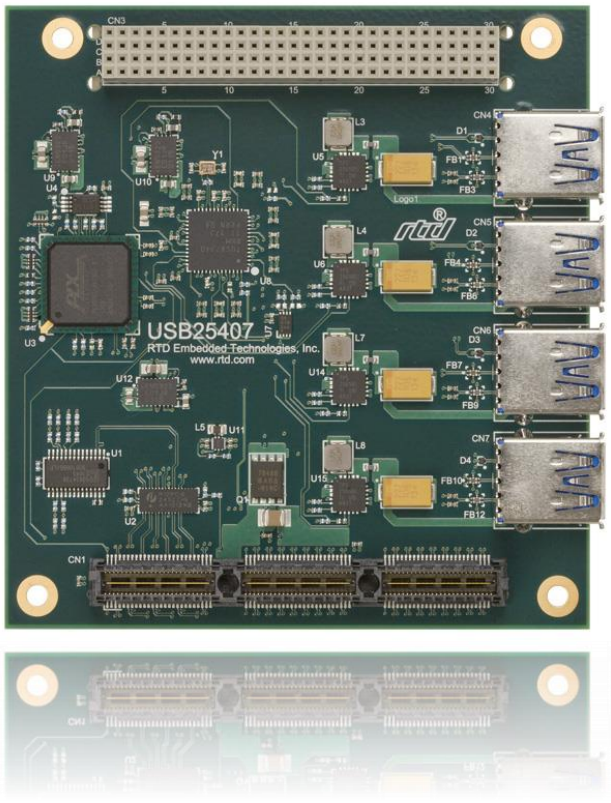
USB25407 and USB35407

PCI Express USB 3.0

User's Manual

BDM-610020101 Rev. C



RTD Embedded Technologies, Inc.
AS9100 and ISO 9001 Certified

RTD Embedded Technologies, Inc.
103 Innovation Boulevard
State College, PA 16803 USA
Telephone: 814-234-8087
Fax: 814-234-5218

www.rtd.com

sales@rtd.com
techsupport@rtd.com

Revision History

Rev A	Initial Release
Rev B	Updated trademark text
	Correct trademarks for IDAN, HiDAN, and HiDANplus throughout
	Section 1.3: Corrected IDAN ordering part numbers
	Section 3.2: Updated board dimensional drawing to include I/O connectors
	Section 3.4: Indicate that STEP models are available upon request
	Section 5.4: Corrected driver type to “USB” driver
Rev C	Section 2.2: Corrected I_{PORT} max current value
	Section 4.2: Updated IDAN Dimension Image
	Section 4.3: Inserted this section to include IDAN Front and Back Panel Images
	Sections 2.2: Added USB section to Electrical Characteristics table, includes bandwidth limitation

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1 Introduction

1.1 Product Overview

The USB25407/USB35407 is a four port USB 3.0 controller. This module provide the latest in high-speed connectivity with transfer rates up to 5 Gbps. Advanced connectivity opens the door to high resolution and high frame rates for USB cameras. It also allows USB hard drives to perform as well as SATA hard drives.

1.2 Board Features

The following sections describe the major features of the USB25407 USB 3.0 communication module.

- General Features
  - USB 3.0 xHCI compliant Host Controller
    - PCIe x1 Interface
    - Repopulates PCIe link
    - TI TUSB7340 Controller Chip
  - Four Downstream Ports
    - Type A connectors
    - Up to 900mA provided per port
  - Supports all USB 3.0 speeds
    - Super Speed (5 Gbit/s)
    - High Speed (480 Mbit/s)
    - Full Speed (12 Mbit/s)
    - Low Speed (1.5 Mbit/s)
  - Best-In-Class Adaptive Receive Equalizer Design
    - Maximizes cable length
- Software
  - Windows Drivers: XP (32-bit), Windows 7 (32- and 64-bit)
  - Linux Support in Kernel (2.6.37 or later)

1.3 Ordering Information

The USB25407 is available with the following options:

Table 1: Ordering Options

Part Number	Description
USB25407HR	PCI/104-Express USB 3.0 Module (with pass-through PCI)
USB35407HR	PCIe/104 USB 3.0 Module (without pass-through PCI)
IDAN-USB25407HRS	PCI/104-Express USB 3.0 Module in IDAN enclosure
IDAN-USB35407HRS	PCIe/104 USB 3.0 Module in IDAN enclosure

Throughout this document, USB25407 refers to both the USB25407 and USB35407 unless otherwise noted.

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.

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 2: 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

2.2 Electrical Characteristics

Table 3: Electrical Characteristics

Symbol	Parameter	Test Condition	Min	Max	Unit
P_d	Power Dissipation	V_{cc5} = 5.0V, I_{PORT} = 0A		3.0	W
I_{cc5}	5V Input Supply Current	Active, Board only		600	mA
V_{PORT}	Port voltage output		4.75	5.25	V
I_{PORT}	Current Limit per port		0.9	1.29	A
PCIe Bus					
	Differential Output Voltage		0.8	1.2	V
	DC Differential TX Impedance		95.2	116.9	Ω
	Differential Input Voltage		0.175	3.3	V
	DC Differential RX Impedance		92.7	115.8	Ω
	Electrical Idle Detect Threshold		61	173	mV
USB					
	USB 3.0 Maximum Bitrate	Combined		500[1]	MB/s

[1] Limited by the USB25407HR's upstream PCIe x1 connectors

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.

- Weight: Approximately 0.07 kg (0.16 lbs.)
- Dimensions: 90.17 mm L x 95.89 mm W (3.550 in L x 3.775 in W)

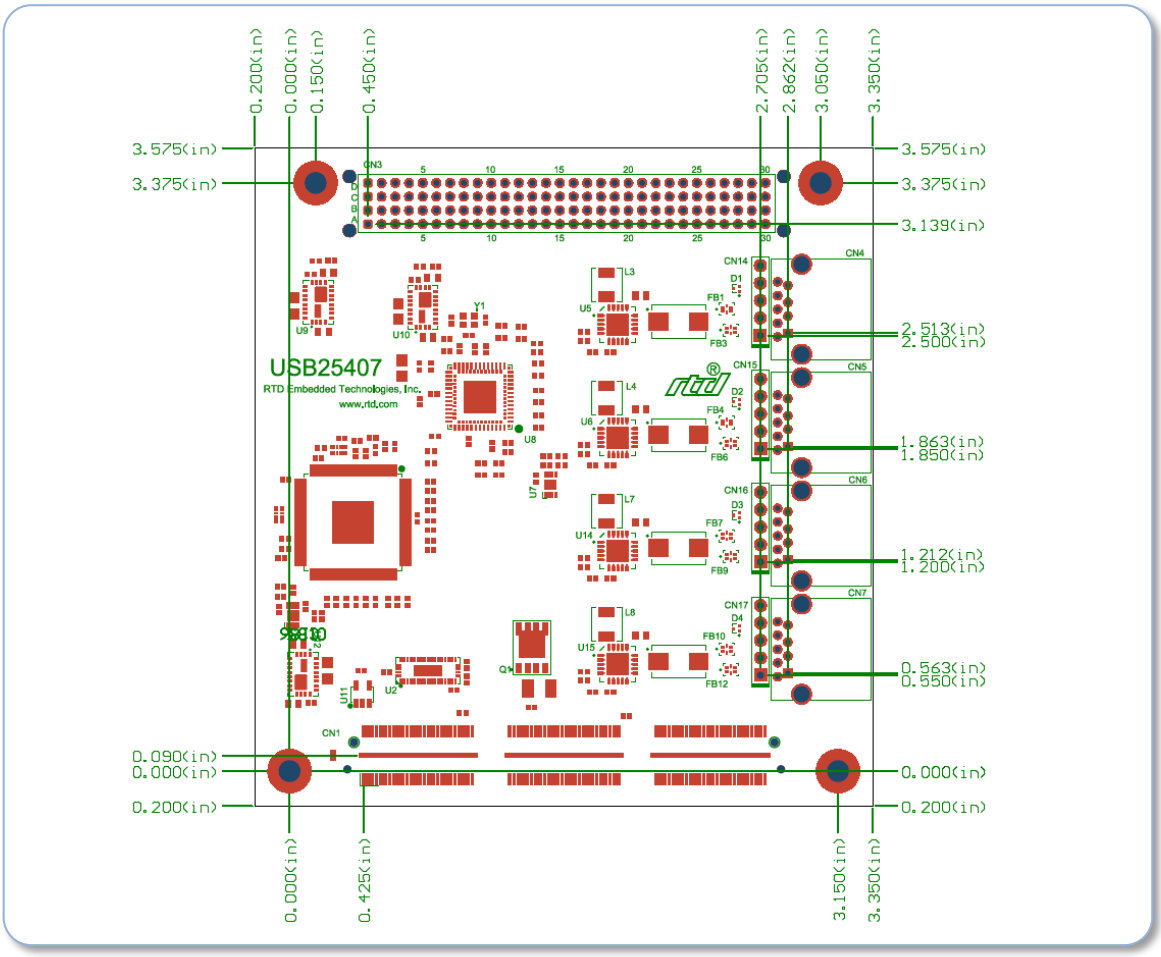


Figure 1: Board Dimensions

3.3 Connectors and Jumpers

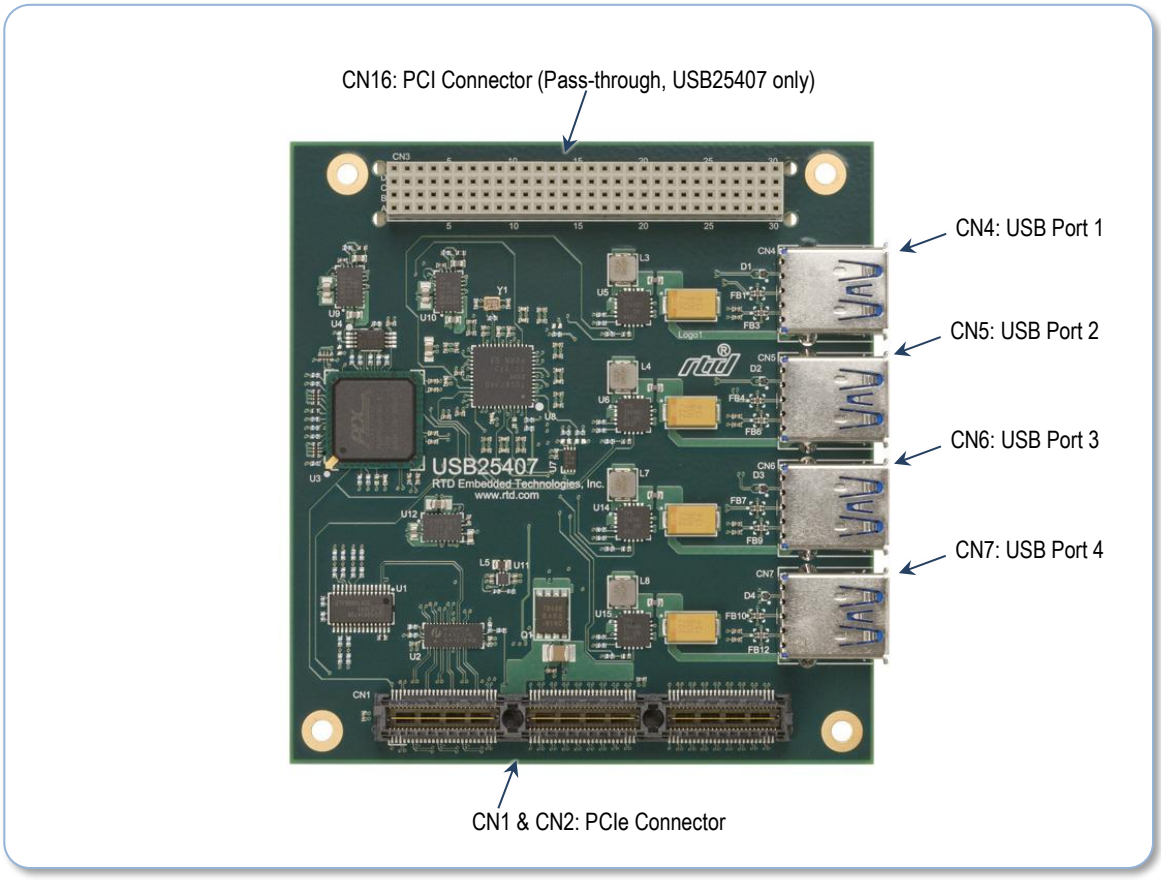


Figure 2: Board Connections

3.3.1 External I/O Connectors

CN4, CN5, CN6 and CN7: USB 3.0 Type A Connectors

CN4, CN5, CN6 and CN7 are USB 3.0 Type A connectors. They support connections at SuperSpeed, HighSpeed, FullSpeed, and LowSpeed. The Type A connector contains a total of three differential pairs, as well as power and ground. Two of the differential pairs are for SuperSpeed (TX and RX) and one is for the other speeds.

3.3.2 Bus Connectors

CN1 (Top) & CN2 (Bottom): PCIe Connector

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 18)

The USB25407 is a "Universal" board, and can connect to either a Type 1 or Type 2 PCIe/104 connector.

CN16: PCI Connector (USB25407 only)

The PCI connector is pass-through. The only electrical connections to the board are power and ground. The position and pin assignments are compliant with the *PCI/104-Express Specification*. (See PC/104 Specifications on page 18)

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.

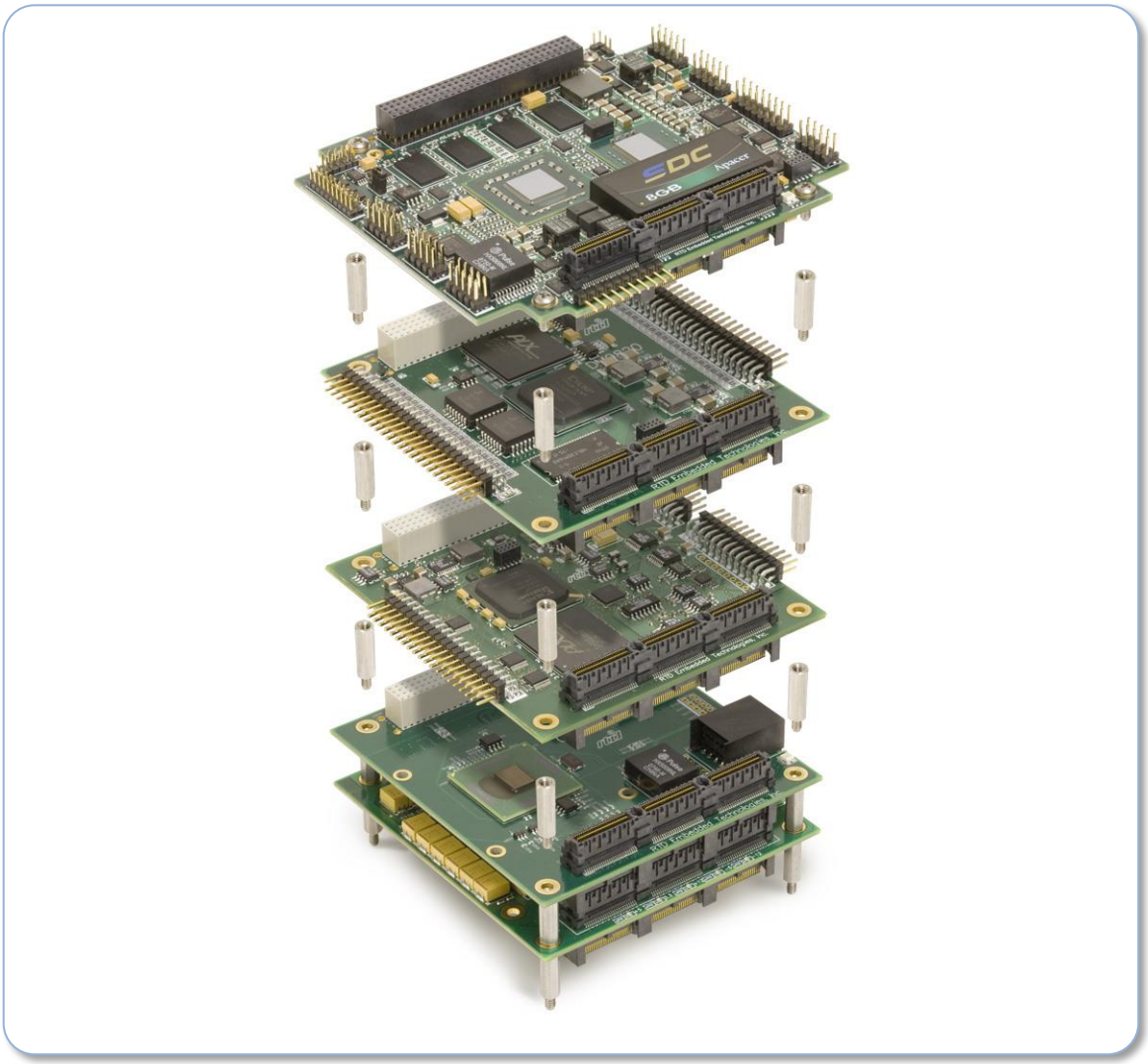


Figure 3: Example 104™ Stack

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 0.21 Kg (0.46 lbs.)
- Dimensions: 152.0 mm L x 130.0 mm W x 17.0 mm H (5.98 in L x 5.12 in W x 0.67 in H)

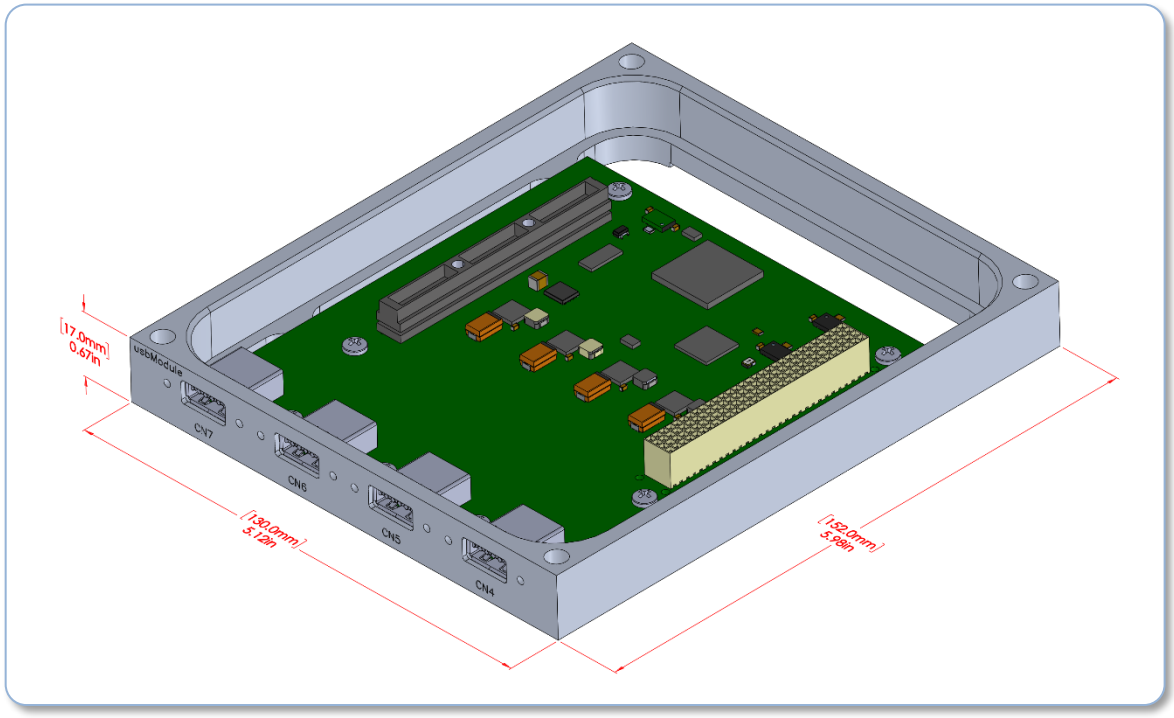


Figure 4: IDAN Dimensions

4.3 Connector Locations

The Diagrams below show the connector locations for the headers of the USB25407 as they are brought out on the front and back panels of the IDAN-USB25407. For a full description of each connector on the USB25407, refer to the External I/O Connectors section of this manual in section 4.4

The USB connectors on the IDAN front panel are compatible with USB3 Vision Standard-A locking connectors.

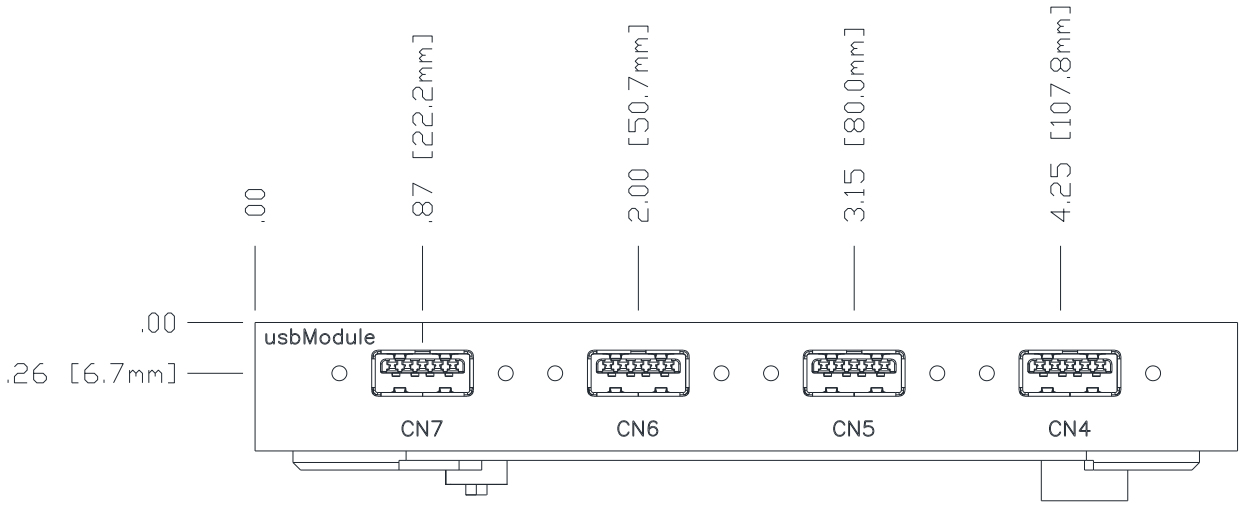


Figure 5: IDAN Front Panel Connectors

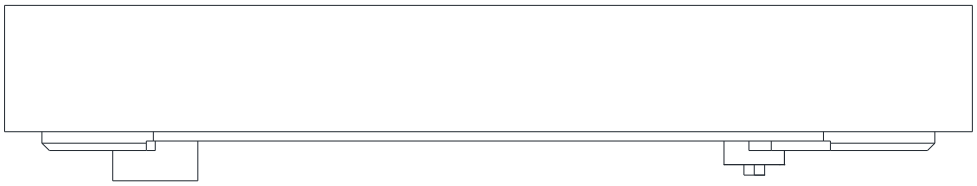


Figure 6: IDAN Back Panel View

4.4 Connectors

4.4.1 External I/O Connectors

CN4, CN5, CN6 and CN7: USB 3.0 Type A Connectors

CN4, CN5, CN6 and CN7 are USB 3.0 Type A connectors. They support connections at SuperSpeed, HighSpeed, FullSpeed, and LowSpeed. The Type A connector contains a total of three differential pairs, as well as power and ground. Two of the differential pairs are for SuperSpeed (TX and RX) and one is for the other speeds.

4.4.2 Bus Connectors

CN1 (Top) & CN2 (Bottom): PCIe Connector

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 18)

The USB25407 is a "Universal" board, and can connect to either a Type 1 or Type 2 PCIe/104 connector.

CN16: PCI Connector (USB25407 only)

The PCI connector is pass-through. The only electrical connections to the board are power and ground. The position and pin assignments are compliant with the *PCI/104-Express Specification*. (See PC/104 Specifications on page 18)

4.5 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.

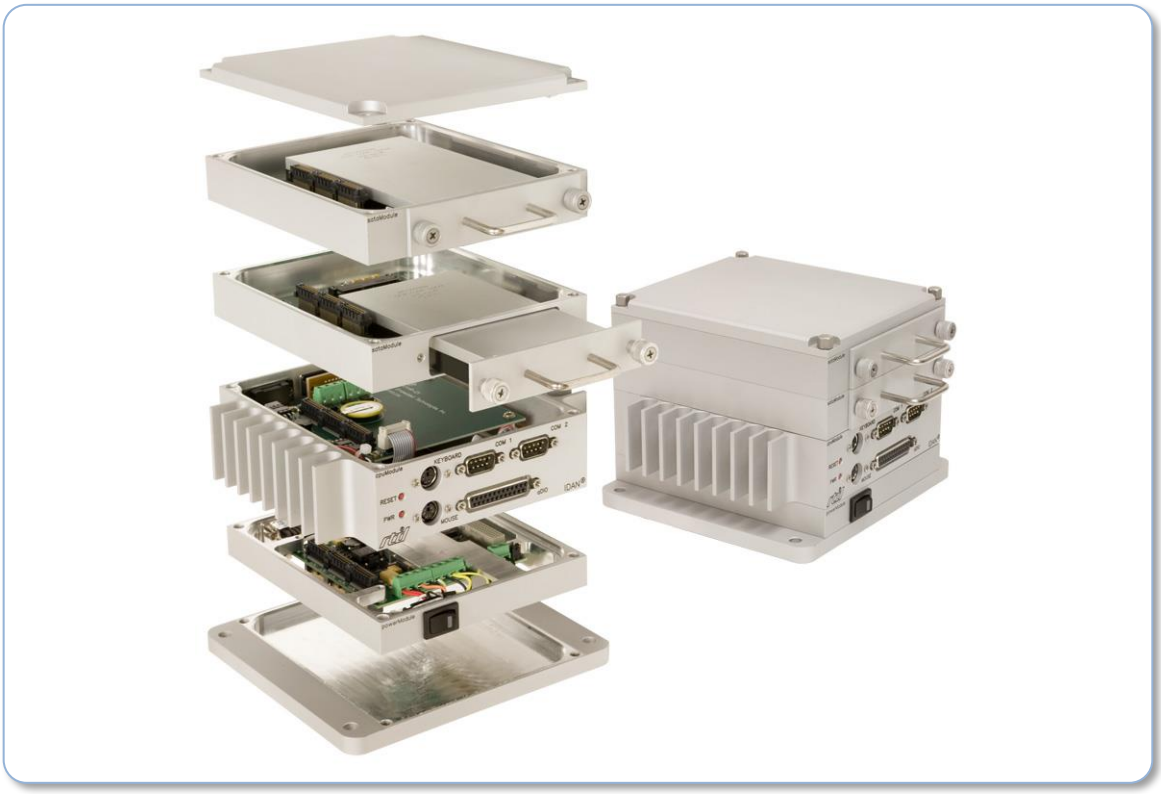


Figure 7: Example IDAN System

5 Functional Description

5.1 Block Diagram

The Figure below shows the functional block diagram of the USB25407. The various parts of the block diagram are discussed in the following sections.

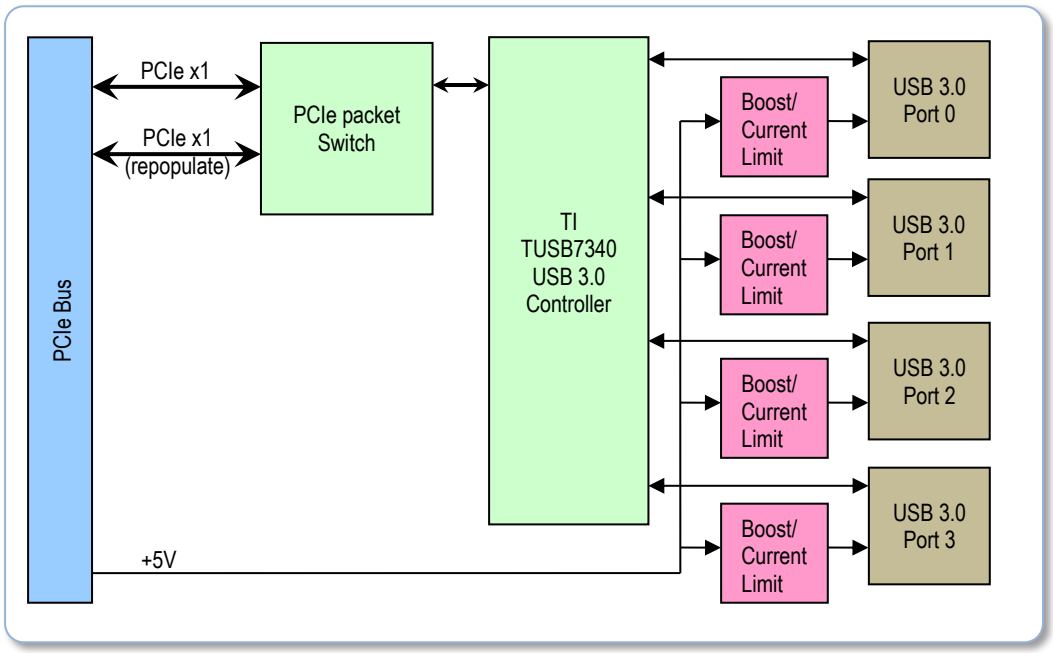


Figure 8: USB25407 Block Diagram

5.2 Current Limited Boost Converter

The USB25407 has four over-current protected boost converters, one for each connector. These serve two functions. The first function is to limit the current output of the port to 900mA. The second function is to ensure that the output voltage at the connector meets the USB requirement of 5V ± 10%, regardless of the input voltage. Even when the board is at its minimum input voltage of 4.75V, the output voltage at the USB connector will be 5V typical.

5.3 PCI Express Repopulation

The USB25407 provides a PCI Express packet switch to repopulate the lane that it uses. The uplink for the switch is attached to the host through the PCIe/104 bus. One of the downlinks is attached to the USB 3.0 controller. The other downlink is fed back to the PCIe/104 bus, and provides connectivity to the fourth card in the stack from the USB25407. This allows the PCIe/104 system to grow beyond the four PCIe x1 links that can be provided by the host. If all of the peripherals in the system provide repopulation, a very large number of peripherals can be used.

5.4 Driver Support

For Windows XP and Windows 7, the USB25407 is supported by an USB driver provided by Texas Instruments. A copy of this driver is provided on the companion CD that is shipped with the board, and may also be downloaded from the RTD web site (www.rtd.com) or the TI web site (www.ti.com). It is recommended that you frequently check the RTD web site for updated documentation and drivers.

Linux support is available in Kernel version 2.6.37 or later. Early Linux support for USB 3.0 has been shown to have issues with USB 3.0 Hubs, therefore we recommend using Kernel version 3.1.0 or later.

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 Embedded Consortium:

www.pc104.org

7.2 PCI Express Specification

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

www.pcisig.com

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.

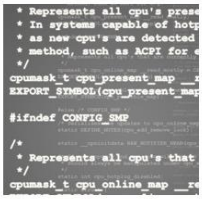
Some states do not allow the exclusion or limitation of incidental or consequential damages for consumer products, and some states do not allow limitations on how long an implied warranty lasts, so the above limitations or exclusions may not apply to you.

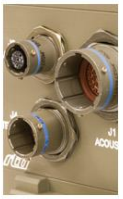
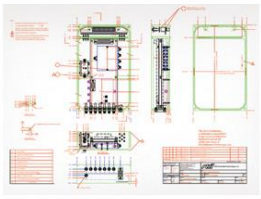
This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

RTD Embedded Technologies, Inc.
103 Innovation Boulevard
State College, PA 16803 USA
Telephone: 814-234-8087
Fax: 814-234-5218

www.rtd.com

sales@rtd.com
techsupport@rtd.com



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