecting chassis fans or a load resistor to the power supply.**

5.4 Installing H2 host adapter card

- Power off the host computer and unplug its power cord.
- Remove the computer's cover.
- Identify any Gen 2 PCIe x4, x8 or x16 slot on the motherboard. **Note: installing the host H2 in a Gen 1 PCIe slot will limit the system speed to 2.5 Gb/s per lane.**
- Remove the metal bracket for the slot you have selected. Keep both the bracket cover and retaining-screw.
- Insert the H2 card into the identified PCIe slot by pushing gently on the card. Secure the card to the computer chassis using the retaining screw.

NOTE: The BIOS or motherboard may not support a PCIe host card in a slot intended for a graphics card (PCIe x16). For more information on installing PCIe cards please refer to your computer's user's manual.

5.5 Installing RT4 backplane and H2 remote adapter card

- The RT4 can be mounted in any microATX or ATX case as shown in section 7 Installing Adnaco-RT4 in ATX chassis.
- Connect the main power supply cable (20 or 24 pin connector) to the RT4 J3 connector.
- If necessary connect an additional load to the power supply as described in section 5.3 Power supply minimum load requirements
- Set up the power control mode on the remote H2 as described in 4 System Operation

S1.4	S1.5	Power control mode
OFF	**OFF**	Power ON/OFF controlled by SW1 button on RT4
ON	**OFF**	Power is always ON
OFF	**ON**	Power is turned ON and OFF automatically when computer is turned ON and OFF

- Install the remote H2 into the J1 slot with the ADNACO ADAPTER label on the RT4

5.6 Installing user's PCIe card in RT4 backplane

- Follow the recommendations and procedures provided by the card manufacturer for installation into standard computer slots.
- Install the user's card into the J2 slot with the ADD-IN CARD label on the RT4

5.7 Connecting fiber optic cable

- Remove the plastic protection plugs from one end of the fiber optic cable and connect the cable to the host H2 SFP transceivers. The cable fibers are marked 0, 1, 2, 3 and they must be connected to the host H2 ports 0, 1, 2, 3 respectively.
- Remove the plastic protection plugs from the other end of the fiber optic cable and connect the cable to the remote H2 SFP transceivers. The cable fibers are marked 0, 1, 2, 3 and they must be connected the remote H2 ports 0, 1, 2, 3 respectively.

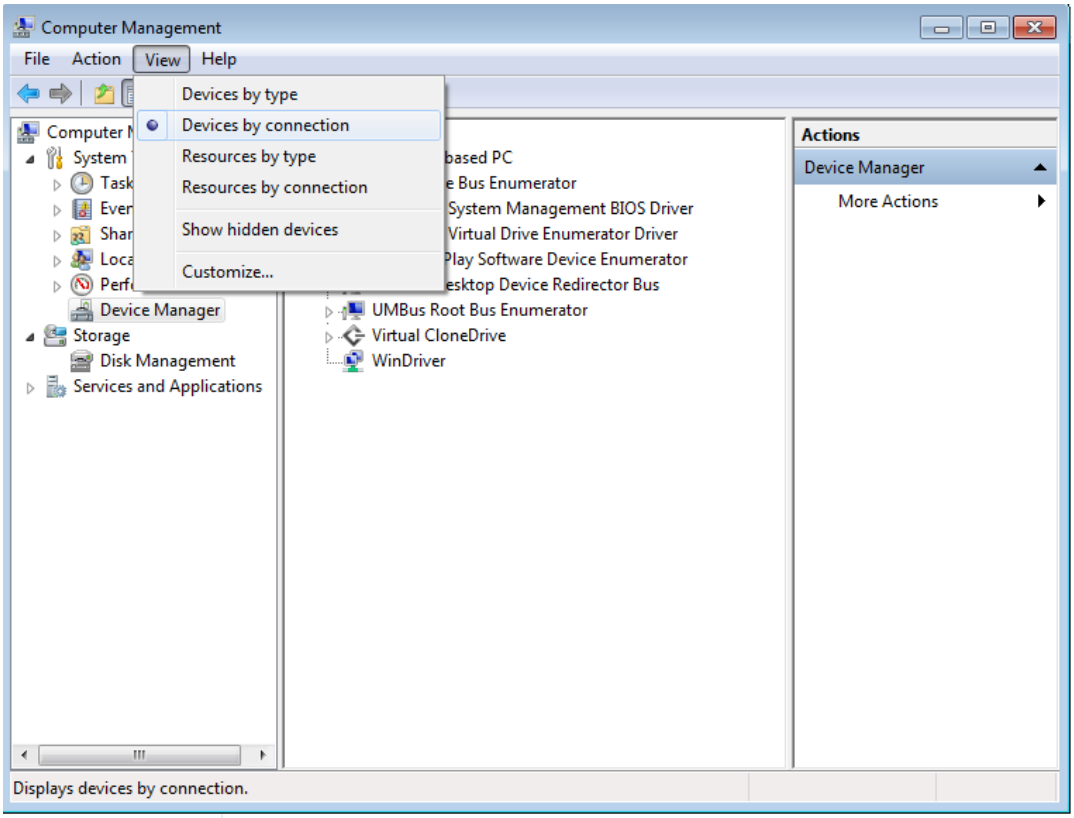
5.8 Turning on system for the first time

- Power on the system as indicated in 4 System Operation.
- Verify the LED statuses. There should be no red LEDs ON.
- The LEDs D1-D4 and D5-D8 on the host H2 show the status of the computer PCIe and optical links respectively.
- The LEDs D1-D4 and D5-D8 on the remote H2 show the status of the user's add-in card PCIe and optical links respectively.
- The number of active link LEDs shows the number of active PCIe lanes. If the LED are blinking, 0.5 seconds ON, 0.5 seconds OFF then the negotiated PCIe link speed is 2.5 Gb/s per lane. If the LED are ON then the negotiated PCIe link speed is 5.0 Gb/s per lane.
- The green LEDs D13-D16 located near the metal bracket should be ON for each installed SFP optical module. All red LEDs D9-D12 should be OFF.
- **Note:** If the user's card is PCIe Gen 1 then, in general, the down-shifting is not allowed (defined as plugging a PCI Express card into a connector that is not fully routed for all of the PCI Express lanes). As a result, the Gen1 cards with x8 and x16 width PCIe connector may not negotiate x4 link width and they will operate only in x1 mode.
- If you see that some red LEDs are ON or that some PCIe link LED are not active please review section 13 Troubleshooting.
- The OS will install drivers for the H2 and add-in card if the system is being connected for the first time. The Adnaco system uses standard PCIe switches and therefore all drivers are included in the OS.
- If the OS cannot automatically install a software driver for the newly added card, refer to the card software and driver installation guides.
- You may need to reboot the host computer after driver installation is completed.
- You can verify if the installation was successful by checking in the Device Manager as indicated in 6 Verifying System Functionality.
- Once installation is completed your card is ready to operate remotely from the host computer at a distance up to the maximum length of the fiber optic cable.

6 Verifying System Functionality

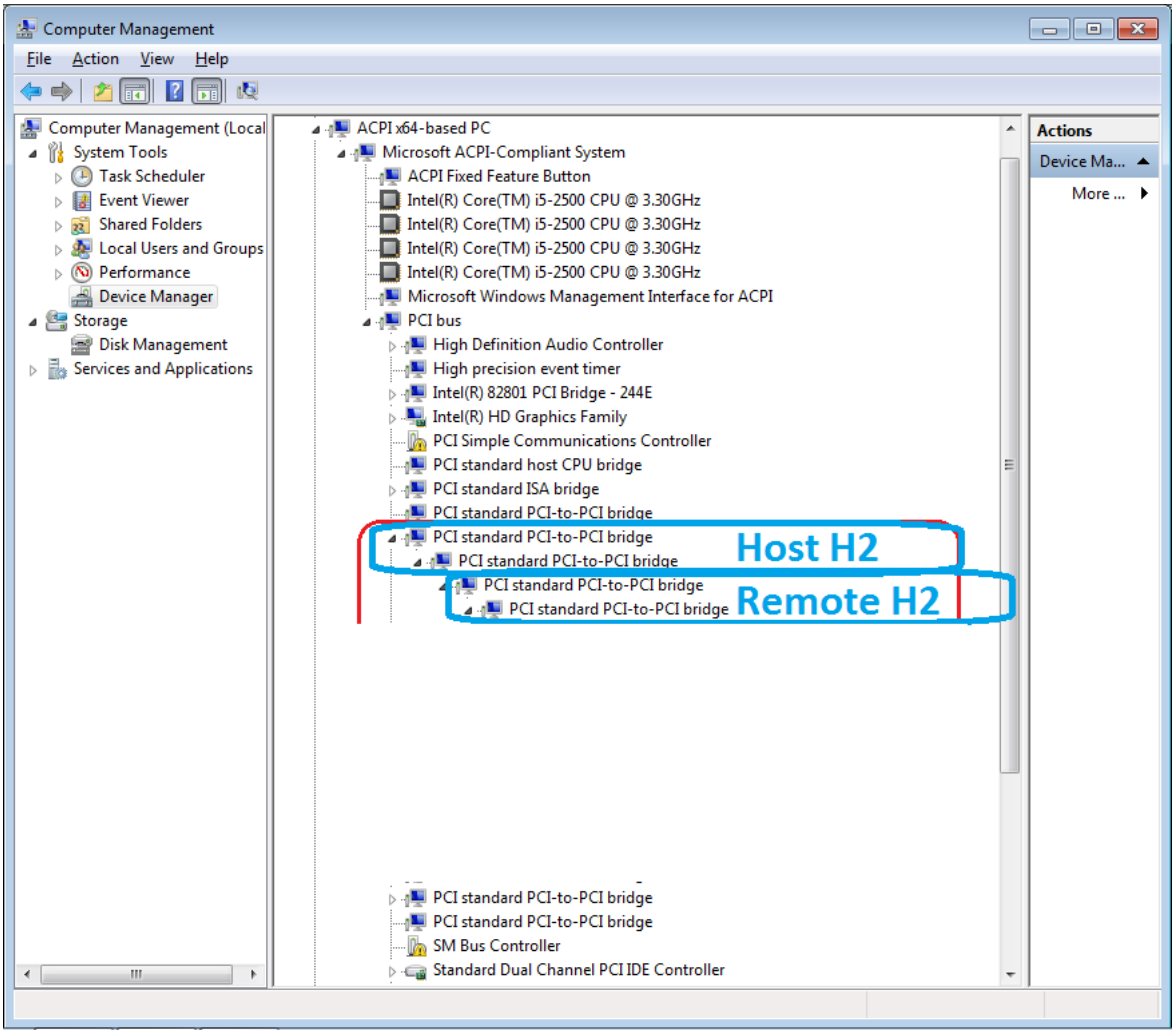
To verify a successful installation, use the **Device Manager**. In the **Device Manager** click on the **View** Menu and select **View Devices by Connection.**

Figure 6-1 Device Manager



To see if your installation is successful click on the arrow to the left of the **ACPI** to open it, then within **PCI Bus** check the lines containing the words "**PCI Express Root**" or "**PCI standard PCI-to-PCI bridge**". Under one of the lines you should see multiple PCI-to-PCI bridges and your add-in card. The Figure 6-2 below shows the host and remote H2 cards.

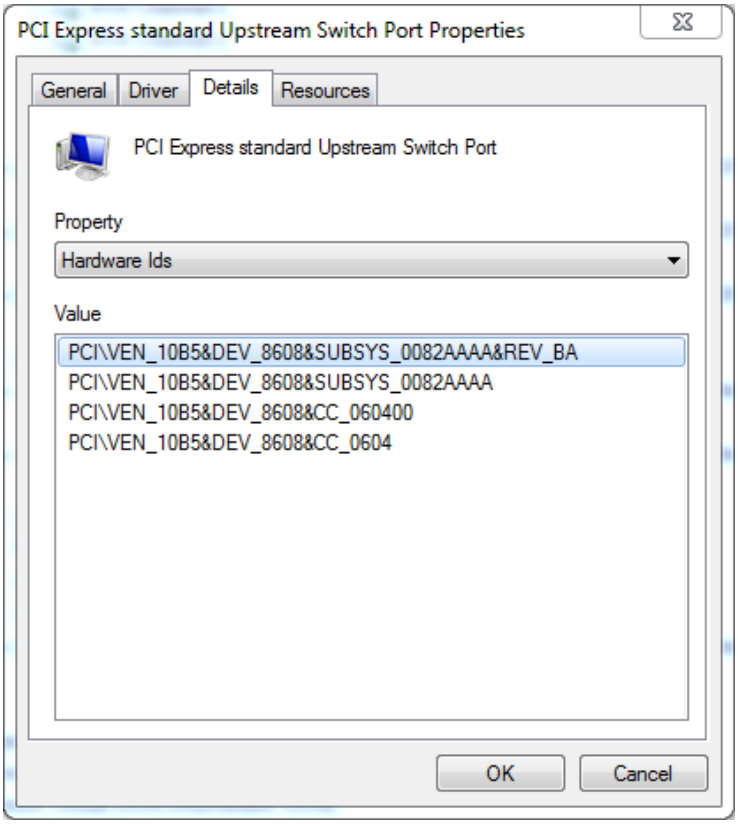
Figure 6-2 S5 System View in Device Manager



Right-click on the "**PCI standard PCI-to-PCI bridge**" line you want to view, then click **Properties.** On the **Details** tab you can verify a vendor and the device ID of the selected device.

All boards have the **Vendor ID =10B5** and **Device ID=8608**, **Subsystem Vendor ID = AAAA** and **Subsystem ID = 0082**. The device and subsystem IDs are shown below

Figure 6-3 H2 Hardware



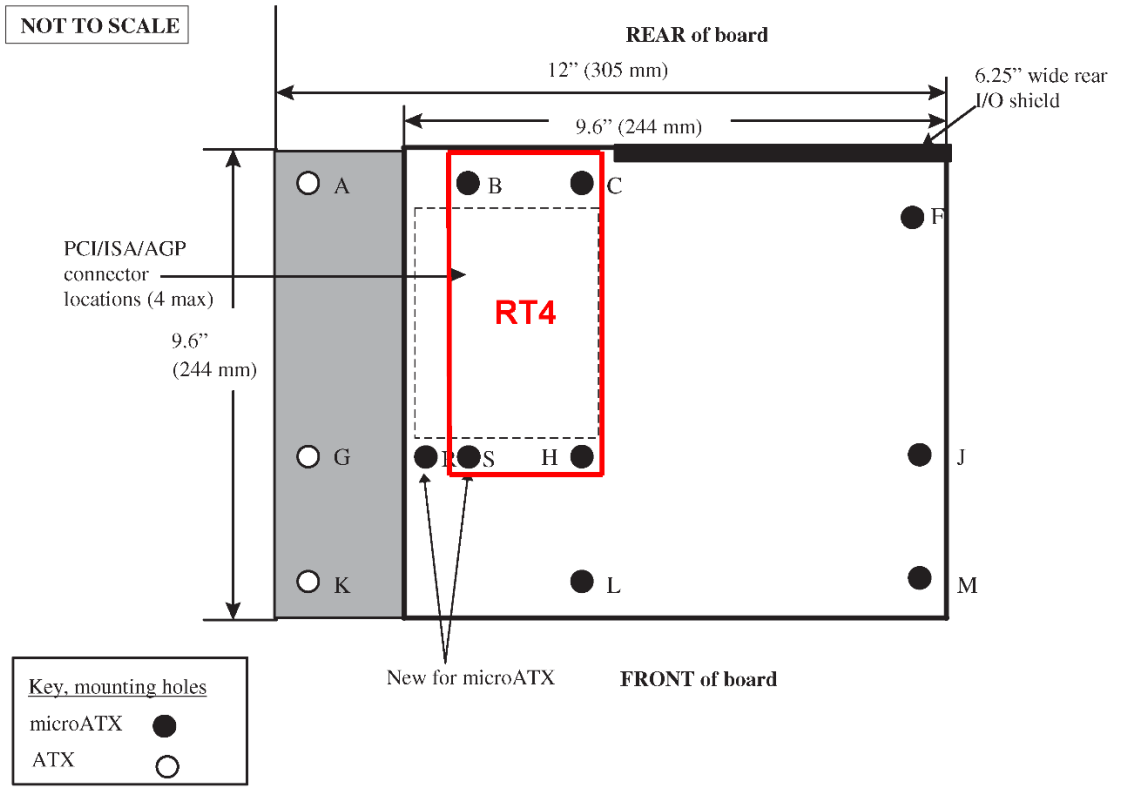
If the installation was unsuccessful, please go to 13 Troubleshooting

7 Installing RT4 in ATX chassis

The RT4 can be mounted in any microATX or ATX case using holes B, C, S, H as shown on the drawing below.

microATX Motherboard Interface Specification
Version 1.2

To avoid damage to traces on microATX and ATX motherboards, chassis standoffs in any locations not specified for microATX and ATX should be removable or not be implemented at all.



Form factor	Mounting hole locations	Notes
microATX	B, C, F, H, J, L, M, R, S	Holes R and S are added for microATX form factor. Hole B was defined in Full AT format
ATX	A, C, F, G, H, J, K, L, M	Hole F must be implemented in all ATX 2.1-compliant chassis assemblies. It was optional in the ATX 1.1 specification.

Figure 2: microATX and ATX Form-factor Mounting Holes

Notes: In Figure 2, Figure 3, and Figure 8, the board is shown oriented with the rear of the board toward the top.
The shaded portion to the left above indicates the greater width of the ATX form factor.
For details about mounting holes and board sizes, see the mechanical drawing in this specification.

8 Designing Custom RT4

If the RT4 does not suit the user's applications there are a few options available:

1. The users can design their own backplane using information provided in this user's guide. The RT4 reference schematic can be found in section 11.4 and the H2 signals description can be found in section 10.9. The Adnaco engineering team can provide some design assistance if needed.

2. The Adnaco can design, prototype and manufacture the backplane per customer's requirements. Minimum order quantity for custom board production is 25 pieces.

3. Other options can be considered upon request.

9 Using RT4 with Custom Power Supply

9.1 Custom power supply requirements

Although the RT4 is designed to operate with a standard computer power supply, some applications may require a custom power supply.

The RT4 requires a 3.3V power supply with 3A maximum current. The user's add-in cards may require additional +12V power, so please check power requirements for your add-in cards and add them to your power supply specifications.

We cannot guaranty that the RT4 will work with any custom power supply unless the power supply meets the Power Supply Design Guide for Desktop Platforms. The main requirements are shown below.

The +3.3V and +12V output voltages must remain within the regulation ranges shown in Table 9-1 when measured at the J3 connector on the RT4 board under all line, load, and environmental conditions.

There is no specific requirement for power supply sequencing of each of the power supply outputs. They may come up or go down in any order.

Table 9-1 DC Output Voltage Regulation

Output	Range	Min	Nom	Max	Unit
+3.3V	+/-5%	+3.14	+3.30	+3.47	V
+12V	+/-5%	+11.40	+12.00	+12.60	V
+5VSB	+/-5%	+4.75	+5.00	+5.25	V

Table 9-2 DC Output Noise/Ripple

Output	Maximum Ripple and Noise (mVp-p)
+3.3V	50

Output	Maximum Ripple and Noise (mVp-p)
+12V	120
+5VSB	50

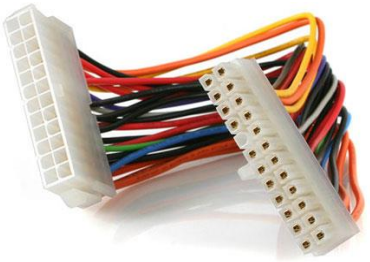
The power on/off switch used in a system with a custom power supply should be connected either to the power supply input or to a power control signal similar to the PS_ON #signal in the computer power supply. Using a power switch between the power supply outputs and the RT4 board is not allowed; it may result in voltage overshoot and damage the RT4, H2 and installed add-in card.

Warning: The connection between the power supply and the RT4 board must not be interrupted when the power supply is ON or its bypass capacitors are not fully discharged.

9.2 Power cable

For power supply connection, we recommend using an ATX power extension cable (available in computer stores). Use a 24 or 20 pin connector.

Figure 9-1 ATX power extension cable



Cut one connector and use wires to make a power cable for your power supply. Make appropriate connections using the connector pin-out shown below. Connect only the signals that are used.

Figure 9-2 Cable Main Power Connector (Pin-side view)

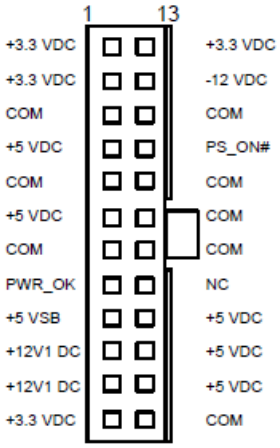
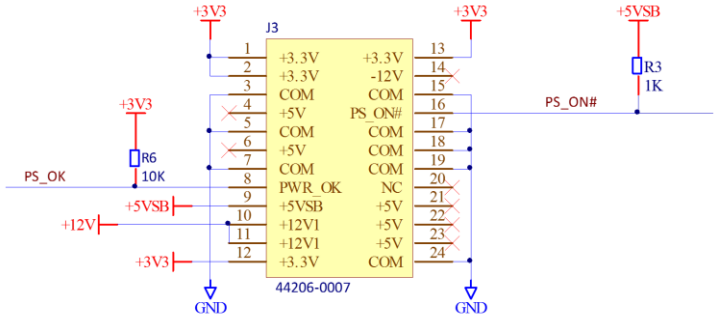


Table 9-3 Cable Main Power Connector Pinout

Pin	Signal	Color	Pin	Signal	Color
1	+3.3VDC	Orange	13	+3.3VDC	Orange
2	+3.3VDC	Orange	14	-12VDC	Blue
3	GND	Black	15	GND	Black
4	+5VDC	Red	16	PS_ON#	Green
5	GND	Black	17	GND	Black
6	+5VDC	Red	18	GND	Black
7	GND	Black	19	GND	Black
8	PWR_OK	Gray	20	Reserved	-
9	+5VSB	Purple	21	+5VDC	Red
10	+12VDC	Yellow	22	+5VDC	Red
11	+12VDC	Yellow	23	+5VDC	Red
12	+3.3VDC	Orange	24	GND	Black

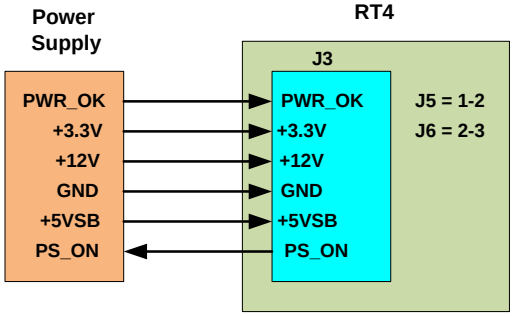
Figure 9-3 RT4 Main Power Schematic



9.3 Custom power supply signals

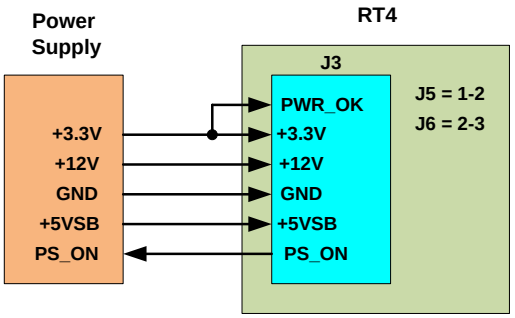
- The remote H2 and RT4 operate from a **3.3V** power supply. If the user's add-in card uses **12V** then this voltage must be supplied as well. The J3 maximum per pin current is 13A.
- **+5VSB** (pin 9) stand-by voltage can be used if the custom power supply has ON/OFF control input similar to the **PS_ON#** signal in a standard computer power supply. The **PS_ON#** (pin 16) on the J3 connector is an open drain output with a 10 K pull-up resistor to +3.3V. The output is 5V tolerant so it can be pulled up to +5V by an external resistor.
- **PWR_OK** (pin 8) should be connected to a "power good" signal from the power supply. This signal is a voltage supervisor for the supplied +3.3V and +12V voltages. The **PWR_OK** has to be asserted HIGH when the +3.3V and +12V are within the regulation thresholds. If **PWR_OK** signal is not available in the custom power supply then connect the pin 8 on the J3 connector to any +3.3V pin on the J3 connector. The **PWR_OK** (pin 8) input on the J3 connector in 5V tolerant it can be pulled up to +5V by an external resistor.

9.4 RT4 to custom power supply connection options



Remote H2

S1.4	S1.5	Power control mode
OFF	OFF	Power ON/OFF controlled by SW1 button on RT4
ON	OFF	Power is always ON
OFF	ON	Power turned ON and OFF automatically when computer is turned ON and OFF



Remote H2

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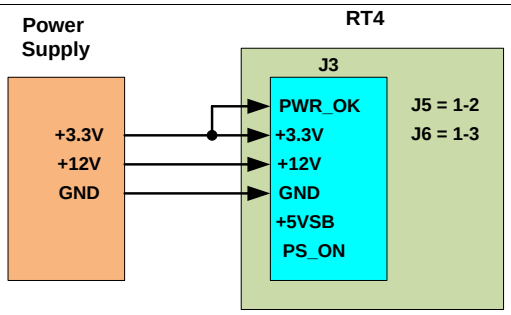


Remote H2

S1.4	S1.5	Power control mode
ON	OFF	Power is always ON

9.5 Connecting power supply to RT4

Turn on your power supply before connecting it to the RT4 and, using a multi-meter, measure all voltages on the pins of the power connector. Ensure that all voltages are within the specifications shown in Table 9-1. Following this, turn the power supply off and wait until all bypass capacitors in the power supply are discharged. Without a load it may take some time until capacitors are fully discharged; verify with a multi-meter that all voltages on the connector pins are 0V. Connecting the power cable when the power supply is on, or when the bypass capacitors are not fully discharged, may result in damage to the RT4 and installed add-in card.

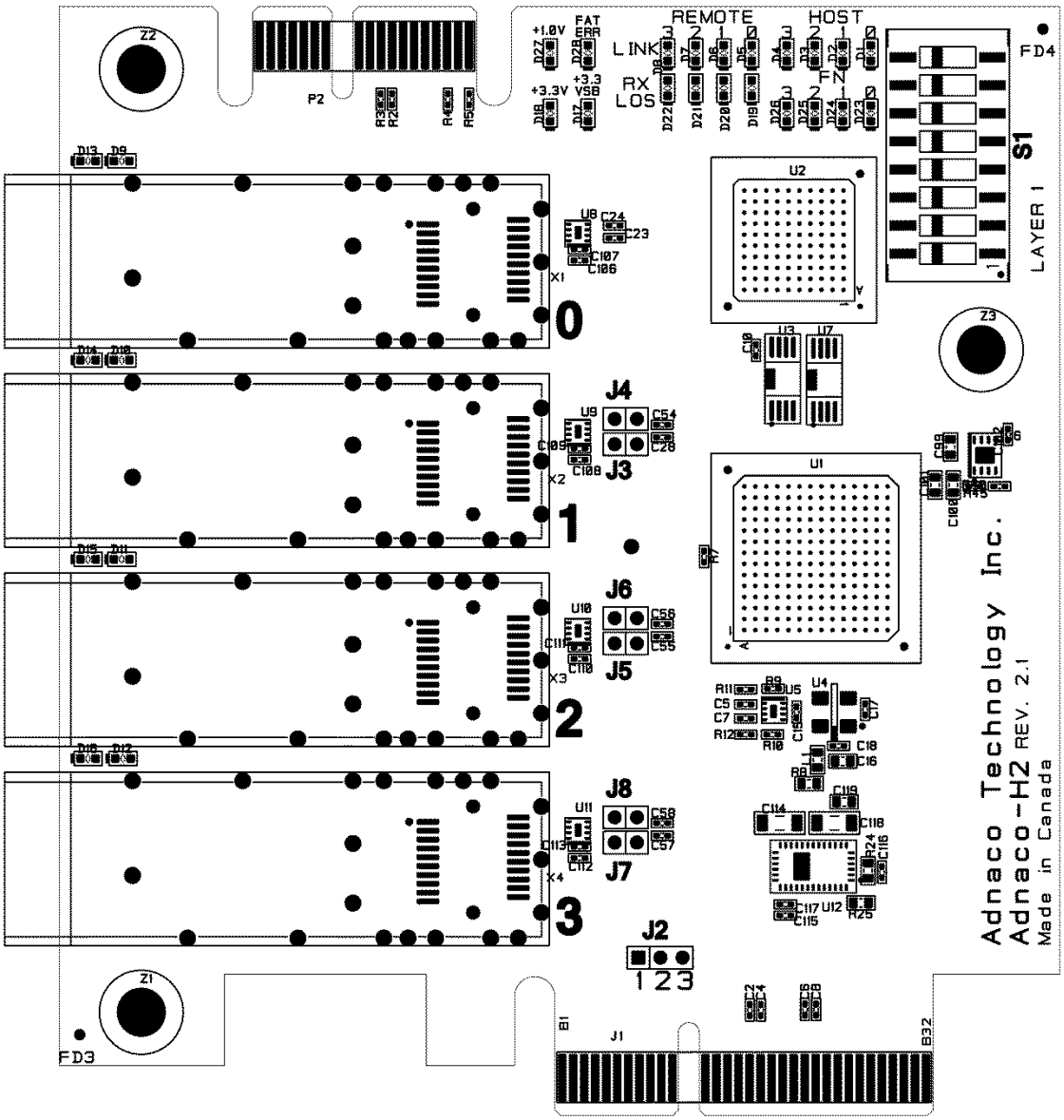
10 H2 Host/Remote Adapter

10.1 H2 Overview

The H2 card can operate in the host and remote mode. The operating mode is selected by the S1.8 DIP switch.

10.2 H2 drawing with dimensions

Click here to download H2 drawing with dimensions



10.3 H2 DIP switch description

Table 10-1 H2 DIP Switch

Switch	Description	Default
1-2	**Configuration selection** **1 2** OFF OFF – Gen2 at 5.0 GT/s per lane ON OFF – Gen1 at 2.5 GT/s per lane OFF ON – reserved ON ON – default switch configuration	OFF OFF
3	**Operating frequency:** ON – default OFF – reserved	ON
4-5	**Power control in remote mode** **4 5** OFF OFF – power ON/OFF controlled by SW1 button on RT4 ON OFF – power is always ON OFF ON – power turned ON and OFF automatically when computer is turned ON and OFF **In host mode must be S1.4 = OFF, S1.5 = OFF**	OFF OFF
6	Reserved	OFF
7	Reserved	OFF
8	**Operating mode:** OFF – host adapter ON – remote adapter	-

10.4 H2 LEDs description

Table 10-2 H2 LEDs

Designator	Description
D1-D4	Local PCIe lanes status: OFF – Lane is not active ON – Lane operates at 5.0 GT/s Blinking, 0.5 seconds ON, 0.5 seconds OFF – Lane operates at 2.5 GT/s
D5-D8	Optical PCIe lanes status: OFF – Lane is not active ON – Lane operates at 5.0 GT/s Blinking, 0.5 seconds ON, 0.5 seconds OFF – Lane operates at 2.5 GT/s
D9-D12	Optical PCIe lane failure. When SFP is installed and LED is ON, Lane is not active
D13-D16	Optical PCie lane status when SFP is installed: OFF – Lane is not active ON – Lane operates at 5.0 GT/s Blinking, 0.5 seconds ON, 0.5 seconds OFF – Lane operates at 2.5 GT/s
D17	Stand-by voltage is ON
D18	+3.3V voltage is ON
D19-D22	Loss of Signal. When ON, indicates the received optical power is below the worst-case receiver sensitivity

Designator	Description
D23-D27	Factory only
D28	Fatal Error. When ON, fatal error is detected and a reset of the board may be required to return to reliable operation

10.5 H2 connectors description

Table 10-3 H2 Connectors

Designator	Description
J1	**PCIe x4 edge connector.**
J2	**Stand-by power source:** **1-2 – 3.3V from PCIe connector** Default in host mode. Used when H2 does not require to control power supply **2-3 – 3.3Vaux from PCIe connector** Default in remote mode Used in remote mode when H2 requires to control the remote backplane power supply.
J3-J8	See 10.6 H2 supported optical configurations

10.6 H2 supported optical configurations

Table 10-4 Supported optical configurations

Configuration	H2 optical transceivers connection	Jumpers
x1	0 <-> 0	J3-J8 - OUT
x2	0-1 <-> 0-1	J3-J4 – IN, J5-J8 - OUT
x4	0-3 <-> 0-3	J3-J8 - IN

Note:
1. The number of fiber optic cables must match the H2 configuration in the Table 10-4 otherwise, the fiber optic link will not work.
2. The cable fibers are marked 0, 1, 2, 3 and they must connect the H2 ports 0, 1, 2, 3 respectively.
3. The length of fiber optic cables must match within a few centimeters.

10.7 H2 optical transceivers

The following Finisar optical transceivers are recommended for the H2 card:

1. FTLF8524P – multi-mode
2. FTLF1326P3 – single-mode

The H2 card is designed to work with any standard SFP optical transceiver provided it can support a 5 Gb/s data rate. SFP transceivers from other manufacturers with similar parameters can also be used but their interoperability with the H2 card must be verified by the users. Click here to download the SFP multiple source agreement.

10.8 H2 power requirements

Table 10-5 Maximum power consumption

Power supply	Maximum current
3.3V	3 A

Power supply	Maximum current
3.3Vaux	375 mA

10.9 H2 PCIe x4 edge connector

10.9.1 Pinout

Pins with dual functionality in host and remote modes are highlighted with orange

Table 10-6 PCIe edge connector side A

Pin#	Name	Host mode signals	Remote mode signal
A1	PRSNT1#	Connected to PRSNT2#	Connected to PRSNT2#
A2	+12V	NC	NC
A3	+12V	NC	NC
A4	GND	GND	GND
A5	TCK	Not used. Input with weak pull-up	POWER ON/OFF SWITCH
A6	TDI	Not used. Output in tri-state	STANDBY LED
A7	TDO	Not used. Output in tri-state	POWER ON LED
A8	TMS	NC	POWER SUPPLY OK
A9	+3.3V	+3.3V	+3.3V
A10	+3.3V	+3.3V	+3.3V
A11	PERST#	PERST#	PERST#
Mechanical key			
A12	GND	GND	GND
A13	REFCLK+	Reference clock (differential pair)	Reference clock (differential pair)
A14	REFCLK-		
A15	GND	GND	GND
A16	PERp0	Receiver differential pair Lane 0, **Upstream port**	Receiver differential pair Lane 0, **Downstream port**
A17	PERn0		
A18	GND	GND	GND
A19	RSVD	Not used. Input with weak pull-up	RST_OK_LED
A20	GND	GND	GND
A21	PERp1	Receiver differential pair Lane 1, **Upstream port**	Receiver differential pair, Lane 1, **Downstream port**
A22	PERn1		
A23	GND	GND	GND
A24	GND	GND	GND
A25	PERp2	Receiver differential pair Lane 2, **Upstream port**	Receiver differential pair Lane 2, **Downstream port**
A26	PERn2		
A27	GND	GND	GND
A28	GND	GND	GND
A29	PERp3	Receiver differential pair Lane 3, **Upstream port**	Receiver differential pair Lane 3, **Downstream port**
A30	PERn3		
A31	GND	GND	GND
A32	RSVD	NC	NC

Table 10-7 PCIe edge connector side B

Pin#	Name	Host mode signals	Remote mode signal
B1	+12V	NC	NC
B2	+12V	NC	NC
B3	+12V	NC	NC
B4	GND	GND	GND
B5	SMCLK	Not used. Output in tri-state	PCIE_RST#
B6	SMDAT	Not used. Output in tri-state	POWER ON/OFF CTRL
B7	GND	GND	GND
B8	+3.3V	+3.3V	+3.3V
B9	TRST#	Not used. Input with weak pull-up	MANUAL RESET SWITCH
B10	3.3Vaux	3.3Vaux	3.3Vaux
B11	WAKE#	Not used. Output in tri-state	POWER OK LED
Mechanical key			
B12	RSVD	Not used. Output in tri-state	POWER FAIL LED
B13	GND	GND	GND
B14	PETp0	Transmitter differential pair	Transmitter differential pair
B15	PETn0	Lane 0, **Upstream port**	Lane 0, **Downstream port**
B16	GND	GND	GND
B17	PRSNT2#	Connected to PRSNT1#	Connected to PRSNT1#
B18	GND	GND	GND
B19	PETp1	Transmitter differential pair	Transmitter differential pair
B20	PETn1	Lane 1, **Upstream port**	Lane 1, **Downstream port**
B21	GND	GND	GND
B22	GND	GND	GND
B23	PETp2	Transmitter differential pair	Transmitter differential pair
B24	PETn2	Lane 2, **Upstream port**	Lane 2, **Downstream port**
B25	GND	GND	GND
B26	GND	GND	GND
B27	PETp3	Transmitter differential pair	Transmitter differential pair
B28	PETn3	Lane 3, **Upstream port**	Lane 3, **Downstream port**
B29	GND	GND	GND
B30	RSVD	NC	NC
B31	PRSNT2#	Connected to PRSNT1#	Connected to PRSNT1#
B32	GND	GND	GND

10.9.2 Reference clock

The REFCLK pins are inputs in the host and remote modes. The H2 clock supports constant and spread spectrum clocking in both host and remote modes. The clock must meet the requirements given in the *PCI Express Base Specification Revision 2.0*.

10.9.3 PCI Express receiver and transmitter signals

The H2 PCI Express port connected to the edge connector is configured as an upstream port in the host mode and as a downstream port in the remote mode. The port can run at Gen 2 (5.0 GT/s) and Gen 1 (2.5 GT/s). The supported link widths are x4, x2 and x1

10.9.4 Dual functionality control pins

Table 10-8 Control pins description

Pin #	Host	Remote
A5	**Name:** Not used **Type:** Input, weak pull up	**Name: POWER ON/OFF SWITCH** **Type:** Input, weak pull up **Active:** LOW Connecting input to ground through a momentary switch toggles **POWER ON/OFF CTRL** output HIGH and LOW
A6	**Name:** Not used **Type:** Output in tri-state	**Name: STANDBY LED** **Type:** Output **Active:** HIGH Indicates that the system is in stand-by
A7	**Name:** Not used **Type:** Output in tri-state	**Name: POWER ON LED** **Type:** Output **Active:** HIGH Indicates that the system is ON
A8	**Name:** Not used **Type:** Input, weak pull up	**Name: POWER OK** **Type:** Input, weak pull up This signal should be connected to a voltage supervisor and asserted high to indicate that the +12 V and +3.3 V outputs from the power supply are within the regulation thresholds. This input should be connected to the PWR_OK signal on the standard computer power supply connector (pin 8) via a 5V to 3.3V voltage converter. The PWR_OK is not available connect this input to +3.3V
A19	**Name:** Not used **Type:** Output in tri-state	**Name: RESET OK LED** **Type:** Output **Active:** LOW Indicates that all resets are released
B5	**Name:** Not used **Type:** Output in tri-state	**Name: PCIE_RST#** **Type:** Output **Active:** LOW Propagates PCIe reset from host computer, PERST#, **MANUAL RESET SWITCH** and **POWER OK** inputs. This signal has to be connected to the PERST# pin on the add-in card slot.

Pin #	Host	Remote
B6	**Name:** Not used **Type:** Output in tri-state	**Name: POWER ON/OFF CTRL** **Type:** Output Control signal to turn ON and OFF a standard computer power supply. When the power is first applied to the remote H2 the output is HIGH (OFF). The signal must be connected to the power supply via a 5V tolerant open drain buffer. HIGH – power supply OFF LOW – power supply ON
B9	**Name:** Not used **Type:** Input, weak pull up	**Name: MANUAL RESET SWITCH** **Type:** Input, weak pull up **Active:** LOW Connecting input to ground through a momentary switch generates reset to the remote H2 and user's add-in card.
B11	**Name:** Not used **Type:** Output in tri-state	**Name: POWER OK LED** **Type:** Output **Active:** LOW Indicates that POWER OK pin is HIGH
B12	**Name:** Not used **Type:** Output in tri-state	**Name: POWER FAIL LED** **Type:** Output **Active:** LOW Indicates that POWER OK pin is LOW

Table 10-9 Control Pins Absolute Maximum Ratings

Parameter	Minimum	Maximum	Unit
DC input voltage	-0.5	4.0	V
DC output current, per pin	-25	-25	mA

Table 10-10 Control Pins DC Electrical Characteristics

Parameter	Minimum	Maximum	Unit
Input pin leakage current	-10	10	µA
Tri-stated I/O pin leakage current	-10	10	µA
Weak pull-up	5	25	kΩ
Input capacitance	–	8	pF

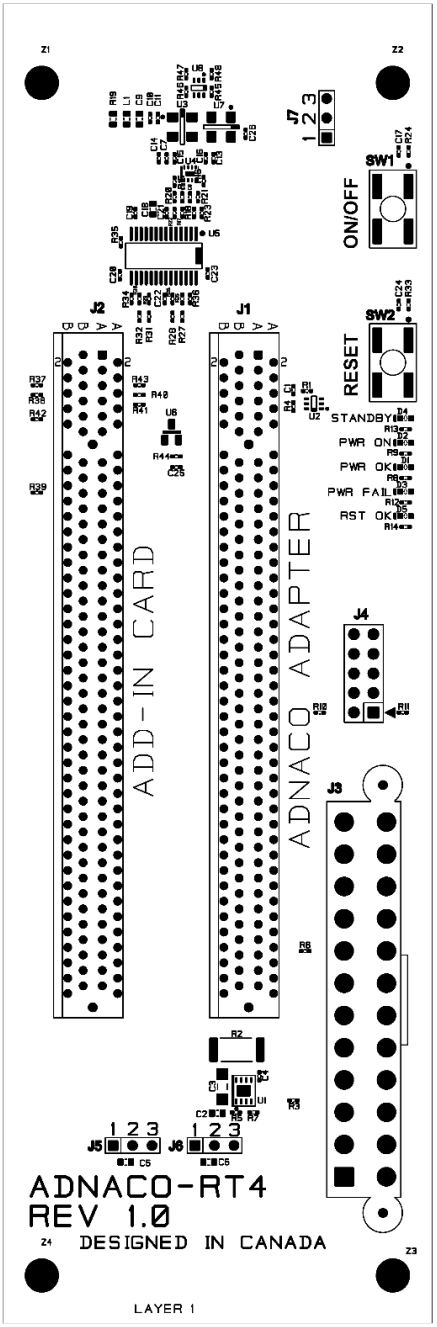
Table 10-11 Control Pins I/O Specifications

Parameter	Minimum	Maximum	Unit
I/O supply voltage	3.0	3.6	V
High-level input voltage	1.7	4.0	V
Low-level input voltage	-0.5	0.8	V
High-level output voltage (IOH = -16mA)	2.4	–	V
Low-level output voltage (IOL = 16mA)	–	0.45	V

11 RT4 PCIe x16 Backplane

11.1 RT4 drawing with dimensions

Click here to download RT4 drawing with dimensions



11.2 RT4 LEDs description

Table 11-1 RT4 LEDs

Designator	Description
D1	Power OK – +3.3V, +12V are within the regulation thresholds
D2	Power ON – board is ON
D3	Power failure – one or both of the +3.3V and +12V power supplies failed
D4	Stand-by – board is OFF
D5	Reset OK

11.3 RT4 connectors and jumpers description

Table 11-2 RT4 Connectors

Designator	Description
J1	**ADNACO ADAPTER CARD** – PCI Express x16 slot for remote H2
J2	**ADD-IN CARD** – PCI Express x16 slot for user's add-in card
J3	Main Power Connector (ATX24)
J4	Front Panel Header
J5	**+3.3Vaux source for add-in card PCIe slots** 1-2 – 3.3V main voltage from J3 connector **(default)** 2-3 – 3.3V stand-by voltage from the RT4 local power supply (**The add-in cards must consume less than 375 mA from +3.3Vaux power supply**) **Note:** Although +3.3Vaux voltage is optional according to specifications some cards may not operate without it.
J6	**Stand-by 3.3V voltage for remote H2** 2-3 – default setting for a standard computer power supply. 1-2 – used for a custom power supply (there is no stand-by mode)
J7	Factory settings

Table 11-3 J3 Main Power Connector

Pin	Signal Name	Pin	Signal Name
1	+3.3VDC	**13**	+3.3VDC
2	+3.3VDC	**14**	-12VDC
3	GND	**15**	GND
4	+5VDC	**16**	PS_ON#
5	GND	**17**	GND
6	+5VDC	**18**	GND
7	GND	**19**	GND
8	PWR_OK	**20**	Not Connected
9	+5VSB	**21**	+5VDC
10	+12VDC	**22**	+5VDC
11	+12VDC	**23**	+5VDC
12	+3.3VDC	**24**	GND

Table 11-4 J4 Front Panel Header

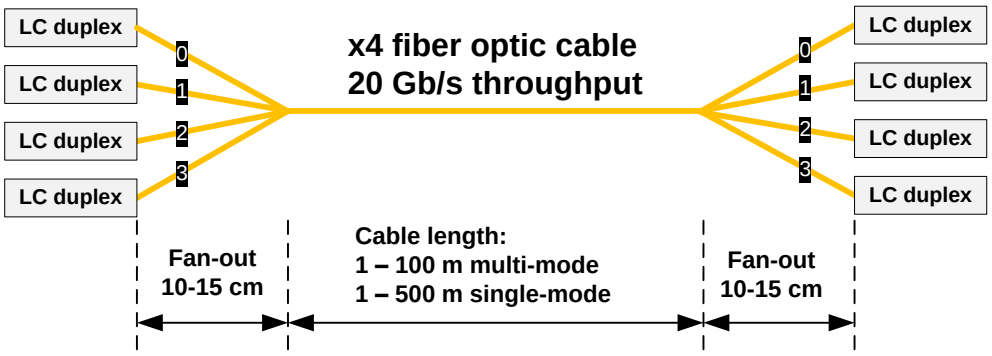
Pin	Signal Name
1	Stand-by LED (+)
3	Stand-by LED (-)
2	Power ON LED (+)
4	Power ON LED (-)
7	Reset Switch
9	Reset Switch
8	Power ON/OFF Switch
10	Power ON/OFF Switch
5	GND
6	GND

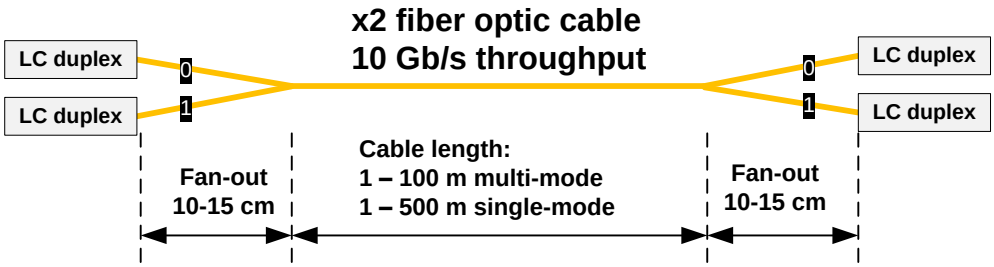
11.4 RT4 reference schematic

Click here to download RT4 reference schematic

12 Multicore Fiber Optic Cable

The S5 system is supplied with a multicore fiber optic cable with x2 or x4 LC fan-out on both ends. Such design combines high fiber count with a compact, space saving single cable design.





13 Troubleshooting

Following all the steps detailed in the previous sections should lead to a successful operation of the system. However, if you are facing any problems, the cases below may help address potential problems preventing your system from running successfully.

It is recommended to go sequentially through all verification steps described in this section

Most problems can be identified by checking the LED statuses.

Table 13-1 LEDs description

Board	LEDs status description
H2	10.4 H2 LEDs description
RT4	11.2 RT4 LEDs description

13.1 The RT4 and remote H2 are not turning ON or their LEDs (other than lane LEDs) are flashing

- When the system and computer are ON the RT4 LEDs D1, D2, D5 should be ON and D3 and D5 are OFF. If the RT4's D3 LED is ON and/or the D1 is OFF this may indicate some problems with the power supply Please read 5.3 Power supply minimum load requirements regarding power supply minimum load requirements. If you are unable to solve the problem, replace the power supply. The D5 LED indicated that the reset to the H2 and user's add-in card is released.

Note: When PCIe links operate in Gen1 mode the lane LEDs are blinking 0.5 seconds ON, 0.5 seconds OFF and this indicates normal board operation.

13.2 Your host computer BIOS is not up-to-date

In order to update your BIOS please do the following:

- Power off the system.
- Remove the H2 from the host computer.
- The BIOS update is normally obtained from the maker of the computer, or in the case of a non-brand computer, from the maker of the motherboard or sometimes the BIOS maker itself.
- Repeat 5 System Installation.

You may still face the following problems after updating the BIOS:

13.3 The H2 is not visible in the Device Manager

- Verify that the S1 DIP switches are set for the host mode (10.3 H2 DIP switch description).
- Check to assure the H2 is properly installed. Please refer to your computer or motherboard user's manual for information on how to install PCI Express add-in cards.
- Check the D1-D4 LEDs host PCI lanes status. If all D1-D4 LEDs are OFF then the PCIe link is not active. Verify that the PCIe slot is operational by inserting a different PCIe card in the slot.
- Try installing the H2 in another computer (if available) to see if that fixes the problem. This may rule out a defective H2 card.
- If the problem is not solved please go to 15 Customer Support.

13.4 The host computer hangs during power-on

- Power-off the system as indicated in 4 System Operation.
- Disconnect the fiber optic cable from the host H2.
- Review the steps 13.2 and 13.3
- Power-on the host computer and check whether the computer can boot and that the H2 is visible in the Device Manager.
- If the H2 is visible in the Device Manager then turn off the computer, reconnect the fiber optic cable and power-on the computer again.
- Try a different computer (if available).
- If the problem is not solved please go to 15 Customer Support.

13.5 Fiber optic cable and transceivers verification

The PCIe lane LEDs show the correct status after computer is booted up and the OS is started, otherwise they may show a not initialized status of PCIe local lanes.

- Power-on the system as described in 4 System Operation.
- Verify LEDs status on the RT4 board as describer in section 13.1 The RT4 and remote H2 are not turning ON or their LEDs (other than lane LEDs) are flashing
- When the cable and transceivers are properly operational, the green LEDs D13-D16 located near the H2 metal bracket should be ON for each installed SFP optical module. When a PCIe lane is not active, the red LED D9-D12 are ON.
- Make sure that the cable fibers marked with 0, 1, 2 and 3 are connected the ports 0, 1, 2, 3 respectively on the host and remote H2.
- If you use a custom cable not supplied by Adnaco make sure that fibers for each optical PCIe lane connection are crossed. That means for each SFP optical module to SFP optical module connection the receiver of one module must be connected to the transmitter of the module at another cable end. This is a very common mistake and it happens very often.
- If there are problems with optical transceivers or with the fiber optic cable, the red D19-D22 LEDs (Loss of Signal) will be ON. Try to remove and reinstall optical transceivers and reconnect the fiber optic cable. If at least one of the red LEDs is still ON try a different fiber optic cable (if available).
- Verify that the host and remote H2s use the same operating frequency settings (S1.3 = ON).
- **If the RT4's D1 or D5 LEDs are OFF and/or the D3 LED is ON this may indicate some problems with the power supply.** Please read 5.1 Installation recommendations regarding power supply minimum load requirements.
- If the problem is not solved please go to 15 Customer Support.

13.6 The remote H2 is not visible in the Device Manager

- Verify that the S1 DIP switches are set for the remote mode (10.3 H2 DIP switch description)
- Power-off the system as described in 4 System Operation.
- Remove the add-in card from the RT4.
- Power-on the system as described in 4 System Operation
- If the remote H2 is visible in the Device Manager then the problem is with the add-in card installation, go to 13.7 Third-party add-in cards installation problem.
- If the remote H2 is not visible in the Device Manager, and you tried all previous steps above, please go to 15 Customer Support.

13.7 Third-party add-in cards installation problem

You can install your add-in card in the host computer to verify that the card hardware and driver operate properly. If you experience difficulties installing third party cards, the card manufacturer or your OS vendor may be able to provide the best support. Please read 14 Adnaco Products Design Disclaimer

13.7.1 Add-in card requires auxiliary voltage to operate

Although a 3.3V auxiliary voltage is optional according to the PCIe specifications some cards may not operate without it. If the card does not work without the auxiliary voltage, install a jumper on the RT4 J5 connector – see 11.3 RT4 jumper's description

13.7.2 User's PCIe add-in card problems

- Verify that all PCIe links are functional by checking the D1-D4 and D5-D8 LEDs status on the host and remote H2. If LEDs are active then the hardware is functional and you need to verify the driver installation. Please read 6 Verifying System Functionality.
- **Note:** If the user's card is PCIe Gen 1 then, in general, down-shifting is not allowed (defined as plugging a PCI Express card into a connector that is not fully routed for all of the PCI Express lanes). As a result, the Gen1 cards with x8 and x16 PCIe connector width may not be able to negotiate x4 link width and they will operate only in x1 mode.
- If there are no active PCIe lanes between the remote H2 and user's add-in card then it is a problem with the hardware. First, try to install the card into a computer and verify that it is functional. If the card is a PCIe Gen 1, check 13.7.3 Interoperability issues with some PCIe Gen 1 cards. Try a different tested PCIe card. If there is still no link with another card and it is known that, the card is good and works in a computer slot please go to 15 Customer Support.

13.7.3 Interoperability issues with some PCIe Gen 1 cards

Some PCIe Gen1 cards are not fully compliant with PCIe Gen2 specifications and as a result, they cannot link with the Gen2 switch used in the H2. For such cards, the recommended workaround is to set the PCIe operating mode to the Gen1 mode by setting the S1.1 DIP switch on the remote H2 to ON position. If afterwards there is still no link and the card is good, please go to 15 Customer Support.

14 Adnaco Products Design Disclaimer

The Adnaco Technology products are designed according to PCI Express specifications listed in their respective data sheets. Hence, they should work with all add-in cards and drivers compliant with those PCI Express specifications. Adnaco Technology can only provide limited support with third-party add-in cards installations. Please go to 15 Customer Support to contact our Support Team.

15 Customer Support

For the latest Customer Support information, please visit our website at www.adnaco.com. When contacting us, please make sure to include all the information below and describe your problem in detail to help us understand your problem better.

1) Full Name.
2) Company Name.
3) Phone Number.
4) Fax Number.
5) Email Address.
6) Product Model Number.
7) Product Serial Number.
8) Computer Make.
9) Computer Model.
10) OS and Version.
11) Make/Model of PCI cards installed.
12) LEDs status on all boards
13) Detailed description of the problem.

16 Warranty

All items of the Adnaco system components are warranted against defects in materials and workmanship for a period of one year from the date of shipment. Adnaco Technology will repair or replace (at its option), at no charge, any item(s) found to be defective during the warranty period. This warranty includes parts and labor. Proof of purchase is required for any warranty work. The warranty provided herein does not cover defective items caused by owner's failure to follow this User's Guide; owner's modification of the product; owner's abuse, misuse, or negligent acts; and power failure or surges, fire, flood, accident, actions of third parties, or other events outside reasonable control. In order to return defective items, an RMA number must be obtained from Adnaco and clearly marked on the outside of the package before any item(s) will be accepted for warranty work. The returned item(s) must be packaged in a manner similar to the manner it (they) was(were) received. Failure to do so will void the warranty. After obtaining the RMA number and properly packaging the defective item(s) please ship the package to the address indicated at our website www.adnaco.com. Please make sure the package label clearly indicates the RMA number provided.

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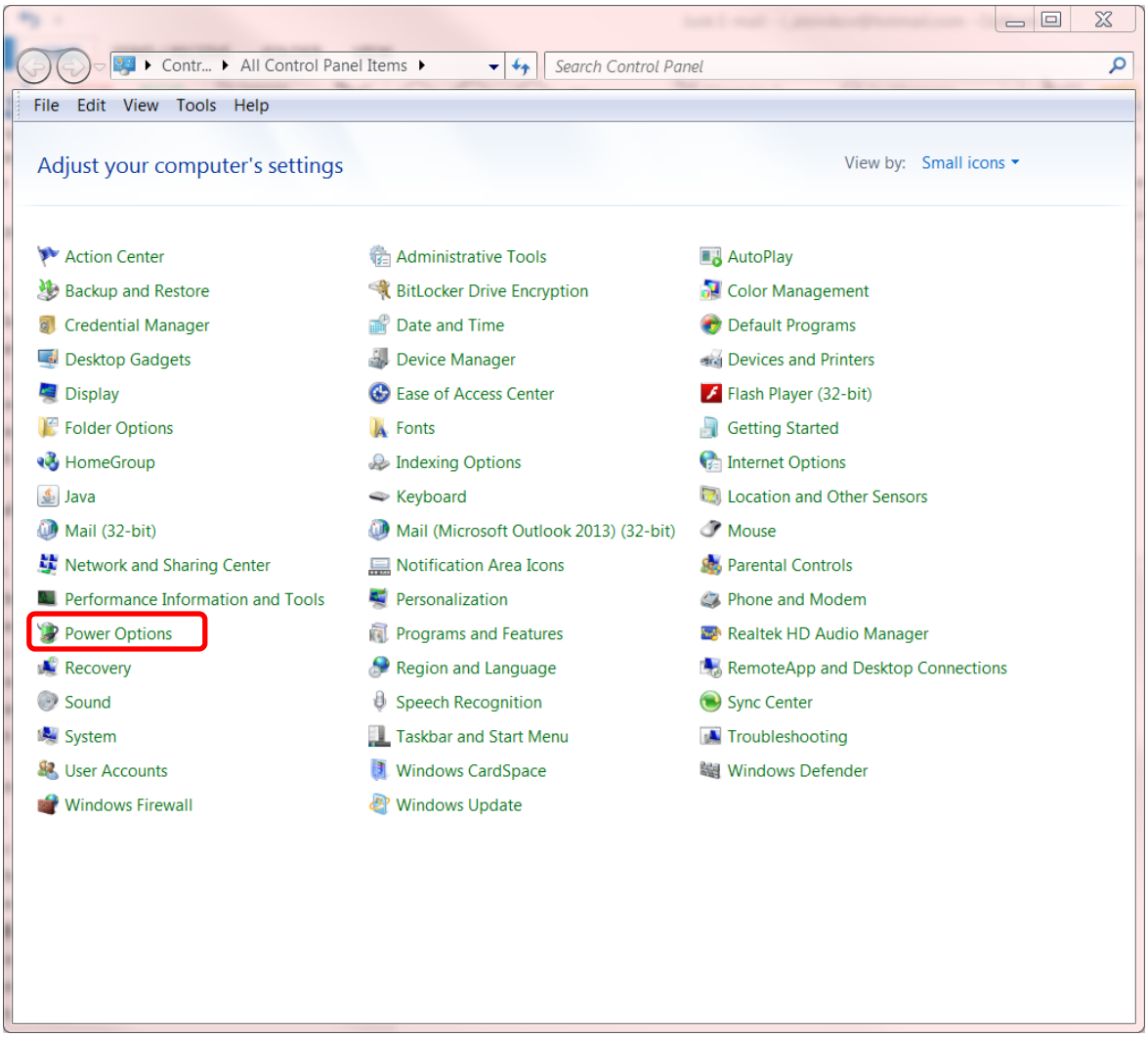
17 Appendix A. How to disable PCIe power management in Windows 7 and 8

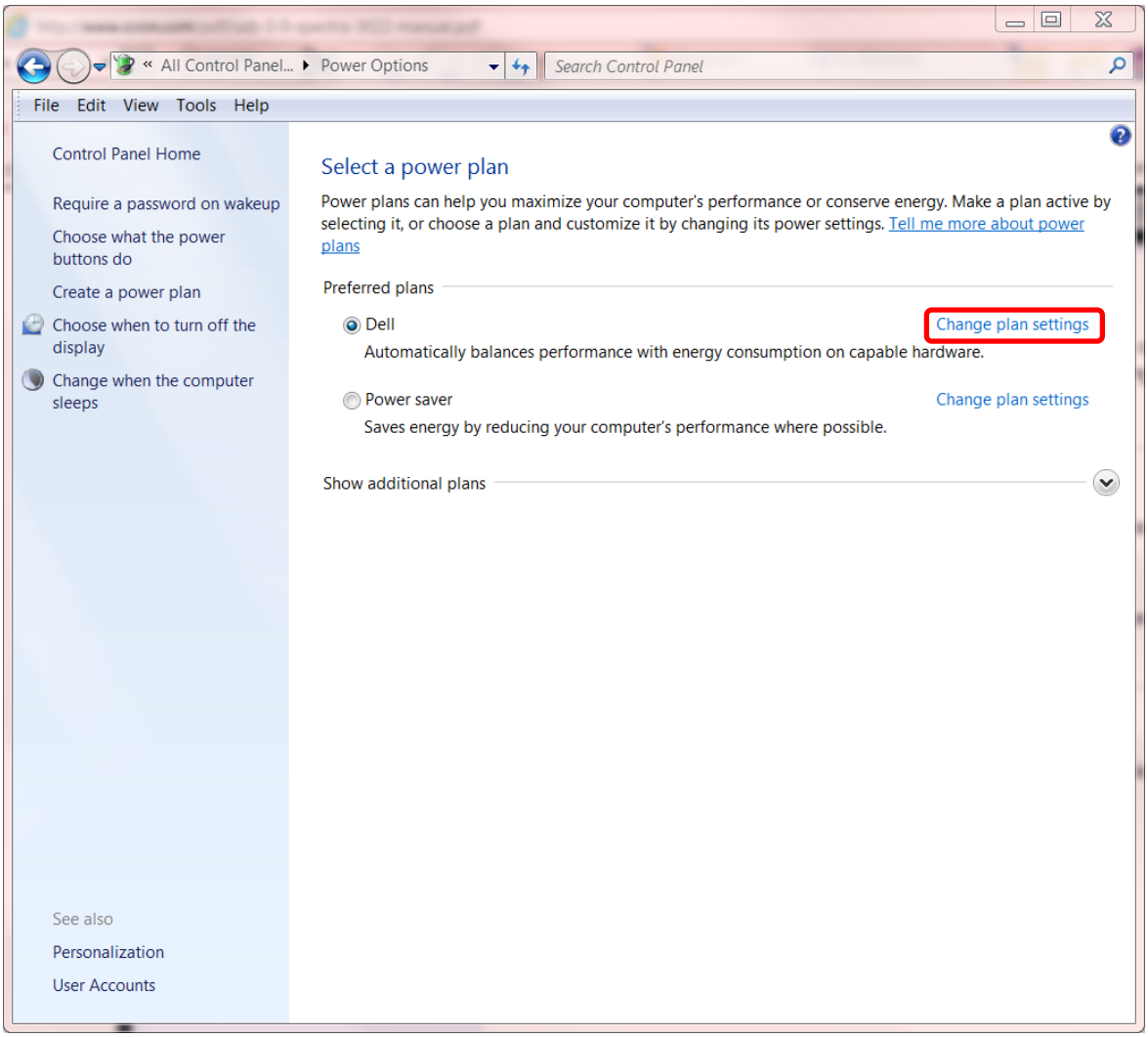
The optical transceivers used in the Adnaco PCI Express over fiber optic expansion systems do not support PCI Express link power management. Therefore, it is recommended to disable all power management features in the computer. Below are the step-by-step instructions for Windows 7 and 8. For other operating systems, please consult your OS documentation or if you need any assistance please contact the OS vendor.

Windows 7 and 8 instructions:

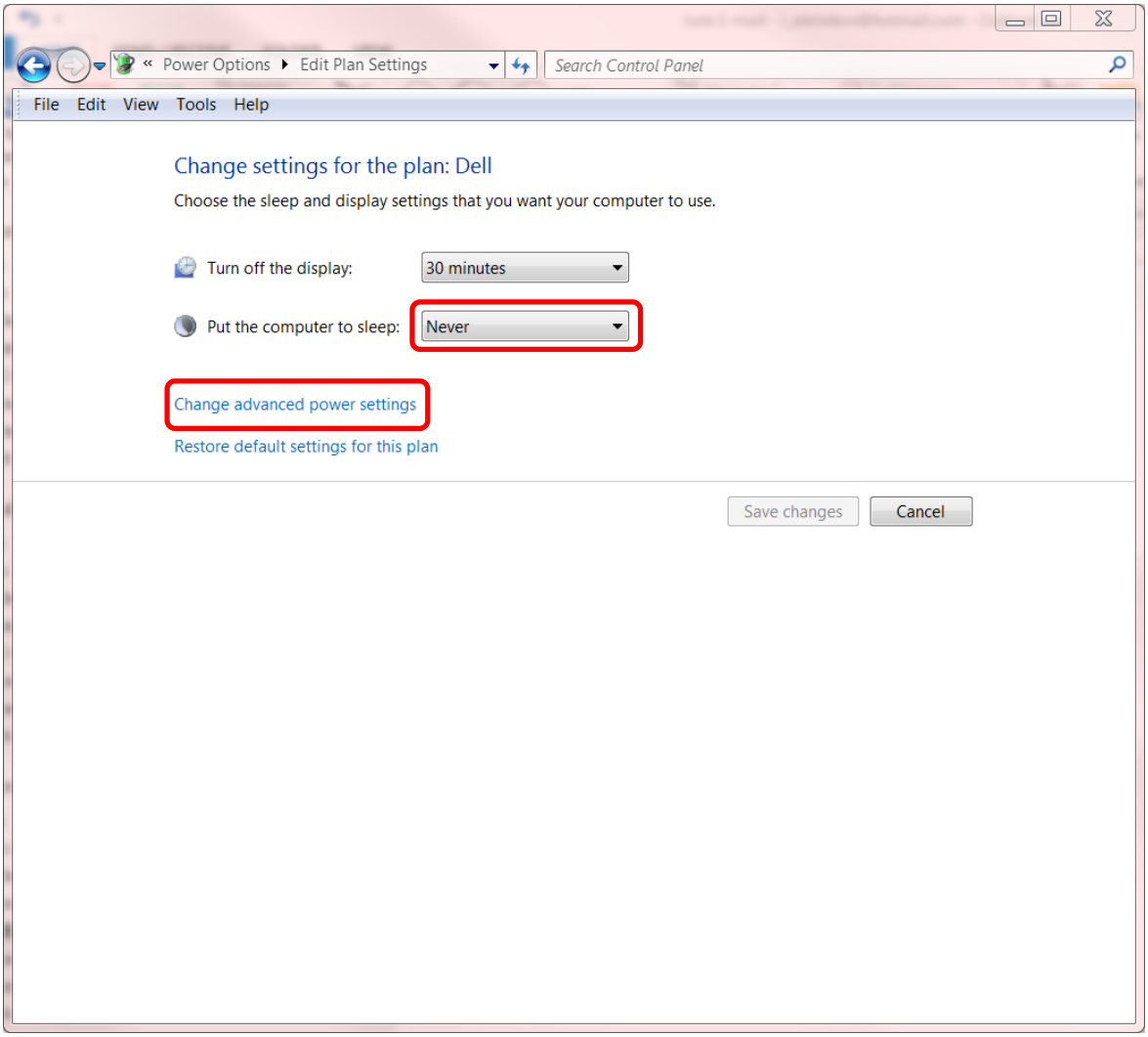
1. Open Control Panel and click on Power Options



2. For the selected plan click on "Change Plan Settings".



3. Select "Never" for "Put the computer to sleep". Click on "Change advanced power settings"



4. Expand PCI Express->Link State Power Management->Settings: and select "OFF".