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December 22, 2016

Two Stacked PXIeTM Cards in 1U

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Abstract

PXI™/PXIe™ is an open-standards based platform that is popular for high-end test and measurement. One issue is combining enterprise-class computing with PXIe test and measurement cards in a compact 1U enclosure. This article discloses a means to install four single-width, 3U PXIe cards in a 1U, rack-mountable enclosure.

Description

PXIe™ is a popular platform for test and measurement systems. PXI and PXIe is an open industry standard as defined by the PXI Hardware Specification[1]. The first release of this standard was in 1997 and today there are 66 members of the consortium[2]. PXIe is based on the CompactPCI® specifications, or as stated on the cover of the PXI Hardware Specification, "*an implementation of Compact PCI*"[3].

A typical PXI or PXIe system has one compute module and one or more test and measurement I/O cards. For most PXI implementations, the cards used are 3U tall, therefore the cards are 160 mm long, 100 mm tall and the faceplate is 128.7 mm long. All cards will have a front panel, with characteristics as defined by both the CompactPCI specifications as well as the IEEE 1101.1 specifications[4]. This sets the single-slot width at 20.32 mm wide. PXI and PXIe cards come in single (20.32 mm wide), double (40.64 mm), triple (60.96 mm) and quad width (81.28 mm) form-factors.

The PXI and PXIe specification was written with the intent that systems that accept these cards would be designed similar to CompactPCI systems, holding the cards in the system with the faceplate long edge in the vertical position. ***Figure 1*** shows a typical PXI system that accepts 3U tall cards. This creates systems that require a minimum of 4U (7") in height for a system that accepts the 3U tall PXI or PXIe cards. This limits flexibility for customers who do not need several cards and desire a more compact solution that can also fit in a standard 19" wide rack.

**Figure 1. PXI system with 3U tall PXI cards installed.**

The proposed solution holds from one to four server-grade compute cartridges and also accepts up to four PXIe cards and fits within 1U of Rackspace in a standard 19" rack. The faceplates for the PXIe cards are located on the rear of the chassis. This solution features two PXIe cards stacked on top of each other, with two of these stacks next to each other, thus achieving four PXIe cards in 1 U of rack vertical height. **Figure 2** shows the rear view of a 1U system that accepts four PXIe cards.


Figure 2. - 1U System with Four PXIe Cards, Chassis End View

Mechanical Challenges

The faceplate width dimensions of a PXI/PXIe card, 20.32mm (0.80") are right at the limits for placing two cards, with the long faceplate dimension, in the horizontal position. The real problem is that the system connector for PXI/PXIe cards impinges on the space of the next card. While this is not a problem for a traditional PXI/PXIe system, when attempting to place two cards in the horizontal position and fit this in a 1U chassis design, this extra space requirement results in a solution that is too tall to fit within the constraints for a 1U rack-mount solution. See
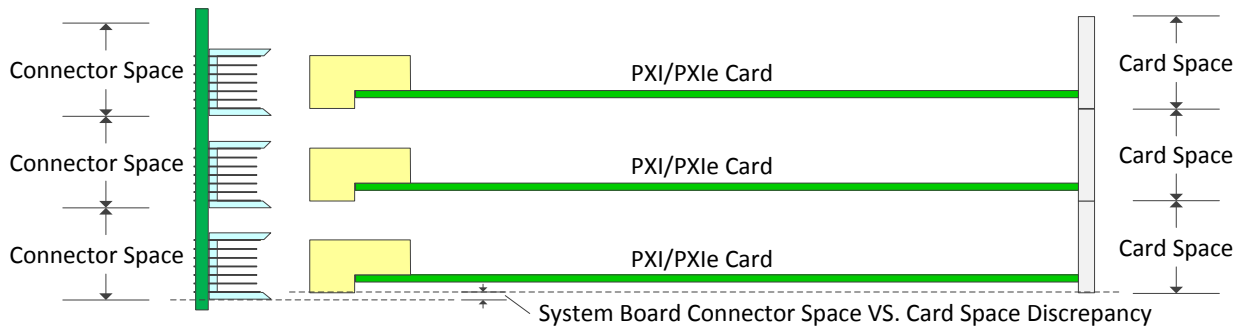
Figure 3 for the dimensions of a PXI/PXIe card and the corresponding system board connector space requirements. Note that while the space per slot connector is the same as the space per card faceplate, the two are skewed .052" from each other.
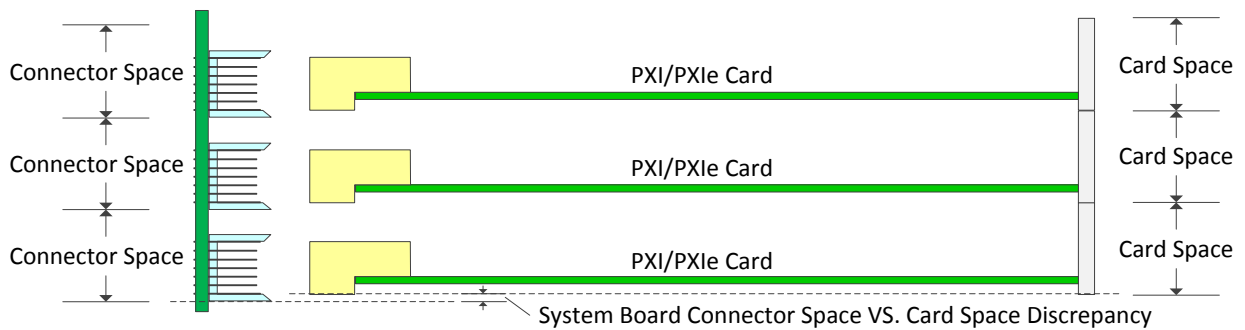
Figure 3. – PXI/PXIe Card Side View Dimensions Showing Connector Impingement

To overcome this non-alignment issue between the system board connector space area and the card space area, our solution moves the connectors in the system so that the card space and connector space areas are in alignment. Then, the PXI/PXIe cards are installed in the system at an angle of 0.45 degrees. This results in a compact package that requires 1.600" of space for the solution, and this can be packaged in a solution that will fit within 1U (1.75") of rack space. **Figure 4** shows the solution.
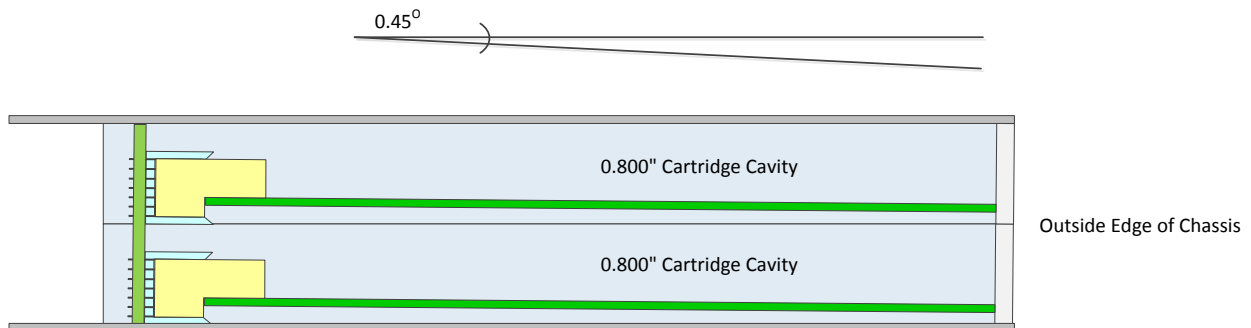

Figure 4. – PXI/PXIe Cards Angled to Fit Within a 1U Solution.

Cooling Considerations

Another concern is cooling. PXIe cards are designed for chassis that provide cooling air from the bottom of the card, with the air flow up across the card, parallel to the faceplate, exiting on the top edge. Placing the cards in a 1U, 19" chassis that features rack-front air entry and rack-rear air exhaust requires some consideration to cooling. For this solution, the cooling air pressurizes the space between the two card stacks, and then flows across the PXIe cards.

To maintain the correct airflow direction (in at the bottom edge of the card), the cards are installed with their bottom edge towards the center of the chassis. This results in the stack on the left side (as viewed from the rear of the chassis) being installed with the component side of the PCB up, while the PXIe cards installed on the right side of the chassis are installed with the component side of the PCB down. Once the air exits the PXIe cards, it enters a plenum area where it is directed out the rear of the chassis. See *Figure 5* for an illustration of the airflow and major component placement within the chassis.
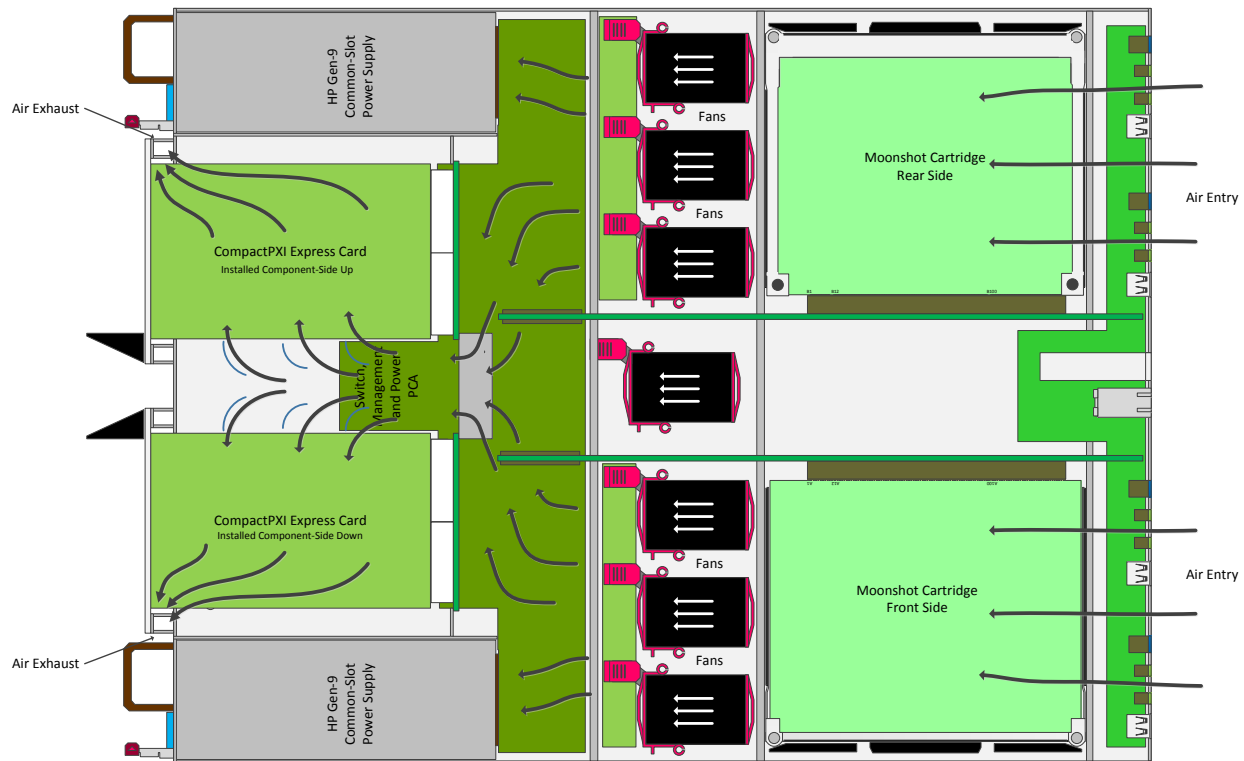
Figure 5. Cooling airflow in the 1U four-slot PXIe system

Summary

It is possible to create a high-performance server-grade compute solution that accepts up to four PXIe cards and up to four server-grade compute cartridges that also fits in 1U of vertical

rack space. Furthermore, this solution is only 24" deep, thus maximizing test and measurement capabilities while minimizing total rack space utilized.

References

1. PXI Systems Alliance, PO Box 1016, Niwot, CO 80544-1016, www.pxisa.org
    a. PXI, PXIe are registered trademarks of PXI Systems Alliance
2. Number of members as listed on the PXISA.org website, members roster, www.PXISA.org/Members/Roster.aspx
3. PICMG® PCI Industrial Computers, 401 Edgewater Place, STE 600, Wakefield, MA 01880, www.PICMG.org
    a. CompactPCI and the PICMG logo are registered trademarks of PCI Industrial Computers Consortium.
4. '1101-1-1998 – IEEE Standard for Mechanical Core Specifications for Microcomputers Using IEC 60603-2 Connectors', IEEE Standards Association, 445 Hoes Lane, Piscataway, NJ 08854-4141, www.ieee.org
5. Chassis image from National Instruments. 11500 Mopac Expressway, Austin, TX 78759, www.NI.com

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