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# **PCIE-6002**

Installation and Use

P/N: 6806800U70B

December 2019

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Embedded Computing

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# About this Manual

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## Overview of Contents

This manual is divided into the following chapters and appendices.

*Safety Notes on page 15* provides information about the safety regulations that should be observed while operating the product.

*Sicherheitshinweise on page 19* provides information about German translation of the safety notes.

*Chapter 1, Introduction on page 23* provides a brief overview of the product features, hardware and software overview, standard safety compliances, and ordering information.

*Chapter 2, Hardware Preparation and Installation on page 27* provides information about the procedure for unpacking the product, environmental and power requirements, and installation and removal instructions.

*Chapter 3, Functional Description on page 37* provides information about the functional blocks in the PCIE-6002 card block diagram.

*Chapter 4, Controls, Indicators, and Connectors on page 41* provides information about the controls, indicators, connectors, and pin assignments associated with the Product-ShortName card.

*Appendix A, PCIE-6002 Card Configuration Example on page 47* provides an example on how a PCIE-6002 card is configured in a MaxCore system.

*Appendix B, Related Documentation on page 49* provides a listing of related product documentation, manufacturer's documents and industry standard specifications.

## Abbreviations

This document uses the following abbreviations:

Abbreviation	Definition
ADC	Analog to Digital Converter
BGA	Ball Grid Array
BIOS	Basic Input/Output System
BMC	Board Management Controller
BSCAN	Boundary Scan (JTAG)
CFC	Constant Frequency Clock

## About this Manual

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Abbreviation	Definition
CPLD	Complex Programmable Logic Device
ECC	Error-Correcting Code
FMEDA	Failure Modes, Effects, and Diagnostics Analysis
FPGA	Field Programmable Gate Array
FRU	Field Replaceable Unit
GB	GigaByte
Gigabit	One Billion (1,000,000,000) bits
GPIO	General Purpose Input Output
I <sup>2</sup> C	Inter-Integrated Circuit
JTAG	Joint Test Action Group
LNC	Lower Non-Critical
LNR	Lower Non-Recoverable
MAC	Media Access Control
mCPU	Management Central Processing Unit
NGFF	Next Generation Form Factor
NVMe	Non-Volatile Memory Express
NVMHCI	Non-Volatile Memory Host Controller Interface Specification
OTT	Over-the-Top
PCIe	PCI Express
SSD	Solid State Drive
TCK	Test Clock
TDI	Test Data Input
TDO	Test Data Output
TDP	Thermal Design Power
TFTP	Trivial File Transfer Protocol
UCR	Upper Critical
UEFI	Unified Extensible Firmware Interface

Abbreviation	Definition
UNC	Upper Non-Critical
UNR	Upper Non-Recoverable
UPM	User-Programmable Machine
UVLO	Under-Voltage Lock Out
VNC	Virtual Network Computing
VPD	Vital Product Data








## Conventions

The following table describes the conventions used throughout this manual.

Notation	Description
0x00000000	Typical notation for hexadecimal numbers (digits are 0 through F), for example used for addresses and offsets
0b0000	Same for binary numbers (digits are 0 and 1)
<b>bold</b>	Used to emphasize a word
Screen	Used for on-screen output and code related elements or commands. Sample of Programming used in a table (9pt)
<b>Courier + Bold</b>	Used to characterize user input and to separate it from system output
<i>Reference</i>	Used for references and for table and figure descriptions
File > Exit	Notation for selecting a submenu
<text>	Notation for variables and keys
[text]	Notation for software buttons to click on the screen and parameter description
...	Repeated item for example node 1, node 2, ..., node 12
.	Omission of information from example/command that is not necessary at the time
..	Ranges, for example: 0..4 means one of the integers 0,1,2,3, and 4 (used in registers)

## About this Manual

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Notation	Description
	Logical OR
	Indicates a hazardous situation which, if not avoided, could result in death or serious injury
	Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury
	Indicates a property damage message
	Indicates a hot surface that could result in moderate or serious injury
	Indicates an electrical situation that could result in moderate injury or death
<p data-bbox="272 1078 386 1130"><b>Use ESD protection</b></p> 	Indicates that when working in an ESD environment care should be taken to use proper ESD practices
	No danger encountered, pay attention to important information

## Summary of Changes

This manual has been revised and replaces all prior editions.

<b>Part Number</b>	<b>Publication Date</b>	<b>Description</b>
6806800U70B	December 2019	Rebrand to SMART Embedded Computing template
6806800U70A	June 2017	Initial version



# Safety Notes

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This section provides warnings that precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed during all phases of operation, service, and repair of this equipment. You should also employ all other safety precautions necessary for the operation of the equipment in your operating environment. Failure to comply with these precautions or with specific warnings elsewhere in this manual could result in personal injury or damage to the equipment.

SMART Embedded Computing intends to provide all necessary information to install and handle the product in this manual. Because of the complexity of this product and its various uses, we do not guarantee that the given information is complete. If you need additional information, ask your SMART EC representative.

The product has been designed to meet the standard industrial safety requirements. It must not be used except in its specific area of office telecommunication industry and industrial control.

Only personnel trained by SMART EC or persons qualified in electronics or electrical engineering are authorized to install, remove or maintain the product.

The information given in this manual is meant to complete the knowledge of a specialist and must not be used as replacement for qualified personnel.

Keep away from live circuits inside the equipment. Operating personnel must not remove equipment covers. Only factory authorized service personnel or other qualified service personnel may remove equipment covers for internal subassembly or component replacement or any internal adjustment.

Do not install substitute parts or perform any unauthorized modification of the equipment or the warranty may be voided. Contact your local SMART EC representative for service and repair to make sure that all safety features are maintained.

## EMC

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. Changes or modifications not expressly approved by SMART Embedded Computing could void the user's authority to operate the equipment. Board products are tested in a

## Safety Notes

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representative system to show compliance with the above mentioned requirements. A proper installation in a compliant system will maintain the required performance. Use only shielded cables when connecting peripherals to assure that appropriate radio frequency emissions compliance is maintained.

## Operation

### **Product Damage—Surface of the Product**

High humidity and condensation on the product surface causes short circuits.

Do not operate the product outside the specified environmental limits. Make sure the product is completely dry and there is no moisture on any surface before applying power.

### **Overheating and Product Damage**

Operating the product without forced air cooling may lead to overheating and thus damage of the product.

When operating the product, make sure that forced air cooling is available in the enclosure.

### **Data Corruption**

If power to the unit is removed while a firmware update is in progress to the card flash memory, the changes will not be saved, and worse, the flash memory may be corrupted. In such case the card is likely to remain in non-operable state and will require reconditioning by qualified repair services.

## Installation

### **Damage of Circuits**

Electrostatic discharge and incorrect installation and removal of the product can damage circuits or shorten their life.

Before touching the product or electronic components, make sure that you are working in an ESD-safe environment.

### **Product Damage**

Incorrect installation of the product can cause damage of the product.

Only use appropriate tools when installing/removing the product to avoid damage/deformation to the card and/or PCB.



### Environment

Always dispose equipment that is finally taken out of operation according to your country's legislation and manufacturer's instructions.

# Safety Notes

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# Sicherheitshinweise

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Dieses Kapitel enthält Hinweise, die potentiell gefährlichen Prozeduren innerhalb dieses Handbuchs vorrangestellt sind. Beachten Sie unbedingt in allen Phasen des Betriebs, der Wartung und der Reparatur des Systems die Anweisungen, die diesen Hinweisen enthalten sind. Sie sollten außerdem alle anderen Vorsichtsmaßnahmen treffen, die für den Betrieb des Produktes innerhalb Ihrer Betriebsumgebung notwendig sind. Wenn Sie diese Vorsichtsmaßnahmen oder Sicherheitshinweise, die an anderer Stelle dieses Handbuchs enthalten sind, nicht beachten, kann das Verletzungen oder Schäden am Produkt zur Folge haben.

SMART Embedded Computing ist darauf bedacht, alle notwendigen Informationen zum Einbau und zum Umgang mit dem Produkt in diesem Handbuch bereit zu stellen. Da es sich jedoch um ein komplexes Produkt mit vielfältigen Einsatzmöglichkeiten handelt, können wir die Vollständigkeit der im Handbuch enthaltenen Informationen nicht garantieren. Falls Sie weitere Informationen benötigen sollten, wenden Sie sich bitte an die für Sie zuständige Geschäftsstelle von SMART EC.

Das System erfüllt die für die Industrie geforderten Sicherheitsvorschriften und darf ausschließlich für Anwendungen in der Telekommunikationsindustrie und im Zusammenhang mit Industriesteuerungen verwendet werden.

Einbau, Wartung und Betrieb dürfen nur von durch SMART EC ausgebildetem oder im Bereich Elektronik oder Elektrotechnik qualifiziertem Personal durchgeführt werden. Die in diesem Handbuch enthaltenen Informationen dienen ausschließlich dazu, das Wissen von Fachpersonal zu ergänzen, können dieses jedoch nicht ersetzen.

Halten Sie sich von stromführenden Leitungen innerhalb des Produktes fern. Entfernen Sie auf keinen Fall Abdeckungen am Produkt. Nur werksseitig zugelassenes Wartungspersonal oder anderweitig qualifiziertes Wartungspersonal darf Abdeckungen entfernen, um Komponenten zu ersetzen oder andere Anpassungen vorzunehmen.

Installieren Sie keine Ersatzteile oder führen Sie keine unerlaubten Veränderungen am Produkt durch, sonst verfällt die Garantie. Wenden Sie sich für Wartung oder Reparatur bitte an die für Sie zuständige Geschäftsstelle von SMART EC. So stellen Sie sicher, dass alle sicherheitsrelevanten Aspekte beachtet werden.

## EMV

Das Produkt wurde in einem SMART EC Standardsystem getestet. Es erfüllt die für digitale Geräte der Klasse A gültigen Grenzwerte in einem solchen System gemäß den FCC-Richtlinien Abschnitt 15 bzw. EN 55022 Klasse A. Diese Grenzwerte sollen einen angemessenen Schutz vor Störstrahlung beim Betrieb des Produktes in Gewerbe- sowie Industriegebieten gewährleisten.

## Sicherheitshinweise

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Das Produkt arbeitet im Hochfrequenzbereich und erzeugt Störstrahlung. Bei unsachgemäßem Einbau und anderem als in diesem Handbuch beschriebenen Betrieb können Störungen im Hochfrequenzbereich auftreten.

Wird das Produkt in einem Wohngebiet betrieben, so kann dies mit grosser Wahrscheinlichkeit zu starken Störungen führen, welche dann auf Kosten des Produktanwenders beseitigt werden müssen. Änderungen oder Modifikationen am Produkt, welche ohne ausdrückliche Genehmigung von SMART EC durchgeführt werden, können dazu führen, dass der Anwender die Genehmigung zum Betrieb des Produktes verliert. Boardprodukte werden in einem repräsentativen System getestet, um zu zeigen, dass das Board den oben aufgeführten EMV-Richtlinien entspricht. Eine ordnungsgemässe Installation in einem System, welches die EMV-Richtlinien erfüllt, stellt sicher, dass das Produkt gemäss den EMV-Richtlinien betrieben wird. Verwenden Sie nur abgeschirmte Kabel zum Anschluss von Zusatzmodulen. So ist sichergestellt, dass sich die Aussendung von Hochfrequenzstrahlung im Rahmen der erlaubten Grenzwerte bewegt.

Warnung! Dies ist eine Einrichtung der Klasse A. Diese Einrichtung kann im Wohnbereich Funkstörungen verursachen. In diesem Fall kann vom Betreiber verlangt werden, angemessene Maßnahmen durchzuführen.

## Betrieb

### **Beschädigung des Produktes**

Hohe Luftfeuchtigkeit und Kondensat auf der Oberfläche des Produktes können zu Kurzschlüssen führen.

Betreiben Sie das Produkt nur innerhalb der angegebenen Grenzwerte für die relative Luftfeuchtigkeit und Temperatur. Stellen Sie vor dem Einschalten des Stroms sicher, dass sich auf dem Produkt kein Kondensat befindet.

### **Überhitzung und Beschädigung des Produktes**

Betreiben Sie das Produkt ohne Zwangsbelüftung, kann das Produkt überhitzt und schliesslich beschädigt werden.

Bevor Sie das Produkt betreiben, müssen Sie sicher stellen, dass das Gerät über eine Zwangskühlung verfügt.

### **Fehlerhafter Datenbestand**

Wenn sie die Spannungsversorgung des Produkts abschalten, während Programmdateien im Flashspeicher aktualisiert, werden, können diese Daten nicht korrekt gespeichert werden. In diesem Fall ist das Produkt mit hoher Wahrscheinlichkeit nicht mehr betriebsbereit und die Funktionsfähigkeit muß durch einen qualifizierten Reparaturdienst wieder hergestellt werden.

### Installation

#### **Beschädigung von Schaltkreisen**

Elektrostatische Entladung und unsachgemäßer Ein- und Ausbau des Produktes kann Schaltkreise beschädigen oder ihre Lebensdauer verkürzen. Bevor Sie das Produkt oder elektronische Komponenten berühren, vergewissern Sie sich, daß Sie in einem ESD-geschützten Bereich arbeiten.

#### **Beschädigung des Produktes**

Fehlerhafte Installation des Produktes kann zu einer Beschädigung des Produktes führen. Verwenden Sie geeignetes Werkzeug, um das Produkt zu installieren/deinstallieren. Auf diese Weise vermeiden Sie, dass das card oder die Platine deformiert oder zerstört wird

### Umweltschutz

Entsorgen Sie alte elektronische Baugruppen stets gemäß der in Ihrem Land gültigen Gesetzgebung und den Empfehlungen des Herstellers.



# Introduction

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## 1.1 Overview

This chapter provides an overview of PCIE-6002 card, its features and applications, its hardware, standard compliance, and ordering information.

The SMART Embedded Computing PCIE-6002 PCI Express storage card provides up to four independent M.2 AHCI or NVMe SSD modules, which can be directly attached to any server CPU or up to four CPUs on MaxCore™ server cards. The PCIE-6002 card is a carrier for COTS M.2 AHCI or NVMe SSD modules with the M.2 form factor and leverages NVMe technology. Currently, this technology is the fastest way to attach an M.2 AHCI or NVMe SSD to a CPU. M.2 modules are considered mainstream for data center and consumer market and deliver outstanding size, price, and performance ratio.

The PCIE-6002 PCIe card is targeted for applications where high-speed storage is critical. This card is best suitable for the following applications:

- Audio/video processing
- Cloud services
- High-performance computing
- Relational database systems
- Web hosting/caching/reverse proxy services

## 1.2 Features

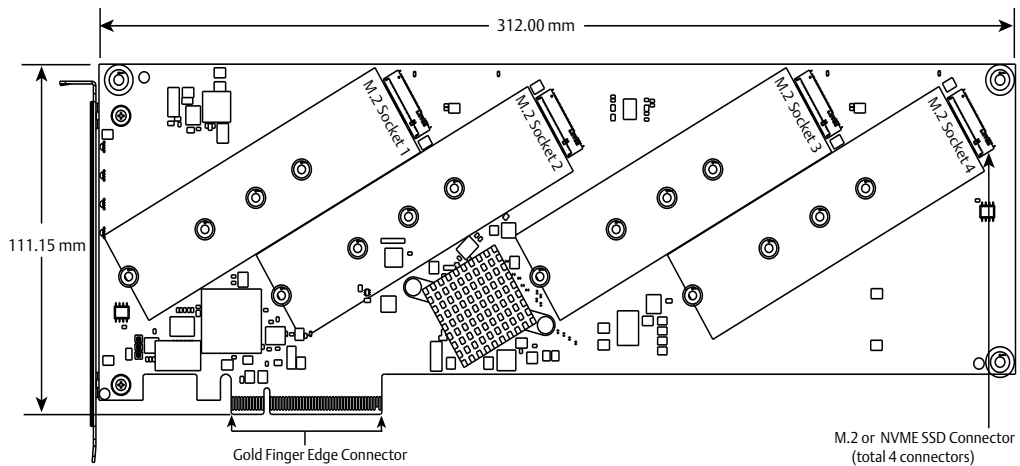
The following are the main features of the PCIE-6002 card:

- Full-length, full-height PCIe card compatible with both standard servers and SMART EC MaxCore platforms
- Supports both AHCI and NVMe protocols
- Switchable bandwidth to each M.2 socket
- Contains four “M” keyed M.2 or NGFF sockets
- Compatible with either 8-lane or 16-lane PCI Express 3.0 slots
- Supports wide range of form factors (42mm to 110mm; both single and double-sided)

### 1.3 Hardware Overview

The PCIE-6002 is a full-height, full-length PCIe expansion card, which acts as a additional storage functionality to SMART EC MaxCore platforms or to any other third-party platforms. The following figure shows the mechanical layout of PCIE-6002 card. [Figure 1-1](#) depicts length and height of the PCIE-6002 card. You will also find the labels of M.2 sockets on the card.

*Figure 1-1 Mechanical Layout*



### 1.4 Software Overview

Any installed AHCI or NVMe SSDs are compatible with the latest Linux distributions, Windows 8.1 and Server 2012 R2. For more information on how to add native driver support in NVM Express in Windows 7 and Windows Server 2008 R2, refer to the Microsoft Support page for [update to add native driver support](#).



## 1.5 Standard Compliances

The PCIE-6002 card meets the following standard and regulatory compliances.

*Table 1-1 Standard and Regulatory Compliances*

Standard	Description
EN 55032:2015 Class A CISPR 32:2015 EN 300 386 V1.6.1:2012 Class A EN 55032:2015 FCC 15.109(b):2016 Class A ANSI C63.4:2014 FCC 15.109(g)(CISPR 32:2015 Class A):2016 Class A ANSI C63.4:2014 ICES-003 (Issue 6):2016 Class A ANSI C63.4:2014 VCCI V-3:2016.11 Class A	Emissions
Directive (EU) 2015/863 (amending Annex II to Directive 2011/65/EU)	Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS).
EN 300 386 v1.6.1: 2012 EN 61000-4-2: 2009	ESD
CISPR 24:2014 (Edition 2.1) EN 55024:2010+A1:2015 EN 300 386 V1.6.1:2012 EN 61000-4-3:2006+A2:2010 EN 61000-4-6:2014	Immunity
EN 300 386 v1.6.1: 2012 EN 61000-4-4: 2012	EFT
EN 300 386 v1.6.1: 2012 EN 61000-4-5: 2014	Surge

## 1.6 Ordering and Support Information

Refer to the data sheet for the PCIE-6002 for a complete list of available variants and accessories. Refer to [Appendix B, Related Documentation](#) or consult your local SMART Embedded Computing sales representative for the availability of other variants.

For technical assistance, documentation, or to report product damage or shortages, contact your local SMART EC sales representative or visit <https://www.smartembedded.com/ec/support/>



# Hardware Preparation and Installation

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## 2.1 Overview

This chapter provides information on unpacking and inspecting the card procedures and safety precautions to be followed while handling the card. The environmental, thermal, and power requirements, and the installation and removal procedures of the card are also explained in this chapter.

## 2.2 Unpacking and Inspecting PCIE-6002 Card

### NOTICE

#### Damage of Circuits

Electrostatic discharge and incorrect installation and removal of the card can damage circuits or shorten their life.

Make sure that you are working in an ESD-safe environment, before touching the card or electronic components.



Make sure the card is thoroughly inspected before shipment. If any damage has occurred during transportation please contact us via our web page at: <https://www.smartembedded.com/ec/support/>.

### Shipment Inspection

To inspect the shipment, perform the following steps:

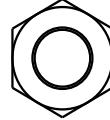
1. Verify that you have received all items of your shipment:
  - One PCIE-6002 card.
  - Four (4) M2.5 x 4 mm screws.
  - Four (4) M2.5 x 4 mm shoulder screws (these screws are used to attach the SSD module to the PCIE card).
  - Four (4) 6 mm long (diameter 3 mm) M2.5 hex standoffs.
  - One printed copy of *Quick Start Guide*.
  - One printed copy of *Safety Notes Summary*.

## Hardware Preparation and Installation

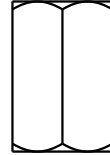
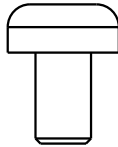
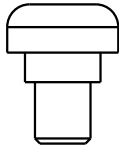
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- Any optional items ordered.

Top View



Side View



M2.5 shoulder screw

M2.5 screw

Standoff

2. Remove the desiccant bag shipped with the card and dispose it according to your country's legislation.



**Make sure the card is thoroughly inspected before shipment. If any damage has occurred during transportation please contact our support group via <https://www.smartembedded.com/leclsupport/>.**

## 2.3 Environmental, Thermal, and Power Requirements

This section contains the environmental, thermal, and power requirements of the PCIE-6002 card.

## 2.3.1 Environmental and Thermal Requirements



Operating temperatures refer to the temperature of the incoming air passing across the card and out of the faceplate and not the temperature of the components.

**NOTICE**

**Card Damage**  
**High humidity and condensation on the card surface causes short circuits.**  
**Do not operate the card outside the specified environmental limits. Make sure that the card is completely dry and there is no moisture on its surface before applying power.**

The following table provides the environmental and the thermal requirements for the PCIe-6002 card.

*Table 2-1 Environmental and Thermal Requirements*

Requirement	Operating	Non-Operating
Cooling Method	Forced air	-
Temperature	+5°C to +40°C (normal operation), +5°C to +55°C (exceptional operation), according to NEBS Standard GR-63-CORE	-40°C to +70°C
Forced air flow, air volume, pressure loss (reference to sea level)	5CFM @ 20°C host system ambient, 12.5CFM @ 35°C host system ambient, and 20CFM @ 55°C host system ambient	-
Temperature Change	±0.5°C/min	±1°C/min
Relative Humidity	5% to 95% non-condensing at +40°C	5% to 95% non-condensing at +40°C
Vibration (vertical)	10 Min 0.01G (sinusoidal) 5 – 200Hz	-
Vibration (transverse)	10 Min. 0.01G (sinusoidal) 5 – 200Hz	-
Vibration (longitudinal)	10 Min. 0.01G (sinusoidal) 5 – 200Hz	-
Freefall	-	1200mm/all edges and corners (packed state) 100mm/3 axis (unpacked)
Altitude	Sea level	

## Hardware Preparation and Installation

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### 2.3.2 Power Requirements

The PCIE-6002 payload card accepts single and double-sided modules up to a power consumption of 10W per module. The module interface must comply with the NVMe (NVM Express) standard. In case of MaxCore platforms, the MaxCore system reads the thermal sensors and provides sufficient cooling.

The following table provides the typical power consumed by a PCIE-6002 card.

*Table 2-2 Power Requirements*

Mode	PCIe slot power
Idle	15 Watts
Active	52 Watts
Peak	75 Watts

**Idle:** Drives are powered, but not being actively utilized.  
**Active:** When the drives are being utilized at room temperature.  
**Peak:** When the drives are being utilized at 40°C ambient temperature.

### 2.4 Weight and Dimensions

The following table provides weight and dimensions of PCIE-6002 card.

*Table 2-3 Weight and Dimensions*

Feature	Value
Height	111.15 mm (4.37 inches)
Length	312.00 mm (12.28 inches)
Width	14.47 mm (0.57 inches)
Weight	0.16 kg (0.35 lb)
Front Panel Width	14.47 mm (0.57 inches)

## 2.5 Precautions



To reduce the risk of personal injury, fire, or damage to the equipment, do not overload the AC supply circuit that provides power to the chassis.

The card must be powered and connected only to a controlled voltage source.

To avoid shock, make sure that the power cables are connected to a properly wired and grounded receptacles.

### NOTICE

#### Electrostatic Discharge

Do not touch the circuit with bare hands.

The static electricity of the human body may damage the ElectroStatic Sensitive Devices (ESSDs) on the circuit.

Make sure that you wear an ElectroStatic Discharge (ESD) preventive wrist strap or antistatic glove to prevent the static electricity from hurting you or damaging the device.

Keep your personal objects such as your clothes away from the system. To prevent the static electricity from damaging the device, it is recommended to wear antistatic clothes.

#### Pin Damage

If the PCIe-6002 is not fully aligned with the interface in the backplane, too much force may twist the pins on the card or backplane.

Do not exert too much force when you insert the card.

### 2.5.1 ESD Prevention

Static electricity may hurt you or damage the device. To minimize the damage, pay attention to the following points:

- Before touching the card or electronic components, make sure that you are working in an ESD safe environment.
- Before you operate the device, wear the ESD-preventive wrist strap. Both terminals of the ESD preventive wrist strap must contact well. One terminal touches your bare skin, and the other is inserted in the jack at the front or back side of the shelf.
- Avoid moving as much as possible. Movement gathers static electricity around you.
- Do not touch the solder point, pin, or bare circuit.
- Do not leave the device in the place where others can operate it.

## Hardware Preparation and Installation

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- Install the device at once after you take it out of the anti-static package. If you need to lay down the device, place it back in the anti-static package. Do not lay the device on the shelf or cabinet.
- Monitor the temperature and humidity of the equipment room. Warm air decreases the humidity but increases the static electricity in the room.

### NOTICE

#### Damage of Circuits

Electrostatic discharge and incorrect module installation and removal can damage circuits or shorten their life. Before touching the module or electronic components, make sure that you are working in an ESD safe environment.

## 2.6 M.2 AHCI or NVMe SSD Installation and Removal

This section provides procedures on how to install or remove M.2 AHCI or NVMe SSDs from a PCIE-6002 card.

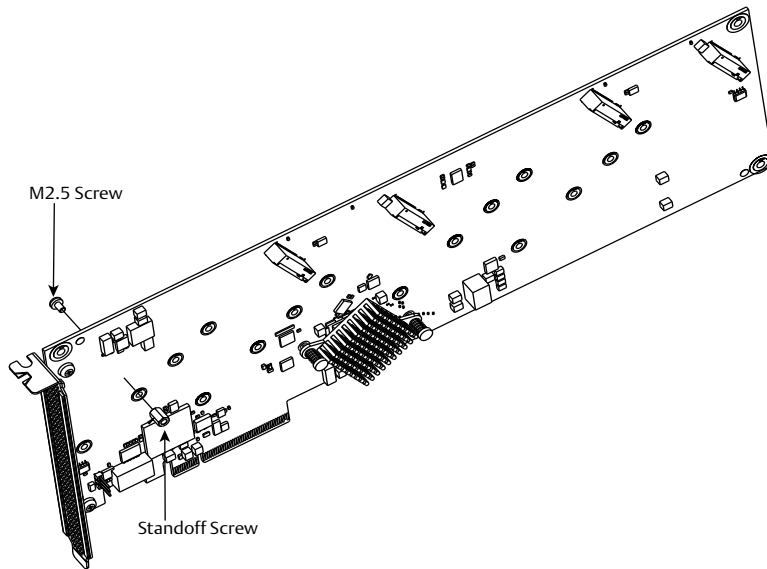
### 2.6.1 M.2 AHCI or NVMe SSD Module Installation on the PCIE-6002 Card

PCIE-6002 provides four (4) sets of the hardware as shown in [Figure 1-1](#).

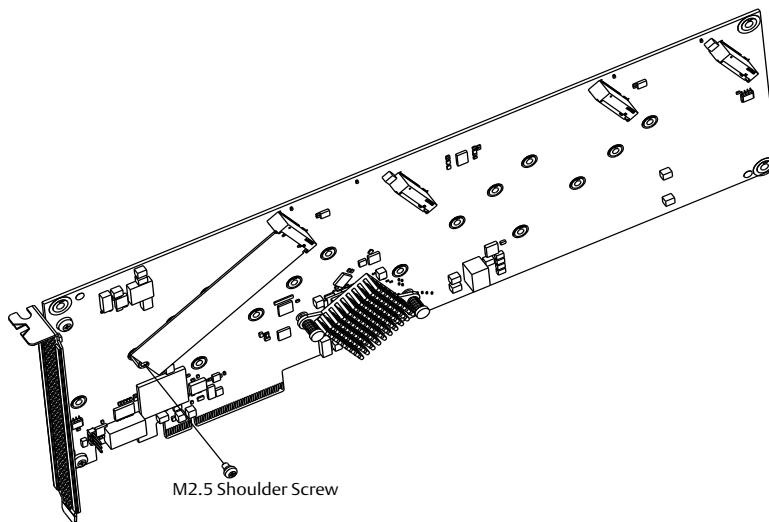
To install M.2 AHCI or NVMe SSD modules on a PCIE-6002 card:

1. Install M2.5 screw and standoff in the PCB hole location based on the length of the M.2 module.





2. Install the M.2 module.
3. Install the M.2 shoulder screw. Torque should not exceed 0.1 Nm



### 2.6.2 M.2 AHCI or NVMe SSD Module Removal from the PCIE-6002 Card

To remove M.2 AHCI or NVMe SSD modules from a PCIE-6002 card:

1. Remove M.2 shoulder screw.
2. Remove M.2 module.

## 2.7 PCIE-6002 Card Installation and Removal

This section contains the PCIE-6002 card installation and removal procedures.

### NOTICE

Shipping the card along with a server is not recommended.

If you still need to ship the card along with the server, ensure the card is properly secured in the server. Check if necessary precautions were followed to keep the card resistive against wobbling. Otherwise, there are chances of card getting damaged.

For more information about securing the PCIe card in a server, refer to MaxCore product documentation.



You must allow the card to cool for 30 minutes, before removing it. In case you try to touch the card, the heat sink could be hot enough to burn your skin.

### 2.7.1 PCIE-6002 Card Installation

To install the PCIE-6002 card, perform the following steps:

1. Use anti-static pads and attach an ESD strap to your wrist. Attach the other end of the ESD strap to an electrical ground (For more details, refer to the section [Precautions on page 29](#)).
2. Identify the system in which the PCIE-6002 card is to be installed.
3. Remove the system cover.



For detailed information about the PCIe card installation, refer to MaxCore product documentation.

4. Insert the PCIE-6002 card into the PCIe slot, secure it, and ensure that the card is properly fitted in the PCIe slot.
5. Close the system cover and then power on the system.

### NOTICE

Make sure that the card has enough air flow after closing the system with the cover. Refer to the *MaxCore MC3000 Platform Installation and Use* manual for setting the fan speed accordingly.



The CPU transcoding performance is directly related to the airflow and cooling ability of the server in which the card is installed.

## 2.7.2 PCIE-6002 Card Removal

To remove the PCIE-6002 card, perform the following steps:

1. Make sure you are in an ESD-safe environment.
2. Power off the system, disconnect the system from the electrical outlet and peripherals and remove any cables connected to the card.
3. Remove the system cover.



Wait at least 30 minutes for the card to cool down as the heat sink could be extremely hot.

4. Remove the screw holding the front panel bracket and gently pull the PCIE-6002 card from the slot

### NOTICE

Place the PCIE-6002 card into an ESD-protective bag and seal it appropriately.

5. Close the cover of the system.



# Functional Description

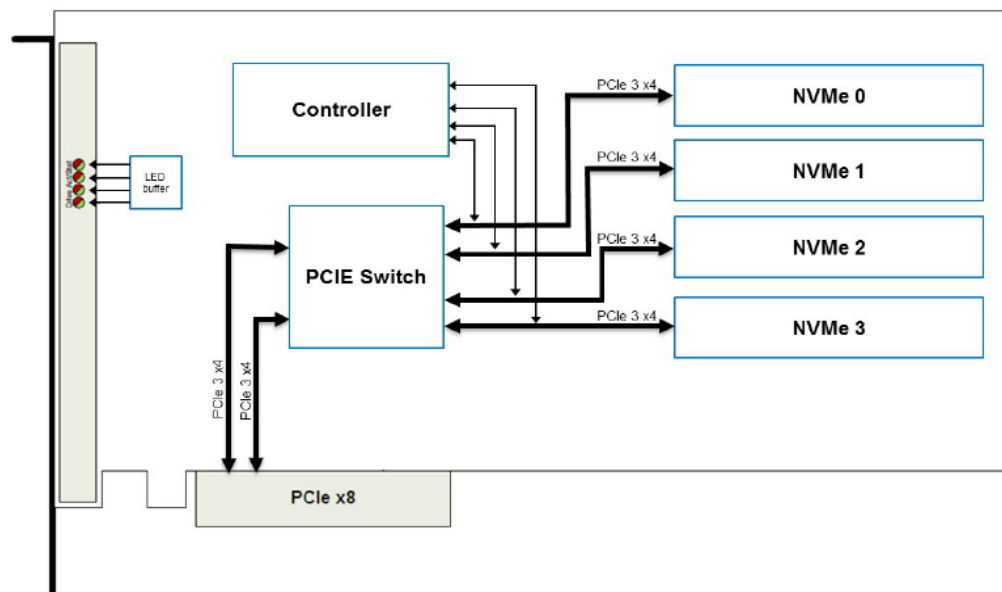
## 3.1 Overview

This chapter describes the functional blocks of the PCIE-6002 card. The PCIE-6002 provides four M.2 card sockets, each accept a PCIe x4 solid state drive for use by any processor installed in the system using the MaxCore's PCIe Switch. The PCIE-6002 payload card connects four M.2 sockets, each with a dedicated four-lane PCIe Gen 3 interface, to a PCIe switch.

In case of a MaxCore platform, the switch in turn connects to the MaxCore backplane or server CPU through two four-lane PCIe Gen 3 interfaces. In the MaxCore platform the backplane can then be configured to connect individual sockets to microserver CPUs using any Gen 3 x8 PCIe slot. In a server application 1,2, or 4 M.2 AHCI or NVMe SSD modules can be connected to the host CPU.

The following figure depicts the functional block diagram of PCIE-6002 card.

*Figure 3-1 PCIE-6002 Block Diagram*



## 3.2 Power

Both 3.3V and 12V power are provided to the PCIE-6002 through the PCIe gold fingers (through the +3.3V Aux and +12V rails respectively).

### 3.3 CPLD

CPLD is used on the board to provide a combination of glue logic and PCIe sideband support. The following are the keys functions of CPLD:

- Power Monitoring and Sequencing
- Temperature Monitoring
- Reset Control
- Additional Glue Logic

### 3.4 PCIe Switch

The PCIE-6002 utilizes a Broadcom Limited ExpressLane PEX 8725 PCI Express switch to expand a single x8 upstream PCI Express channel to four x4 downstream PCI Express channels.

### 3.5 M.2/NGFF Card Sockets

The primary purpose of the PCIE-6002 is to extend the storage capabilities of the MaxCore chassis by providing four M.2/NGFF card sockets for solid state drives.

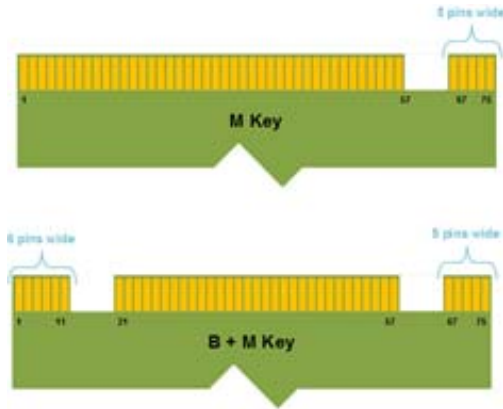
PCIE-6002 supports all standard module sizes for Socket 3 (2242, 2260, 2280 and 22110) for both single and dual-sided modules (S1-S3 and D0-D5). It supports only AHCI and NVME SSD modules.

#### ***NOTICE***

**SATA is not supported in a PCIE-6002 card and installing a SATA module will cause damage to both the module and the card.**

The sockets are mounted horizontally and accept M.2 AHCI or NVMe SSD modules in 2242, 2260, 2280 and 22110 sizes utilizing either the “M” or “B + M” key.

*Figure 3-2 Supported M.2 or NGFF Module Keying*

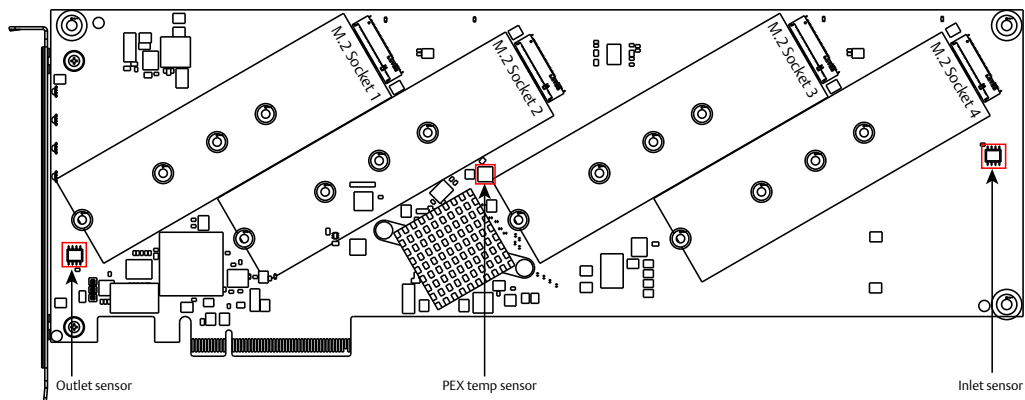


## 3.6 Temperature Sensors

To ensure the board operate at safe temperatures, the PCIE-6002 has a pair of LM75A temperature sensors (at the inlet and outlet) along with an ADT7461A that provides the internal PEX die temperature. These sensors cannot be directly accessed via the upstream host processor, but can be accessed via a CPLD register. Also, there are typically temperature sensors built into each M.2 AHCI or NVMe SSD module.

The following figure shows the location of the temperature sensors on the card.

*Figure 3-3 Location of Temperature Sensors*



### 3.7 Clock Distribution

The PCIE-6002 utilizes the PCI Express common clock architecture with the upstream host providing the reference clock. A low-jitter fanout buffer is used to provide this clock to the PEX and each M.2 or NGFF socket. A 32.768kHz PCI Express suspend clock is generated on-board and provided to each M.2 or NGFF socket.

### 3.8 Reset Control

In addition to responding to the PCI Express fundamental reset, each installed M.2 AHCI or NVMe SSD module can be individually controlled via the NVMe Reset Status or Control register.



# Controls, Indicators, and Connectors

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## 4.1 Overview

This chapter contains information about the controls, indicators, and connectors of a PCIE-6002 card.

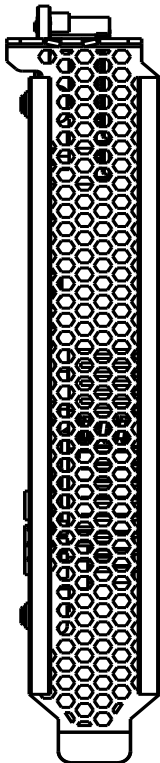
## 4.2 Connectors

The PCIE-6002 card comes with a PCIe x8 edge connector. This edge connector is compatible with either 8-lane or 16-lane PCI Express 3.0 slots.

### 4.2.1 PCIE-6002 Face Plate View

The following figure shows the face plate view of PCIE-6002 card.

*Figure 4-1 PCIE-6002 Face Plate*



## Controls, Indicators, and Connectors

### 4.2.2 M.2 or NGFF Edge Card Socket J3-J6

This section provides information about the M.2 or Next Generation Form Factor (NGFF) Edge Card Socket J3-J6 pinout.

*Table 4-1 M.2 or NGFF Edge Card Socket J3-J6 Assignment*

Pin #	Name	Description
1	GND	Ground
2	+3.3V	+3.3 Volt power
3	GND	Ground
4	+3.3V	+3.3 Volt power
5	NVME_T3_N	PCIe Transmit Pair
6	No Connect	Not connected
7	NVME_T3_P	PCIe Transmit Pair
8	No Connect	Not connected
9	GND	Ground
10	ACTLED	SSD Drive Activity Signal (3.3V LVTTTL)
11	NVME_R3_N	PCIe Receive Pair
12	GND	Ground
13	NVME_R3_P	PCIe Receive Pair
14	GND	Ground
15	GND	Ground
16	GND	Ground
17	NVME_T2_N	PCIe Transmit Pair
18	GND	Ground
19	NVME_T2_P	PCIe Transmit Pair
20	No Connect	Not connected
21	GND	Ground
22	No Connect	Not connected
23	NVME_R2_N	PCIe Receive Pair

## Controls, Indicators, and Connectors

Table 4-1 M.2 or NGFF Edge Card Socket J3-J6 Assignment (continued)

Pin #	Name	Description
24	No Connect	Not connected
25	NVME_R2_P	PCIe Receive Pair
26	No Connect	Not connected
27	GND	Ground
28	No Connect	Not connected
29	NVME_T1_N	PCIe Transmit Pair
30	No Connect	Not connected
31	NVME_T1_P	PCIe Transmit Pair
32	No Connect	Not connected
33	GND	Ground
34	Not connected	Not connected
35	NVME_R1_N	PCIe Receive Pair
36	No Connect	Not connected
37	NVME_R1_P	PCIe Receive Pair
38	Not connected	Not connected
39	GND	Ground
40	No Connect	Not connected
41	NVME_T0_N	PCIe Transmit Pair
42	No Connect	Not connected
43	NVME_T0_P	PCIe Transmit Pair
44	No Connect	Not connected
45	GND	Ground
46	No Connect	Not connected
47	NVME_R0_N	PCIe Receive Pair
48	No Connect	Not connected
49	NVME_R0_P	PCIe Receive Pair

## Controls, Indicators, and Connectors

*Table 4-1 M.2 or NGFF Edge Card Socket J3-J6 Assignment (continued)*

Pin #	Name	Description
50	PERST_L	PCIe Fundamental Reset (3.3V LVTTTL)
51	GND	Ground
52	CLKREQ_L	PCIe Clock Request (3.3V LVTTTL)
53	REFCLK_N	PCIe Reference Clock (HCLK)
54	PEWAKE_L	PCIe Wake Signal (3.3V LVTTTL)
55	REFCLK_P	PCIe Reference Clock (HCLK)
56	No Connect	Not connected
57	GND	Ground
58	No Connect	Not connected
Mechanical Key		
67	No Connect	Not connected
68	SUSCLK	Suspend Clock
69	No Connect	Not connected
70	+3.3V	+3.3 Volt power
71	GND	Ground
72	+3.3V	+3.3 Volt power
73	GND	Ground
74	+3.3V	+3.3 Volt power
75	GND	Ground

## 4.3 LEDs

The following figure shows front panel LEDs.

Figure 4-2 Front Panel LEDs

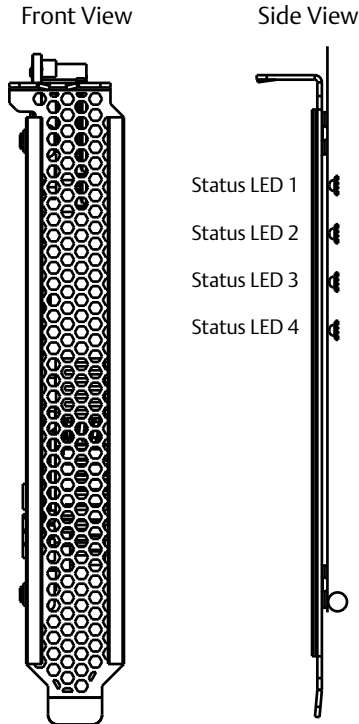


Table 4-2 Front Panel LEDs

LED	Color	Function
NVMe 0	Blinking Green	Drive activity
	Steady Red	Drive is held in reset. Error.
NVMe 1	Blinking Green	Drive activity
	Steady Red	Drive is held in reset. Error.
NVMe 2	Blinking Green	Drive activity
	Steady Red	Drive is held in reset. Error.
NVMe 3	Blinking Green	Drive activity
	Steady Red	Drive is held in reset. Error.

## Controls, Indicators, and Connectors

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The following figure shows on-board LEDs. These LEDs are used for debugging purposes

*Table 4-3 On-Board LEDs*

LED	Color	Function
Upstream Card Edge	Off	No link
	Blinking Green, 2Hz	PCI Express Gen 1 (2.5GT/s) Link
	Blinking Green, 1Hz	PCI Express Gen 2 (5GT/s) Link
	Steady Green	PCI Express Gen 3 (8GT/s) Link
NVMe 0	Off	No link
	Blinking Green, 2Hz	PCI Express Gen 1 (2.5GT/s) Link
	Blinking Green, 1Hz	PCI Express Gen 2 (5GT/s) Link
	Steady Green	PCI Express Gen 3 (8GT/s) Link
NVMe 1	Off	No link
	Blinking Green, 2Hz	PCI Express Gen 1 (2.5GT/s) Link
	Blinking Green, 1Hz	PCI Express Gen 2 (5GT/s) Link
	Steady Green	PCI Express Gen 3 (8GT/s) Link
NVMe 2	Off	No link
	Blinking Green, 2Hz	PCI Express Gen 1 (2.5GT/s) Link
	Blinking Green, 1Hz	PCI Express Gen 2 (5GT/s) Link
	Steady Green	PCI Express Gen 3 (8GT/s) Link
NVMe 3	Off	No link
	Blinking Green, 2Hz	PCI Express Gen 1 (2.5GT/s) Link
	Blinking Green, 1Hz	PCI Express Gen 2 (5GT/s) Link
	Steady Green	PCI Express Gen 3 (8GT/s) Link

# PCIE-6002 Card Configuration Example

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## A.1 Configuration Example

This section provides information required to configure M.2 AHCI or NVMe SSDs on a PCIE-6002 card to the CPUs on the host PCIe cards in the SMART Embedded Computing MaxCore system and also in any other third-party systems.

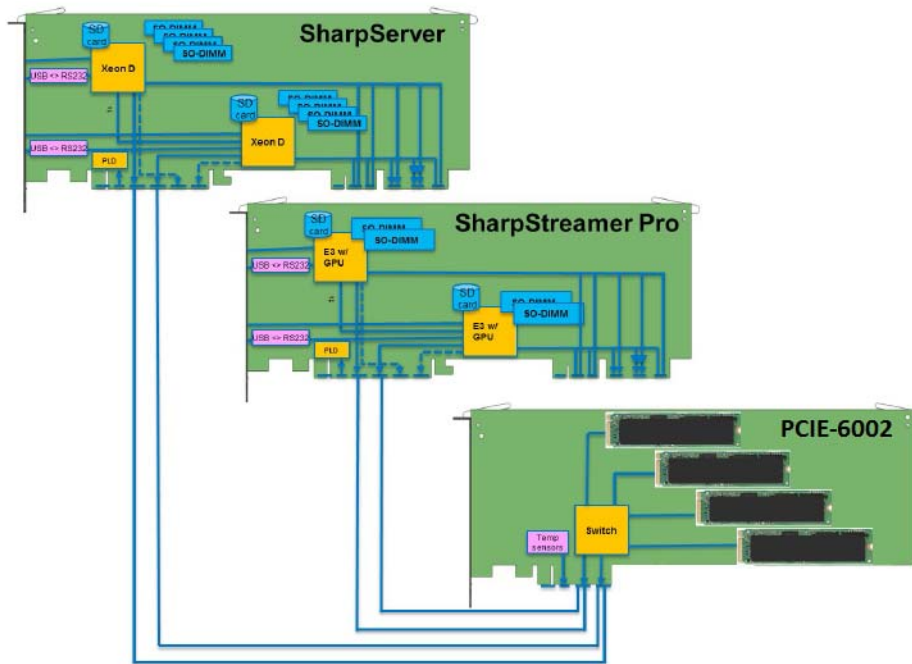
### A.1.1 SMART EC MaxCore System

The System Services Framework (SSF) management system provides the MaxCore operator console which enables the user to connect each M.2 AHCI or NVMe SSD on a PCIE-6002 card to any CPU on a SharpServer PCIE-7410 card or SharpStreamer Pro PCIE-7210 card in the same box.

The PCIE-6002 M.2 AHCI/NVMe SSD will show up in the CPUs PCIe device tree after booting the CPUs, along with many other PCIe devices which were connected by SSF to a CPU. This M.2 AHCI/NVMe SSD can be mounted at run time but can also be used as boot device. All four module slots are accessible in an 8-lane MaxCore slot. The amount and location of 8-lane slots differs depending on the MaxCore platform being used.

For more information on how to assign individual M.2 AHCI or NVMe SSD modules to CPUs within the system, refer to *SSF for MaxCore MC3000 Platform GUI Help*.

Figure A-1 Configuration Example—SMART EC MaxCore System



## A.1.2 Third-Party System

No additional configuration is required in case of a third-party system. The upstream host will detect all four M.2 AHCI or NVMe SSD modules. For more information, refer to respective manufacturer's product documentation.



# Related Documentation

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## B.1 SMART Embedded Computing Documentation

The documentation listed is referenced in this manual. Technical documentation can be found by using the Documentation Search at <https://www.smartembedded.com/ec/support/> or you can obtain electronic copies of SMART EC documentation by contacting your local sales representative.

*Table B-1 SMART EC Documentation*

<b>Document Title</b>	<b>Publication Number</b>
PCIE-6002 Quick Start Guide	PCIE-6001-DS
PCIE-6002 Quick Start Guide	6806800U71
PCIE-6002 Safety Notes Summary	6806800U72
MaxCore MC3000 Platform Installation and Use	6806800T88





