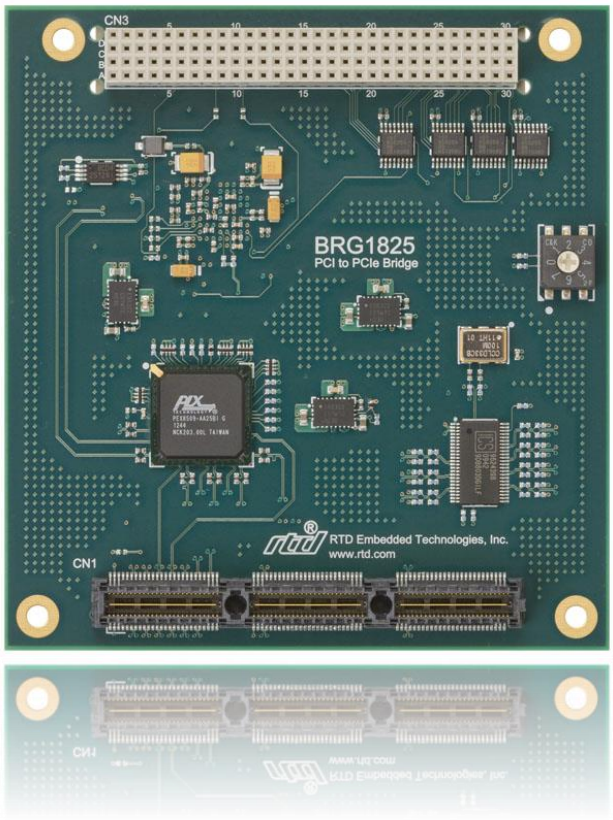
BRG1825HR

PCI Express to PCI Bridge

User's Manual

BDM-610020113 Rev. A



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

Advanced Analog I/O, Advanced Digital I/O, aAIO, aDIO, a2DIO, Autonomous SmartCal, "Catch the Express", cpuModule, dspFramework, dspModule, expressMate, ExpressPlatform, HiDANplus, "MIL Value for COTS prices", multiPort, PlatformBus, and PC/104EZ are trademarks, and "Accessing the Analog World", dataModule, IDAN, HiDAN, RTD, and the RTD logo are registered trademarks of RTD Embedded Technologies, Inc (formerly Real Time Devices, Inc.). PS/2 is a trademark of International Business Machines Inc. PCI, PCI Express, and PCIe are trademarks of PCI-SIG. PC/104, PC/104-Plus, PCI-104, PCIe/104, PCI/104-Express and 104 are trademarks of the PC/104 Embedded Consortium. All other trademarks appearing in this document are the property of their respective owners.

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1 Introduction

1.1 Product Overview

The BRG1825 is designed to provide a PCI to PCI Express (PCIe) Bridge. It allows for the expansion of existing PCI based systems with the latest PCI Express devices, such as high-speed analog I/O, USB 3.0, and video controllers. Up to six PCIe/104 modules may be added from a single PCI-104 slot position without requiring any modifications to software. It is compatible with all PCI cpuModules.

1.2 Board Features

- PCI Upstream Interface to CPU
- PCI Express (PCIe) Downstream Interface to Peripheral Cards
- Power rails (+5V, +3.3V, +12V) connected between the PCIe and PCI bus
- PCI Bus:
    - 32-bit, 33 MHz PCI Bus
    - PCI Target Controller allows PCI access to PCI Express Target Devices
    - PCI Master Controller allows full transparent access to PCI resources
    - Message Signaled Interrupt (MSI) support
    - Legacy Interrupt support
    - 5V or 3.3V signal level
- PCI Express Bus:
    - Provides four x1 links
    - Provides a single lane to each of the two x4 links or x16 link
    - Provides 2.5 Gbps in each direction
    - Single lane and single Virtual Channel operation
        - Compatible with multi-Virtual Channel chipsets
    - Packetized serial traffic with PCI Express Split Completion protocol
    - Data Link Layer Cyclic Redundancy Check (CRC) generator and checker
    - Automatic Retry of bad packets
    - In-band interrupts and messages
    - Message Signaled Interrupt (MSI) support
    - Supports peer-to-peer transactions
    - Total throughput to the CPU is limited by the PCI bus bandwidth

1.3 Ordering Information

The BRG1825 is available with the following options:

Table 1: Ordering Options

Part Number	Description
BRG1825AHR	PCI to PCIe Bridge for **Above** the CPU
BRG1825BHR	PCI to PCIe Bridge for **Below** the CPU
IDAN-BRG1825AHRS	PCI to PCIe Bridge for **Above** the CPU in IDAN enclosure
IDAN-BRG1825BHRS	PCI to PCIe Bridge for **Below** the CPU in IDAN enclosure

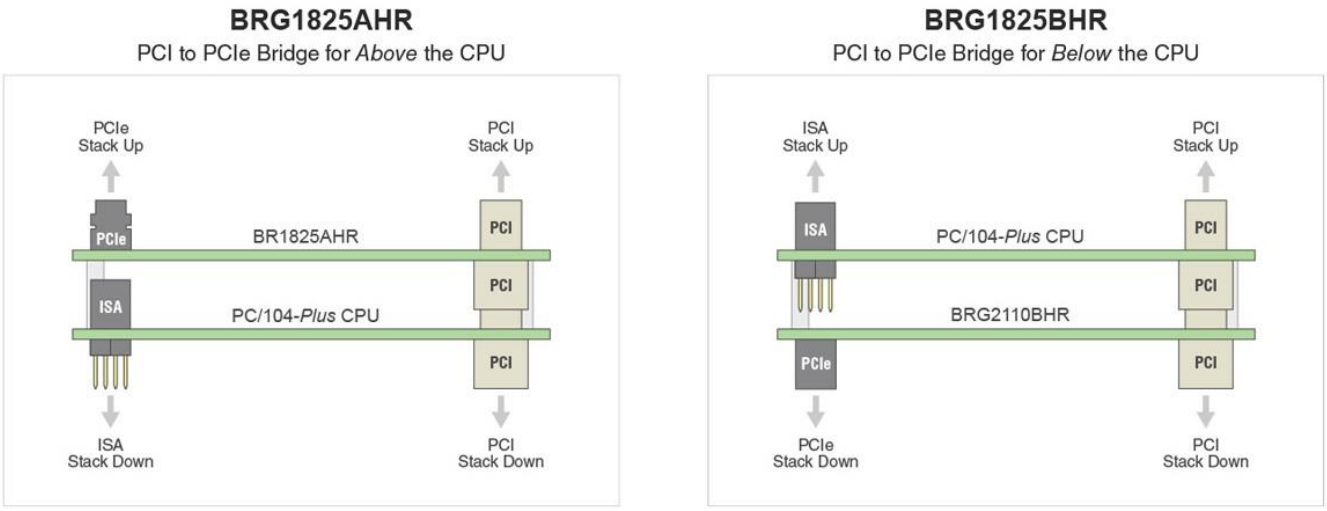


Figure 1: BRG1825 Ordering Options

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 you 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	23C, Ground Benign		TBD	Hours

2.2 Electrical Characteristics

Table 3: Electrical Characteristics

Symbol	Parameter	Test Condition	Min	Max	Unit
P	Power Consumption	V_{cc5} = 5.0V		2.25	W
I_{cc5}	5V Input Supply Current	Active		450	mA
I_{BUS5}	5V Current between buses			8.0	A
$I_{BUS3.3}$	3.3V Current between buses			3.0	A
I_{BUS12}	12V Current between buses			1.0	A
PCI Bus					
$V_{IH3.3}$	PCI 3.3V Input High Voltage		1.65	3.3	V
$V_{IL3.3}$	PCI 3.3V Input Low Voltage		0	0.7	V
V_{IH5}	PCI 5V Input High Voltage		2.0	5.5	V
V_{IL5}	PCI 5V Input Low Voltage		0	0.8	V
I_{IL}	PCI Input Leakage	0<V_I<VIO	-10	10	uA
I_{OZ}	PCI Hi-Z Leakage	0<V_I<VIO		10	uA
$V_{OH3.3}$	PCI 3.3V Output High Voltage		2.97		V
$V_{OL3.3}$	PCI 3.3V Output Low Voltage			0.33	V
V_{OH5}	PCI 5V Output High Voltage		2.4		V
V_{OL5}	PCI 5V Output Low Voltage			0.4	V
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

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

- Weight: Approximately 60 g (0.14 lbs.)
- Dimensions: 90.17 mm L x 95.89 mm W (3.550 in L x 3.775 in W)

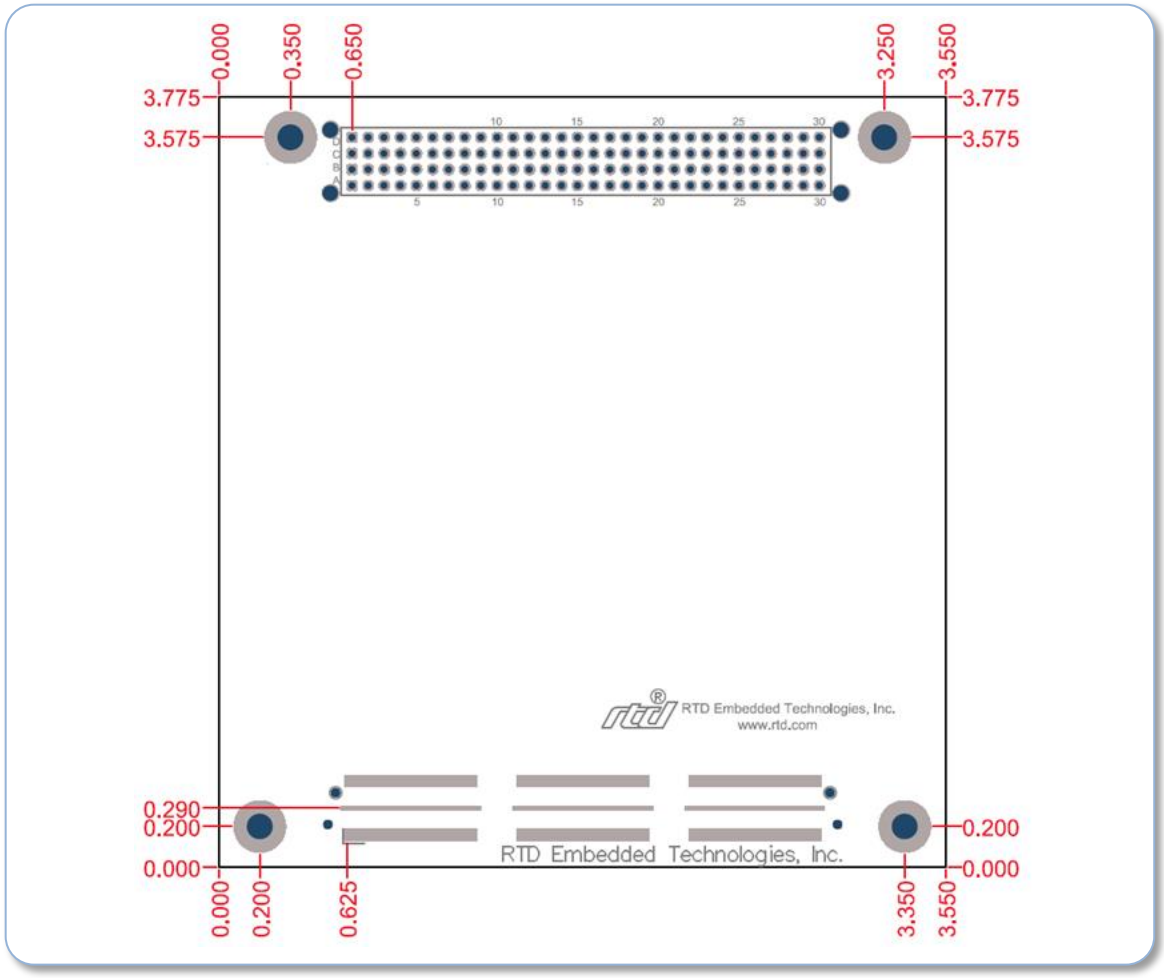


Figure 2: Board Dimensions

3.3 Connectors and Jumpers

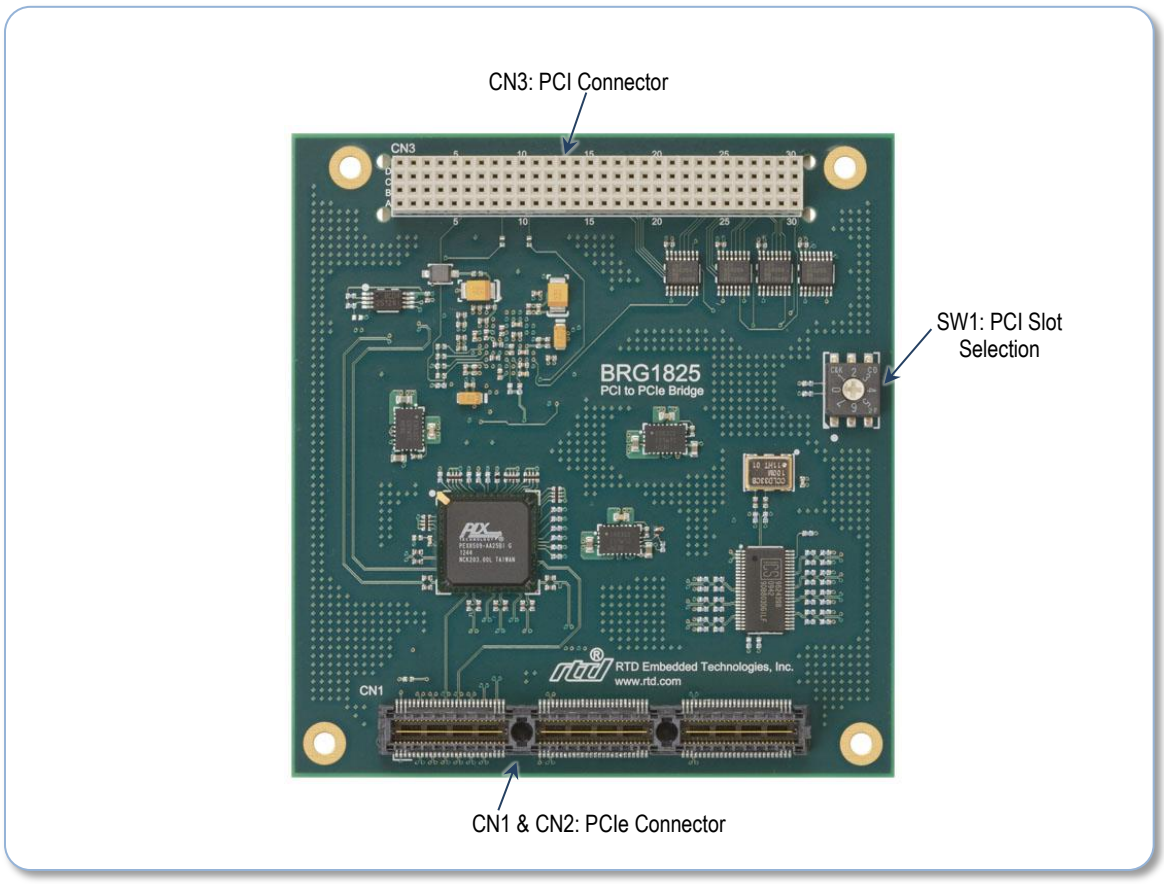


Figure 3: Board Connections

3.3.1 External I/O Connectors

There are no external I/O connectors on the BRG1825.

3.3.2 Bus Connectors

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

The PCIe connector is the connection to peripheral modules. The position and pin assignments are compliant with the *PCI/104-Express Specification*. (See PC/104 Specifications on page 19)

CN3: PCI Connector

The PCI 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 19)

3.3.3 BOARD CONFIGURATION

Switch SW1: PCI Slot Selection

To install the BRG1825 into the stack, the PCI Slot Number must be configured correctly. This is done by the PCI Slot Selector located at SW1.

There are four possible PCI Slot Numbers (0 – 3). Each PCI device (PC/104-*Plus* or PCI-104) must a use a different slot number. The slot number is related to the position of the board in the stack. Slot 0 represents the PCI device closest to the CPU. Slot 3 represents the PCI devices farthest away from the CPU.

Switch Position	PCI Slot Number
0	Slot 0 (closest to CPU)
1	Slot 1
2	Slot 2
3	Slot 3

NOTE: In a PC/104-Plus or PCI-104 system, all PCI devices should be located on one side of the CPU board (above or below the add-on cards). The CPU should not be located between two PCI devices.

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.

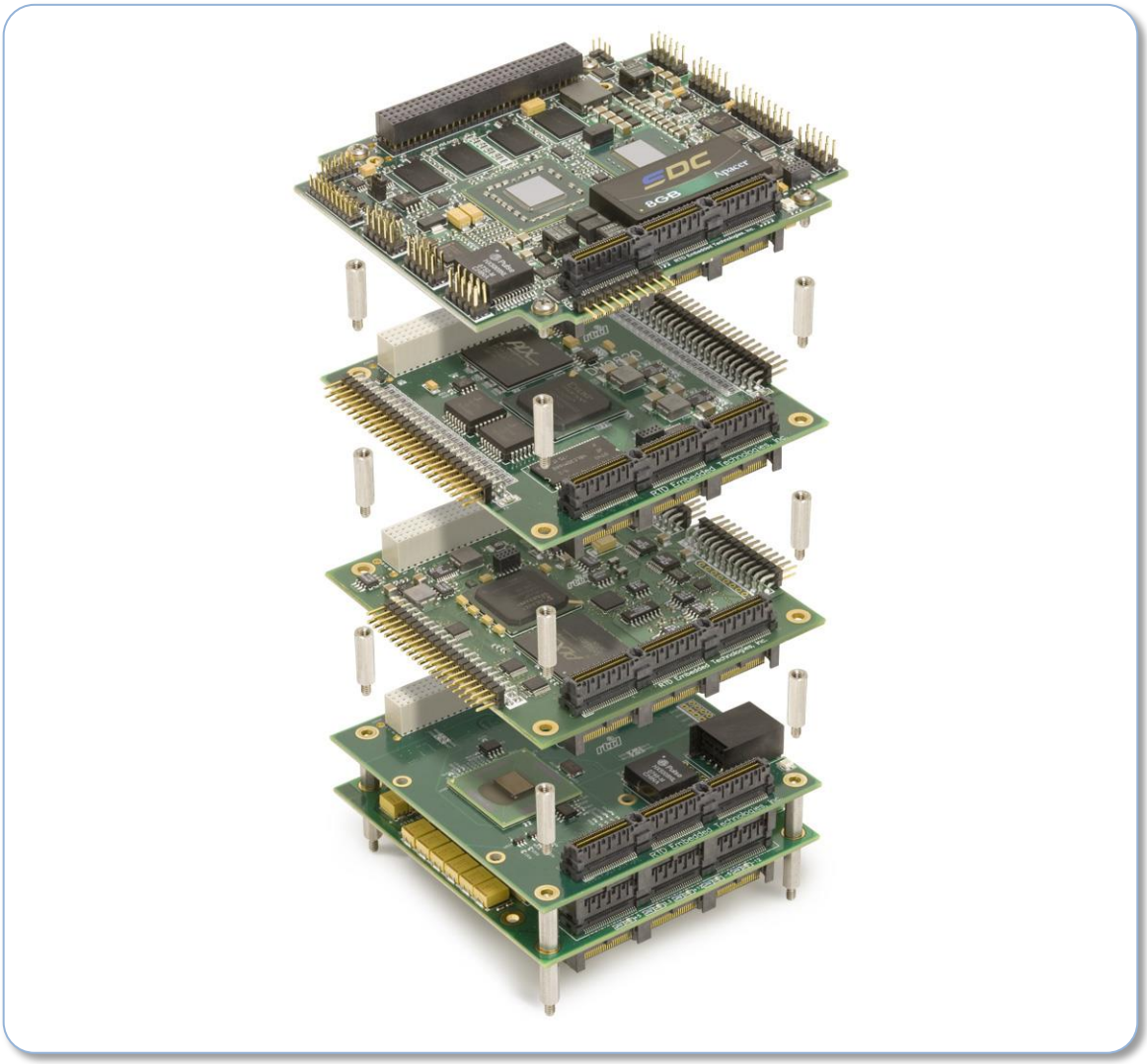


Figure 4: Example 104™ Stack

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: 151.972 mm L x 129.978 mm W x 16.993 mm H (5.983 in L x 5.117 in W x 0.669 in H)

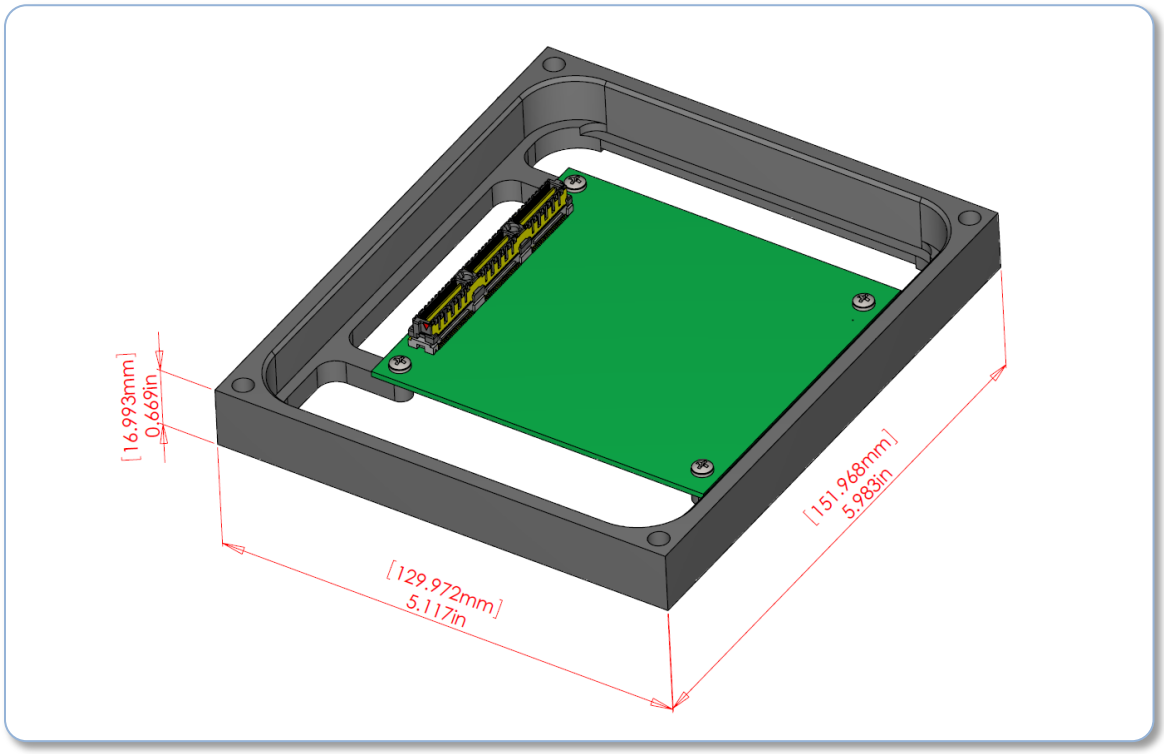


Figure 5: IDAN Dimensions

4.3 Connectors

4.3.1 External I/O Connectors

There are no external I/O connectors on the BRG1825

4.3.2 Bus Connectors

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

The PCIe connector is the connection to peripheral modules. The position and pin assignments are compliant with the *PCI/104-Express Specification*. (See PC/104 Specifications on page 19)

CN3: PCI Connector

The PCI 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 19)

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.

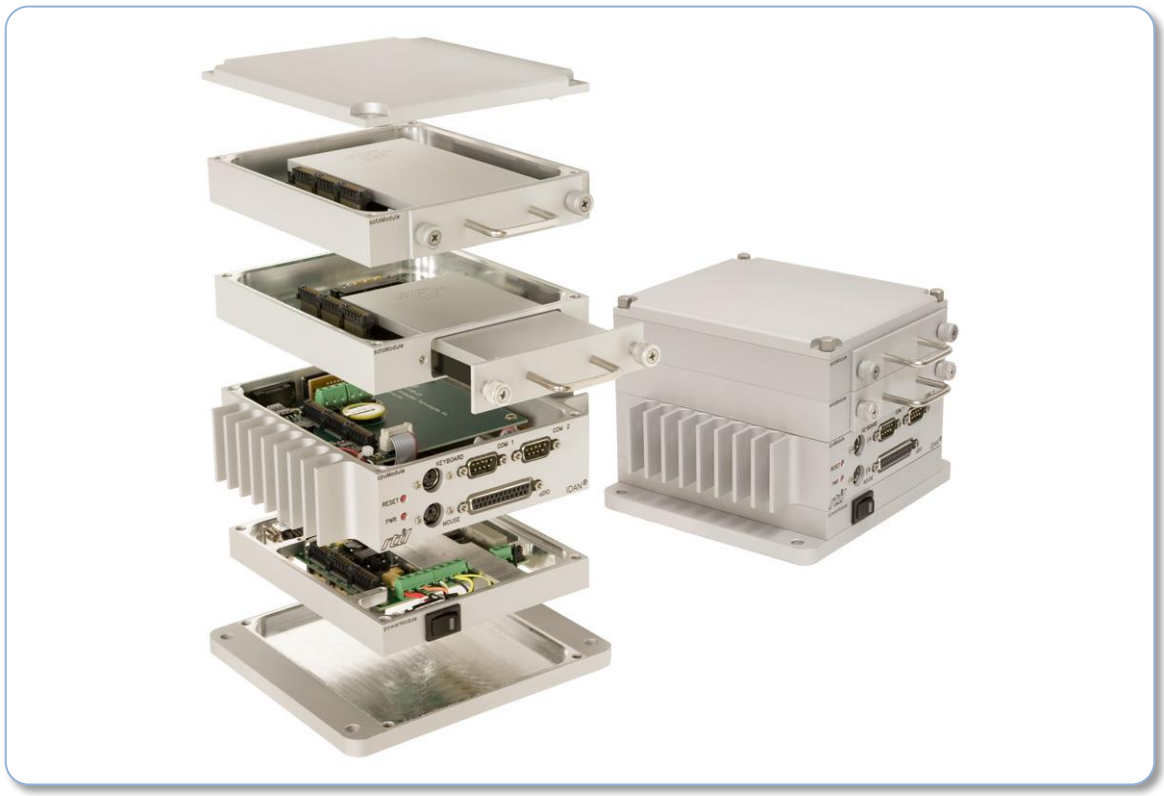


Figure 6: Example IDAN System

5 Functional Description

5.1 Block Diagram

The Figure below shows the functional block diagram of the BRG1825. The various parts of the block diagram are discussed in the following sections.

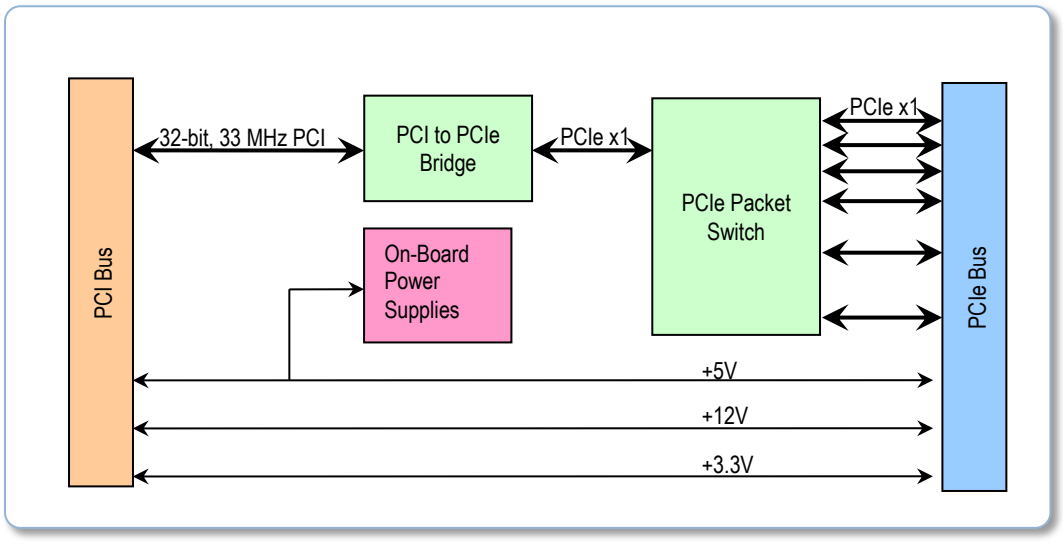


Figure 7: BRG1825 Block Diagram

5.2 PCI to PCIe Bridge

The PCI to PCI Express Bridge allows newer PCI Express devices to be used with legacy PCI chipsets. It utilizes a 33 MHz, 32-bit PCI bus to communicate with the host, and a single PCIe x1 link to communicate with the PCIe Packet Switch. It appears in the system as a standard PCI to PCI Bridge, and therefore requires no software changes to operate.

5.2.1 PCI Bus Masters

The BRG1825 supports bus mastering on all four positions on the PCI bus segment. The bus masters can access targets on the CPU, as well as other targets on that segment of the PCI bus.

5.2.2 Wake from PCI Devices

A device on the PCIe bus of the BRG1825 is not capable of waking the system from standby.

5.3 PCIe Packet Switch

The PCIe Packet Switch provides six downstream PCIe x1 links to the PCIe bus connector, using the single PCIe x1 link to the PCI to PCIe Bridge as the upstream interface. It appears in the system as a group of standard PCI to PCI Bridge, and therefore requires no software changes to operate. The switch allows four PCIe/104 x1 peripheral modules, as well as two x4 or a x16 peripheral module, to be attached to the system. Additional cards may be added if the peripheral modules provide lane repopulation.

NOTE: The total bandwidth to the CPU is limited by the bandwidth of the PCI bus.

5.3.1 PEER-TO-PEER

The PCI architecture allows transactions directly between peripheral cards under some conditions. These are called peer-to-peer transactions. An example of this is a TV tuner board writing video data directly to a video board, or a data acquisition board directly writing data to a DSP board. The BRG1825 allows peer-to-peer transactions between any of the downstream PCIe peripheral cards, as well as between a PCIe peripheral card and a card on the upstream PCI bus.

5.4 Power

The main power rails (+5V, +3.3V, and +12V) are connected between the PCIe and PCI bus. The ATX control signals are also connected between the two busses. Therefore, the system power supply may be located on either the PCIe or PCI side of the BRG1825. Regardless of where the power supply is located in the system, the amount of current that can be supplied across the bridge is shown in Table 3: Electrical Characteristics on page 9.

The BRG1825 only requires +5V to operate.

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 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

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.

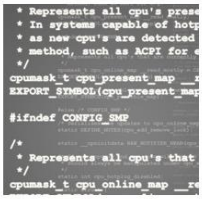
Some states do not allow the exclusion or limitation of incidental or consequential damages for consumer products, and some states do not allow limitations on how long an implied warranty lasts, so the above limitations or exclusions may not apply to you.

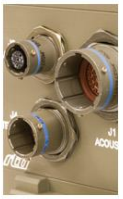
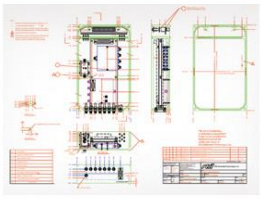
This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

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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