PCI Express Gen3 Test Backplane

Hardware Manual

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Revision 2.0

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1 About this Document

1.1 Purpose

This document describes hardware installation, features, specification and operation of the AMFELTEC Corp. PCI Express Gen3 Test Backplane.

1.2 Feedback

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To provide your feedback, please send an email to support@amfeltec.com

Your comments or corrections are greatly valued in our effort for excellence and continued improvement.

1.3 Revision History

Rev. No.	Description	Rev. Date
1.0	Initial Release Version 2.0	September 25, 2021

2 General Description

2.1 Introduction

The “PCI Express Gen 3 Test Backplane” (backplane) is a four-slot PCI express backplane. All four slots have x16 PCI Express connectors. Two of them have 16 lane PCI express connections, and another two have four-lane PCI express connections. The Backplane connects to the upstream host computer via two cables (CAT7 data cable and ten-wire flat Power Control cable) and a Host board. The Host board has to be installed into Host Computer. Host board can be in the form of standard 2U x1 PCI express board with full size or low-profile PCI express bracket (default package) or the form of ExpressCard® or MiniPCI Express form factor.

PCI express Gen 3 Test backplane is based on the Broadcom PCI express switch that enables connection between the Host computer and each of the four PCI express slots. Upstream connection to Host computer is done by x1 PCI express Gen 2 interface (5 Gbit/sec speed); connection to four downstream PCI express connectors on the board is done by PCI express Gen 3 interface (8 Gbit/sec speed).

Test backplane supports x4/x4/x4/x4 and x8/x8 bifurcation configuration for two from four downstream PCI express slots.

All four downstream PCI Express connectors are powered from separate Hot-swap power controllers. Those power controllers are independent and have over current and under voltage protections. Thus all UUTs (Unit-under-Test – PCI Express add-in boards) and host system are fully protected from damage in case of power shortage. Each slot has an additional auxiliary power connector (GND, +12 Volts and +3.3 Volts) to provide per slot power to the external devices (UUTs) connected to the backplane.

By using the PCI express hot-swap power controllers (one per each downstream PCI express slot), the power of each PCI express slot can be shut down due to the overcurrent protection and, in this case, doesn’t affect the other PCI express slots on the backplane or upstream host computer. The SW1 local power switch controls all four power controllers and can power down local PCI express slots without affecting the upstream host computer. This allows easy replacing of plugged-in PCI express cards (referred UUT, Unit-under-Test) on the backplane and significantly decreases testing/verification time.

The Test backplane has four JTAG connectors (optional; one for each PCI express slot) to provide access from an external programmer/emulator to the PCI express bus JTAG signals. It gives the possibility to run JTAG production tests, use a JTAG emulator for UUT debugging and/or to use **“eLoader”™** from AMFETLEC Corp. for programming/loading CPLD/FPGA on the UUT during debugging or production cycle.

The backplane has surface-mount LEDs, which provide a convenient visual check for the main powers (+12V, +3.3V, +5VSB), the status of the power controllers per PCI Express slot (Power ON/OFF, power GOOD/FAIL) and the status of the upstream and downstream PCI express connections.

An additional PCI Express Gen 3 Test Backplane has the support tab for mechanical stabilization of add-in PCI express cards (U.S. Patent 7,255,750).

The backplane supports debugging, verification as well as production testing and programming of PCI express based boards. Using the backplane eliminates the risk of damage to the host computer during debugging, programming and testing PCI express boards and at the same time, the host computer can be removed from the testing area to free up space and minimize noise.

2.2 Package Details

The PCI Express Gen 3 Test Backplane package includes the follow components:

1. PCI Express Gen 3 Test Backplane (Figure 1)
2. x1 PCI express Host board (Figure 2) (default)
3. ExpressCard® Host board (Figure 3) (optional)
4. MiniPCI express Host board (Figure 4) (optional)
5. CAT7 data cable and Power Control flat cable (both cables 10 ft.)
6. Ex10 software package for support hot-swap operation (Linux, Windows)

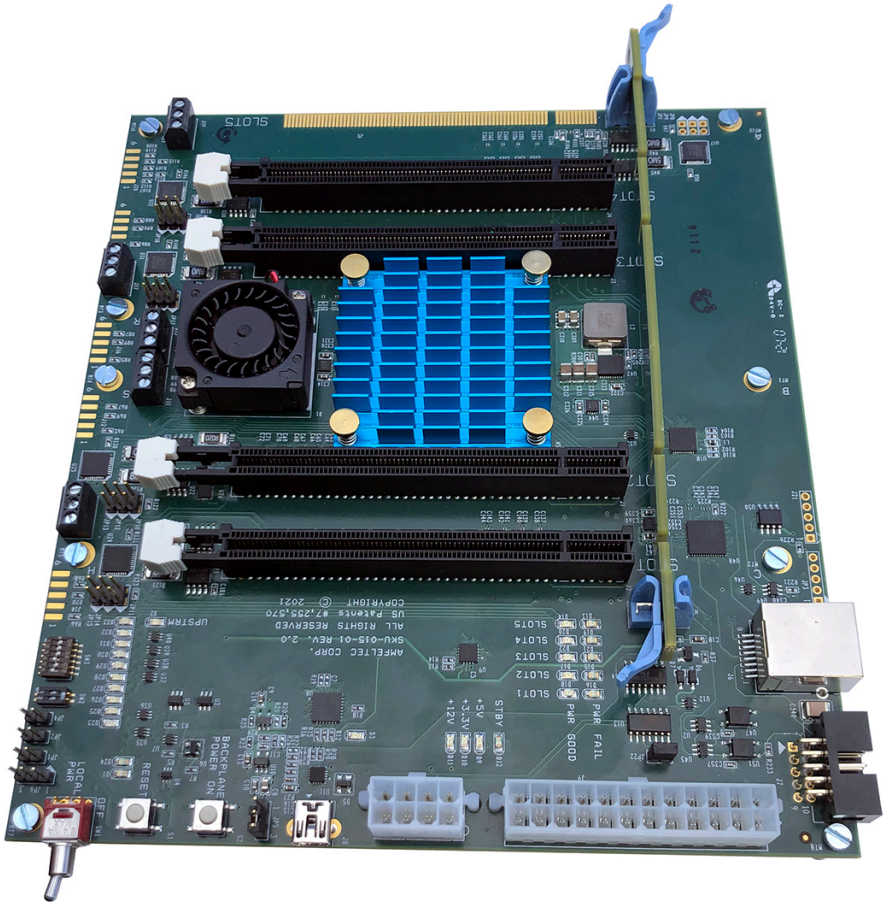

Figure 1: PCI Express Gen 3 Test Backplane

Figure 2: x1 PCI express Host board

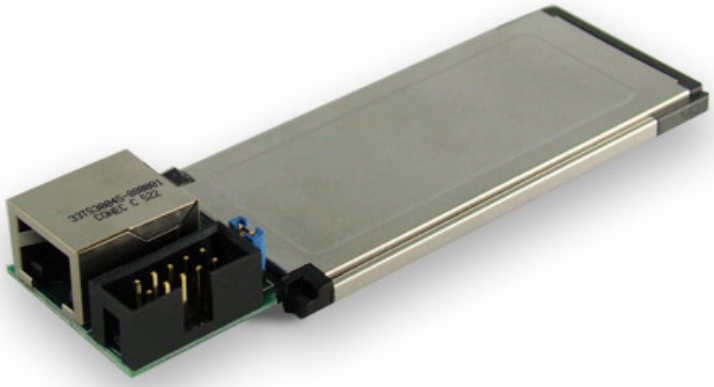

Figure 3: ExpressCard® Host board

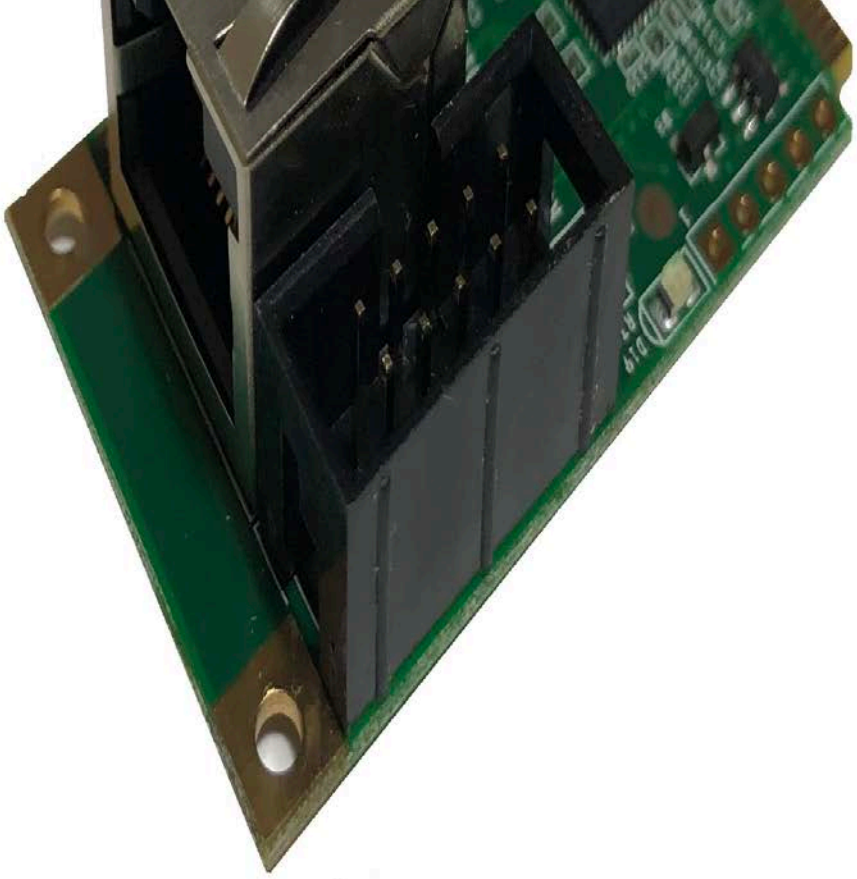

Figure 4: MiniPCI Express Host board

3 Requirements/Features

3.1 Power/Interface signals

- Visualization of UUT power status +3.3V, +12V, +5VSB (Green LED)
- Overloading Protection (OLP) on the UUT +3.3V and +12V supplies
- Under-voltage protection (UVP) on the UUT +3.3V and +12V
- UUT power failure protection (in case OLP or UVP), failure is indicated by red LED per PCI Express slot
- Backplane is powered from external standard ATX power supply. (Standard ATX 20/24 pin power connector) with additional eight pins 12V connection.
- Meets PCI Express Bus Specification 3.0.
- Supports hot-swapping of all four UUTs without shutting down host computer

3.2 Debugging support

Allows access to the PCI JTAG interface of each of the four UUTs

3.3 Software

AMFELTEC Corp. provides software for supporting how-swap functionality. The software allows to save and restore the PCI Express configuration for UUT device (refer to *eX10 Software Manual for more details*).

4 Installation

4.1 Hardware

Following steps provide the exact sequence that needs to be followed in order to properly install the PCI Express Expansion Backplane product from AMFELTEC Corp.:

- Turn OFF Host computer before installation.
- Remove the chassis cover from host computer.
- Locate an unused PCI express slot (for PCI Express Host board) and remove the corresponding slot cover from computer chassis.
- Plug-in the x1 PCI express interface card to PCI express slot and attach its bracket to the computer chassis with a screw. (For ExpressCard® Host board -insert it in the empty slot of the laptop; for MiniPCI express Host board – install it in the empty full size MiniPCIe full size circuit on the Host motherboard).
- Put the chassis cover back on the computer.
- Connect CAT7 data cable and Power Control flat cable to Host board and another end to the dedicated connectors on the PCI Express Gen 3 Test Backplane.
- Connect ATX power supply to the PCI Express Gen 3 Test Backplane.
- Turn ATX psu power switch to ON position. LED D12 (STBY) indicates that the stand by power is present and that it's ready for operation.
- Check JP5 (position 2-3 for control from Host computer) and SW1 setting (position power ON) on the PCI Express Gen 3 Test Backplane (It has to be in position ON if you need to supply power for the local 4 PCI express slots on the backplane).
- If jumper JP5 is set in position 1-2 (backplane power will be controlled by push button S2). Turn backplane power ON by toggling push button S2. Please check position of SW1. It has to be in the ON position if you need to supply power to the local 4 PCI express slots on the backplane. Then you can turn on the host computer.
- When the system is booted, you can install the software.

NOTE:

1. Some of the ATX power supplies require a minimum load on the 12Volt line to achieve stability. If the installed UUTs don't draw much power from 12V line, this minimum load might not be met. The additional load module is available from Amfeltec Corp.

4.2 Software

PCI Express Test Backplane doesn’t require any software/device driver for operation. You will only need to install the software provided by AMFELTLEC Corp. in order to use the hot-swap feature.

Please refer to eX10Suite Manual for software installation details.

5 Operation

5.1 Hot-Swap Support

Perform hot swapping with a certain degree of carefulness. Remember that PCI Express configuration won't be restored automatically after insertion of a new UUT device unless you use the supplied HOT SWAP software to reload the UUT's PCI Express configuration.

5.1.1 Remove UUT Device

The following steps describe the sequence for removing UUT device:

1. Save UUT PCI configuration into a file (refer to Software Manual for *more details).*
2. Unload all device drivers associated with the UUT.
3. Set the switch SW1 to "OFF" (disable power).

Now, you can remove UUT device from any of the 4 local PCI express slots on the backplane.

5.1.2 Install UUT Device

The following steps describe the sequence for installing UUT device back to the system:

1. Plug in UUT device into original PCI express slot on the backplane (If you are using multiple UUT devices, please install these device into original PCI express slot positions).
2. Set the switch SW1 to "ON" (enable power).
3. Restore PCI configuration for the UUT device.

Now, the UUT device is ready for use.

6 Hardware Description

6.1 Board Layout

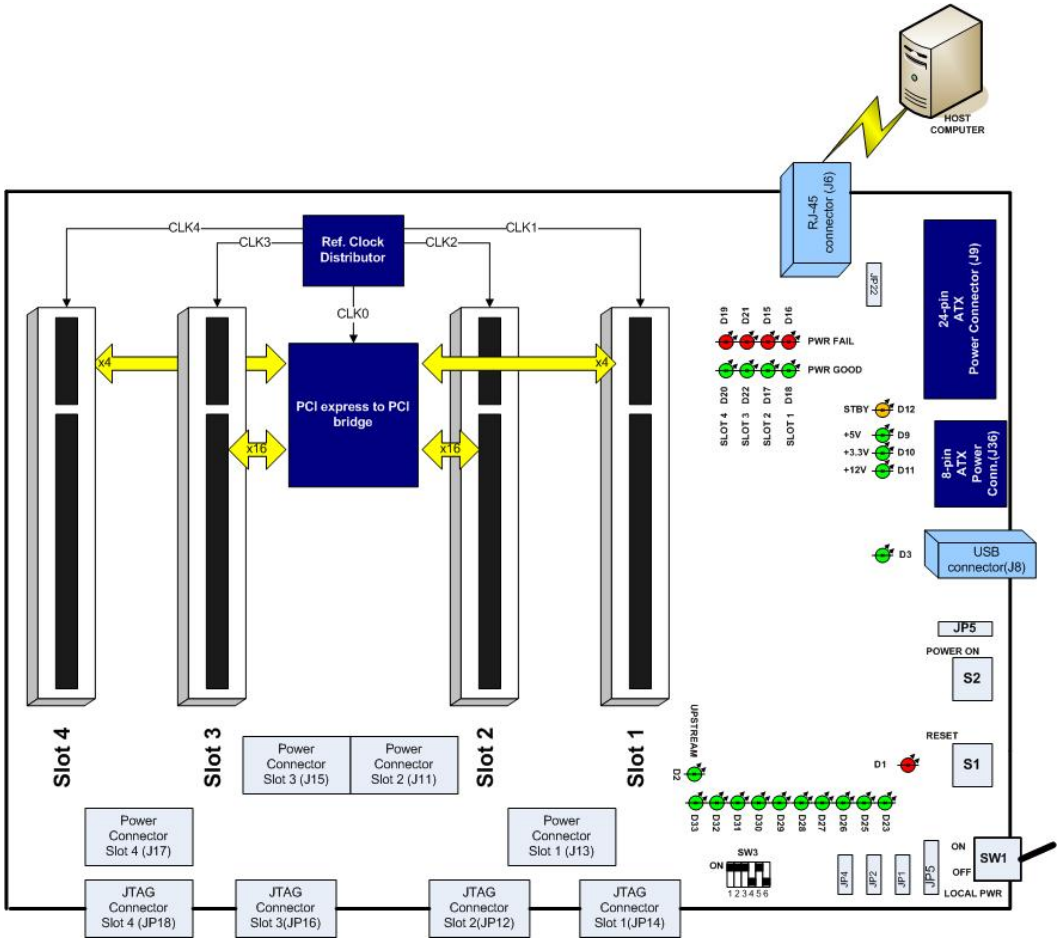

Figure 5: PCI Express Gen 3 Test Backplane block diagram

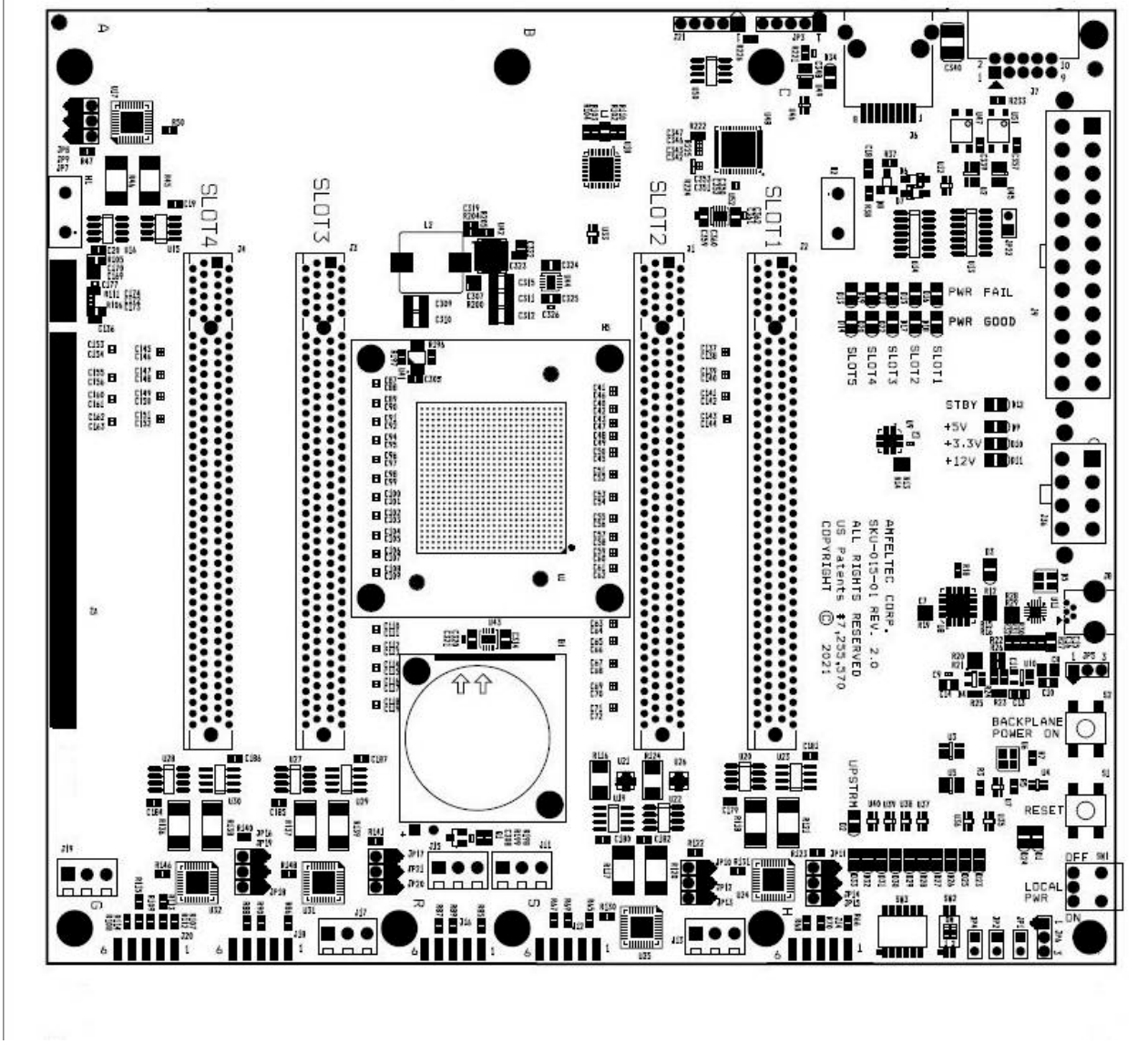

Figure 6: PCI Express Gen 3 Test Backplane component placement

6.2 LEDs

Name	Ref. Des.	Color	Usage
LRST	D1	RED	Local RESET signal indicator
STBY	D12	GREEN	Power Supply stand by power indication
+3.3V	D10	GREEN	+ 3.3V backplane local power
+5V	D9	GREEN	+5V backplane local power
+12V	D11	GREEN	+ 12V backplane local power
UPSTRM	D2	GREEN	Upstream PCI express link status indicator
Slot 1	D23	GREEN	PCIe link status, Slot 1; 4 lanes PCI Express
Slot 2	D25	GREEN	PCIe link status, Slot 2; 16 lanes PCI Express; Lanes 1-3 PCIe status in case bifurcation x4/x4/x4/x4; Lanes 1-7 in case bifurcation x8/x8
Slot 2	D26	GREEN	PCIe link status, Slot 2; Lanes 4-7 PCIe status in case bifurcation x4/x4/x4/x4;
Slot 2	D27	GREEN	PCIe link status, Slot 2; Lanes 8-11 PCIe status in case bifurcation x4/x4/x4/x4; Lanes 8-15 in case bifurcation x8/x8
Slot 2	D28	GREEN	PCIe link status, Slot 2; 16 lanes PCI Express Lanes 12-15 PCIe status in case bifurcation x4/x4/x4/x4;
Slot 3	D29	GREEN	PCIe link status, Slot 3; 16 lanes PCI Express; Lanes 1-3 PCIe status in case bifurcation x4/x4/x4/x4; Lanes 1-7 in case bifurcation x8/x8
Slot 3	D30	GREEN	PCIe link status, Slot 3; Lanes 4-7 PCIe status in case bifurcation x4/x4/x4/x4;
Slot 3	D31	GREEN	PCIe link status, Slot 3; Lanes 8-11 PCIe status in case bifurcation x4/x4/x4/x4; Lanes 8-15 in case bifurcation x8/x8
Slot 3	D32	GREEN	PCIe link status, Slot 3; 16 lanes PCI Express Lanes 12-15 PCIe status in case bifurcation x4/x4/x4/x4;
Slot 4	D33	GREEN	PCIe link status, Slot 4; 4 lanes PCI Express

PWR	D18	GREEN	Power status on the slot number 1
FAIL	D16	RED	Power Fail on the slot number 1 (In case overload or under voltage)
PWR	D17	GREEN	Power status on the slot number 2
FAIL	D15	RED	Power Fail on the slot number 2 (In case overload or under voltage)
PWR	D22	GREEN	Power status on the slot number 3
FAIL	D21	RED	Power Fail on the slot number 3 (In case overload or under voltage)
PWR	D20	GREEN	Power status on the slot number 4
FAIL	D19	RED	Power Fail on the slot number 4 (In case overload or under voltage)
Monitor	D3	GREEN	Monitoring operation indicator. Normal operation when blinking.

Table 1: LEDs

6.3 Switches

Follow table shows settings for the PCI Express Gen 3 Test Backplane switches:

Name	**Ref. Des.**	**Type**	**Usage**
BACKPLANE POWER	SW1	Switch	Power switch for all 4 PCI Express slots. In case OFF state – the power on all 4 PCI Express slots is off. UUT boards can be replaced. (Hot swap mode)
PWR ON	S2	Push Button	“PWR ON” push button switch ON/OFF ATX power supply in case that JP5 in position 1-2. (Local backplane Power supply control)
RESET	S1	Push Button	”RESET” push button provides RESET signal for the local PCI Express bus.

Table 2: Switches

6.4 Control jumpers

Ref. Des.	Type	Usage
JP22	2 pins jumper	Open state disconnect reset signal from Host computer in local mode. For normal operation has to be closed.
JP5	3 pins jumper	If 1-2 pins closed, then backplane ATX power supply is controlled by S2 (local control). If 2-3 pins are closed, then backplane ATX power supply is controlled by host computer. (Power On host computer automatically switch power on the backplane).

Table 3: Jumpers

6.5 Connectors

Ref. Des.	Type	Usage
JP6	3 pins connector	External Power LED connection. (In parallel with D9)
JP1	2 pins connector	External RESET LED connection. (In parallel with D1)
JP2	2 pins connector	External RESET push button. (In parallel with S1)
JP4	2 pins connector	External Power ON / OFF push button connection. (In parallel with S2)
J14,J12, J16,J19	5x2 (2.5 mm) header	JTAG emulator/programmer connection. Direct connection to the “eLoader ™” from Amfeltec Corp. (per PCIe slot)
J1,J2, J3,J4	Standard x16 PCI Express connectors	J1, J4 have 4 PCIe lane and J2, J3 have 16 lane PCIe connection.
J9	Standard ATX power supply 24 pin connector	Connector for ATX power supply. (Supplies power for PCI Express Expansion Backplane).
J7	5x2 (2.5 mm) header	Connector for control cable between PCI Express Expansion Backplane and host computer.
J6	RJ45 connector for the PCI express cable connection	Connector for CAT7 cable between PCI Express Test Backplane and host computer.

Table 4: Connectors

6.6 Power Limits per Slot

Power	Maximum current
+3.3V	4.9 A
+12V	0.8 A

Table 5: Power Limits

7 Appendix A: JTAG Programming Interface

Function	JTAG connector
TCK	1
N/C	2
TDO	3
VIO (power out)	4
TMS	5
N/C	6
TRST	7
N/C	8
TDI	9
GND	10

Table 6: JTAG connectors J14, J12, J16 and J18

8 Appendix B: DIP Switch

Picture of the DIP Switch setting in the normal operation mode:

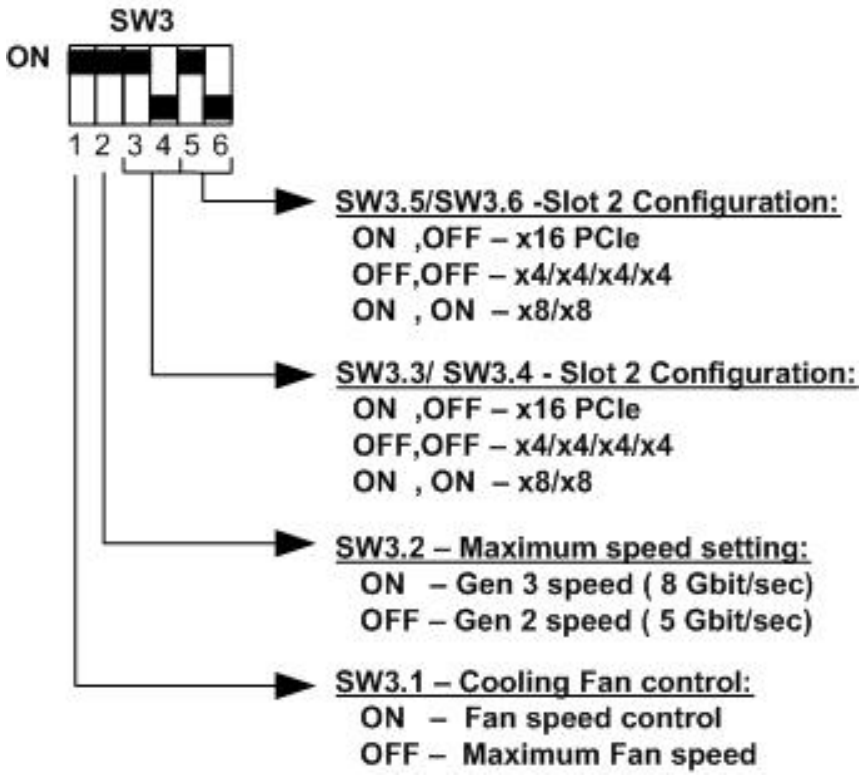

Table 7: DIP switch (SW3)

9 Appendix C: Limited warranty

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