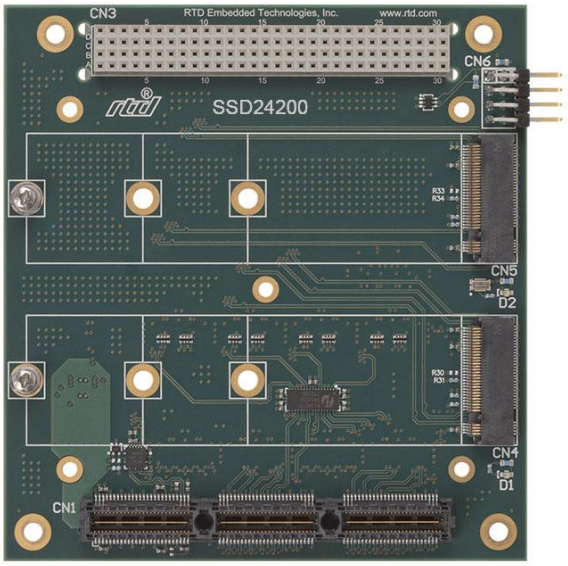
SSD24100 / SSD34100

SSD24200 / SSD34200

M.2 Socket (M Key) High Speed SSD Carriers

User's Manual

BDM-610020151 Rev. A



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Revision History

Rev A	Initial Release

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Failure to follow the instructions found in this manual may result in damage to the product described in this manual, or other components of the system. The procedure set forth in this manual shall only be performed by persons qualified to service electronic equipment. Contents and specifications within this manual are given without warranty, and are subject to change without notice. RTD Embedded Technologies, Inc. shall not be liable for errors or omissions in this manual, or for any loss, damage, or injury in connection with the use of this manual.

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1 Introduction

1.1 Product Overview

RTD's SSD24200HR high speed SSD storage module is based on the M.2 format (formerly called Next Generation Form Factor, or NGFF). Two M.2 Socket 3 interfaces leverage the PCIe/104 Type 2 connector, allowing the inserted devices to utilize a PCIe x4 link or SATA connection for data transfer to and from the host CPU.

The Non-Volatile Memory Express protocol (NVMe) enables high speed data transfer from the CPU's PCIe x4 connection to the SSD device at theoretical transfer rates up to 985 MB/s per lane (PCIe revision 3.0). These low latencies make the SSD24200HR the perfect candidate for edge computing applications. Pair the SSD24200HR with RTD's 25 MSPS data acquisition module (DM34216HR), and continuous data from four high speed A/Ds can simultaneously be written to SSD via the NVMe connection without losing any data.

The dual M.2 sockets of the SSD24200HR enable a shorter stack height over traditional PCIe/104 storage technologies, making it particularly attractive to SWaP- sensitive applications which are often limited to one 2.5" SATA drive per board.

For applications where only one M.2 socket is required, RTD offers the SSD24100HR single socket ordering option.

1.2 Board Features

- PC/104 form factor
- PCIe/104 stackable bus structure
    - PCIe/104 or PC/104-Express Type 2 connection
        - Uses PCIe x4 links and SATA links from the host PCIe Type 2 cpuModule
        - Operable when stacked above or below the host CPU
    - PCI pass-through expansion bus
- Up to two M.2 sockets in the socket 3 configuration (M key) support NVMe and SATA SSDs
    - High speed SSD storage
    - PCI Express SSDs supported through NVMe (Non-Volatile Memory Express) with theoretical transfer rates up to 985 MB/s per PCIe lane (PCIe revision 3.0)
    - SATA SSDs supported through AHCI with theoretical transfer rates up to 6 Gbit/s per SATA link (SATA revision 3.1)
    - Single and dual socket ordering options
    - Transfer rates may be limited by the host cpuModules
    - Selected M.2 devices may affect standard operating temperature and power requirements
- External LED connector to indicate drive activity
- Requires only +5 VDC for operation
- Available in stackable, rugged enclosures
- Software
    - SATA SSDs natively supported through the AHCI driver
    - PCIe Express SSDs supported through NVMe:
        - Natively supported in Linux 3.x (3.3 and newer) and 4.x Kernels
        - Natively supported in the latest updates for Windows 7 and 10 (32-bit and 64-bit)
    - NVMe boot permitted when supported by the BIOS of the host cpuModules or if the selected NVMe device has an option ROM onboard

1.3 Ordering Information

The table below shows the part numbering scheme for RTD's SSD24x00HR product family:

Table 1: Ordering Options

(IDAN) – **SSD** (P) **4** (N) **0 0 H R –** (/Axxx) (/Bxxx)	
Coding	**Description**
IDAN	Board option: - [blank] = Stand-alone board - IDAN = Stackable IDAN frame
P	Bus: - 2 = PCI/104-Express connectors (PCIe and PCI buses) - 3 = PCIe/104 connector (PCIe only)
N	Number of M.2 sockets - 2 = Dual sockets - 1 = Single socket
/Axxx	Specify device type and capacity for socket 1 - /N128 = NVMe SSD, 128GB - /S128 = SATA SSD, 128GB
/Bxxx	Specify device type and capacity for socket 2 *(SSDxx200HR only)* - /N128 = NVMe SSD, 128GB - /S128 = SATA SSD, 128GB

When ordered without SSD storage, the product is available with the following options:

Table 2: Example Ordering Options (SSD not included)

Part Number	Description
SSD24100HR	PCI/104-Express with Single M.2 socket
SSD34100HR	PCIe/104 with Single M.2 socket
SSD24200HR	PCI/104-Express with Dual M.2 sockets
SSD34200HR	PCIe/104 with Dual M.2 sockets
IDAN-SSD24100HR	SSD24100HR in IDAN enclosure
IDAN-SSD34100HR	SSD34100HR in IDAN enclosure
IDAN-SSD24200HR	SSD24200HR in IDAN enclosure
IDAN-SSD34200HR	SSD34200HR in IDAN enclosure

The table below shows several different ordering options which includes onboard NVMe and SATA SSD devices installed. Note that these are just several of the available permutations.

Table 3: Example Ordering Options (with SATA or NMVe SSD storage)

Part Number	Description
SSD24100HR/N128	SSD24100HR with 128GB NVMe SSD
SSD34100HR	SSD34100HR with no devices installed
SSD24200HR/N128/N128	SSD24200HR with two 128GB NVMe SSDs
SSD34200HR/N128/S128	SSD34200HR with one 128GB NVMe SSD (socket 1) and one 128GB SATA SSD (socket 2)
IDAN-SSD24100HR/S128	IDAN-SSD24100HR with 128GB SATA SSD
IDAN-SSD34100HR/N128	IDAN-SSD34100HR with 128GB NVMe SSD
IDAN-SSD24200HR/N128/N128	IDAN-SSD24200HR with two 128GB NVMe SSDs
IDAN-SSD34200HR	IDAN-SSD34200HR with no devices installed

The Intelligent Data Acquisition Node (IDAN®) building block can be used in just about any combination with other IDAN building blocks to create a simple but rugged 104™ stack. This module can also be incorporated in a custom-built RTD HiDAN® or HiDAN*plus*® High Reliability Intelligent Data Acquisition Node. Contact RTD sales for more information on our high reliability systems.

Throughout this document, SSD24x00HR refers to all variations of the SSD24100HR and SSD24200HR unless otherwise noted.

Figure 1: SSD24100HR

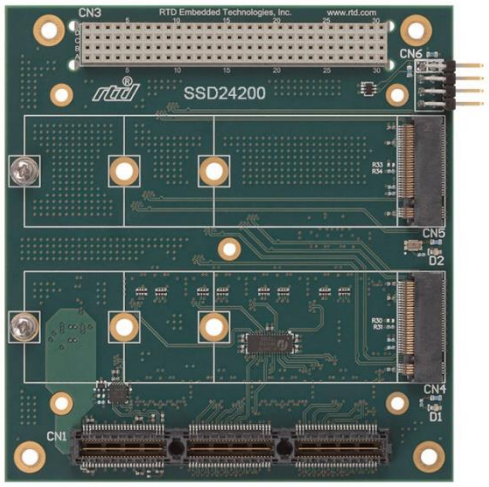

Figure 2: SSD24200HR

1.4 Contact Information

1.4.1 Sales Support

For sales inquiries, you can contact RTD Embedded Technologies sales via the following methods:

Phone: 1-814-234-8087 Monday through Friday, 8:00am to 5:00pm (EST).
E-Mail: sales@rtd.com

1.4.2 Technical Support

If you are having problems with your system, please try the steps in the Troubleshooting section of this manual.

For help with this product, or any other product made by RTD, you can contact RTD Embedded Technologies technical support via the following methods:

Phone: 1-814-234-8087 Monday through Friday, 8:00am to 5:00pm (EST).
E-Mail: techsupport@rtd.com

2 Specifications

2.1 Operating Conditions

Table 4: Operating Conditions

Symbol	Parameter	Test Condition	Min	Max	Unit
V_{cc5}	5V Supply Voltage		4.75	5.25	V
V_{cc3}	3.3V Supply Voltage		n/a	n/a	V
V_{cc12}	12V Supply Voltage		n/a	n/a	V
V_{cc-12}	-12V Supply Voltage		n/a	n/a	V
T_a	Operating Temperature		-40	+85	C
T_s	Storage Temperature		-55	+125	C
RH	Relative Humidity	Non-Condensing	0	90%	%
MTBF	Mean Time Before Failure	Telcordia Issue 2 30°C, Ground benign, controlled		TBD	Hours

NOTE: The Operating Environment and Storage Conditions apply to the SSD24100HR and SSD24200HR boards only. For recommended operating conditions of third party SATA and NVMe modules, refer to documentation from the manufacturer.

2.2 Electrical Characteristics

The bus connectors on the SSD24x00HR offer several voltage inputs. Only +5V is required for operation and is used to generate the voltage requirements for both M.2 sockets. All other bus connector supply voltages are pass-through and unused by the SSD24x00HR.

Table 5: Supply Voltage Requirements

Symbol	Parameter	Note	Min	Max	Unit
V_{cc5}	5 V Supply Voltage		4.75	5.25	V
$V_{cc5\text{-}STBY}$	5 V Stand-by Supply Voltage		n/a	n/a	V
V_{cc3}	3.3 V Supply Voltage		n/a	n/a	V
V_{cc12}	12 V Supply Voltage		n/a	n/a	V

Supply current and power consumption for the SSD24x00HR are listed in the table below.

Table 6: Power Ratings (SSD24200HR – No devices installed)

Symbol	Parameter	Test Condition	Min	Max	Unit
P	Power Consumption	V_{cc5} = 5.0 V, Typical		0.200	W
I_{cc5}	5 V Input Supply Current	Active		40	mA

Table 7: Power Ratings (SSD24200HR/N128/N128)

Symbol	Parameter	Test Condition	Min	Max	Unit
P	Power Consumption	V_{cc5} = 5.0 V, Typical		2.175	W
I_{cc5}	5 V Input Supply Current	Active		435	mA

3 Board Connection

3.1 Board Handling Precautions

To prevent damage due to Electrostatic Discharge (ESD), keep your board in its antistatic bag until you are ready to install it into your system. When removing it from the bag, hold the board at the edges, and do not touch the components or connectors. Handle the board in an antistatic environment, and use a grounded workbench for testing and handling of your hardware.

3.2 Physical Characteristics

STEP model is available upon request; contact RTD Tech Support for more information.

- SSD24100HR Weight (no modules installed): Approximately 0.12 lbs. (54 g)
- SSD24200HR Weight (no modules installed): Approximately 0.14 lbs. (64 g)
- Dimensions: 3.550 in. L x 3.775 in. W (90.17 mm L x 95.89 mm W)

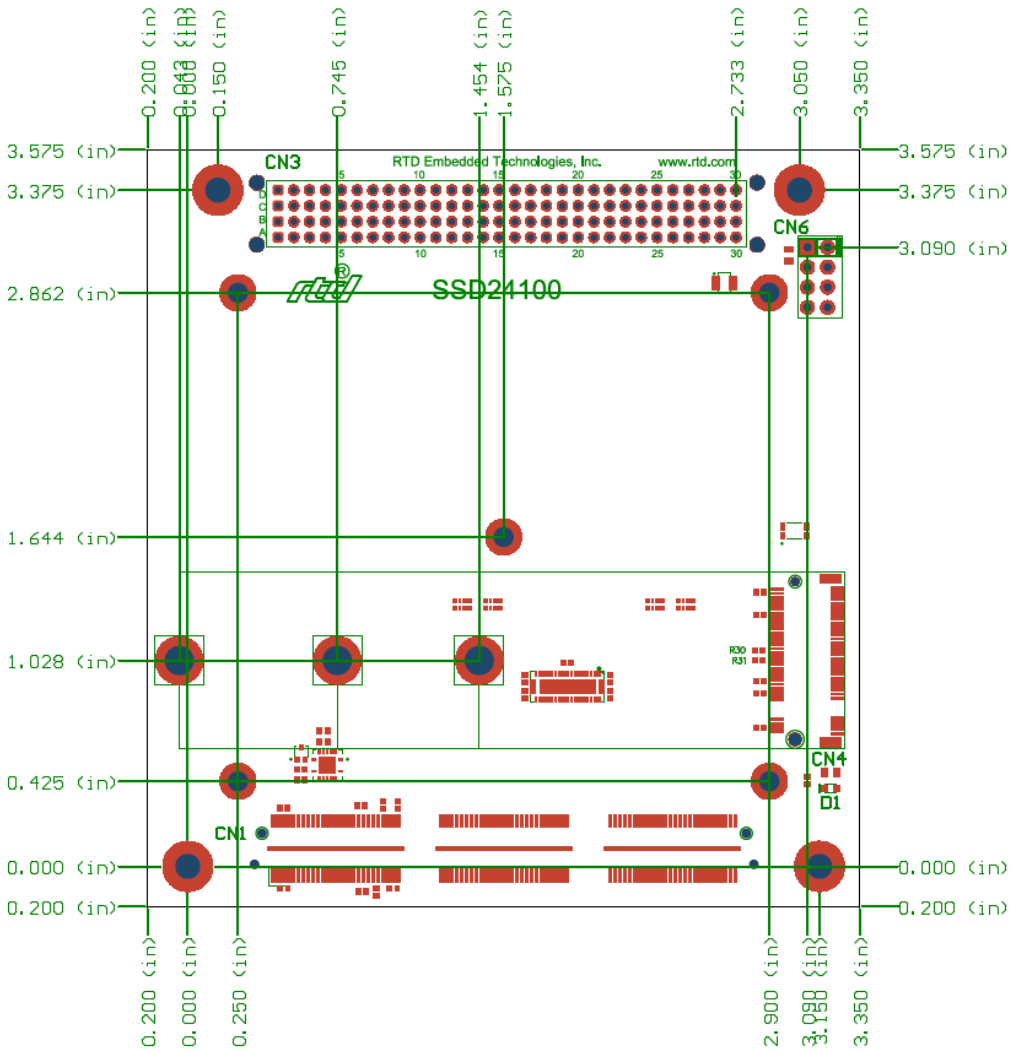

Figure 3: Board Dimensions (SSD24100HR)

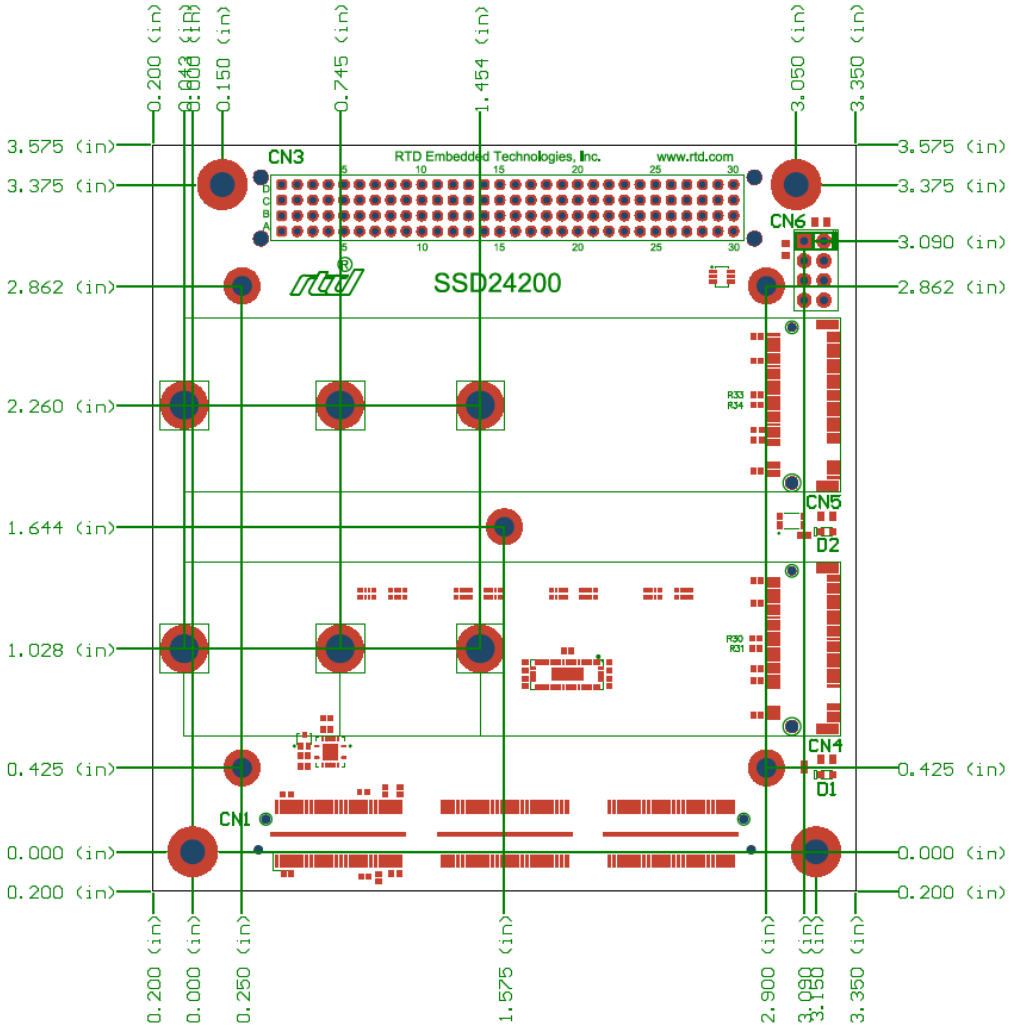

Figure 4: Board Dimensions (SSD24200HR)

3.3 Connectors and Jumpers

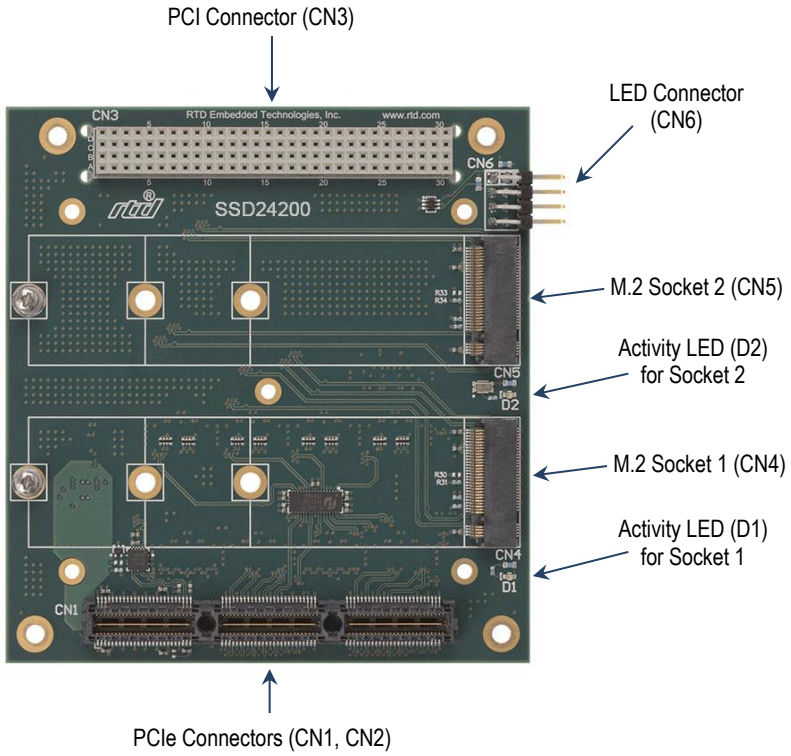

Figure 5: Board Connections (SSD24200HR shown)

3.3.1 External I/O Connectors

For all connectors, pin 1 is designated by a thick white silkscreen line, and a square pad on the PCB.

Table 8: SSD24x00HR External I/O and Mating Connectors

Designator	Function	Size and Pitch	Mating Connector
CN6	Activity LED Connector	2x4, 0.1", right angle	3M 89108-0001

Activity LED Connector (CN6)

The Activity LED Connector (CN6) provides access to the activity LEDs signals of the M.2 sockets (CN4 and CN5).

Table 9: Activity LED Connector (CN6) Pinout

Pin	Signal	Function	In/Out	Notes
1	DAS_S1#	SSD socket 1 (CN4): SSD activity output	out	
2	DAS_S2#	SSD socket 2 (CN5): SSD activity output	out	SSD24200HR only
3	+3.3V_S1	Connection to +3.3V with 150ohm current limiting resistor; for SSD socket 1 (CN4)	out	
4	+3.3V_S2	Connection to +3.3V with 150ohm current limiting resistor; for SSD socket 2 (CN5)	out	SSD24200HR only
5	*Reserved*	—	—	
6	*Reserved*	—	—	
7	*Reserved*	—	—	
8	*Reserved*	—	—	

Facing the Activity LED Connector, the pinout is:

7	5	3	1
Reserved	*Reserved*	+3.3V_S1	DAS_S1#
Reserved	*Reserved*	+3.3V_S2	DAS_S2#
8	6	4	2

3.3.2 Bus Connectors

PCIe Connectors (CN1, CN2)

The PCIe connector is the connection to the system CPU. The position and pin assignments are compliant with the *PCI/104-Express Specification*. (See PC/104 Specifications on page 23)

The SSD24x00HR utilizes SATA and PCIe x4 links, and therefore must connect to a Type 2 PCIe/104 connector on the host cpuModule.

PCI Connector (CN3)

The PCI connector is the connection to PCI peripheral modules. The position and pin assignments are compliant with the *PCI/104-Express Specification*. (See PC/104 Specifications on page 23)

3.4 Steps for Installing

1. Always work at an ESD protected workstation, and wear a grounded wrist-strap.
2. Turn off power to the PC/104 system or stack.
3. Select and install stand-offs to properly position the module on the stack.
4. Remove the module from its anti-static bag.
5. Check that pins of the bus connector are properly positioned.
6. Check the stacking order; make sure all of the busses used by the peripheral cards are connected to the cpuModule.
7. Hold the module by its edges and orient it so the bus connector pins line up with the matching connector on the stack.
8. Gently and evenly press the module onto the PC/104 stack.
9. If any boards are to be stacked above this module, install them.
10. Attach any necessary cables to the PC/104 stack.
11. Re-connect the power cord and apply power to the stack.
12. Boot the system and verify that all of the hardware is working properly.

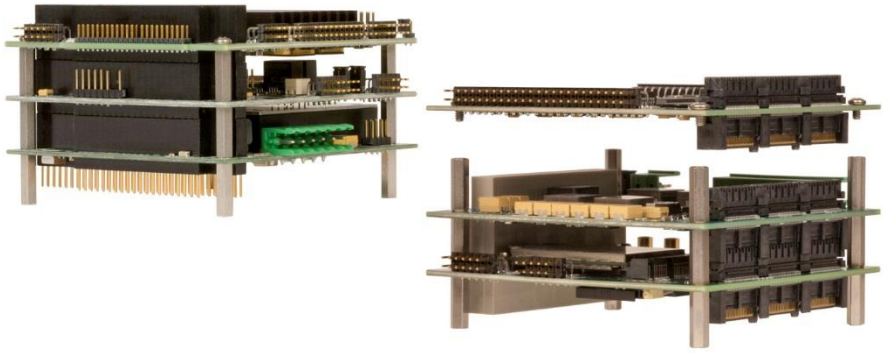

Figure 6: Example PC/104 Stacks

4 IDAN Connections

4.1 Module Handling Precautions

To prevent damage due to Electrostatic Discharge (ESD), keep your module in its antistatic bag until you are ready to install it into your system. When removing it from the bag, hold the module by the aluminum enclosure, and do not touch the components or connectors. Handle the module in an antistatic environment, and use a grounded workbench for testing and handling of your hardware.

4.2 Physical Characteristics

- Weight: Approximately TBD lbs. (TBD Kg)

- Dimensions:
  - Length: 5.98 inches (152.0 mm)
  - Width: 5.12 inches (130.0 mm)
  - Height: 0.67 inches (17.0 mm)

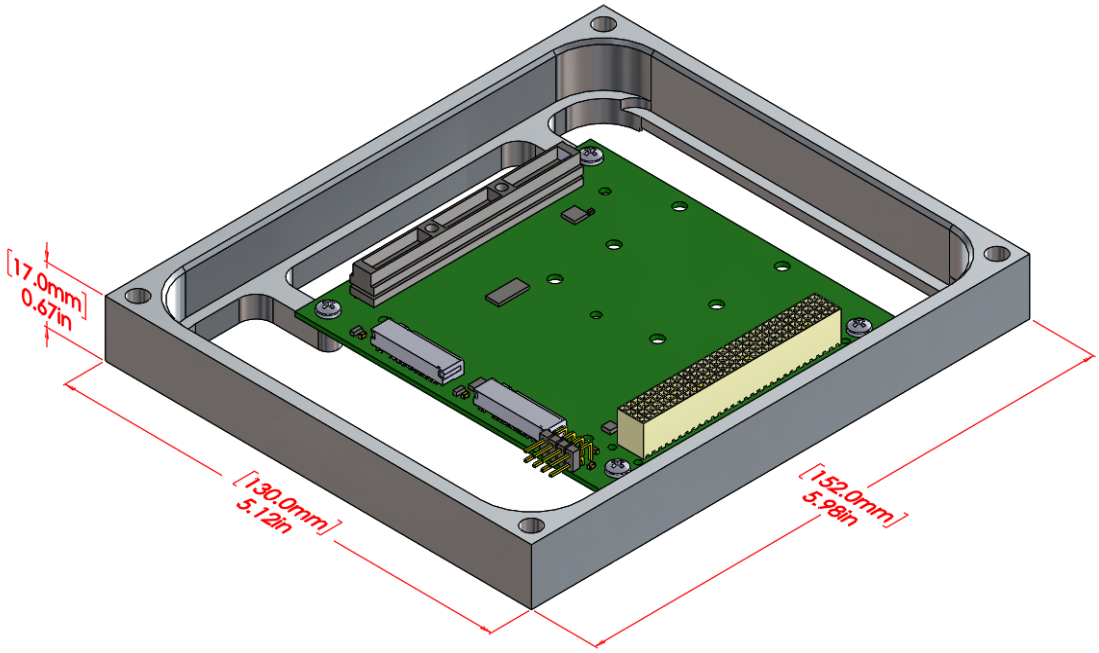

Figure 7: IDAN Dimensions (IDAN-SSD24200HR shown)

4.3 Connectors

4.3.1 External I/O Connectors

There are no external I/O connectors on the IDAN-SSD24x00HR

4.3.2 Bus Connectors

PCIe Connectors (CN1, CN2)

The PCIe connector is the connection to the system CPU. The position and pin assignments are compliant with the *PCI/104-Express Specification*. (See PC/104 Specifications on page 23)

The SSD24x00HR utilizes SATA and PCIe x4 links, and therefore must connect to a Type 2 PCIe/104 connector on the host cpuModule.

PCI Connector (CN3)

The PCI connector is the connection to PCI peripheral modules. The position and pin assignments are compliant with the *PCI/104-Express Specification*. (See PC/104 Specifications on page 23)

4.4 Steps for Installing

1. Always work at an ESD protected workstation, and wear a grounded wrist-strap.
2. Turn off power to the IDAN system.
3. Remove the module from its anti-static bag.
4. Check that pins of the bus connector are properly positioned.
5. Check the stacking order; make sure all of the busses used by the peripheral cards are connected to the cpuModule.
6. Hold the module by its edges and orient it so the bus connector pins line up with the matching connector on the stack.
7. Gently and evenly press the module onto the IDAN system.
8. If any boards are to be stacked above this module, install them.
9. Finish assembling the IDAN stack by installing screws of an appropriate length.
10. Attach any necessary cables to the IDAN system.
11. Re-connect the power cord and apply power to the stack.
12. Boot the system and verify that all of the hardware is working properly.

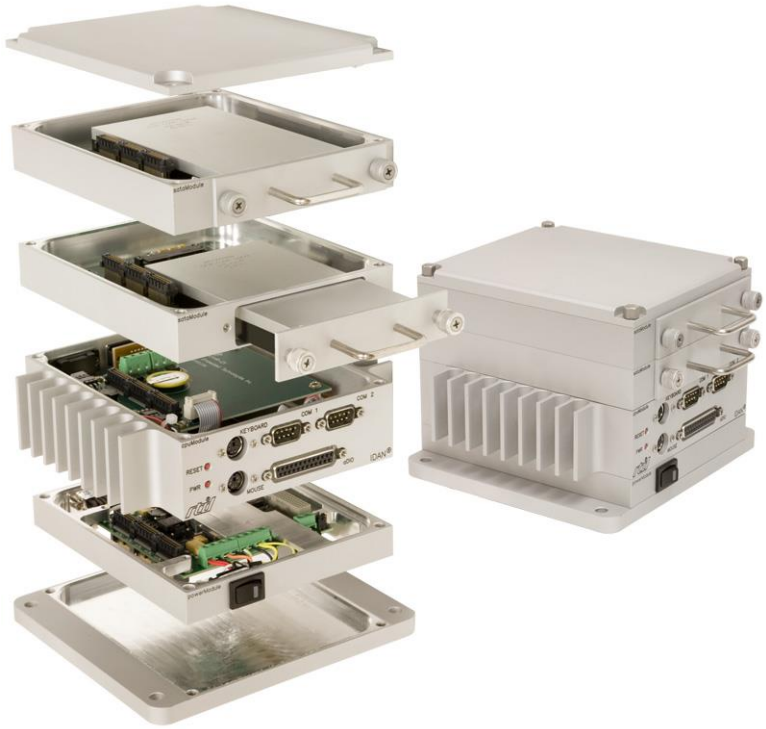

Figure 8: Example IDAN System

5 Functional Description

5.1 Functional Diagram

The Figure below shows the functional block diagram of the SSD24x00HR. The various parts of the block diagram are discussed in the following sections.

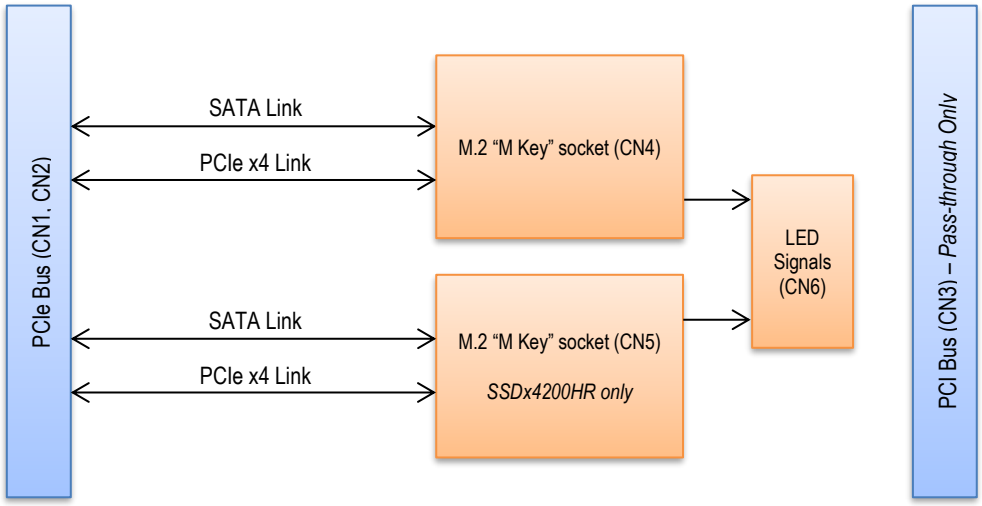

Figure 9: Functional Diagram

5.2 SATA and PCIe x4 Utilization on the Host CPU

As is shown in the functional diagram for the SSD24x00HR, the SATA and PCIe x4 link connections for the M.2 "M Key" sockets are directly connected to the bus. This means that the SS24100HR utilizes one SATA connection and one PCIe x4 link from the host CPU module's PCIe connector. Similarly, the SSD24200HR utilizes two SATA links and two PCIe x4 links from the host CPU module's PCIe connector.

For both the SSD24100HR and SSD24200HR, the board will utilize the SATA and PCIe x4 link resources from the host CPU whether or not a device is installed in the M.2 sockets (CN4 and CN5). Similarly, SATA and PCIe x4 connections will be allocated to CN4 and CN5 whether the installed device operates via a SATA connection or a PCIe x4 link.

Each PCIe/104 connector (CN1 on the top, and CN2 on the bottom) has the capability of hosting up to two SATA links and two PCIe x4 links. Therefore, for systems where only one M.2 socket is desired, it is recommended that the SSD24100HR is used to avoid using the second SATA link and second PCIe x4 link on the bus. On host CPUs which provide two SATA links and two PCIe x4 links, the SSD24100HR will then shift the second SATA connection and second PCIe x4 link across the bus, making these connections available for another SATA or PCIe x4 peripheral in the system.

For more information on PCIe/104 link shifting please refer to the PCIe/104 and PCI/104-Express specifications.

5.3 M.2 Interoperability Warning

On October 30th, 2018, the PCI Special Interest Group (PCI-SIG) announced the following M.2 Interoperability Warning. RTD recommends that SSD24x00HR users heed this announcement:

> "The NGSFF or NF1 mechanical form factor is not-compatible with the M.2 specification as it connects a subset of NC pins for proprietary purposes. The use of these pins is in direct conflict with the latest M.2 specification, and could cause interoperability problems and host and/or AIC damage. All of these can be avoided by adding mechanical keying to ensure incompatible hosts and AICs do not mate. Given the industry has shipped over 1 billion M.2 host and AICs and 100s of millions more ship every year, the PCI-SIG believes it is critical for the industry and consumers to be aware of this situation to minimize impact to the industry and consumers."

For more information, please refer to the PCI-SIG news release, "M.2 Interoperability Warning" (https://pcisig.com/newsroom/news-releases/).

6 Troubleshooting

If you are having problems with your system, please try the following initial steps:

- **Simplify the System** – Remove modules one at a time from your system to see if there is a specific module that is causing a problem. Perform you troubleshooting with the least number of modules in the system possible.

- **Swap Components** – Try replacing parts in the system one at a time with similar parts to determine if a part is faulty or if a type of part is configured incorrectly.

If problems persist, or you have questions about configuring this product, contact RTD Embedded Technologies via the following methods:

Phone: +1-814-234-8087
E-Mail: techsupport@rtd.com

Be sure to check the RTD web site (http://www.rtd.com) frequently for product updates, including newer versions of the board manual and application software.

7 Additional Information

7.1 PC/104 Specifications

A copy of the latest PC/104 specifications can be found on the webpage for the PC/104 Consortium:

- www.pc104.org

7.2 PCI, PCI Express, and M.2 Specifications

A copy of the latest PCI, PCI Express, and M.2 specifications can be found on the webpage for the PCI Special Interest Group:

- www.pcisig.com

7.3 NVM Express Specification

A copy of the latest NVMe specification can be found on the NVM Express website:

- www.nvmexpress.org

8 Limited Warranty

RTD Embedded Technologies, Inc. warrants the hardware and software products it manufactures and produces to be free from defects in materials and workmanship for one year following the date of shipment from RTD Embedded Technologies, Inc. This warranty is limited to the original purchaser of product and is not transferable.

During the one year warranty period, RTD Embedded Technologies will repair or replace, at its option, any defective products or parts at no additional charge, provided that the product is returned, shipping prepaid, to RTD Embedded Technologies. All replaced parts and products become the property of RTD Embedded Technologies. Before returning any product for repair, customers are required to contact the factory for a Return Material Authorization (RMA) number.

This limited warranty does not extend to any products which have been damaged as a result of accident, misuse, abuse (such as: use of incorrect input voltages, improper or insufficient ventilation, failure to follow the operating instructions that are provided by RTD Embedded Technologies, “acts of God” or other contingencies beyond the control of RTD Embedded Technologies), or as a result of service or modification by anyone other than RTD Embedded Technologies. Except as expressly set forth above, no other warranties are expressed or implied, including, but not limited to, any implied warranties of merchantability and fitness for a particular purpose, and RTD Embedded Technologies expressly disclaims all warranties not stated herein. All implied warranties, including implied warranties for merchantability and fitness for a particular purpose, are limited to the duration of this warranty. In the event the product is not free from defects as warranted above, the purchaser's sole remedy shall be repair or replacement as provided above. Under no circumstances will RTD Embedded Technologies be liable to the purchaser or any user for any damages, including any incidental or consequential damages, expenses, lost profits, lost savings, or other damages arising out of the use or inability to use the product.

Some states do not allow the exclusion or limitation of incidental or consequential damages for consumer products, and some states do not allow limitations on how long an implied warranty lasts, so the above limitations or exclusions may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

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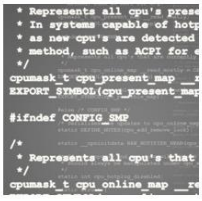

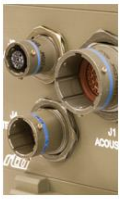
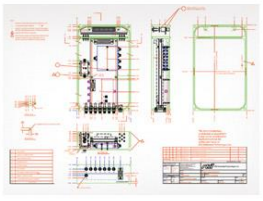

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