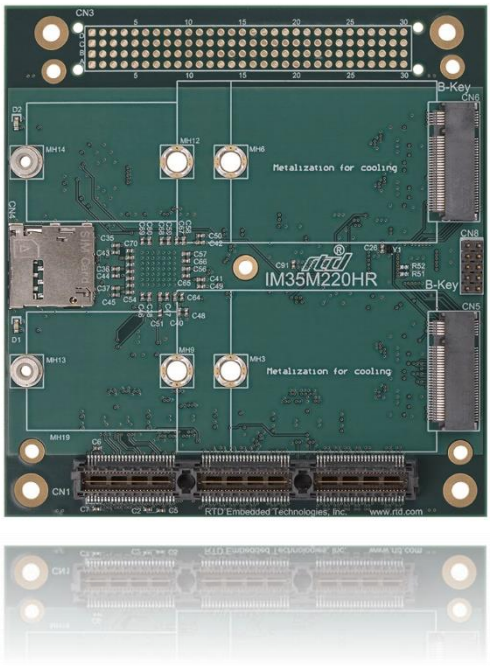
IM35M220HR / IM25M220HR

Dual M.2 B-Key Carrier Module

User's Manual

BDM-610020162 Rev. B



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Revision History

Rev A	12/08/2023	Initial Release
Rev B	01/22/2024	Added SIM card connections to the block diagram

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1 Introduction

1.1 Product Overview

RTD's IM35M220HR / IM25M220HR modules offer dual M.2 B-Key sockets, designed to permit integration of third-party M.2 B-Key modules into rugged PCIe/104 systems and enclosures. M.2 B-Key is a form factor for devices which supports both PCI Express and USB 3.0 connectivity and offer support for a cellular device with a single or dual SIM card attachment.

A x1 PCI Express connection is provided to each of the two M.2 B-Key sockets using two upstream x1 PCI Express links from the PCIe/104 bus.

Both M.2 sockets contain USB Super Speed sourced by a USB Super Speed hub that derives its' bandwidth from a single USB Super Speed connection from the PCIe/104 bus.

For devices installed in the dual M.2 B-Key sockets of the IM35M220HR / IM25M220HR-- referred to as Sockets A and B throughout this hardware manual (or designators CN5 and CN6, respectively).

The dual sockets on the IM35M220HR / IM25M220HR permit mounting of 38mm, 48mm, and 76mm M.2 B-Key modules, allowing maximum flexibility with the specification.

1.1.1 B-KEY DESCRIPTION

A M.2 card with B-Key has pins 12 through 19 missing for the keying position. The card can be easily identified because there are 6 pins on one side and 5 pins on the other before the keying position. Be careful not to confuse it with a M-Key which has 5 pins on one side of the key and 4 on the other side.

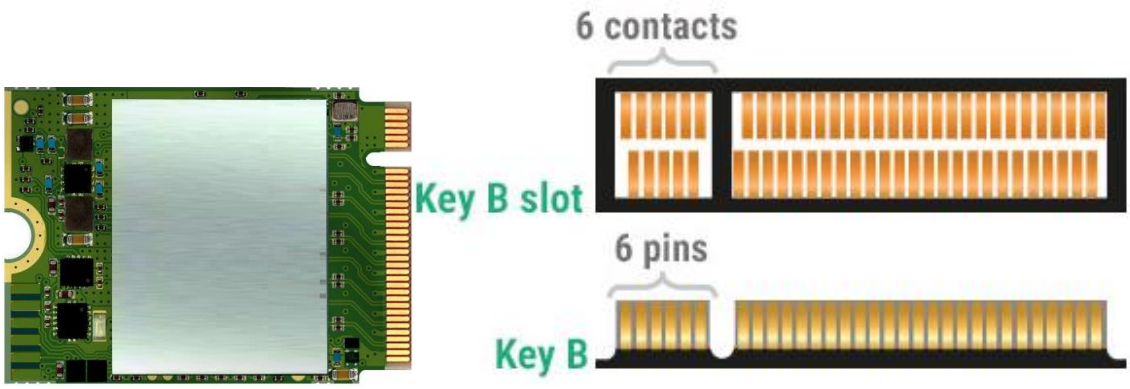

Figure 1 B-Key Identification

1.1.2 EXAMPLES OF M.2 CARDS THAT CAN BE USED.

Sierra Wireless EM7421 Q-M2M-110468 Cellular modem

Quectel 5G RM521F-GLCellular Module

Delkin Devices, Inc. MB2HFRCFD-80000-2 NVME

1.2 Board Features

- PCI Express Universal Connector
  - Permits compatibility with PCIe/104 Type 1 and Type 2 cpuModules
  - CPU_DIR pin permits stacking above or below the CPU
  - +5V-only operation
- Onboard PCIe Switch and USB 3.0 hub
  - Dual sockets require two x1 PCI Express link and/or one USB 3.0 link for operation
  - USB 3.0 link repopulation
- Dual M.2 B-Key Card Sockets
  - Each socket supports three modes of operation
    - Single x1 PCIe link **and** single USB 3.0 link
    - Single x1 PCIe link
    - Single USB 3.0 link
  - Mounting holes permit installation of 42mm, 52mm, and 80mm sized M.2 B-Key modules

1.3 Ordering Information

The IM35M220HR / IM25M220HR are available with the following options:

Table 1: Ordering Options

Part Number	Description
IM35M220HR	Dual M.2 B-Key sockets, PCIe/104
IDAN-IM35M220HR	Dual M.2 B-Key sockets, PCIe/104; in IDAN enclosure
IM25M220HR	Dual M.2 B-Key sockets, PCI/104-Express
IDAN-IM25M220HR	Dual M.2 B-Key sockets, PCI/104-Express; in IDAN enclosure

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 HiDANplus High Reliability Intelligent Data Acquisition Node. Contact RTD sales for more information on our high reliability systems.

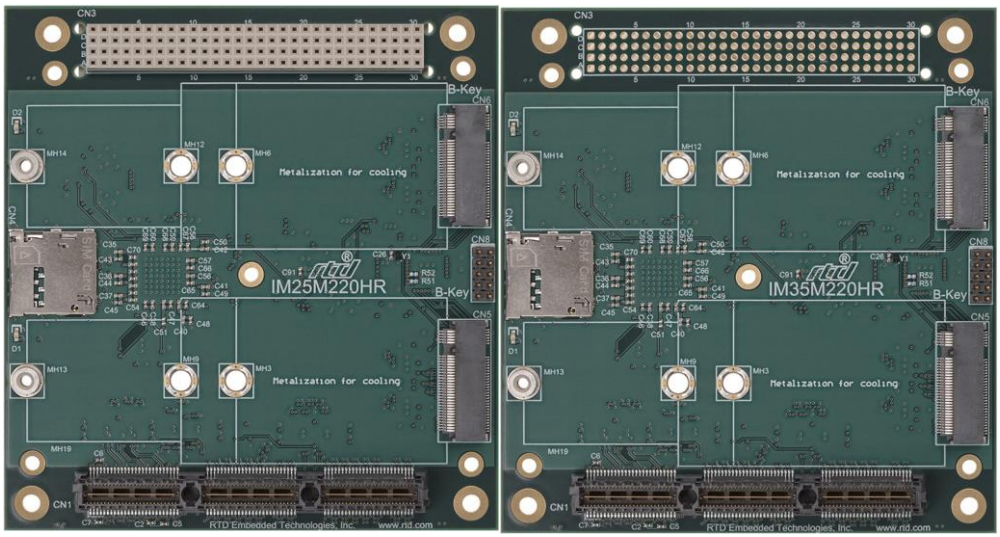

Figure 2 Images of PCI/104-Express and PCIe/104 Models Respectfully

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 Board Operating Conditions

Table 2: Operating Environment and Storage Conditions

Symbol	Parameter	Test Condition	Min	Max	Unit
T_a	Operating Temperature		-40	+85	C
T_s	Storage Temperature		-55	+125	C
RH	Relative Humidity	Non-Condensing	0	90%	%

NOTE: The Operating Environment and Storage Conditions listed in Table 2 apply to the IM35M220HR / IM25M220HR board only. For recommended operating conditions of third-party M.2 B-Key modules, refer to documentation from the manufacturer.

2.2 Board Electrical Characteristics

The bus connectors on the IM35M220HR / IM25M220HR offer several voltage inputs. Only +5V is required for operation and is used to generate the voltage requirements for both M.2 B-Key sockets. All other bus connector supply voltages are pass-through and unused by the IM35M220HR / IM25M220HR.

Table 3: Supply Voltage Requirements

Symbol	Parameter	Note	Min	Max	Unit
V_{cc5}	5 V Supply Voltage		4.75	5.25	V

Supply current and power consumption for the IM35M220HR / IM25M220HR are listed in the table below.

Table 4: Power Ratings

Symbol	Parameter	Test Condition	Min	Max	Unit
P	Board Power Consumption	V_{cc5} = 5.0 V, Typical		TBD	W
I_{cc5}	5 V Input Supply Current	Active		TBD	mA
M.2 B-Key – Peak Current per Socket					
$I_{cc3.3}$	3.3 V Input Supply Current	Peak current; Socket A or B		TBD	A
M.2 B-Key – Combined Current (Sockets A and B)					
$I_{cc3.3}$	3.3 V Input Supply Current	Combined current; Socket A + B		TBD	A

NOTE: Board Power Consumption was recorded with no devices installed in the M.2 B-Key sockets.

2.3 Third-Party M.2 B-Key Operating Conditions

Each third-party M.2 B-Key module has its own individual operating conditions which will vary from one manufacturer's device to another. Installing third party M.2 B-Key modules on the IM35M220HR / IM25M220HR can affect the overall operating temperature of the system. Make sure to verify the operating conditions of third-party M.2 B-Key modules before using the IM35M220HR / IM25M220HR in extreme conditions.

2.4 Physical Characteristics

- IMx5M220HR Weight: Approximately 69 g (0.152 lbs.)
- Dimensions: 90.17 mm L x 95.89 mm W (3.550 in L x 3.775 in W)

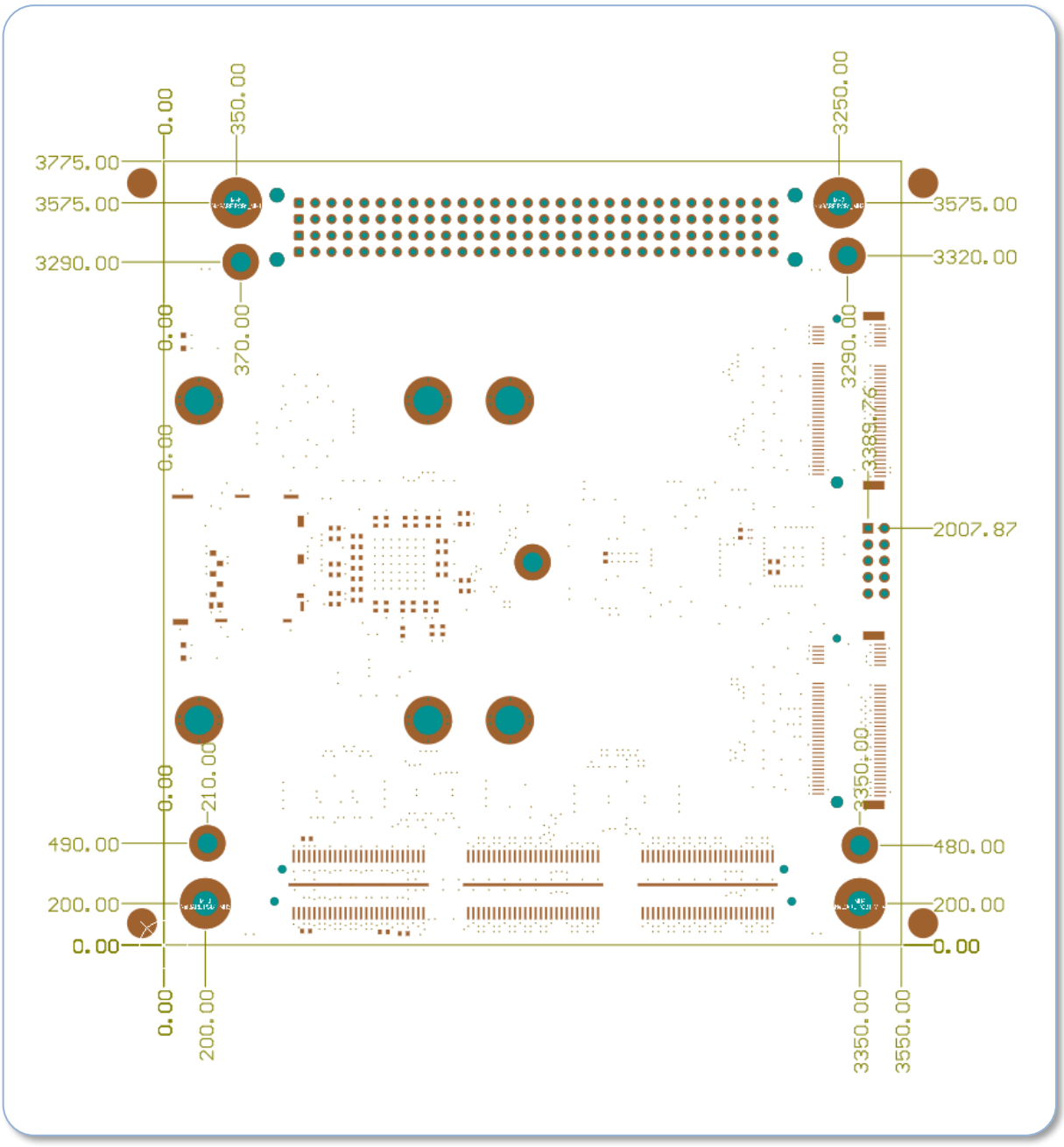

Figure 3: Board Dimensions

3 Board Connections and Functionality

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 Steps for Installing

1. Always work at an ESD protected workstation, and wear a grounded wrist-strap.
2. Turn off power to the 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 stack.
9. If any boards are to be stacked above this module, install them.
10. Attach any necessary cables to the 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.

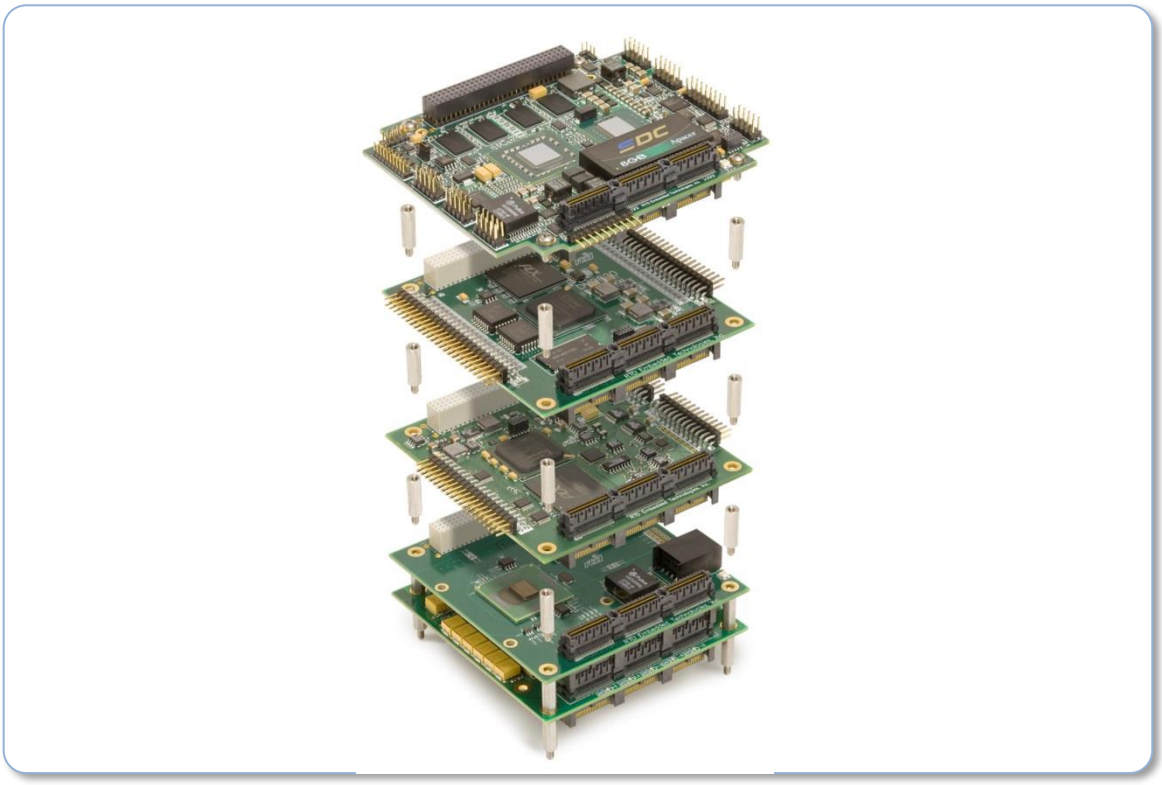

Figure 4: Example 104™ Stack

3.3 Connector Locations

The following top-side photo of the IM35M220HR / IM25M220HR provides a reference for designators of the bus connectors, I/O connectors as well as their locations.

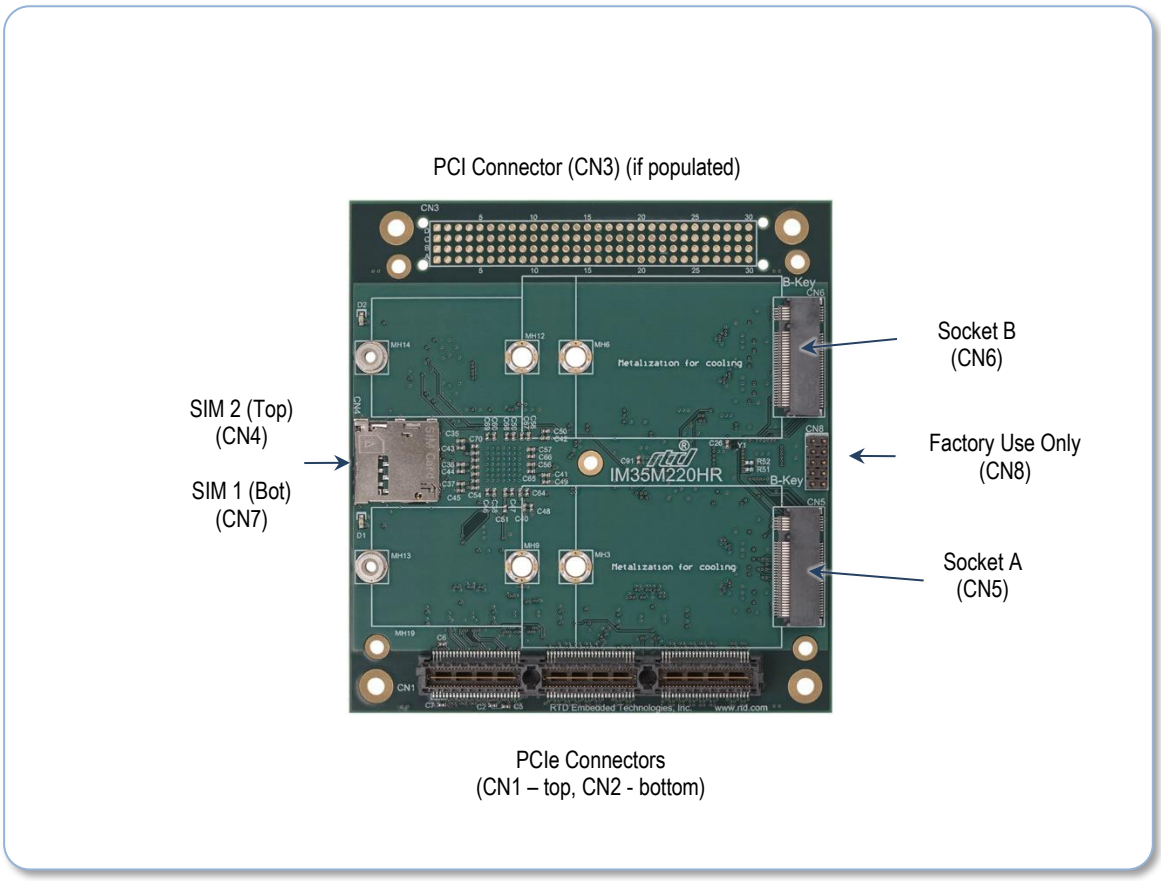

Figure 5: Connector Locations (Top View)

3.4 Attaching M.2 Modules

The IM35M220 / IM25M220 carrier is shipped with mounting fasteners for M.2 modules. There should be two 4mm screws, two 8mm screws, two nuts and two washers. All components are for M2.5 x 0.45mm fasteners. The figure below shows how to fasten a third-party M.2 module to the carrier. Insert the metal spacer in the carrier, run the 8mm screw down to tighten the M.2 module to the spacer, then apply the washer and nut to the bottom of the board. Two spacers are already soldered to the board for the 80mm position, and it takes the 4mm screw with no washer.

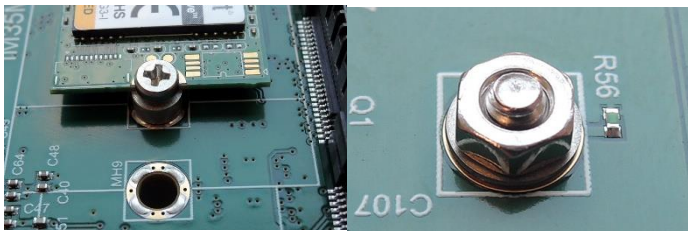

Figure 6 M.2 Fasteners

3.5 Functional Block Diagram

The Figure below shows the diagram of the IM35M220HR / IM25M220HR's dual M.2 B-Key sockets and their respective breakout and I/O connectors. The various parts of the block diagram are discussed in the following sections.

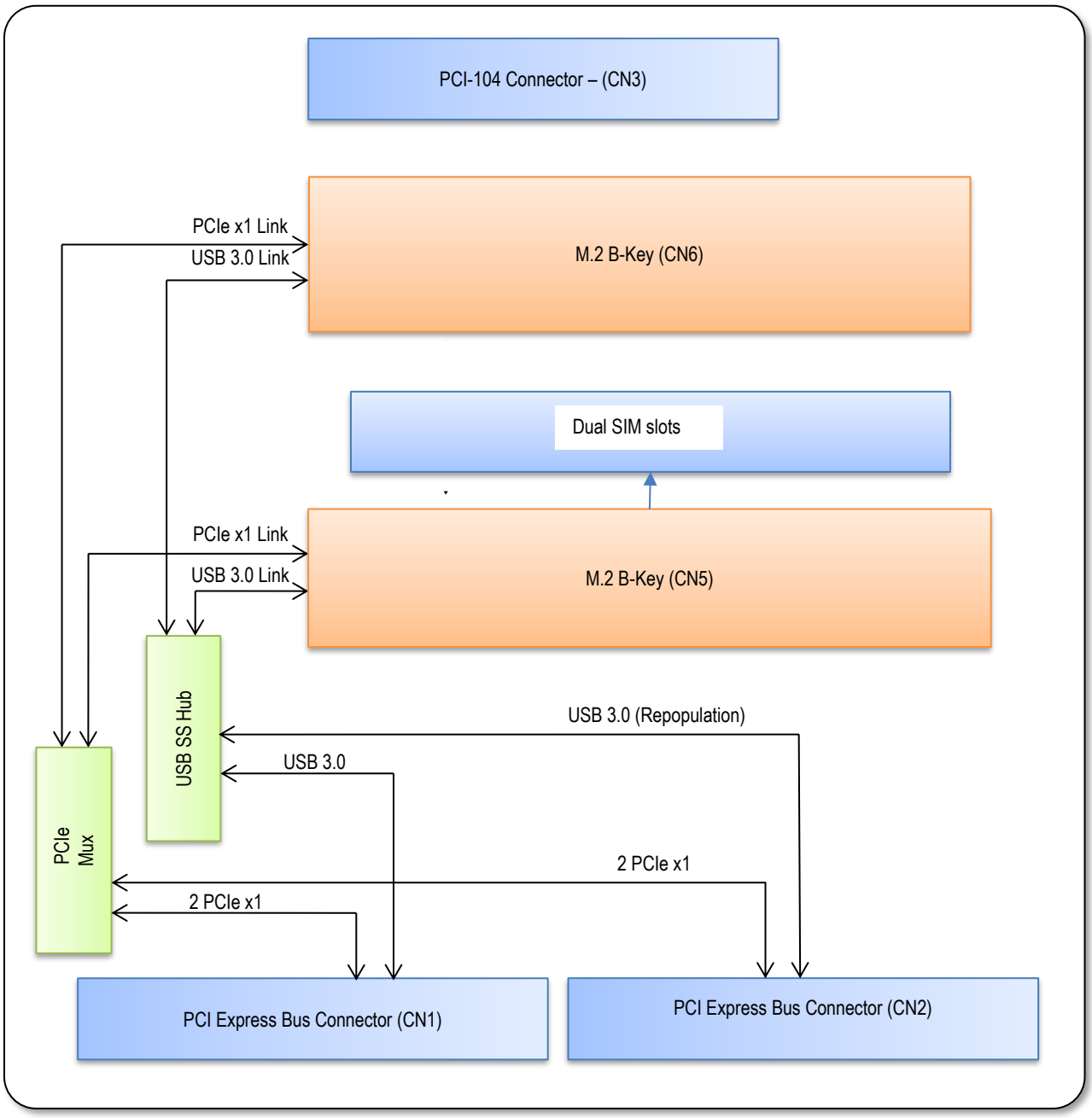

Figure 7: Block Diagram

3.6 Connector Functionality

3.6.1 Bus Connectors

Table 5: Bus Connectors

Connector	Function	Size and Pitch	Mating Connector
CN1	PCIe/104 Universal Bus (Top)	156-pin, 0.635mm	Samtec ASP-129646-03
CN2	PCIe/104 Universal Bus (Bottom)	156-pin, 0.635mm	Samtec ASP-129637-03
CN3	PCI-104 (PCI) Bus	120-pin, 2mm	Samtec ESQT-130-02-G-Q-368

PCIe Connectors (CN1 – Top, CN2 – Bottom)

The IM35M220HR / IM25M220HR is a "Universal" board and can connect to either a Type 1 or Type 2 connector of a PCIe/104 or PCI-104 Express system. The position and pin assignments are compliant with the *PCIe/104 Specification*. (See PC/104 Specifications on page 20)

PCI Connector (CN3)

This connector (if populated) is used as a pass-through connector only. Only ground is the only pins attached to copper.

3.6.2 Internal and External I/O Connectors

The IM35M220HR / IM25M220HR offers two sockets for installing a third-party M.2 B-Key module, Socket A (CN5) and Socket B (CN6).

Table 6: I/O Connectors

Socket A	Function	Connector
CN5	M.2 B-key, Socket A	*(Refer to PCI Express M.2 Specification)*
CN4	SIM Socket Top	TE Connectivity Push-Push model 2229333
CN7	SIM Socket Bottom	TE Connectivity Push-Push model 2229333
Socket B	**Function**	**Connector**
CN6	M.2 B-key, Socket B	*(Refer to PCI Express M.2 Specification)*

M.2 B-Key Sockets A and B (CN3, CN4)

The offers two soldered-down connectors that support third party M.2 B-Key modules.

Sockets A and B (or designators CN5 and CN6) each offer one downstream x1 PCI Express Gen 2 link and one downstream USB 3.0 link from the host cpuModule to the M.2 B-Key device installed in the socket. For maximum flexibility, the module provides mounting holes for cards designed to several length card M.2 B-Key form factors.

The pinout for each M.2 B-Key connector is shown below.

Table 7: M.2 B-Key Pin Assignments

Pin Name	#	#	Pin Name
3.3V	2	1	CONFIG3
3.3V	4	3	GND
PWR_OFF# 3.3V	6	5	GND
N/C	8	7	USB_HS_D+
LED 1#	10	9	USB_HS_D-
-Key-	12	11	GND
-Key-	14	13	-Key-
-Key-	16	15	-Key-
-Key-	18	17	-Key-
N/C	20	19	-Key-
N/C	22	21	CONFIG0
N/C	24	23	N/C
N/C	26	25	N/C
N/C	28	27	GND
SIM 1 RST	30	29	USB_SS_R-
SIM 1 CLK	32	31	USB_SS_R+
SIM 1 DATA	34	33	GND
SIM 1 PWR	36	35	USB_SS_T-
N/C	38	37	USB_SS_T+
SIM 2 DET	40	39	GND
SIM 2 DATA	42	41	PER0+
SIM 2 CLK	44	43	PER0-
SIM 2 RST	46	45	GND
SIM 2 PWR	48	47	PET0-
PE_RST	50	49	PET0+
N/C	52	51	GND
N/C	54	53	REFCLK-
N/C	56	55	REFCLK+
N/C	58	57	GND
N/C	60	59	N/C
N/C	62	61	N/C
N/C	64	63	N/C
SIM 1 DET	66	65	N/C
SUSCLK	68	67	N/C
3.3V	70	69	CONFIG1
3.3V	72	71	GND
3.3V	74	73	GND
		75	CONFIG2

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 0.230 Kg (0.508 lbs.)
- Dimensions: 152mm L x 130 mm W x 17.0 mm H (5.98 in L x 5.12 in W x 0.67 in H)

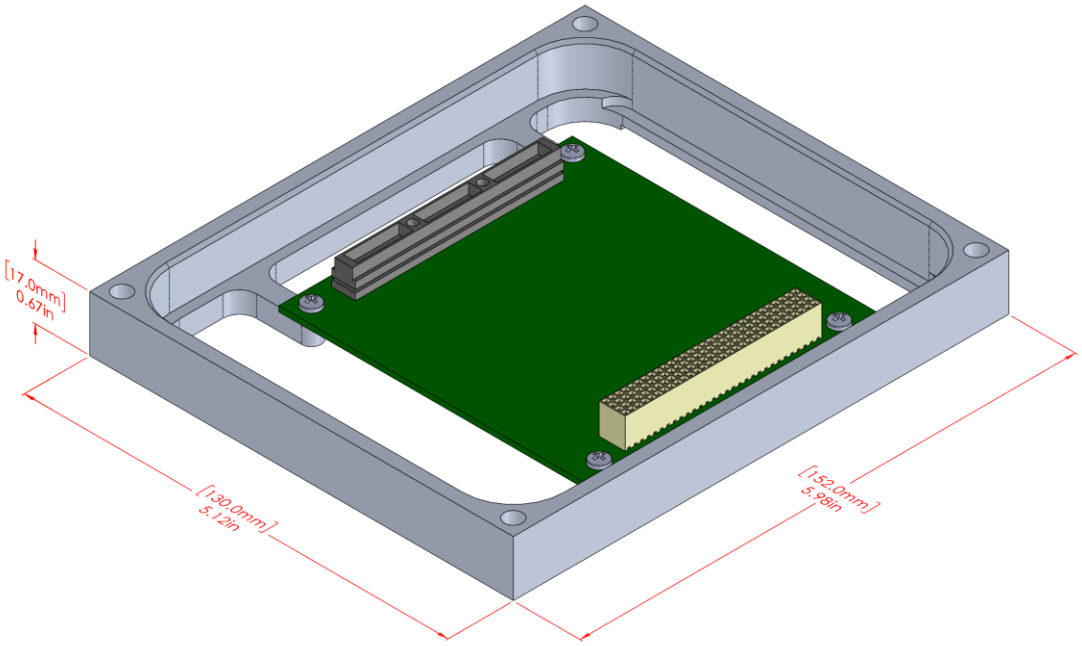

Figure 8: IDAN Dimensions

4.3 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.

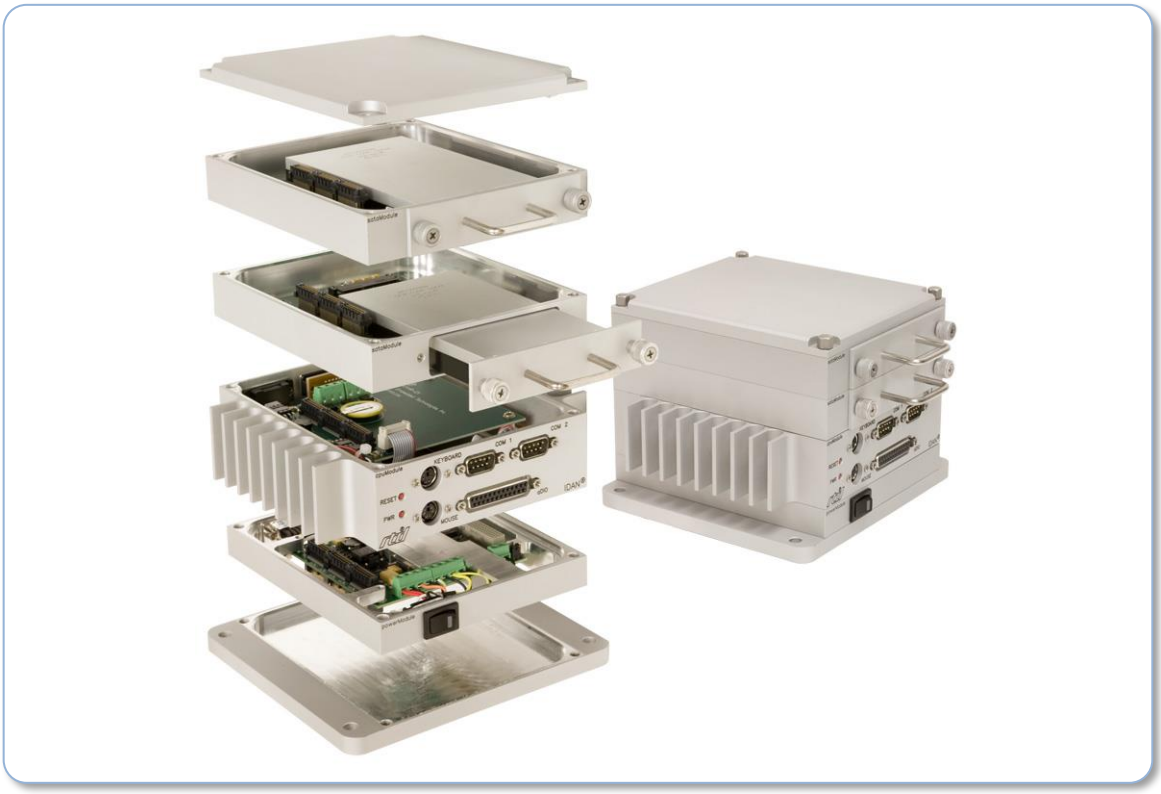

Figure 9: Example IDAN System

5 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.

6 Additional Information

6.1 PC/104 Specifications

A copy of the latest PCI/104-Express™ & PCIe/104™ Specification can be found on the webpage for the PC/104 Embedded Consortium:

www.pc104.org

6.2 PCI and PCI Express Specification

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

www.pcisig.com

PCI Express M.2 Specification

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

www.pcisig.com

7 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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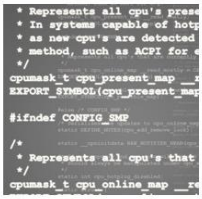

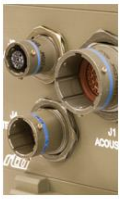
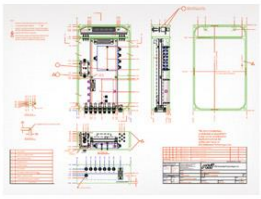

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