Squid PCIe Gen 3 Carrier Board™ for six M.2 / NGSFF(NF1) SSD modules (SKU-086-36)

Hardware Manual

August 15, 2020

Revision 1.3

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1   About this Document

1.1   Purpose

This document describes hardware installation, features, specification and operation of the *Squid* PCI Express Gen 3 Carrier Board™ for six M.2/NGSFF(NF1) SSD modules from Amfeltec Corporation.

1.2   Feedback

AMFELTEC Corp. makes every effort to ensure that the information contained in this document is accurate and complete at the time of release. Please contact Amfeltec if you find any errors, inconsistency or have trouble understanding any part of this document.

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 continuous improvement.

1.3   Revision History

Rev. No.	Description	Rev. Date
1.0	Initial Release.	July 15, 2019
1.1	Minor changes	February 17, 2020
1.2	Minor changes	April 9, 2020
1.3	Minor changes	August 15, 2020

2 General Description

2.1 Introduction

Squid PCI Express family is a series of PCIe Carrier Boards designed for desktop computers, servers, embedded appliances or storage expansion. *Squid* family expands a motherboard's PCIe slot with multiple full/half-size MiniPCI Express or multiple M.2/NGSFF(NF1) PCI Express SSD modules.

The carrier board is a full-height PCIe board, and occupies the space equal to a standard one-slot wide PCIe board, as defined by the PCIe Specification. It is located in the middle of motherboard's PCIe slot, and connects to the motherboard via exchangeable x8 or x16 PCIe upstream adapters. This unique PCI Express structure (US. Pat #9,996,495) allows for allocating of multiple PCIe M2/NGSFF(NF1) modules on the top and bottom sides of the carrier board without violation PCI Express Specification.

This carrier board has six M.2 (M-key) circuits. Three circuits are placed on the top (component) side of the board, and another three circuits are placed on the bottom (soldering) side of the board. Each circuit support any M.2/NGSFF(NF1) PCI express module (M-key) with a standard length of 80 mm and 110 mm. and width up to 32 mm.

This carrier board has two new futures:

- Real-time performance and temperature monitoring via USB port;

- On-board Batteryless Data Logger with a backup status indication

  (US. Pat. #10,481.660).

2.2 Package Contents

PCIe Gen 3 Carrier Board package includes the following parts:

1. PCIe Gen 3 Carrier Board for six M.2 / NGSFF(NF1) PCIe modules
    (Figure 1, 2) with x16 or x8 PCIe upstream Adapter

2. Auxiliary 12V power cable SKU-043-39 (Appendix A, Figure 10)

3. Set of Heat sinks for all six of M.2 / NGSFF (NF1) modules.

4. Auxiliary 12V power cable SKU-050-40 (Appendix A, Figure 11)(optional)

5. USB terminal cable SKU-043-37 (Appendix A, Figure 8)(optional)
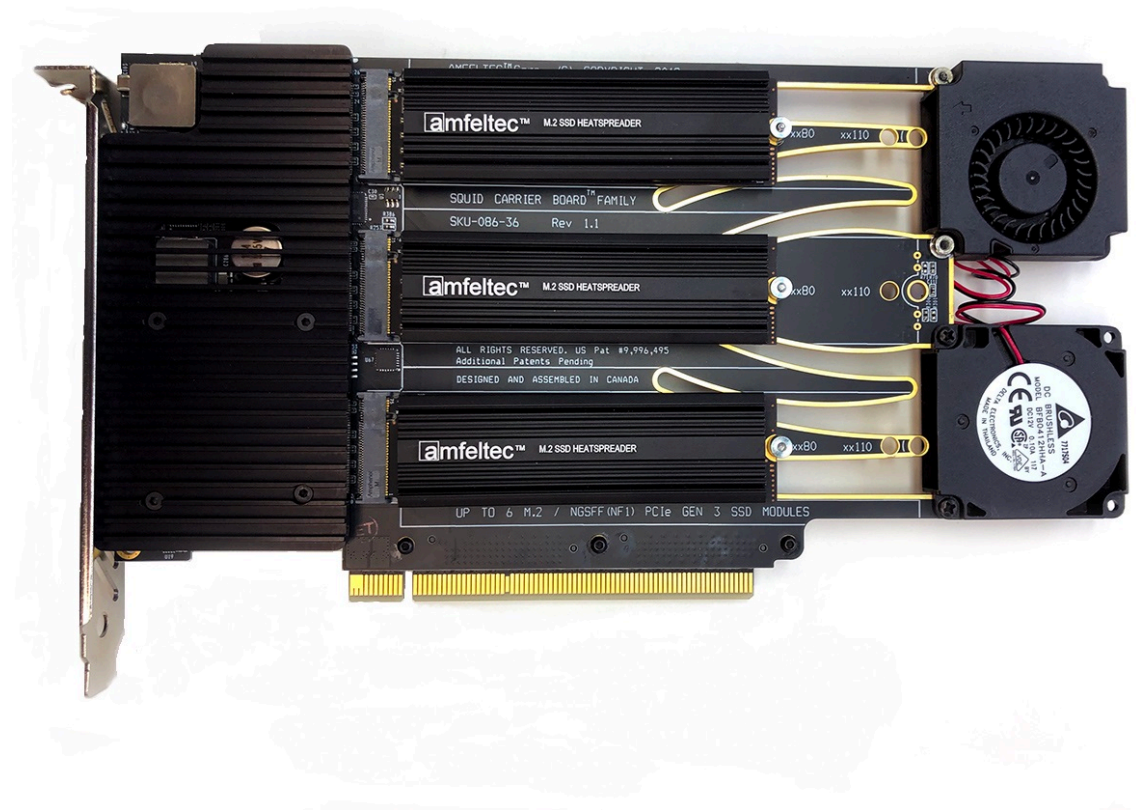
Figure 1: PCIe Gen 3 Carrier Board with six M.2 SSD modules (top and bottom sides)

3   Features

3.1   Features

- Easy 'Plug and Play" installation. No drivers needed. Transparent to the operation system.

- Compatible to any motherboard.

- Supports up to six M.2 or NGSFF(NF1) PCI Express SSD modules (M-key)

- Supports any modules with 80 mm and 110 mm length, and up to 32 mm in width.

- x4 PCIe Gen 3 (8.0 Gbps) downstream connection to each M.2 circuit.

- x16 or x8 PCIe Gen 3 (8.0 Gbps) upstream motherboard connection via exchangeable x16 or x8 PCI Express upstream Adapter.

- Occupies space equal to standard one-slot wide PCIe board defined by PCIe Specification.

- Supports auxiliary 12V power connection.

- Easily removable cooling fans.

- Performance and temperature monitoring during operation; cooling fan speed control.

- Real-time transmission of carrier board & modules' status to host computer via USB connection. (optional)

- On-board Batteryless Data Logger for backup status indication (US. Pat. #10,481,660)

- Meets PCIe 3.0 and M.2 1.1 Specifications.

- Dimension:

  - Without Cooling Fans - 111.15 mm x 167.65 mm (full-height, half-length PCIe board)
  - With Cooling Fans   - 111.15 mm x 202.65 mm.

- RoHS compliant.

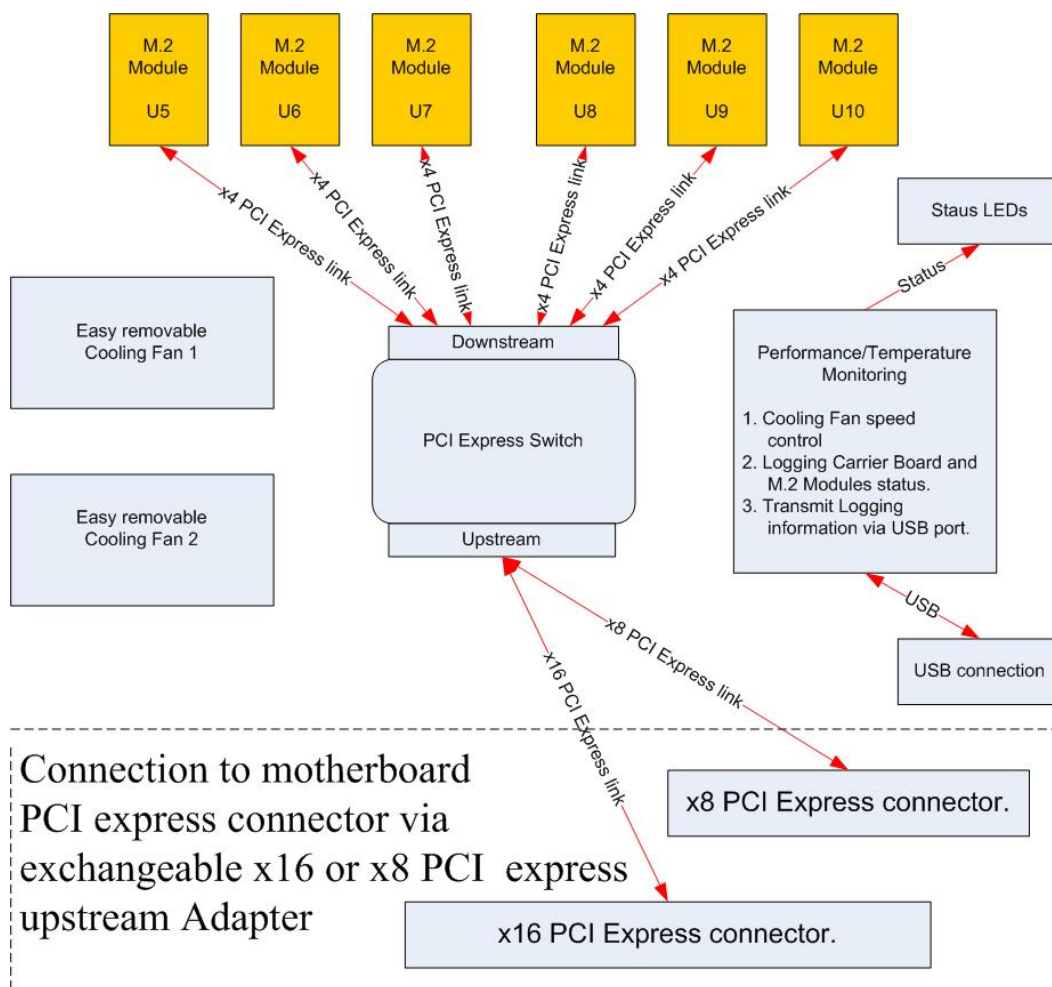## 3.2 PCI Express Carrier board for six M.2/NGSFF SSD modules block diagram.

Figure 2: Carrier board internal block diagram.

4 Installation

4.1 Carrier board installation

Following steps provide the exact sequence that needs to be followed in order to properly install the Amfeltec PCIe Carrier Board:

- Turn OFF computer before installation.

- Remove the chassis cover from the computer.

- Locate an unused PCI express slot and remove the corresponding slot cover from computer chassis. For maximum performance, it is preferable to use x16 PCI express slot that has a direct connection to CPU.

- Insert the carrier board into the appropriate PCI express slot, and attach its bracket to the computer chassis with a screw.

- (optionally) Install USB monitoring cable SKU-043-37. (Connector J16 on the board and the 10-pin USB connector on the motherboard)

- (optionally) Install auxiliary 12V power cable SKU-050-40 or SKU-043-39. Auxiliary cable must be installed if the total modules' power consumption exceed 55W (9.1 W per module) or NGSFF/NF1 SSD module installed!

- Put the chassis cover back on the computer.

- Turn ON the computer.

4.2 Carrier board Power ON

During power ON, the Carrier board runs self-test that include:

- Upstream and downstream PCI express connection verification

- Checking status LEDs

- Cooling fans operation

After power ON, the operation status test result is shown on D22 (red) and D23 (green) LEDs:

D22 is solid ON	Power ON Carrier Board verification status
D23 is solid ON	Power ON Carrier Board verification status

The following status information is displayed on the status LEDs D14-D21 during normal operation (located on the bottom/soldering side of the board):

Squid PCIe Gen 3 Carrier Board™ for six M.2/NGSFF(NF1) SSD modules.
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D14-D21 are solid OFF	There is normal operation and all PCIe lanes are connected.
D14	Always off
D15 on	U10 module connection issue: connection with less than 4 PCIe lanes or connection speed is less than 8.0 Gbps.
D16 on	U9 module connection issue: connection with less than 4 PCIe lanes or connection speed is less than 8.0 Gbps.
D17 on	U8 module connection issue: connection with less than 4 PCIe lanes or connection speed is less than 8.0 Gbps.
D18 on	U7 module connection issue: connection with less than 4 PCIe lanes or connection speed is less than 8.0 Gbps.
D19 on	U6 module connection issue: connection with less than 4 PCIe lanes or connection speed is less than 8.0 Gbps.
D20 on	U5 module connection issue: connection with less than 4 PCIe lanes or connection speed is less than 8.0 Gbps.
D21 on	Upstream PCIe connection issue: connection with reduced PCIe lane number or connection speed is less than 8.0 Gbps.

4.3   Carrier board Power OFF. Backup status Indication.

The carrier board has an on-board batteryless data logger, which stores the operation status of the board. The status (backup) information can be checked after computer power shuts off or even when the carrier board is removed from a computer during 5-10 minutes after power was cut off. This future helps to allocate problems that may happen during the carrier board's normal operation. The Logger will indicate operation status after power is cut off, and computer/server chassis containing the carrier board can be opened. Status information is displayed with on-board LEDs.

To enable status information output to on-board LEDs **push button S1,** located on the bottom (soldering) side of the carrier board.

The following status information is displayed on the status LEDs D14-D21 located on the bottom (soldering) side of the board after power is shut off:

|	
D14 blinking	Backup status information is displayed on the D15-D21 LEDs.
D15 on	U10 module connection issue: connection with less than 4 PCIe lanes or connection speed is less than 8.0 Gbps.
D16 on	U9 module connection issue: connection with less than 4 PCIe lanes or connection speed is less than 8.0 Gbps.
D17 on	U8 module connection issue: connection with less than 4 PCIe lanes or connection speed is less than 8.0 Gbps.
D18 on	U7 module connection issue: connection with less than 4 PCIe lanes or connection speed is less than 8.0 Gbps.
D19 on	U6 module connection issue: connection with less than 4 PCIe lanes or connection speed is less than 8.0 Gbps.
D20 on	U5 module connection issue: connection with less than 4 PCIe lanes or connection speed is less than 8.0 Gbps.
D21 on	Upstream PCIe connection issue: connection with reduce PCIe lane number or connection speed is less than 8.0 Gbps.

5 Hardware Description

5.1 Board Layout
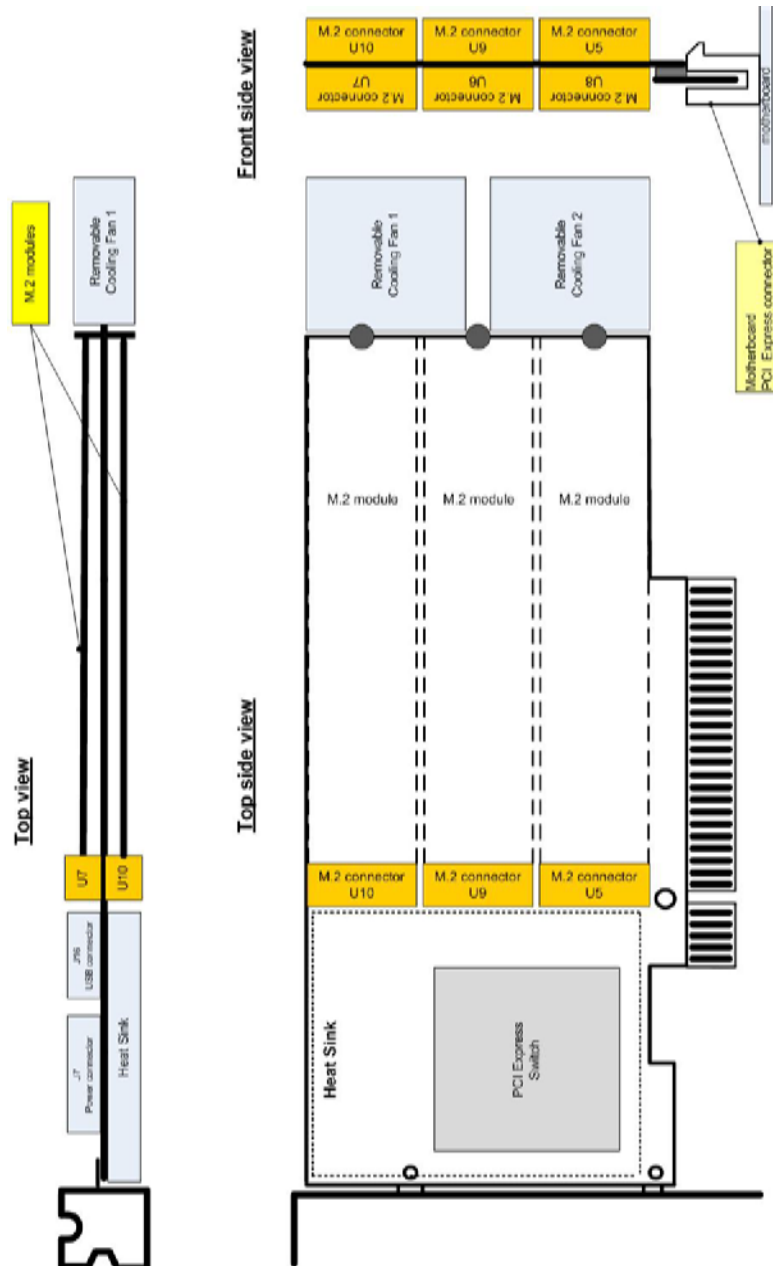
Figure 3: PCIe Gen 3 Carrier Board for six M.2/NGSFF(NF1) modules - layout

5.2   LEDs

Name	Ref. Des.	Color	Usage
RESET	D1	RED	Global PCI Express RESET signal from motherboard
STATUS	D2	YELLOW	(Currently not used).
UPSTREAM	D3	GREEN	Upstream PCIe Link status.
U5 M.2 circuit	D4	GREEN	Downstream x4 PCI Express Gen 3 link status.
U6 M.2 circuit	D5	GREEN	Downstream x4 PCI Express Gen 3 link status.
U7 M.2 circuit	D6	GREEN	Downstream x4 PCI Express Gen 3 link status.
U8 M.2 circuit	D7	GREEN	Downstream x4 PCI Express Gen 3 link status.
U9 M.2 circuit	D8	GREEN	Downstream x4 PCI Express Gen 3 link status.
U10 M.2 circuit	D9	GREEN	Downstream x4 PCI Express Gen 3 link status.
Mode of operation	D14	GREEN	Normal operation mode: D14 is off. Power OFF mode: D14 is blinking
U10 PCIe link status	D15	Yellow	Module connection issue: connection with less than 4 PCIe lanes or connection speed is less than 8.0 Gbps.
U9 PCIe link status	D16	Yellow	Module connection issue: connection with less than 4 PCIe lanes or connection speed is less than 8.0 Gbps.
U8 PCIe link status	D17	Yellow	Module connection issue: connection with less than 4 PCIe lanes or connection speed is less than 8.0 Gbps.
U7 PCIe link status	D18	Yellow	Module connection issue: connection with less than 4 PCIe lanes or connection speed is less than 8.0 Gbps.
U6 PCIe link status	D19	Yellow	Module connection issue: connection with less than 4 PCIe lanes or connection speed is less than 8.0 Gbps.
U5 PCIe link status	D20	Yellow	Module connection issue: connection with less than 4 PCIe lanes or connection speed is less than 8.0 Gbps.
Upstream PCIe link status	D21	Yellow	Upstream connection issue: connection with less than 16/8 PCIe lanes (depend of the PCIe adapter) or connection speed is less than 8.0 Gbps.
(on the bracket)	D22	RED	Board power ON status.
(on the bracket)	D23	GREEN	Board power ON status.
(on the bracket)	D24	BLUE	Board operation status (currently not used).

Table 1: PCIe Gen 3 Carrier Board for six M.2/NGSFF(NF1) modules - LEDs

LEDs D3-D9 will indicate the follow status of the PCIe links:

Solid OFF	PCIe link is down
Blinking at 1 Hz (512 ms OFF, 512 ms ON)	PCIe link is UP at 2.5 GT/s (Gen 1)
Blinking at 2 Hz (256 ms OFF, 256 ms ON)	PCIe link is UP at 5 GT/s (Gen 2)
Solid ON	PCIe link is UP at 8 GT/s (Gen 3)

5.3 Connectors

Ref. Des.	Type	Usage
J2, J1, J6	Connectors	Connection to the x16 or x8 PCI Express Adapter
J8, J9	Connectors	Removable Cooling Fans power connections
J16	Connector	USB terminal connection for collecting real-time board operation status information.
U10, U9, U5	M.2/NGSFF connectors (M-key)	M.2/NGSFF add-in modules connection (top side)
U7, U6, U8	M.2/NGSFF connectors (M-key)	M.2/NGSFF add-in modules connection (bottom side)
J7	Power connector	Auxiliary 12V power connector. For the cases when power consumption of all SSD modules exceeds 55W.

Table 2: PCIe Gen 3 Carrier Board for six M.2/NGSFF(NF1) modules - Connectors

6 Appendix A:

6.1 Cables

Figure 4: SKU-043-37   USB terminal cable (optional).

Figure 5: SKU-043-41   USB terminal cable (optional)

Both SKU-043-37 and SKU-043-41 Terminal cables is using to support Real-time performance and temperature monitoring option via USB connection. This monitoring option requires Silicon Labs CP2102 bridge driver installation

https://www.silabs.com/products/development-tools/software/usb-to-uart-bridge-vcp-drivers

Figure 6: SKU-043-39   12V Auxiliary power cable (included)

Auxiliary power can be taken from not-used x1, x4, x8 or x16 PCI Express slot by using SKU-043-39 power cable. Auxiliary cable has to be installed in case that total modules' power consumption exceeds 55W (9.1 W per module) or NGSFF/NF1 SSD module installed!

Figure 7: SKU-050-40   12V Auxiliary power cable (optional)

Auxiliary power can be taken from standard 2x3 ATX psu connector by using SKU-050-40 power cable. Auxiliary cable has to be installed in case that total modules' power consumption exceeds 55W (9.1 W per module) or NGSFF/NF1 SSD module installed!
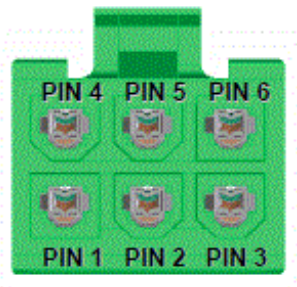
Appendix A:

2 x 3 Plug	Signal
1	+12 V
2	
3	+12 V
4	Ground
5	
6	Ground

7 Appendix B: Limited warranty

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