



OPEN

Compute Project

MGX 1.2 Accelerated Computing Rack and Trays Design Specification

Revision 1.2.0

Design Specification
Effective October 6, 2026

Author: John Norton

Author: Robert Ober

Version History

Date	Version #	Author	Description
08 JUN 26	1.1.5	John Norton	Initial Draft
01 JUL 26	1.1.6	Robert Ober	Updated Template and Details
08 SEPT 26	1.1.7	Robert Ober	Corrections, References, links and format, proper OCP terminology
14 SEPT 26	1.1.9	Robert Ober	Resolved open reference and materials issues
23 SEPT 26	1.2.0	Robert Ober	Final Feedback
06 OCT 26	1.2.0	Robert Ober	OCP Steering Committee Approval

Current Template Version:

OCP Modular Design Specification Template V1.6.0

Table of Contents

Version History	2
Current Template Version:	2
1. License	6
1.1. Open Web Foundation (OWF) CLA	6
2. Acknowledgements	7
3. Compliance with OCP Tenets	7
3.1. Openness	8
3.2. Efficiency	8
3.3. Impact	8
3.4. Scale	8
3.5. Sustainability	9
4. Description	9
4.1. Solution Architecture	10
4.2. Accompanying Design Specifications	12
4.3. Environmental / Regulatory Requirements	13
5. Physical Specification	13
5.1. Hybrid Cooled Compute and Switch Tray Mechanical Form Factor	13
5.2. Rack Form Factor	17
5.2.1. 19" EIA IT Gear Support and Front Cabling	17
5.2.2. Rear Rack Extender	18
5.2.3. Rack Manifold Mounting	20
5.2.4. Rack Stiffener Mounting	22
5.3. Slide Rail Interface	24
5.3.1. Standard Chassis Rail Interface	24
5.3.2. Blind Mate Slide Rail	24
5.4. MGX DC-SCM Module	25
5.5. Fanless Liquid Cooled Compute Tray	28
6. Power Bus Bar Requirements	33
6.1. Busbar Electrical Requirements	34
6.2. Busbar Grounding Requirements	35
6.2.1. Chassis to RTN Connection	35

6.2.2.	Ground Connection to Rack	36
6.3.	Busbar Mechanical Requirements	37
6.4.	Busbar Thermal Requirements	41
6.4.1.	Busbar Liquid Cooling Requirements	41
6.4.2.	Busbar Leak Containment and Detection	46
6.5.	Busbar Installation	46
6.6.	Busbar Testing	46
6.6.1.	Recommended Minimum Validation	46
6.6.2.	Rack Level System Integration Testing	47
6.6.3.	Manufacturing Testing	48
6.7.	Busbar Environmental Requirements	48
6.8.	Busbar Reliability Requirements	48
6.9.	Busbar Labeling Requirements	49
6.10.	Busbar Compliance Requirements	49
7.	Compute Tray Board and IO Form Factors	50
7.1	Board Form Factors	51
7.2	Micro MGX Outline	52
7.2.1.	Micro MGX Mounting Holes	53
7.2.2.	Micro MGX Keepout Zones	53
7.2.3.	Micro MGX Board Pan	58
7.3	MGX Board Outline	58
7.3.1.	MGX Board Outline	59
7.3.2.	MGX Board Mounting Holes	60
7.3.3.	MGX Board Keepout Zones	60
7.3.4.	MGX Board Pan	64
7.4	IO Bay Form Factor	64
7.4.1.	Bay Design and Location	66
7.4.2.	Type A Bay Module	68
7.4.3.	Type B Bay Module	70
7.4.4.	Type C Bay Module	71
7.4.5.	Type D Bay Module	74
7.4.6.	Type E Bay Module	76

7.4.7.	Bay Chassis Interface	77
7.4.8.	Fanless and Cable-less Bay Dimensions	80
8.	Interconnect and Liquid Cooling Interfaces	81
8.1	Universal Quick Disconnect Interface	81
8.1.1.	Blind Mate Float Mechanism Overview	81
8.1.2.	UQD Component Design Requirements	82
8.1.3.	Blind Mate Mechanism Mechanical Features	82
8.1.4.	Compute Tray Liquid Cooling Interface	84
8.2	Interconnect Cartridge Definition	85
8.2.1.	Interconnect Cartridge Drawings	85
8.2.2.	Interconnect Cartridge Loading and Support	88
8.2.3.	Key Bracket and Support 2D	90
9.	Rack and Tray Thermal Requirements	90
10.	Prescribed Materials	91
11.	References	92

1. License

THE UPDATED DEFAULT CONTRIBUTOR LICENSE AGREEMENT (CLA) IS [OWFa 0.9](#). PLEASE VERIFY THE CORRECT CLA/FSA IS USED AND EXECUTED FOR THIS CONTRIBUTION.

1.1. Open Web Foundation (OWF) CLA

Contributions to this Specification are made under the terms and conditions set forth in **Modified Open Web Foundation Agreement 0.9 (OWFa 0.9)**. (As of October 16, 2024) (“Contribution License”) by:

NVIDIA

Usage of this Specification is governed by the terms and conditions set forth in **Modified OWFa 0.9 Final Specification Agreement (FSA)** (As of October 16, 2024) (“**Specification License**”).

You can review the applicable Specification License(s) referenced above by the contributors to this Specification on the OCP website at <https://www.opencompute.org/contributions/templates-agreements>.

For actual executed copies of either agreement, please contact OCP directly.

Notes:

The above license does not apply to the Appendix or Appendices. The information in the Appendix or Appendices is for reference only and non-normative in nature.

NOTWITHSTANDING THE FOREGOING LICENSES, THIS SPECIFICATION IS PROVIDED BY OCP "AS IS" AND OCP EXPRESSLY DISCLAIMS ANY WARRANTIES (EXPRESS, IMPLIED, OR OTHERWISE), INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY, NON-INFRINGEMENT, FITNESS FOR A PARTICULAR PURPOSE, OR TITLE, RELATED TO THE SPECIFICATION. NOTICE IS HEREBY GIVEN, THAT OTHER RIGHTS NOT GRANTED AS SET FORTH ABOVE, INCLUDING WITHOUT LIMITATION, RIGHTS OF THIRD PARTIES WHO DID NOT EXECUTE THE ABOVE LICENSES, MAY BE IMPLICATED BY THE IMPLEMENTATION OF OR COMPLIANCE WITH THIS SPECIFICATION. OCP IS NOT RESPONSIBLE FOR IDENTIFYING RIGHTS FOR WHICH A LICENSE MAY BE REQUIRED IN ORDER TO IMPLEMENT THIS SPECIFICATION. THE ENTIRE RISK AS TO IMPLEMENTING OR OTHERWISE USING THE SPECIFICATION IS ASSUMED BY YOU. IN

NO EVENT WILL OCP BE LIABLE TO YOU FOR ANY MONETARY DAMAGES WITH RESPECT TO ANY CLAIMS RELATED TO, OR ARISING OUT OF YOUR USE OF THIS SPECIFICATION, INCLUDING BUT NOT LIMITED TO ANY LIABILITY FOR LOST PROFITS OR ANY CONSEQUENTIAL, INCIDENTAL, INDIRECT, SPECIAL OR PUNITIVE DAMAGES OF ANY CHARACTER FROM ANY CAUSES OF ACTION OF ANY KIND WITH RESPECT TO THIS SPECIFICATION, WHETHER BASED ON BREACH OF CONTRACT, TORT (INCLUDING NEGLIGENCE), OR OTHERWISE, AND EVEN IF OCP HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

2. Acknowledgements

The Contributors of this Specification would like to acknowledge the following companies for their feedback:

Aivres	Envicool	Microsoft	SUNON
Amphenol	FIT	Molex	Supernmicro
Asrock Rack	GIGABYTE	MotivAir	Taicheng
Astron	Google	Nidec	TE Connectivity
Asus	HPE	nVent	Vertiv
Auras	Ingrasys	Oracle	Western Digital
AVC	Interplex	Parker	Wistron
AWS	Inventec	Pegatron	Wiwynn
Behee	Jonhon	Quanta	
BizLink	Kingslide	Rafas	
Boyd	Kioxia	Readore	
CoolerMaster	LEAD WEALTH	Recochem	
CoolIT	Lenovo	Repon	
CPC	LiteOn	Rittal	
Danfoss	Lotes	Samsung	
Dell	Luxshare	Schneider Electric	
Delta	Meta	SK Hynix	
Eaton	Micron	Staubli	

3. Compliance with OCP Tenets

This contribution complies with the OCP Tenets of Openness, Efficiency, Impact, Scale, and Sustainability. The MGX Accelerated Computing Rack and Tray specification is built on top of existing OCP specifications to extend the utility of those specifications for

higher power and liquid cooled AI devices. This specification allows any third party to build racks and trays with common blind mate power and liquid cooling interfaces and mounting locations.

3.1. Openness

Third parties may build to this specification such that trays and racks are interoperable in power, cooling and latching interfaces. In addition, a volumetric and mounting locations are supported for tray to tray connectivity that may be implemented at the discretion of the implementer. Tray to tray connectivity electrical and mechanical specifics are not detailed in this specification given the myriad of options in the industry and silicon specific requirements of such interconnects. Implementers of this specification may deviate or build upon this specification as needed to meet product requirements.

3.2. Efficiency

This specification builds upon existing OCP contributions. These include:

- Open Rack V3 Base Specification
- Open Rack Busbar Specification
- Universal Quick Disconnect (UQD) Specification

In addition, this specification defines the first modular IO bay system for an OCP 1RU server which allows customization by end users with limited impact to existing infrastructure.

By leveraging and then building upon existing specifications, the MGX Accelerated Computing Rack and Tray Specification brings continuous improvement to the OCP community and allows leveraging of existing OpEx investments in datacenters and datacenter components.

3.3. Impact

Through establishing common infrastructure for an accelerated computing platform, this specification will streamline deployment of new hardware to enable new workloads. By leveraging this common infrastructure, users can reduce time-to-market and OpEx while increasing supply chain assurance and reducing technical risk. Known suppliers of relevant components are shared in this specification.

3.4. Scale

Accompanying and within this specification are the necessary documents (2D, 3D, design documentation) to kick off and scale production of the rack infrastructure

specified. All designs shown are available from a variety of sources and may be procured by the implementor as desired.

3.5. Sustainability

By integrating liquid cooling into the rack and tray architecture, this specification maximizes heat capture and enables the implementor to reach a more sustainable datacenter PUE compared to air cooling. In addition, by leveraging existing specifications, this specification eliminates waste and encourages reuse.

4. Description

This document defines a Hardware Design Specification for the MGX v1.2.0 Accelerated Computing Rack and Trays with enhanced specifications for power, cooling, service, and density, which is derived from, but not fully compatible with the MGX 1.1 OCP contribution. It also uses the pending MQD/MQDB OCP contribution. The following details are defined within this specification.

- Rack overview design documentation (2D and 3D)
 - Rack alignment and reinforcement components for multi-node connectors and blind mate liquid
 - 5000A Bus Bar design based on ORV3 bus bar
 - Adaption to support 19" EIA hardware
 - Mounting locations, brackets and UQDB components for blind mate liquid cooling manifolds
 - Blind Mate Slide Rails for compute and switch trays
 - Rack level thermal requirements
- Compute and Switch tray mechanical form factors
 - Multi-node connector zones
 - UQD location and float mechanism design
 - Locking ejector design
 - MGX IO bay design
 - MGX Compute board form factor
 - MGX DC-SCM Form Factor

The following components are outside the scope of this specification:

- Power shelves
- TOR and MGMT Switches
- CDUs
- IO and Power cabling design

4.1. Solution Architecture

This specification describes and documents a rack and tray infrastructure design that supports blind mate liquid cooling, intra-rack tray interconnectivity zones, liquid cooled bus bar power, configurable rack reinforcements, modular compute trays and switch trays. The goal of the design is to build on top of existing OCP specifications and increase utility by adding the features above. The rack, trays, and internal components specified here were derived from the MGX architecture to build a modular and reusable infrastructure for AI on top of existing standards. The following figures show additions to the ORV3 base rack progressively for clarity, each building on the figure before.

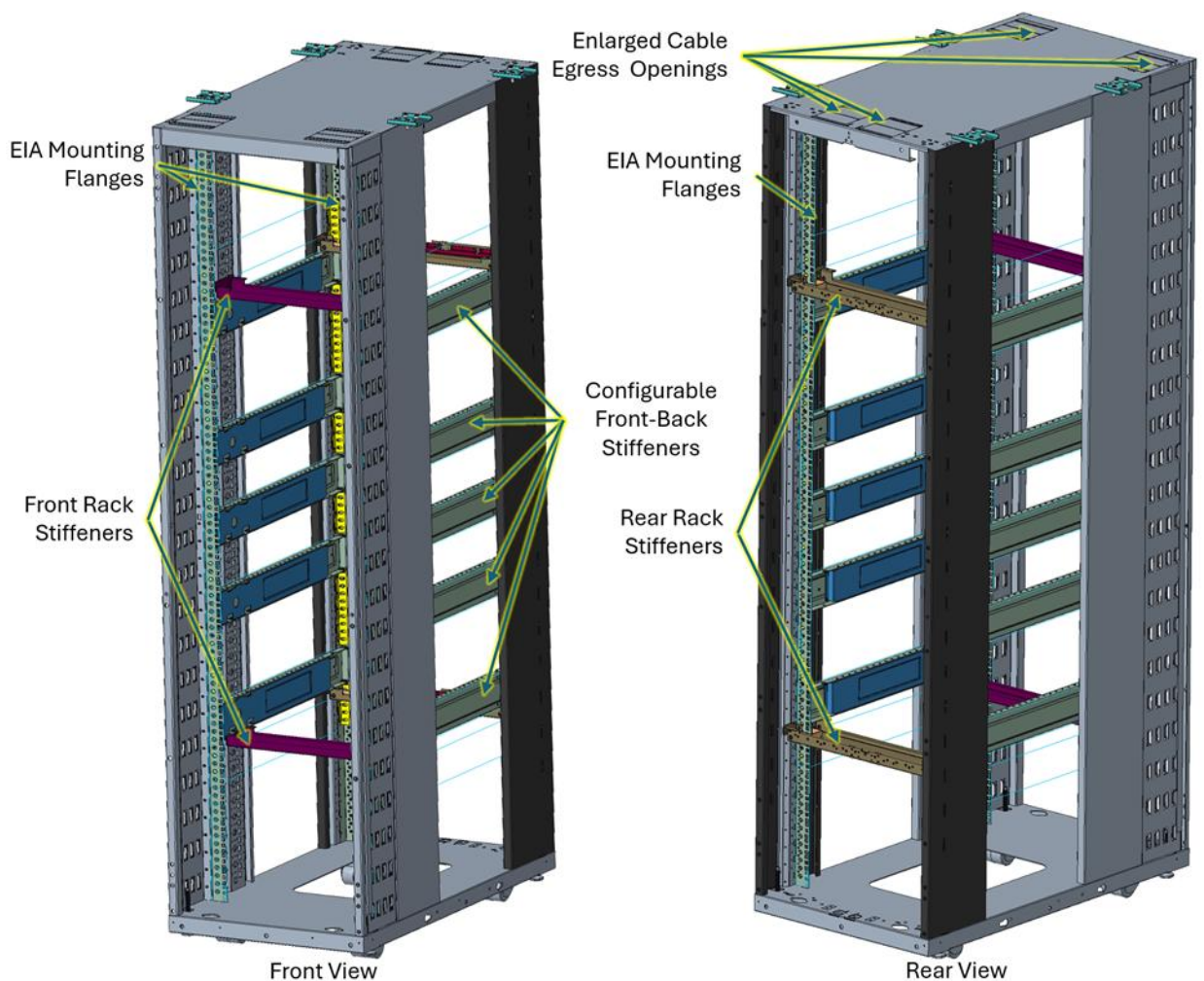


Figure 1: MGX Rack Overview 1 – Rack Extender, Blind Mate latching, and Manifold/Cartridge Supports

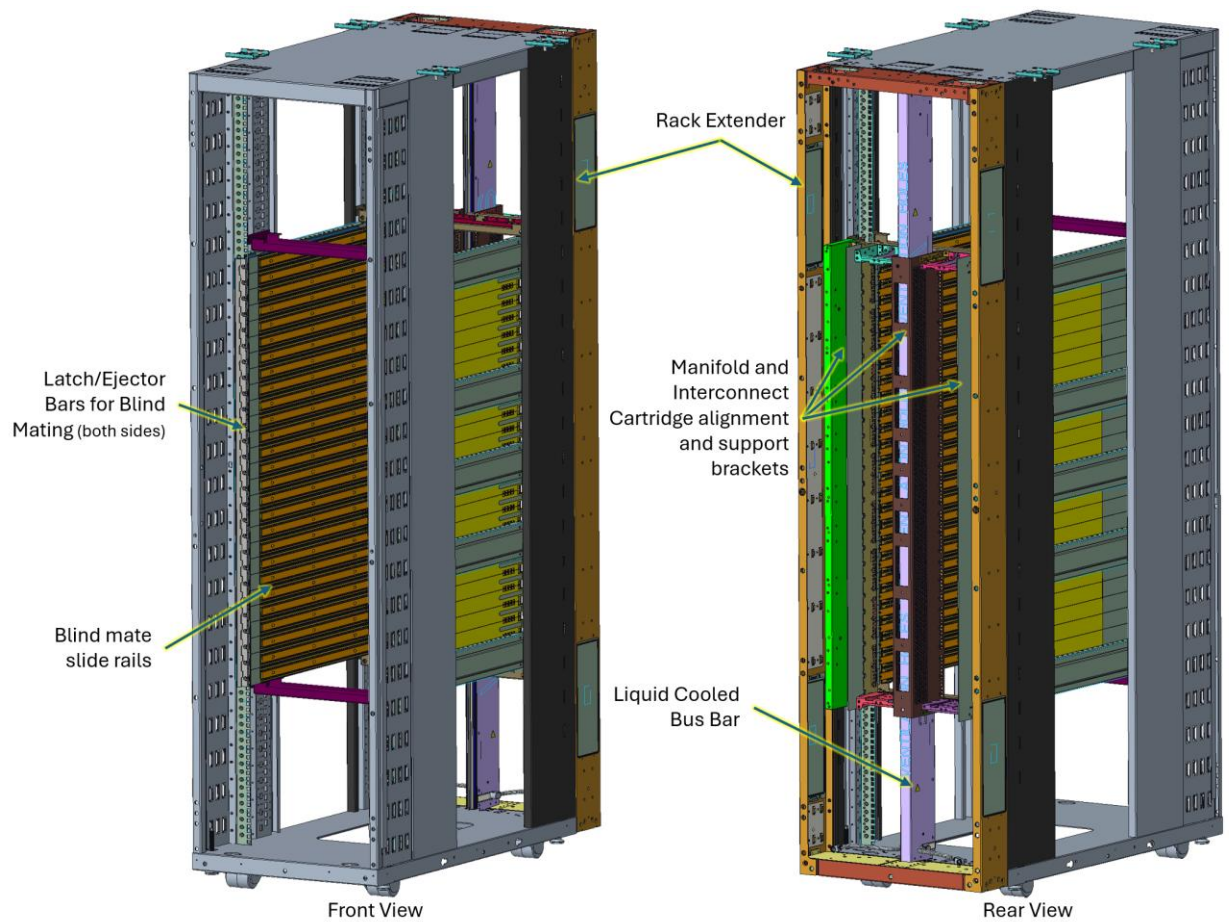


Figure 2: MGX Rack Overview 2 – Rack Extender, Blind Mate latching, and Manifold/Cartridge Supports

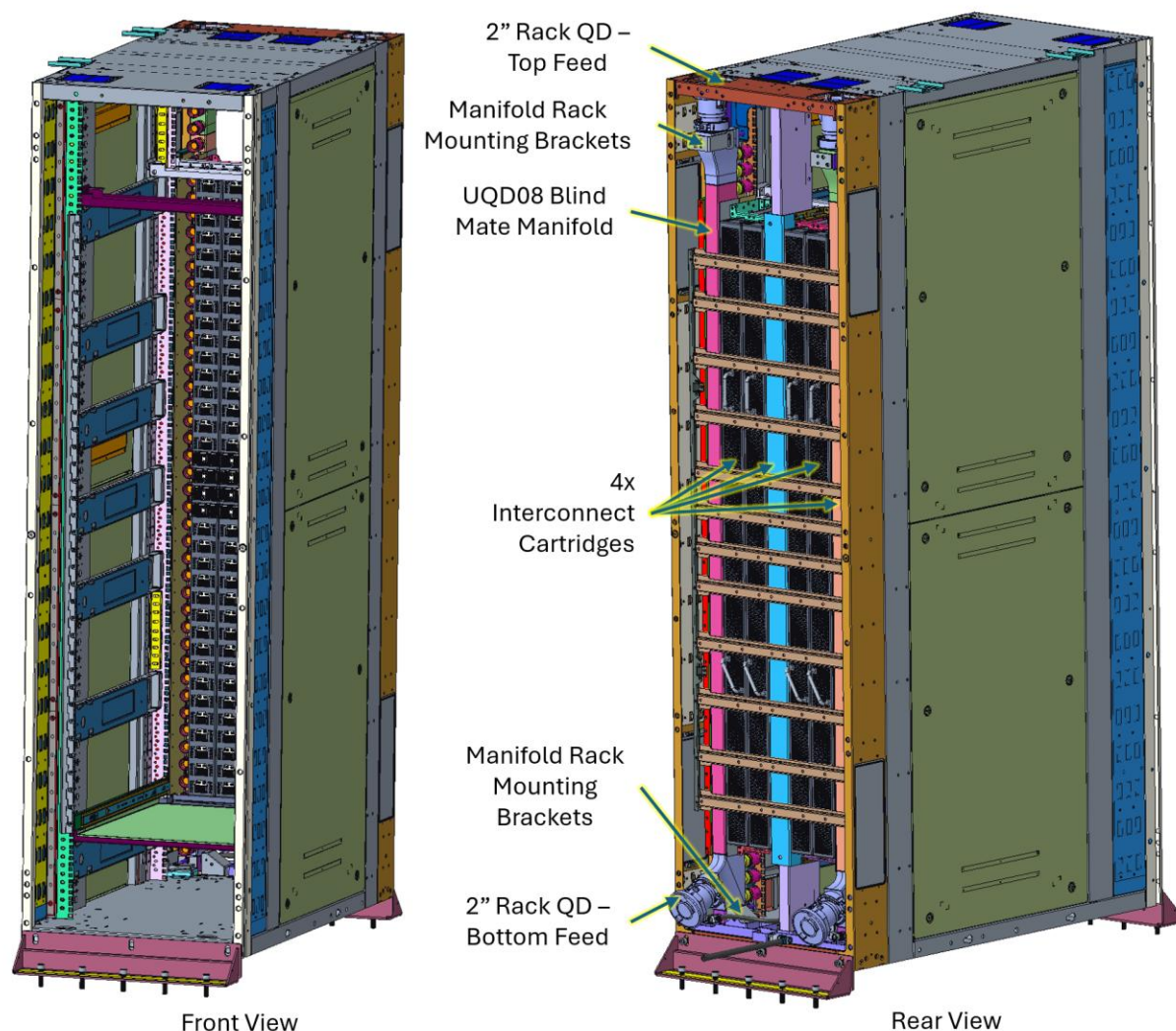


Figure 3: MGX Rack Overview 3 – Rack Extender, Blind Mate latching, and Manifold/Cartridge Supports

4.2. Accompanying Design Specifications

The following specifications are references throughout this document.

- Open Rack V3 Base Specification: [Link](#)
- Open Rack Busbar Specification: [Link](#)
- Universal Quick Disconnect (UQD) 2.0 Specification: [Link](#)
- OCP DC-SCM Module Specification: [Link](#)
- MGX Quick Disconnect (MQD) Specification: pending OCP contribution

4.3. Environmental / Regulatory Requirements

The rack and tray infrastructure is designed to support “rack and roll” deployment with the option to be charged with liquid. The following environmental ratings and shock and vibration testing are used to validate the L11 implementation:

- Packaged L11 Shock and Vibration requirements
 - 2 hours ISTA 3B vibration. 1-200 Hz, 0.54 G_{rms}. No top load.
 - 2 hours of air vibration per ASTM D4169-23 e1.
- Rotational Drop Test – ISFTA 3B Palletized/Skidded, 6 inch drop, Front and left flat side, 2 opposing corners, 4 drops total
- Incline Impact Test – 4 sides, 4.0 ft/s
- Packaged L11 Handling Requirements
 - Tip Test – 22° in all directions (Front, Back, Left, Right)
 - Fork Lift Handling – Refer to ISTA 3B for details

5. Physical Specification

This specification defines the rack design and tray form factors for Accelerated Computing systems and form factors for IO bays and boards. Datacenter layout, specific module and IO board designs are not included in this specification. Unless otherwise specified, tolerances in this document are shown below.

Table 1: Controlling Tolerances Unless Otherwise Specified

Dimension Type	Tolerance
Center of hole to center of hole	+/- 0.127 mm (+/- 0.005 inch)
Center of hole to edge	+/- 0.254 mm (+/- 0.010 inch)
Edge to edge	+/- 0.127 mm (+/- 0.005 inch)
Feature size	+/- 0.100 mm (+/- 0.004 inch)
PCB thickness	+/- 10% of nominal

5.1. Hybrid Cooled Compute and Switch Tray Mechanical Form Factor

This section details the mechanical form factor of the compute tray and switch tray. In this specification, a compute tray refers to a 1RU server chassis that contains some element of CPU and/or GPU. A switch tray refers to a 1RU server chassis that contains the necessary ASICs and interconnects to create a multi-node network of compute trays. Both the compute tray and switch tray leverage the MGX 1RU reference chassis specified below. Refer to 3D models provided for design details not shown here.

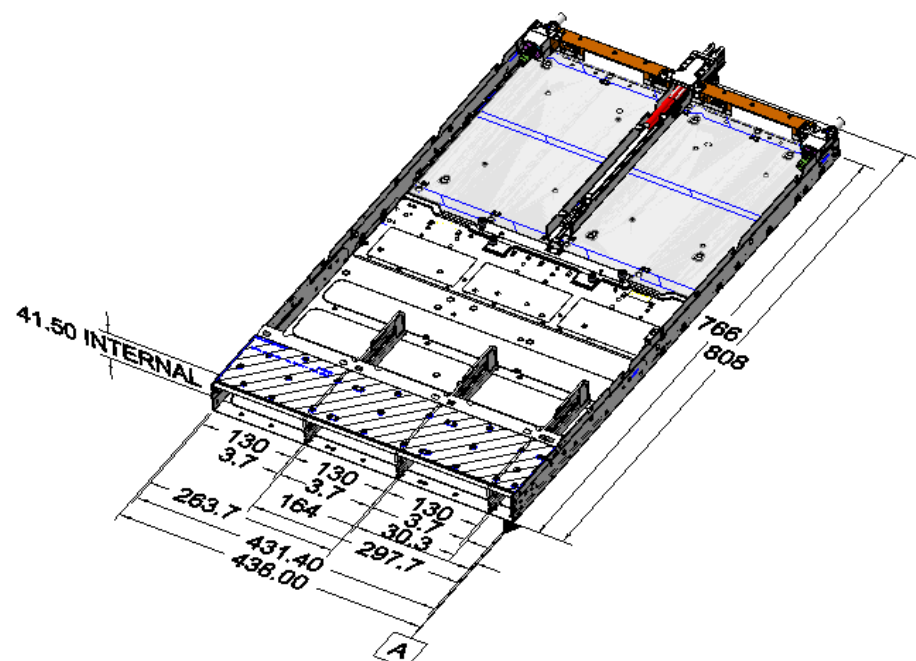


Figure 4: MGX 1RU Hybrid Cooled Common chassis dimensions

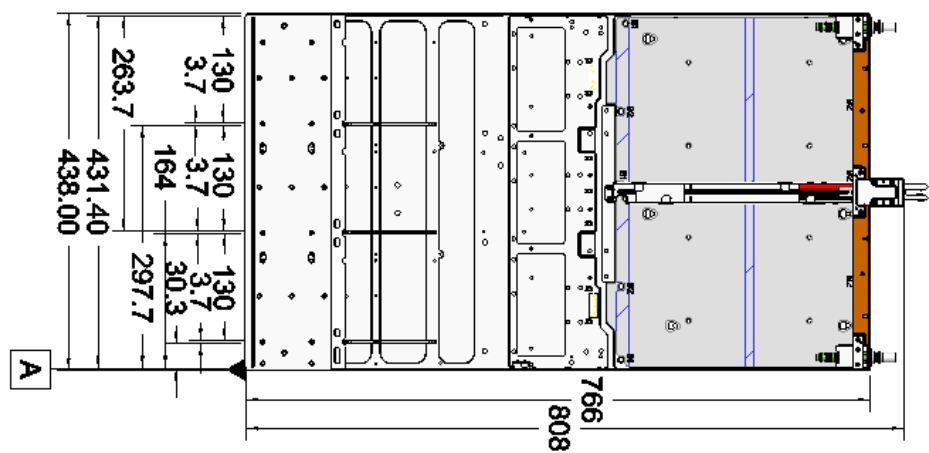


Figure 5: MGX 1RU Hybrid Cooled Common chassis dimensions – Top view

The figures below illustrate the compute tray design and key aspects of this specification.

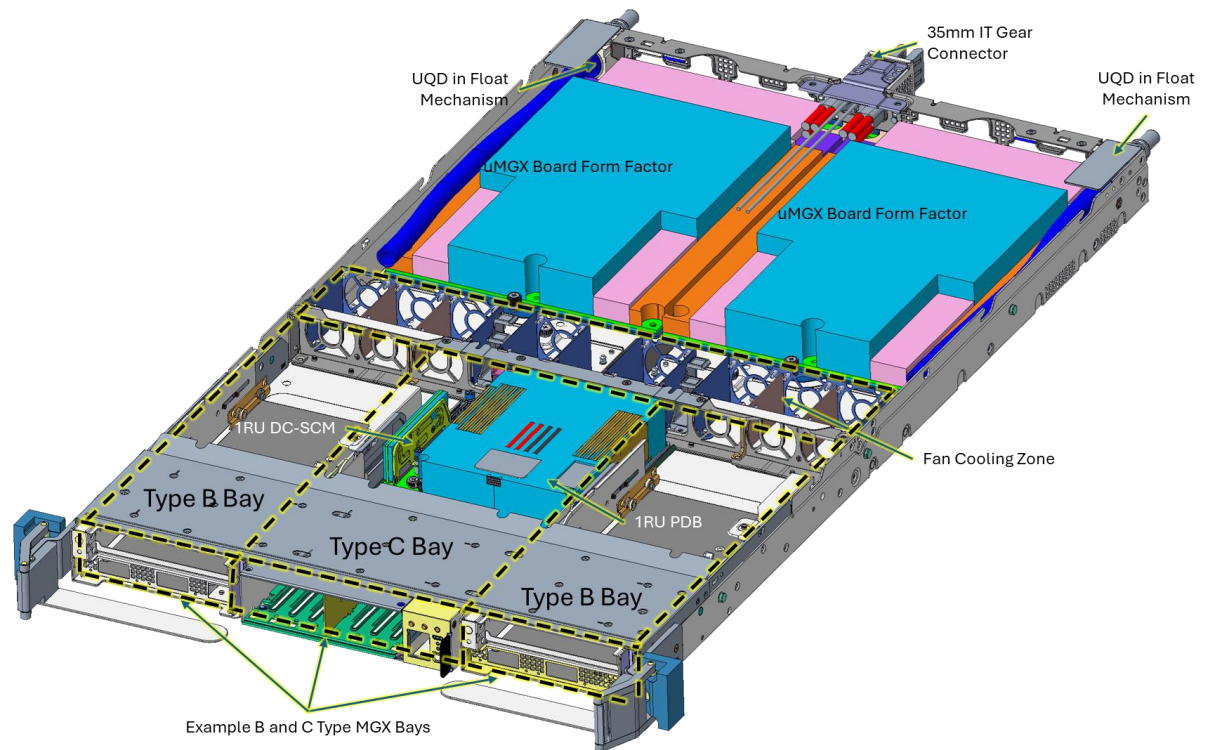


Figure 6: MGX 1RU Hybrid Cooled System Overview – Front view

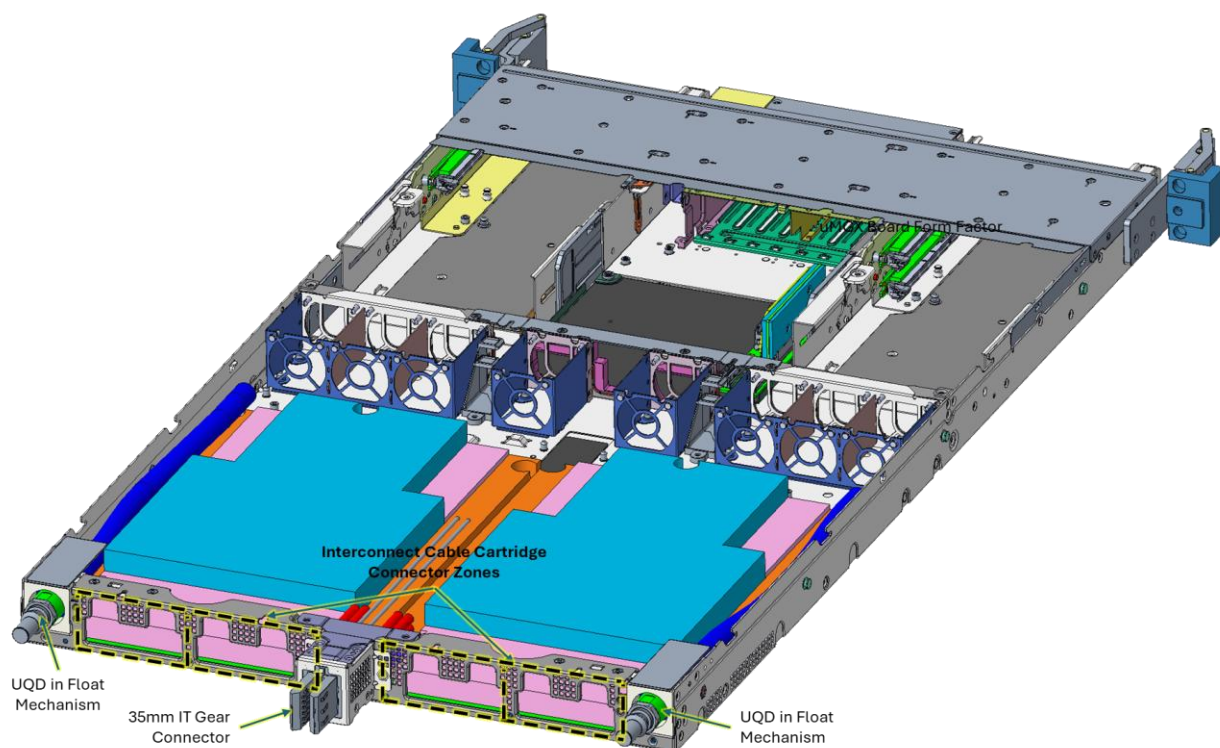


Figure 7: MGX 1RU Hybrid Cooled System Overview – Rear view

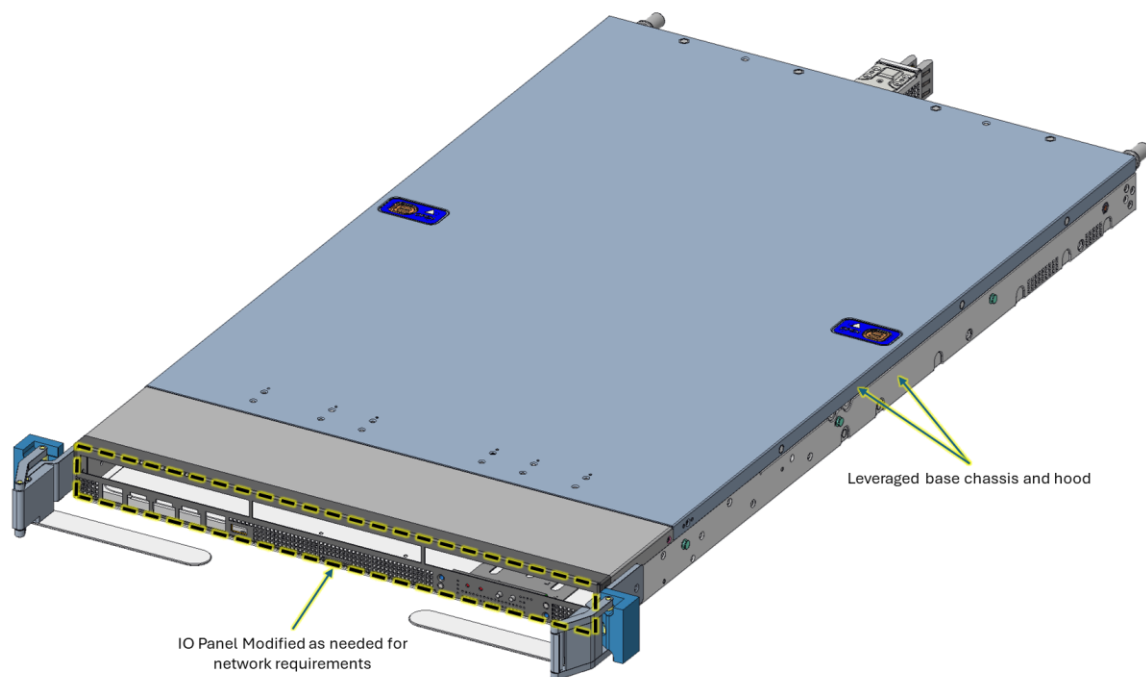


Figure 8: MGX 1RU Switch Overview – Front view

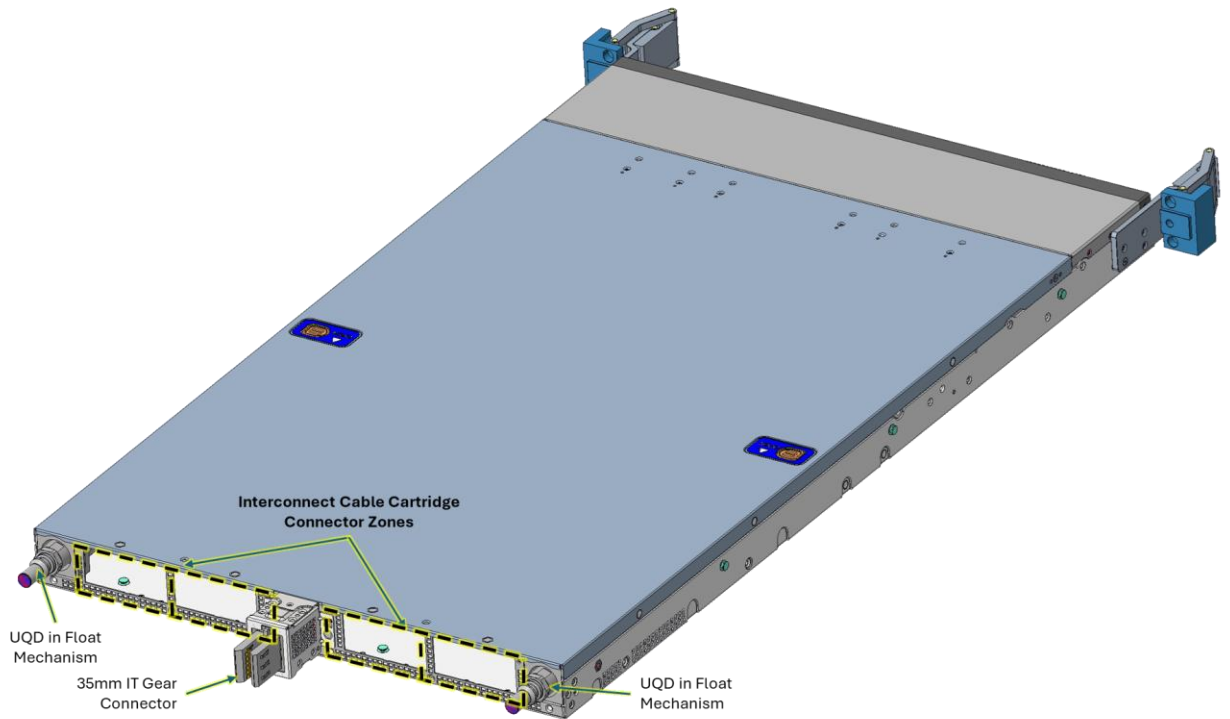


Figure 9: MGX 1RU Switch Overview –Rear view

5.2. Rack Form Factor

This section defines the MGX rack features built on top of the ORV3 rack specification. These include native 19" component support, rear extender to 1200mm, expanded IO cabling volume, full rack blind mate manifold, interconnect cartridge mounting, and additional rack structural support. Refer to 3D models provided for design details not shown here. Note that for rack supports, rear brackets and primary load bearing components SGC400 material or equivalent is recommended. The MGX 1.2 rack supports an IT payload up to 4000lbs.

5.2.1. 19" EIA IT Gear Support and Front Cabling

As previously mentioned, the MGX rack adapts the ORV3 rack to support 19" EIA gear and deploy on a 1RU pitch. For AI applications, this brings the benefits of additional front cabling volume for IO and management connectivity, space for latching and slide components, and additional structure to support blind mate liquid and interconnect forces. In addition, existing EIA native hardware such as switches, servers and CDUs may be supported.

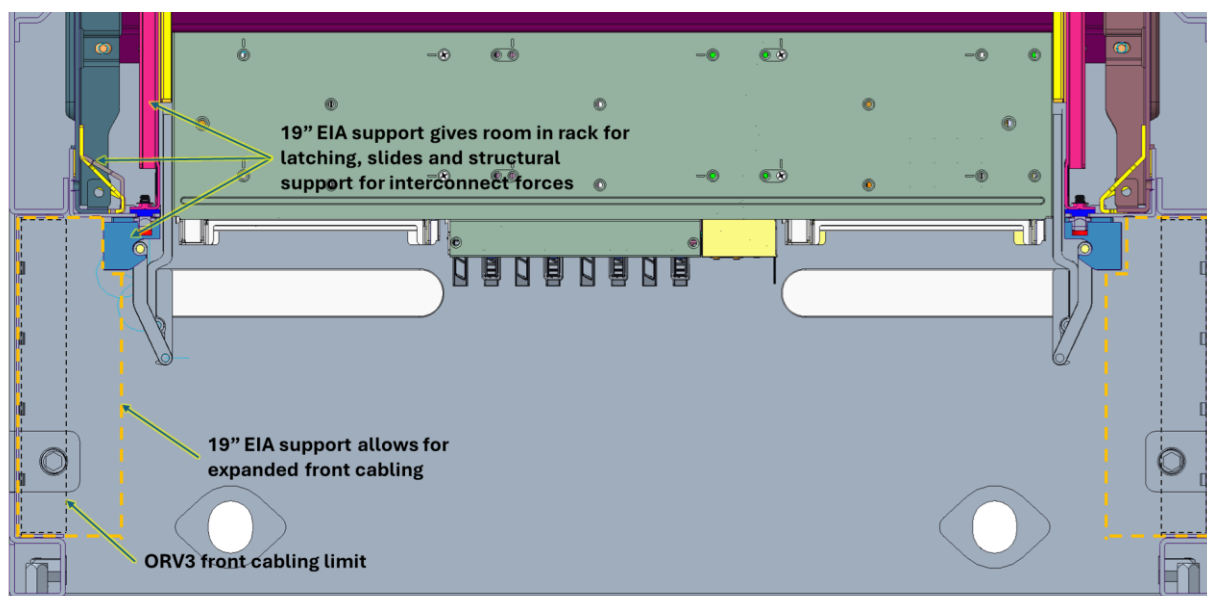


Figure 10: Front cabling volume expansion using 19" EIA rack mounting

5.2.2. Rear Rack Extender

Shown below is the rear rack extender which increase to the depth of the rack to 1200mm. This optional addition provides protection to rear rack components such as the cable bracing and manifold fittings while maintaining the existing OCP ORV3 rear hole pattern for seismic bracing and doors as needed. Refer to the 3D database for more details.

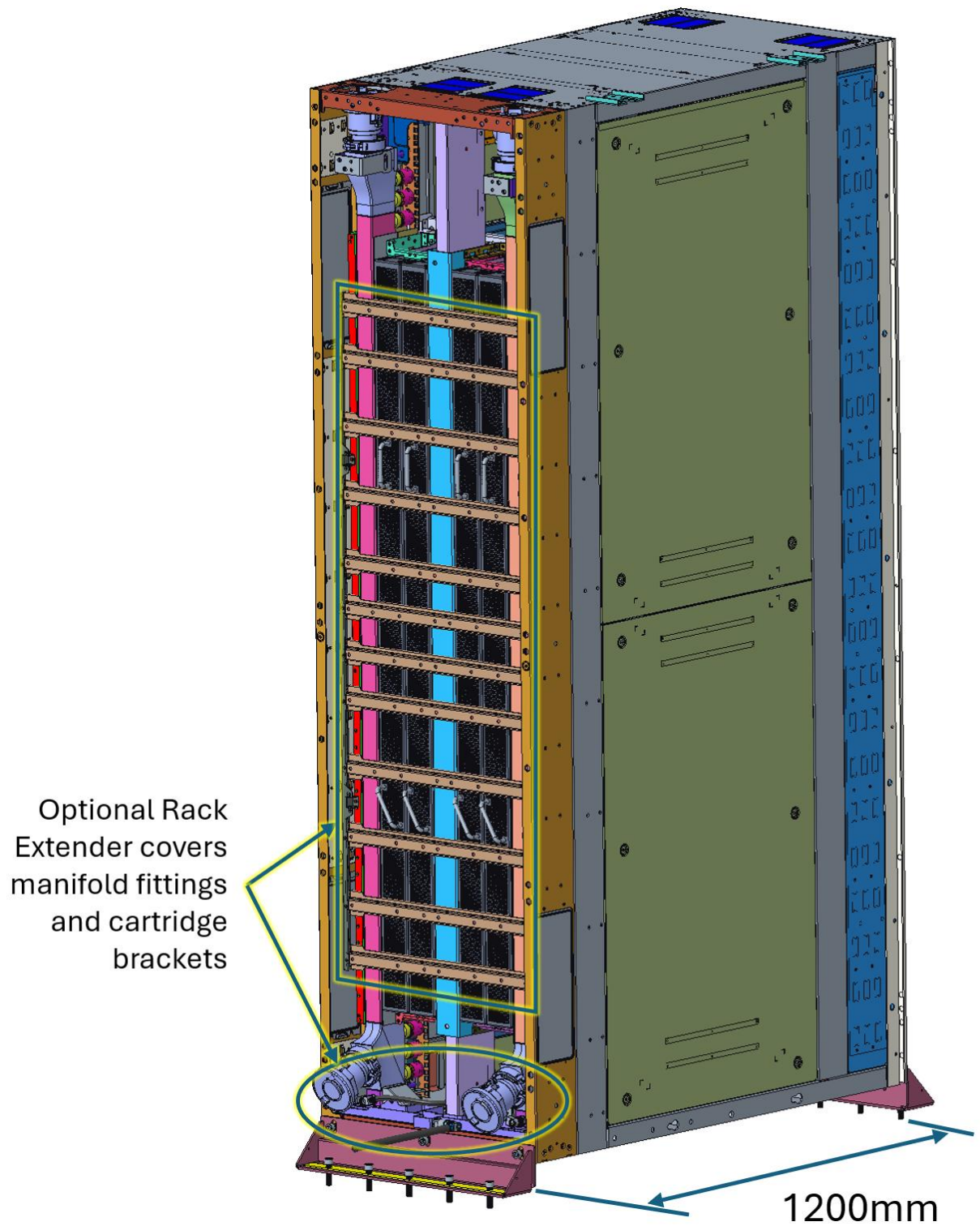


Figure 11: MGX Rack Extender Overview

5.2.3. Rack Manifold Mounting

The following figures define the manifold detailed design, sub-components, manufacturing requirements, mounting brackets and mounting position within the MGX Rack and the ORV3 OCP Rack.

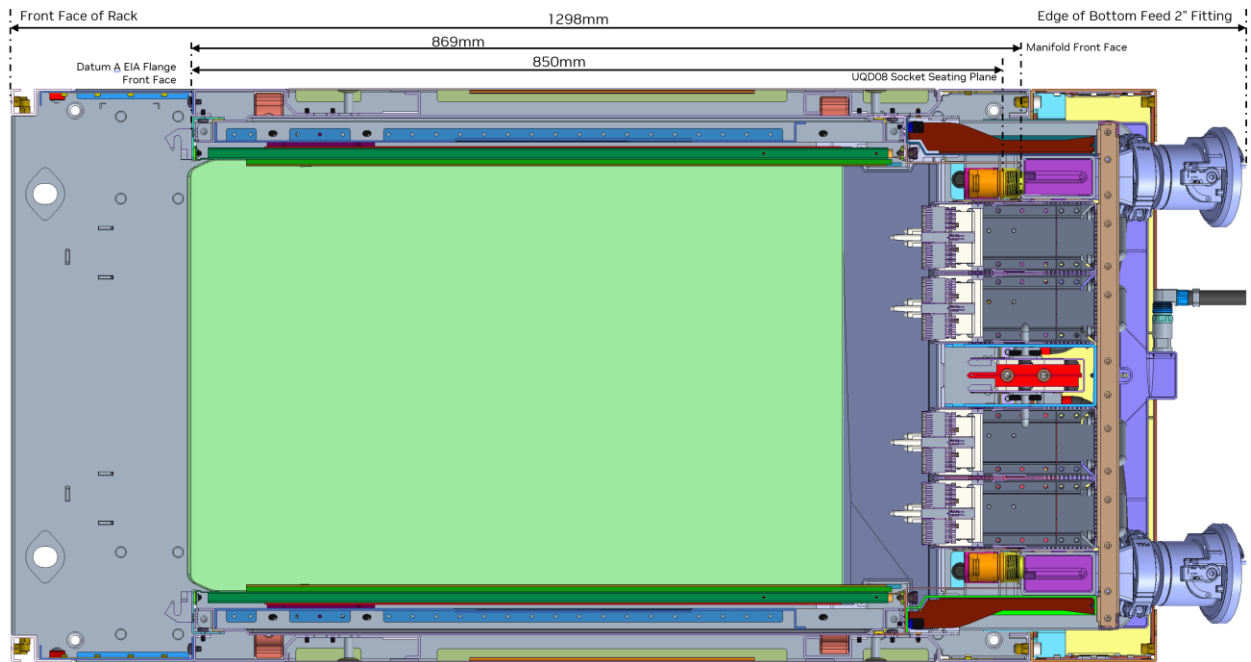


Figure 12: MGX Rack Manifold Locations – Top View

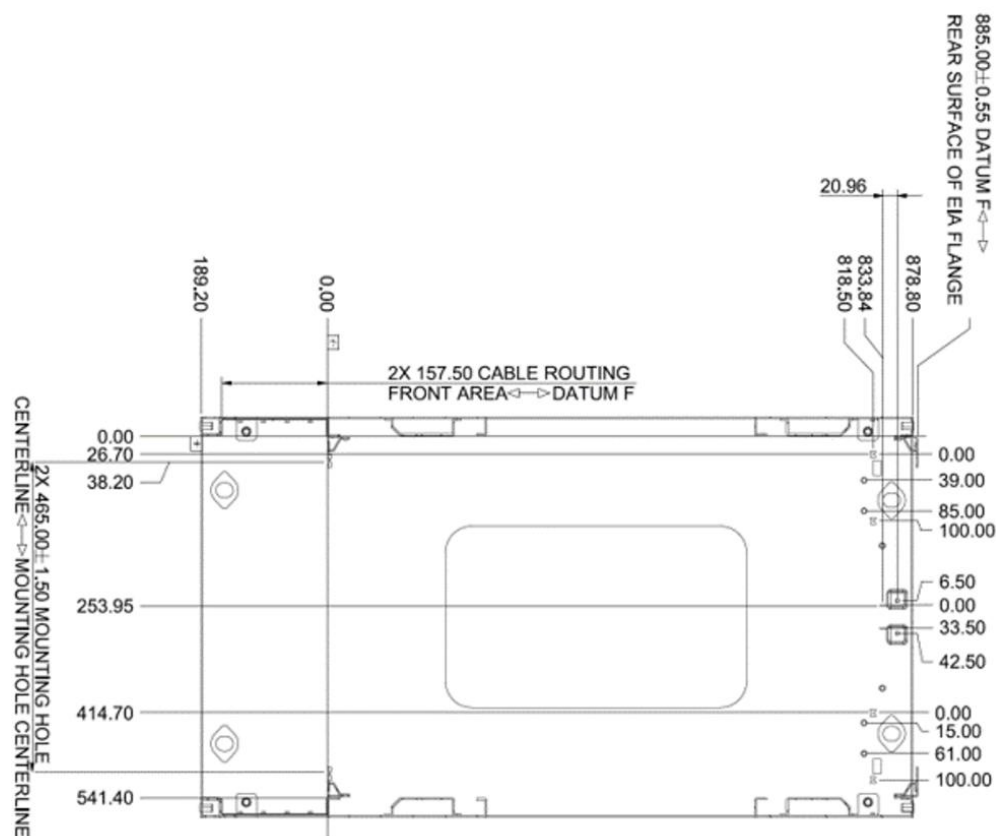


Figure 13: MGX Rack Base – Top View

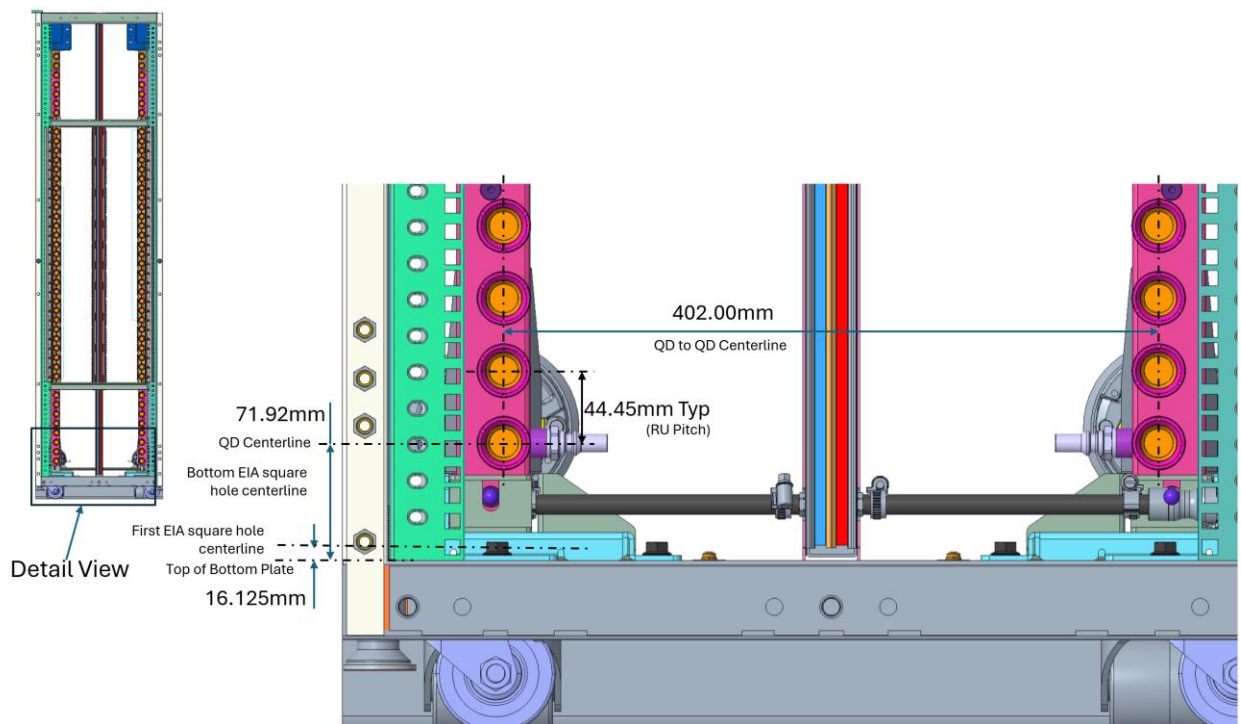


Figure 14: MGX Rack Manifold Locations Detail

Refer to the 2D drawing package released with this specification for detailed 2D mechanical drawings of the manifold assembly and subcomponents.

5.2.4. Rack Stiffener Mounting

The cross rack and front-back stiffener components are fully repositionable in the MGX 1.2 Rack. Each component may shift in 1RU increments. The figure shown below illustrates the stiffener placement and count for the 27RU cartridge and corresponding loading. However, additional stiffeners may be added, or stiffeners may be deployed closer together for larger cartridges and/or higher load applications. A cross rack stiffener is recommended at the top and bottom RU spaces above and below the interconnect cartridge. This gives the rack stiffness and provides mounting and alignment features for the cartridge support brackets. Front-back rack stiffeners are 2U in height, and may be placed every 2U if needed or spaced apart based on specific implementation and loading requirements.

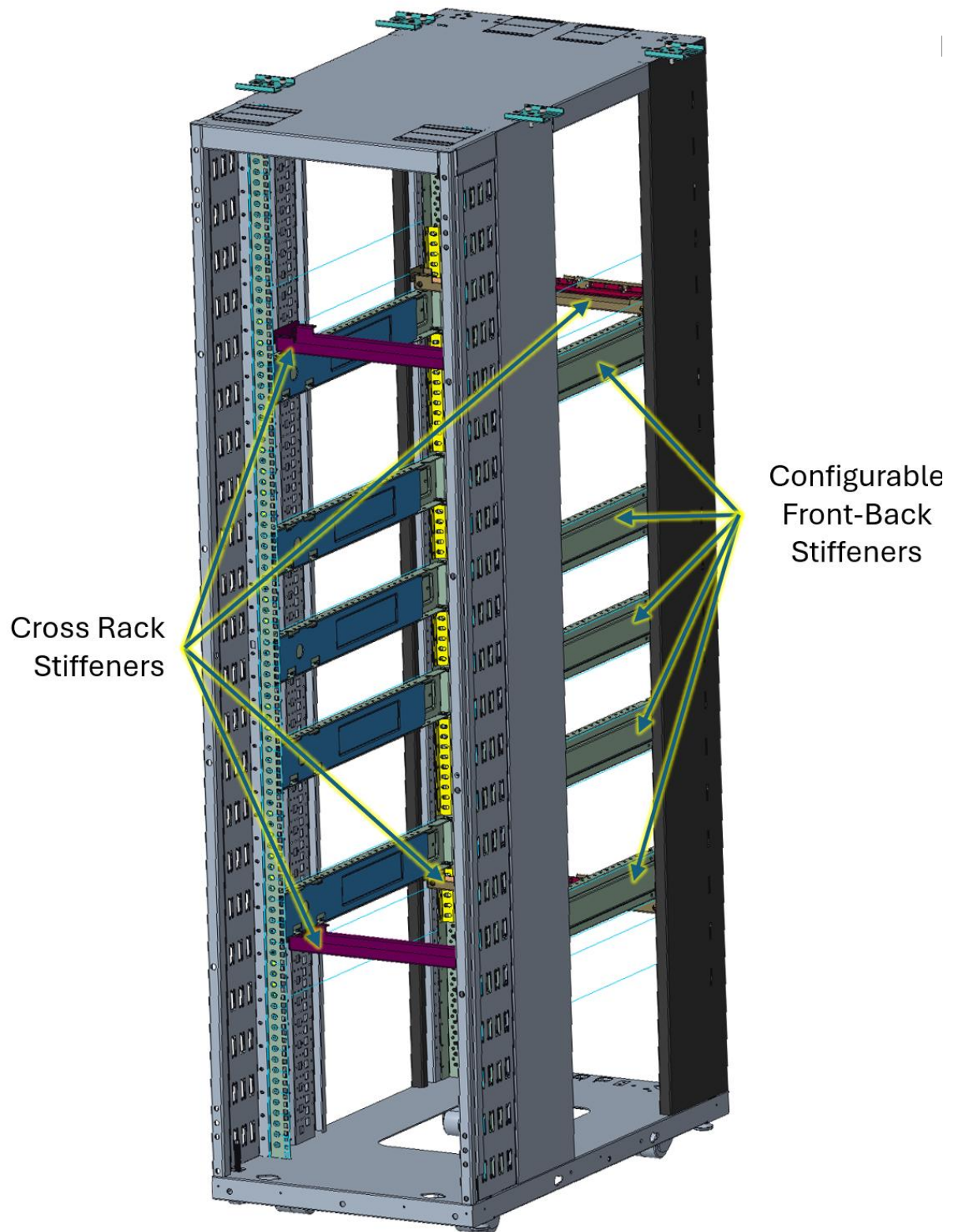


Figure 15: MGX Rack Configurable Cross Rack and Front-Back Stiffeners

5.3. Slide Rail Interface

To ensure interoperability of rack slides pre-defined t-pin locations on the chassis side wall to enable a common slide rail interface. The specified t-pin locations and t-pin design are used across the MGX ecosystem as discussed in the following sections and allow for use of a standard slide rail design.

5.3.1. Standard Chassis Rail Interface

The Figure below shows the preferred location of the t-pins referenced from chassis Datum A on a 1RU system. Using these pre-defined locations is strongly preferred for the MGX ecosystem as any variance from the following figure will require unique slide rail designs.

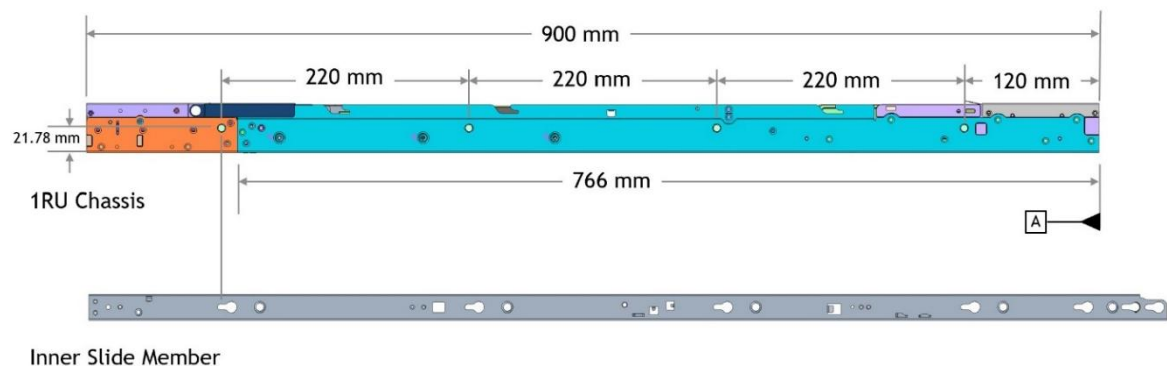


Figure 16: MGX Rack Slide Rail T-Pin Locations

5.3.2. Blind Mate Slide Rail

The following figures illustrate positioning and mounting enablement features included in the slide rail design. These features are used to properly support and align the tray to the interconnect and rack level manifolds. In addition, a latching surface is specified to enable latch designs for the blind mate liquid implementations and interoperability between slide and chassis. Ensure that the specific supplier implementation is capable of safely supporting the weight of the compute tray or switch being installed.

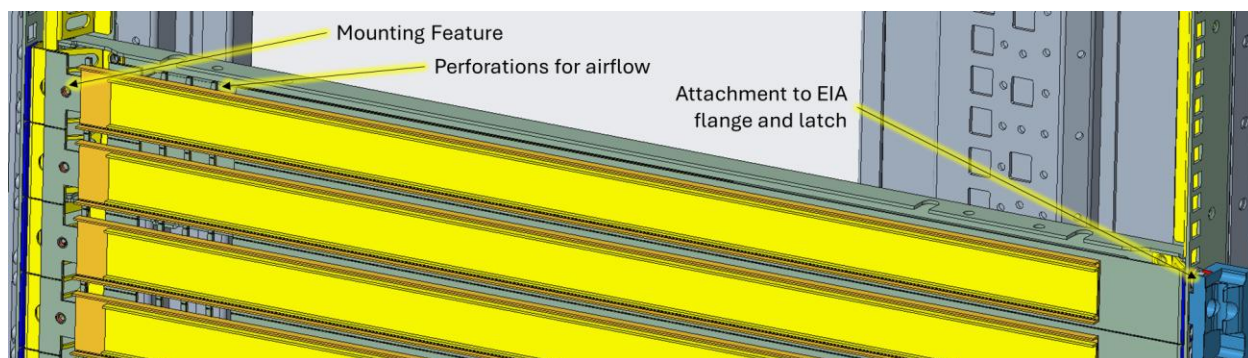


Figure 17: MGX Rack Blind Mate System Slide Rail Features

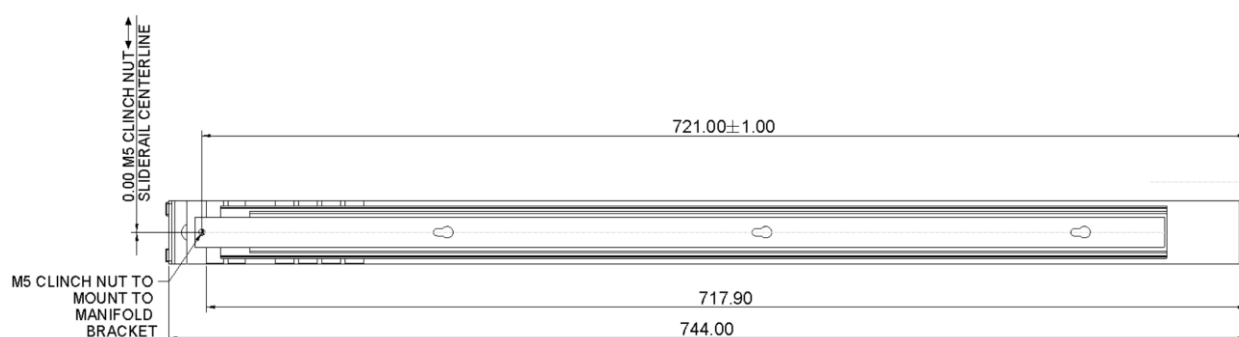


Figure 18: MGX Rack Blind Mate System Slide Rail Detail

5.4. MGX DC-SCM Module

This section defines the PCB outline and pinout of the MGX DC-SCM module. The module is designed to enable vertical installation within a 1RU server using the same SFF-TA-1002 based interface as existing DC-SCM form factors. The figures below show the module mated to a board connector and support bracket. Refer to 3D models for details not specified here.

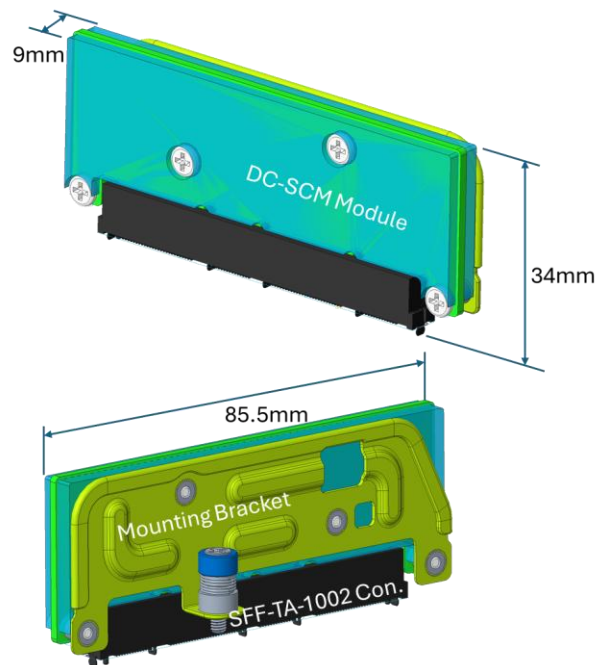


Figure 19: MGX Compact 1RU DC-SCM Module Overview

The module implements a subset of the DC-SCI pinout as shown in the table below.

Table 2: 1RU DC-SCM Module Pinout

DC-SCI PIN#	NV BMC DC-SCI PIN name	DC-SCI PIN#	NV BMC DC-SCI PIN name	DC-SCI PIN#	NV BMC DC-SCI PIN name
OA02	NC(USB3_SCMHOST2_SCM_HPM_	B03	ESPI_HPMCNTL_RESET_N/GPIO	A49	I2C_3V3_6_SCL/GPIO
OA03	NC(USB3_SCMHOST2_SCM_HPM_	B04	ESPI_HPMCNTL_IO_0/GPIO	A50	I2C_3V3_6_SDA/GPIO
OB02	NC(USB3_SCMHOST2_HPM_SCM_	B05	ESPI_HPMCNTL_IO_1/GPIO	A58	I2C_I3C_1V8_12_SCL/GPIO
OB03	NC(USB3_SCMHOST2_HPM_SCM_	B06	ESPI_HPMCNTL_IO_2/GPIO	A59	I2C_I3C_1V8_12_SDA/GPIO
OB05	DISPLAYPORT_AUX_DN/(VGA_B)	B07	ESPI_HPMCNTL_IO_3/GPIO	A61	I2C_I3C_1V8_13_SCL/GPIO
OB06	DISPLAYPORT_AUX_DP/(DDC_SCL	B08	ESPI_HPMCNTL_ALERT0_N/GPIO	A62	I2C_I3C_1V8_13_SDA/GPIO
OA05	DISPLAYPORT_LANE0_DN/(VGA_R)	A63	UART0_HPM_SCM_DATA / GPIO /	B39	I2C_I3C_1V8_14_SCL/GPIO
OA06	DISPLAYPORT_LANE0_DP/(VSYNC		UART0_SCM_HPM_DATA /		
	)	B51	PCIE_SCM_HPM_PERST_N /	B40	I2C_I3C_1V8_14_SDA/GPIO
OA11	DISPLAYPORT_LANE1_DN/(VGA_G	B56	UART1_SCM_HPM_DATA /	B41	I2C_I3C_1V8_15_SCL/GPIO
OA12	DISPLAYPORT_LANE1_DP/(DDC_S	B57	UART1_HPM_SCM_DATA /	B42	I2C_I3C_1V8_15_SDA/GPIO
OB11	USB2_SCMHOST3_DN	A08	JTAG_TCK_CPU_BMC	A51	I2C_1V8_16_SCL/GPIO
OB12	USB2_SCMHOST3_DP	A09	JTAG_TDI_CPU_BMC	A52	I2C_1V8_16_SDA/GPIO
OA08	SGMII_SCM_HPM_DN	A10	JTAG_TDO_CPU_BMC	B09	I2C_1V8_17_SCL /
OA09	SGMII_SCM_HPM_DP	A11	JTAG_TMS_CPU_BMC	B10	ESPI0_HPMCNTL_CS1_N/GPIO
OB08	SGMII_HPM_SCM_DN	A12	JTAG_TRST_CPU_BMC_L	B52	I2C_1V8_17_SDA /
OB09	SGMII_HPM_SCM_DP	A20	NC(LTPI_SCM_HPM_DATA_DN)	B53	ESPI0_HPMCNTL_ALERT1_N/GPI
A28	PCIE_HPM_SCM_PERST_N	A21	NC(LTPI_SCM_HPM_DATA_DP)	B54	I2C_3V3_7_SCL / SGPIO_CLK
A30	PCIE_HPMROOT_SCM_HPM_DN	A23	NC(LTPI_SCM_HPM_CLK_DN)	B55	/NCSI2_HPM_SCM_CLK/ GPIO
A31	PCIE_HPMROOT_SCM_HPM_DP	A24	NC(LTPI_SCM_HPM_CLK_DP)	A01	I2C_3V3_7_SDA / SGPIO_LD
B30	PCIE_HPMROOT_HPM_SCM_DN	B20	NC(LTPI_HPM_SCM_DATA_DN)	A02	/NCSI2_HPM_SCM_CRD / GPIO
B31	PCIE_HPMROOT_HPM_SCM_DP	B21	NC(LTPI_HPM_SCM_DATA_DP)	A03	I2C_3V3_8_SCL / SGPIO_DATAOUT
A36	PCIE_HPM_SCM_CLK_100M_0_DN	B23	NC(LTPI_HPM_SCM_CLK_DN)	A04	/NCSI2_SCM_HPM_D0 / GPIO
A37	PCIE_HPM_SCM_CLK_100M_0_DP	B24	NC(LTPI_HPM_SCM_CLK_DP)	OA01	I2C_3V3_8_SDA / SGPIO_DATAIN
A65	NC(USB3_SCMHOST1_SCM_HPM_	B43	NCSI_HPM_SCM_CLK / GPIO	OA04	/NCSI2_SCM_HPM_D1 / GPIO
A66	NC(USB3_SCMHOST1_SCM_HPM_	B44	NCSI_HPM_SCM_CRD / GPIO	OA07	
B65	NC(USB3_SCMHOST1_HPM_SCM_	B45	NCSI_SCM_HPM_TX_EN / GPIO	OA10	GND
B66	NC(USB3_SCMHOST1_HPM_SCM_	B46	NCSI_SCM_HPM_D0 / GPIO	OA13	GND
A33	PCIE_SCMROOT_SCM_HPM_DN	B47	NCSI_SCM_HPM_D1 / GPIO	A05	GND
A34	PCIE_SCMROOT_SCM_HPM_DP	B48	NCSI_HPM_SCM_D0 / GPIO	A06	GND
B33	PCIE_SCMROOT_HPM_SCM_DN	B49	NCSI_HPM_SCM_D1 / GPIO	A19	GND
B34	PCIE_SCMROOT_HPM_SCM_DP	A07	PRSN1_HPM_SCM_N	A22	GND
A68	PCIE_HPM_SCM_CLK_100M_1_DN	B58	PRSN0_SCM_HPM_N	A25	GND
A69	PCIE_HPM_SCM_CLK_100M_1_DP	A13	SCM_HPM_STBY_RST_N	A29	GND
B36	USB2_SCMHOST1_DN /	A14	SCM_HPM_STBY_EN	A32	GND
B37	USB2_SCMHOST1_DP /	B26	HPM_SCM_STBY_RDY	A35	GND
B68	NC(USB2_SCMHOST2_DN /				
	USB2_HPMHOST2_DN)	B27	HPM_SCM_INTRUSION_N	A38	GND
	NC(USB2_SCMHOST2_DP /				
	USB2_HPMHOST2_DP)	B28	P3V0_HPM_SCM_BAT	A53	GND
B60	SPI_SCMCNTRL_CLK	B50	VCC_SCM_HPM_FRU	A64	GND
B61	SPI_SCMCNTRL_MISO	OA14	PECL_HPM_SCM	A67	GND
B62	SPI_SCMCNTRL_MOSI	OB14	PECL_VREF_HPM_SCM	A70	GND
B63	SPI_SCMCNTRL_CS0_N	A39	I2C_I3C_1V0_18_SCL /	OB01	GND
A60	GPIO/SPI_SCMCNTRL_IRQ0_N	A40	I2C_I3C_1V0_18_SDA /	OB04	GND
B59	SPI_SCMCNTRL_CS1_N / GPIO	A41	I2C_I3C_1V0_19_SCL /	OB07	GND
B12	QSPI_HPMCNTL_CLK/GPIO	A42	I2C_I3C_1V0_19_SDA /	OB10	GND
B13	QSPI_HPMCNTL_CS0_N/GPIO	A15	I2C_3V3_0_SCL/GPIO	OB13	GND
B14	QSPI_HPMCNTL_IO_0/GPIO	A16	I2C_3V3_0_SDA/GPIO	B11	GND
B15	QSPI_HPMCNTL_IO_1/GPIO	A17	I2C_3V3_1_SCL/GPIO	B19	GND
B16	QSPI_HPMCNTL_IO_2/GPIO	A18	I2C_3V3_1_SDA/GPIO	B22	GND
B17	QSPI_HPMCNTL_IO_3/GPIO	A26	I2C_3V3_2_SCL/GPIO	B25	GND
B18	QSPI_HPMCNTL_CS1_N/GPIO	A27	I2C_3V3_2_SDA/GPIO	B29	GND
A54	SPI_HPMCNTL_TPM_CLK	A43	I2C_3V3_3_SCL/GPIO	B32	GND
A55	SPI_HPMCNTL_TPM_CS_N	A44	I2C_3V3_3_SDA/GPIO	B35	GND
A56	SPI_HPMCNTL_TPM_MOSI	A45	I2C_3V3_4_SCL/GPIO	B38	GND
A57	SPI_HPMCNTL_TPM_MISO	A46	I2C_3V3_4_SDA/GPIO	B64	GND
B01	ESPI_HPMCNTL_CLK/GPIO	A47	I2C_3V3_5_SCL/MDIO/GPIO	B67	GND
B02	ESPI_HPMCNTL_CS0_N/GPIO	A48	I2C_3V3_5_SDA/MDIO/GPIO	B70	GND

5.5. Fanless Liquid Cooled Compute Tray

This section details the mechanical form factor of the fanless liquid cooled compute tray. In this tray, 100% of tray cooling is performed by the liquid loop and fans are no longer needed or supported. The fanless compute tray leverages the same outer chassis dimensions as the MGX 1RU reference chassis specified above but does not have all of the same mounting feature details. Refer to 3D models and 2D drawings provided for design details not shown here. The fanless chassis enables multiple opportunities for system customization to enable larger HPMs and modules as well as tightly integrated liquid distribution to eliminate or minimize hoses and blind mate IO connectivity to eliminate cables.

The example chassis below illustrates the Bay B, Bay C, Bay B front layout of a fanless compute tray. The tray shown replaces the fan zone with an Integrated Cooling and IO Zone that supports a manifold and midplane assembly. This assembly hosts the blind mate MQD interfaces to distribute liquid to the modules and blind mate IO connectors to distribute IO and management signals between modules and HPMs. The Modular IO Bays and HPMs are extended to support larger devices and higher power compared to the hybrid cooled tray.

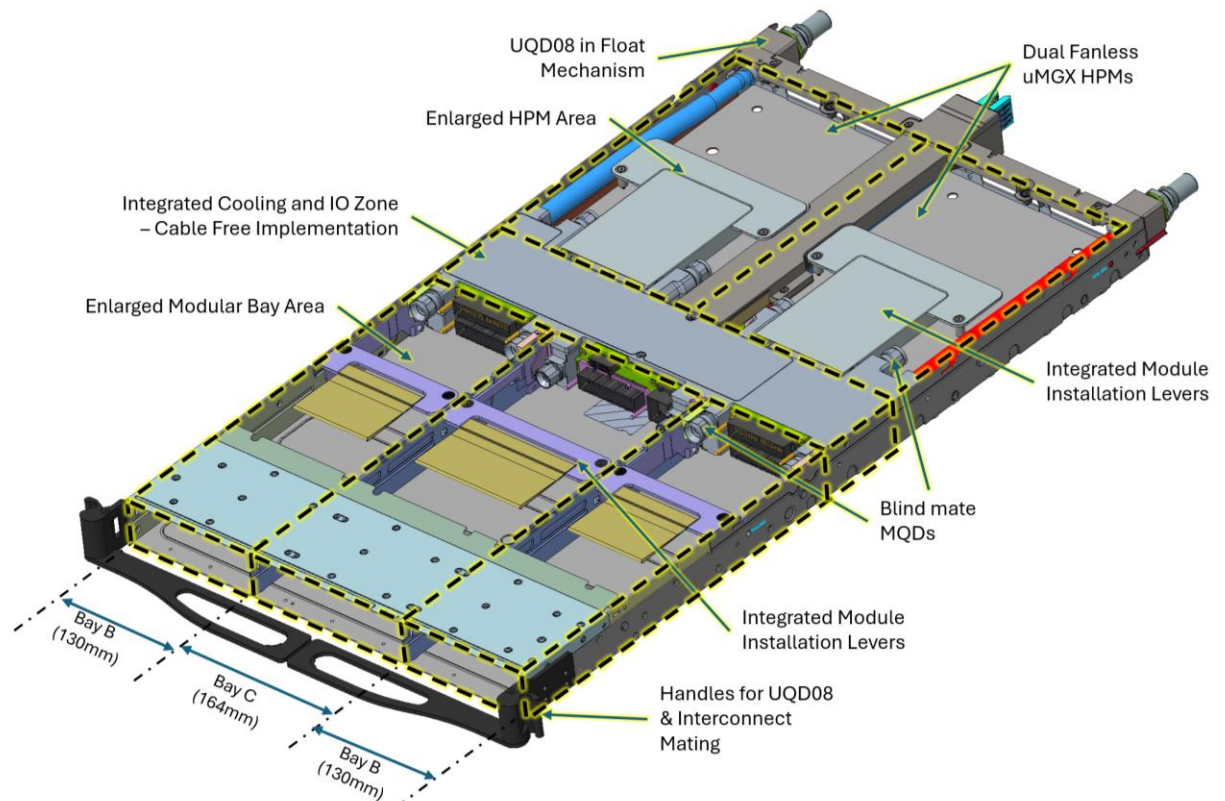


Figure 20: Example Fanless MGX Compute Tray Implementation with Dual HPMs and IO Midplane

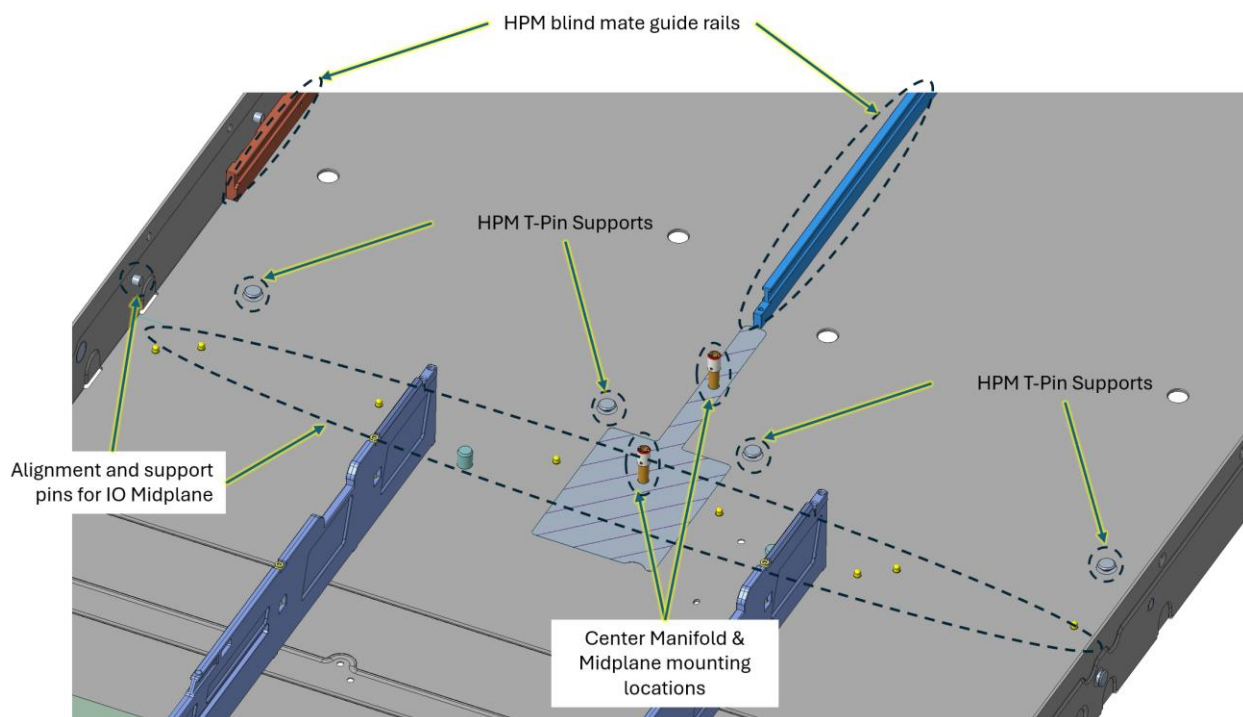


Figure 21: Fanless Chassis alignment and support features for HPM and Manifold/Midplane Assembly

The figures below illustrate another example of a Fanless MGX system. Shown below, a full size MGX fanless HPM is interchangeable with independent Bay B and Bay E modules. The blind mate features that allow dual Fanless uMGX HPMs to be installed from the rear have been de-populated from the chassis to allow for a full size HPM that installs on MGX T-pin locations. Each Bay module connects to the HPM through coplanar connections rather than a midplane in this example. In addition, the liquid cooling is distributed through a manifold integrated into the HPM itself rather than a discrete assembly.

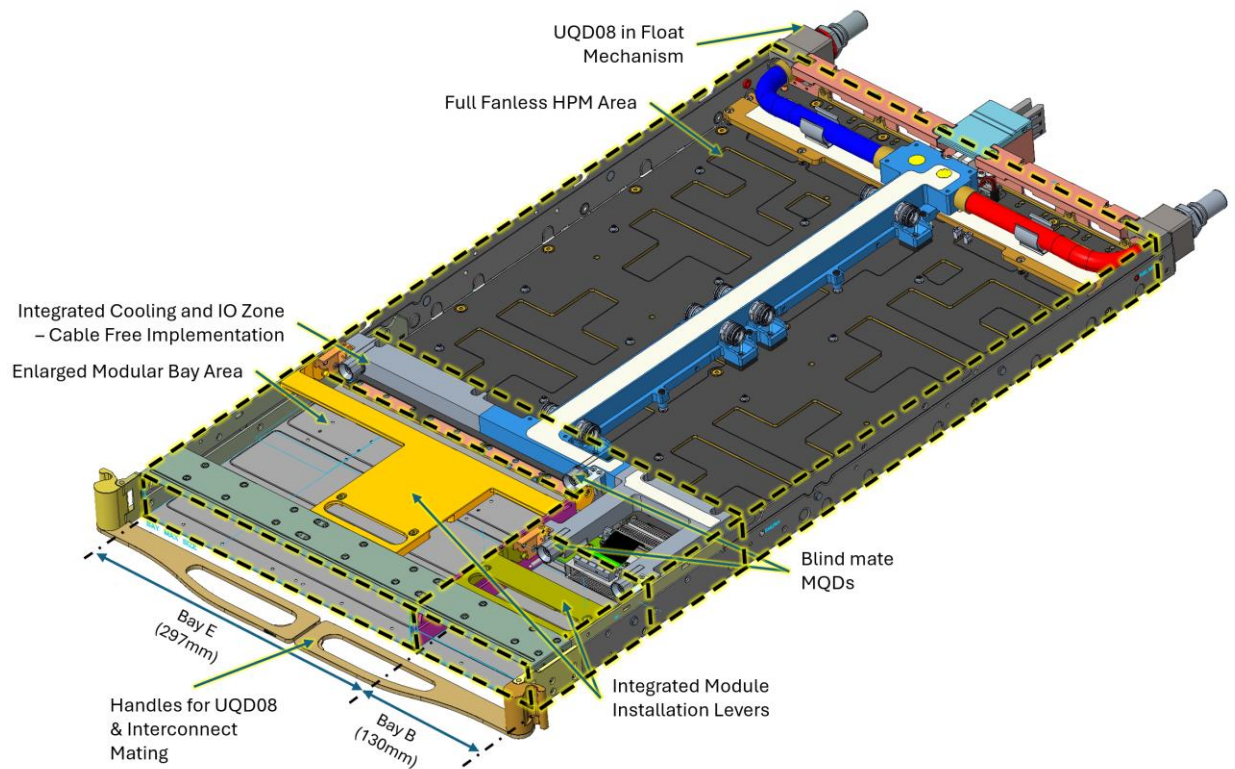


Figure 22: Example Fanless MGX Compute Tray Implementation with Full Fanless HPM, Coplanar IO and IO Midplane

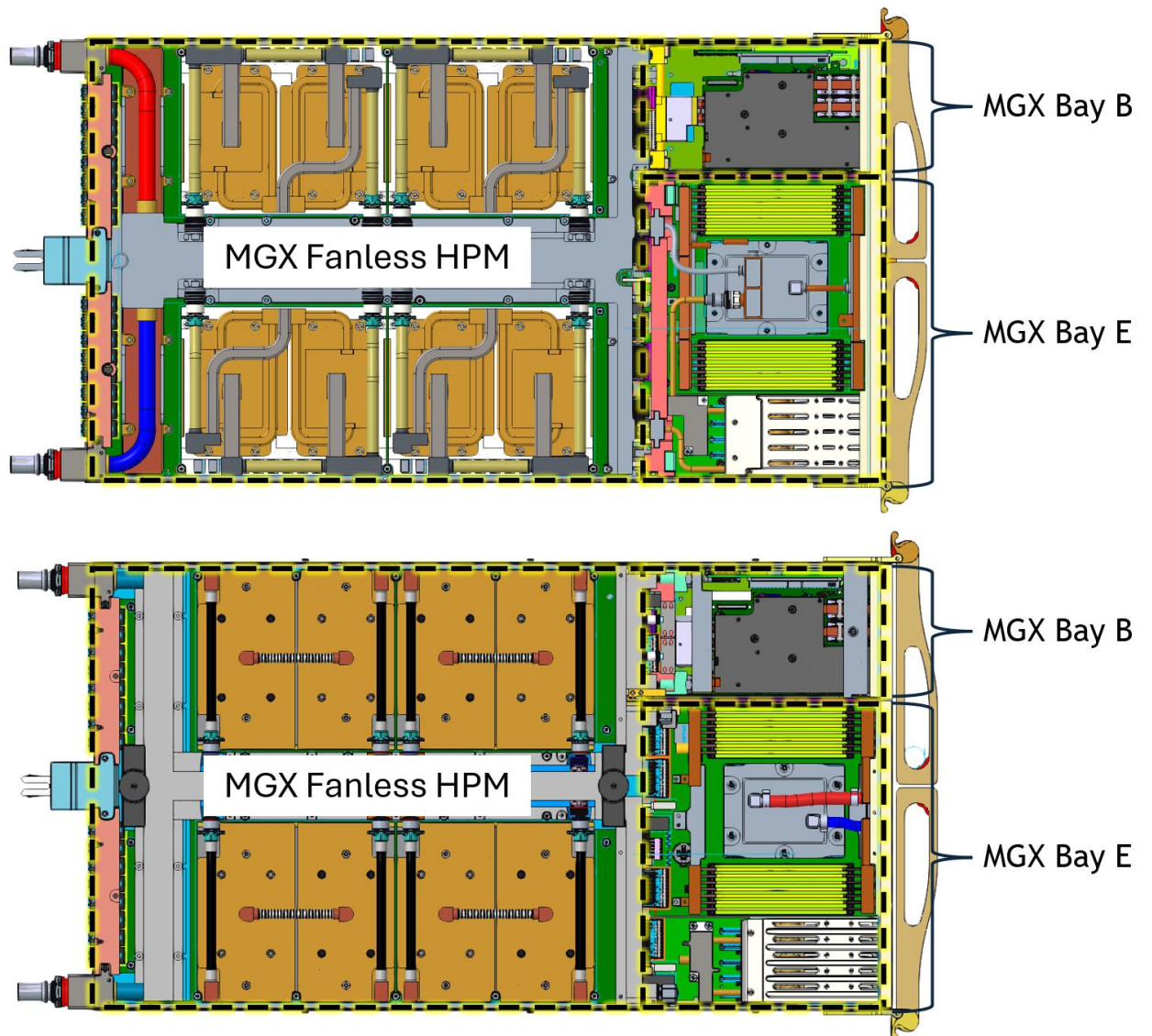


Figure 23: Two examples of Fanless MGX Compute Trays with common HPM and Bay form factors

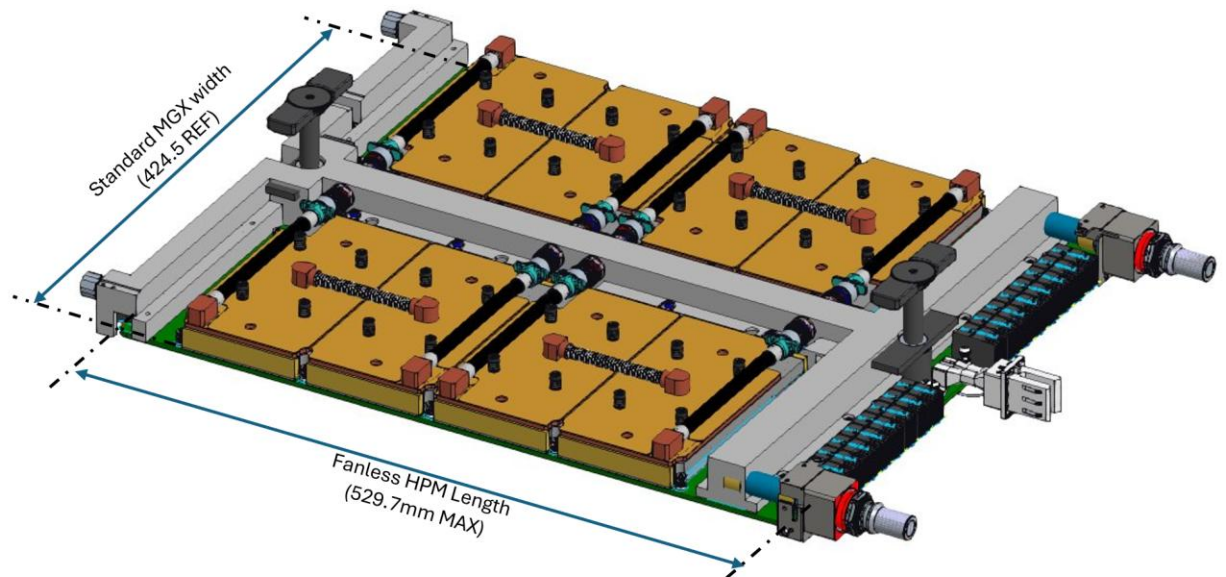


Figure 24: Fanless HPM Overview with pluggable modules

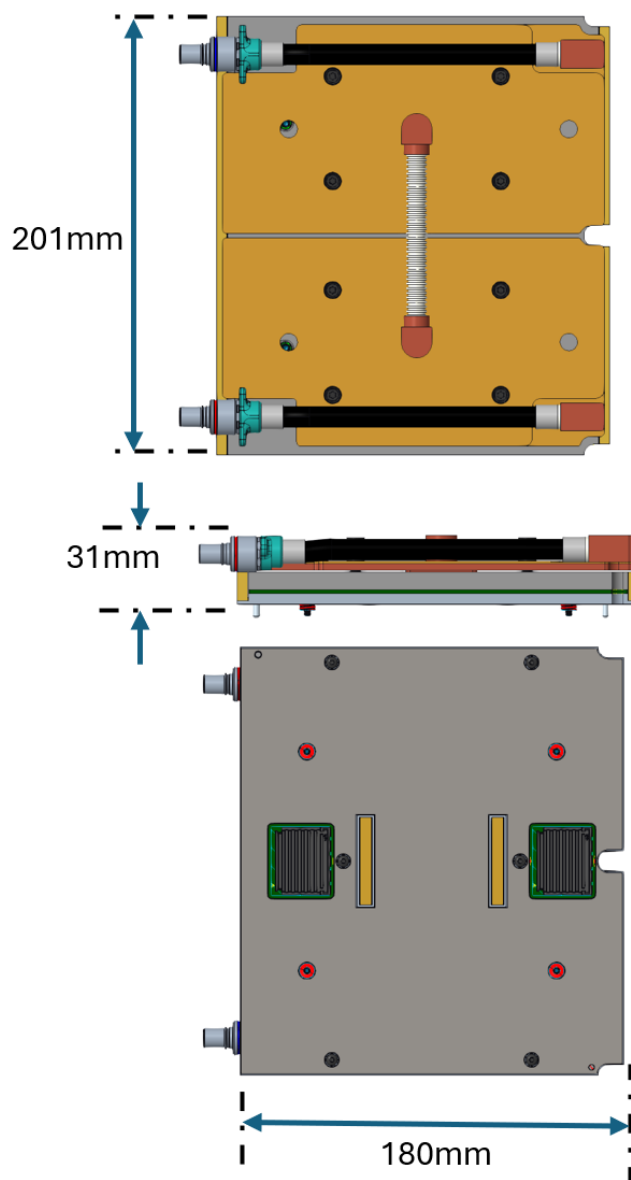


Figure 25: Example Pluggable modules

6. Power Bus Bar Requirements

The MGX 1.2 Rack supports a 48VDC nominal, 40 – 59.5VDC, liquid cooled bus bar that supports up to 5000A. The bus bar assembly is the same width as the existing ORV3 bus bar but supports greater ampacity by growing deeper and supporting liquid cooling.

The bus bar assembly may also be implemented in an existing ORV3 rack. The electrical and mechanical requirements for the bus bar are specified below.

6.1. Busbar Electrical Requirements

The busbar shall be capable of meeting 5000A at 40 C ambient, 3050 m elevation, static airflow (natural convection only), and meet all touch temperature safety requirements and stay within the specified IT busbar clip's temperature rating.

Typical power shelf output voltages are 48V, 51V, or 54V nominal (note some variance based off droop compensation etc... see specific power shelf spec for detailed voltage ranges).

Both power and ground busbar components within the assembly shall be continuous electrically for the entire height of the busbar to form a single power zone.

The busbar assembly is expected to have the following parasitic resistance, inductance, and capacitance per RU when measured at 25C.

Please describe the I/O System of the contribution, be sure to delineate the control and data planes. Block diagrams here.

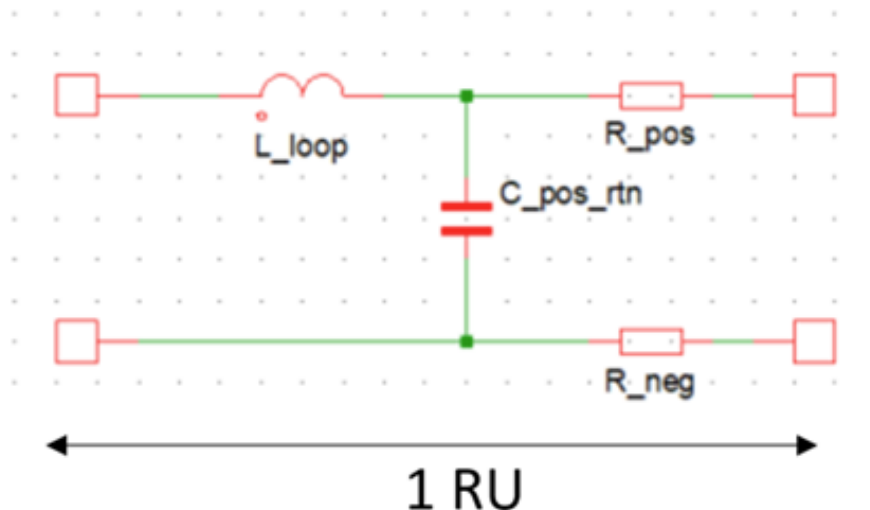


Figure 26: Electrical Parasitics Model

Table 3: 1400A Busbar Parasitics

	Min.	Typ.	Max.	Unit
Resistance per RU Positive or Return	-	2	2.2	$\mu\Omega$ / RU (44.45 mm)
Loop Inductance per RU Positive and Return	-		8.8	nH / RU (44.45 mm)
Capacitance positive to return per RU	-	49	52	pF / RU (44.45 mm)

Note: Presently these are calculated values and more conservative than Finite Element Analysis derived values. Tolerance is $\pm 5\%$ off typical.

See compliance section for HiPot requirements.

6.2. Busbar Grounding Requirements

The busbar shall have two orderable SKUs, one with isolated chassis and return and another with a hard ground tie between the chassis return. This opens the possibility of two different rack grounding schemes with minimal hardware changes.

6.2.1. Chassis to RTN Connection

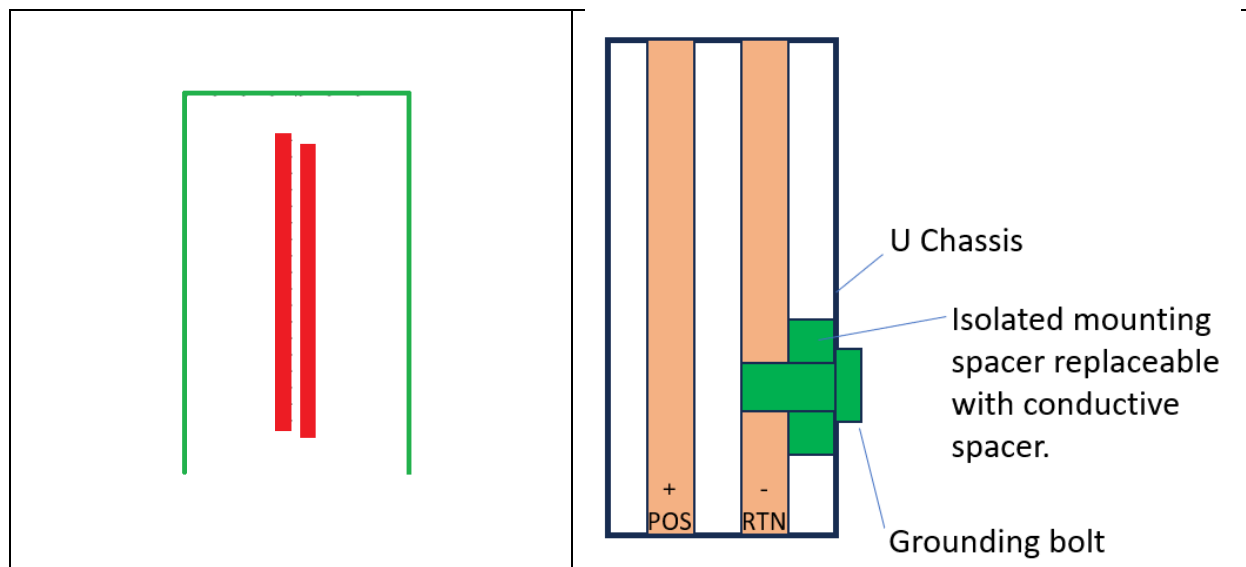


Figure 27: [Left]: Top view cross section of busbars in Red (Positive & Return) and Chassis in Green
[Right]: Grounding bolt and/or conductive mounting spacer used to tie RTN to chassis

6.2.2. Ground Connection to Rack

The busbar chassis / U-channel must connect to the rack electrically to maintain a common ground potential. This is done with a connection at the top and the bottom of the rack.

The connection at the top and bottom of the rack requires either masking or serrated washers to make an electrical connection between the rack and the busbar. The inside of the rack where the busbar surface contacts the rack shall be masked to minimize impedance

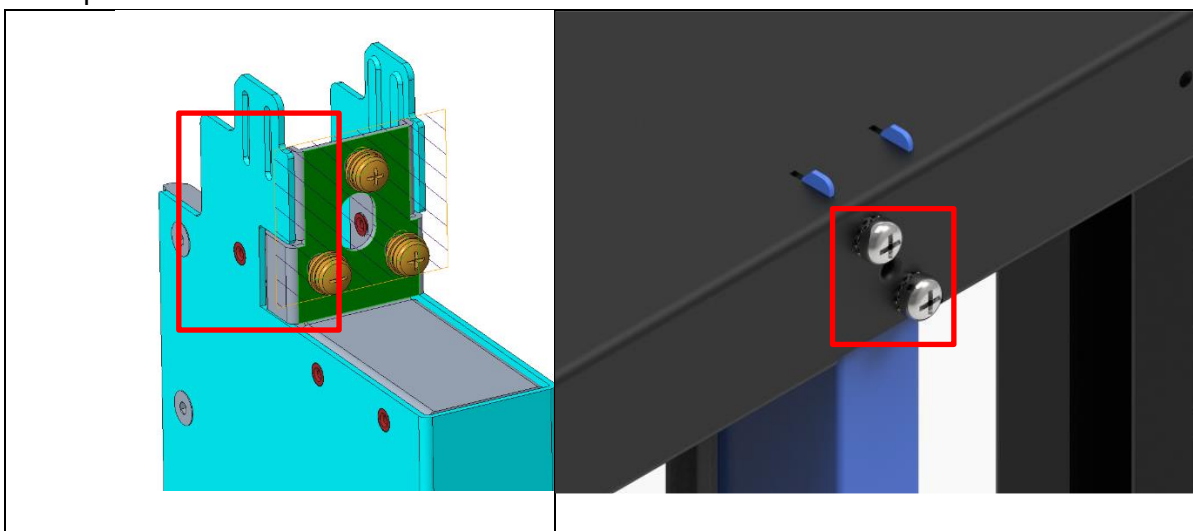


Figure 28: [Left] Busbar top mounting holes with masked section shown in green
[Right] Bolts with serrated washers mounting through the rack, to the masked section of busbar

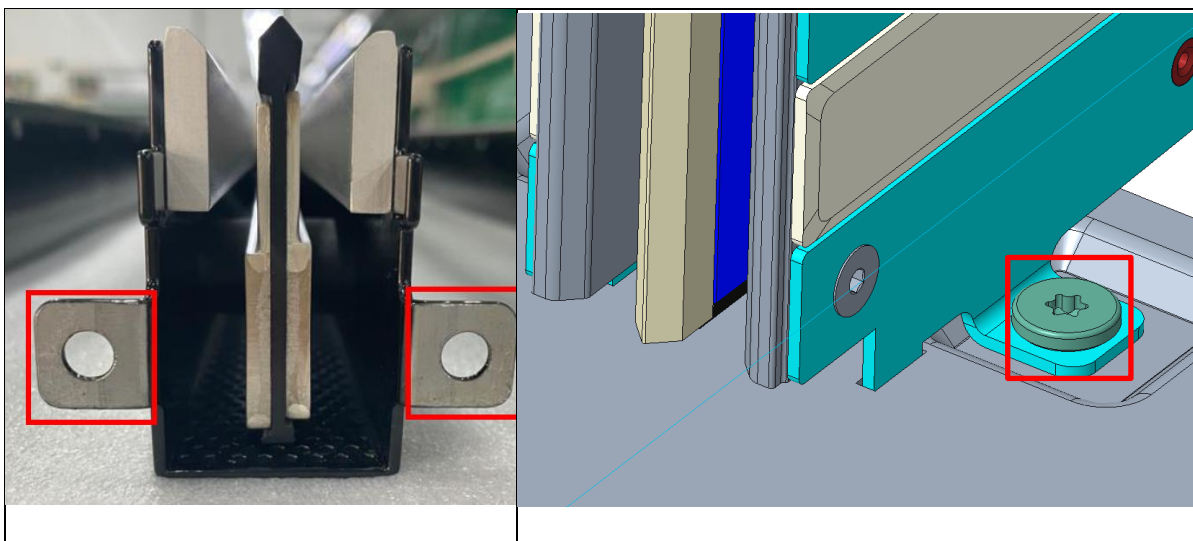


Figure 29: [Left] Bottom of the busbar and masked section
[Right] Busbar mounted onto the rack with bottoms of tabs connecting to the rack Model

6.3. Busbar Mechanical Requirements

The busbar is designed to be replaced by a trained technician.

The busbar shall be positioned in the center of the rack per the Open Rack Base Frame V3 Specification. Refer to that specification for all other dimensioning and tolerancing of the bus bar.

The busbar shall have 48 RU total rack positions for IT equipment.

The busbar shall have venting on both side and rear surfaces to maximize airflow across the busbar without compromising structural rigidity as needed. Perforations shall conform to UL 62368-1.

The power and return busbars shall be constructed of C11000, H02 temper copper or equivalent.

The chassis ground busbars shall be constructed of Aluminum 4047.

The busbar should have a typical weight of 31 kg.

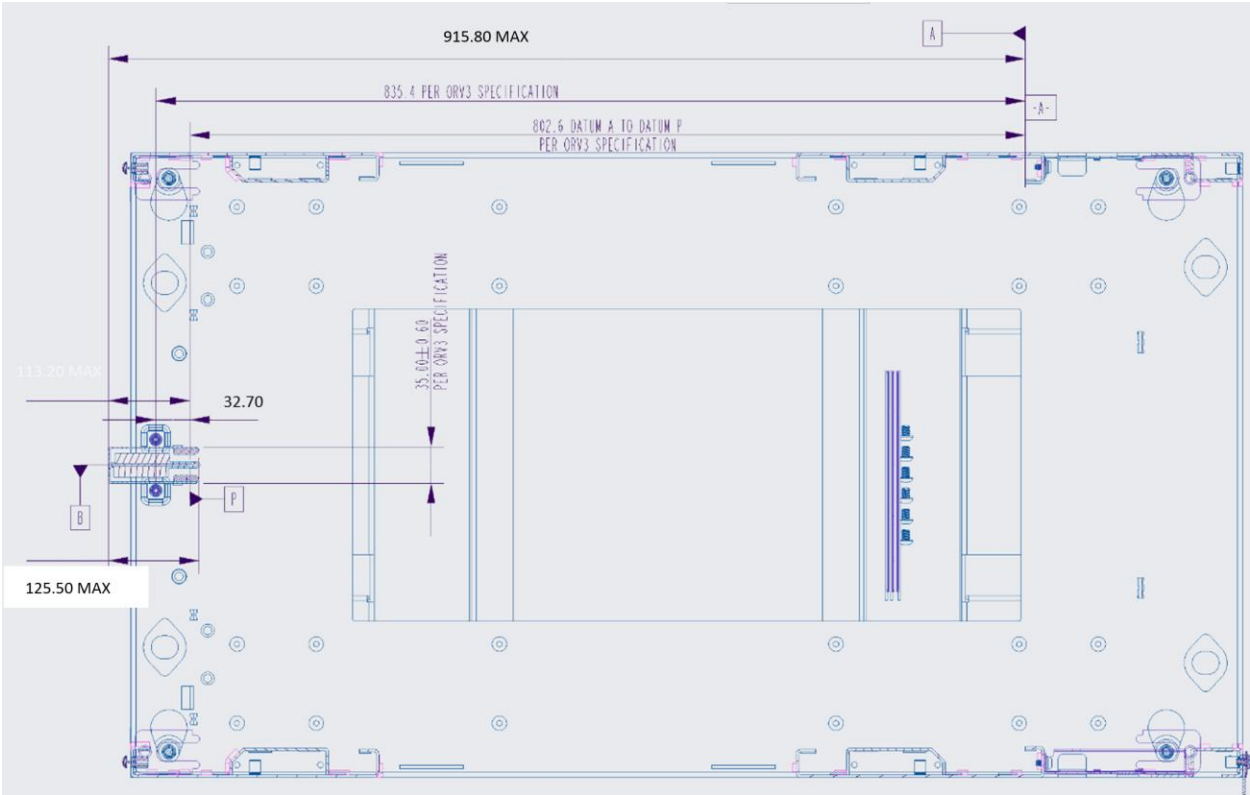


Figure 30: Busbar Maximum Depth and Position within ORV3 Rack.

Note: Rack and busbar not to scale

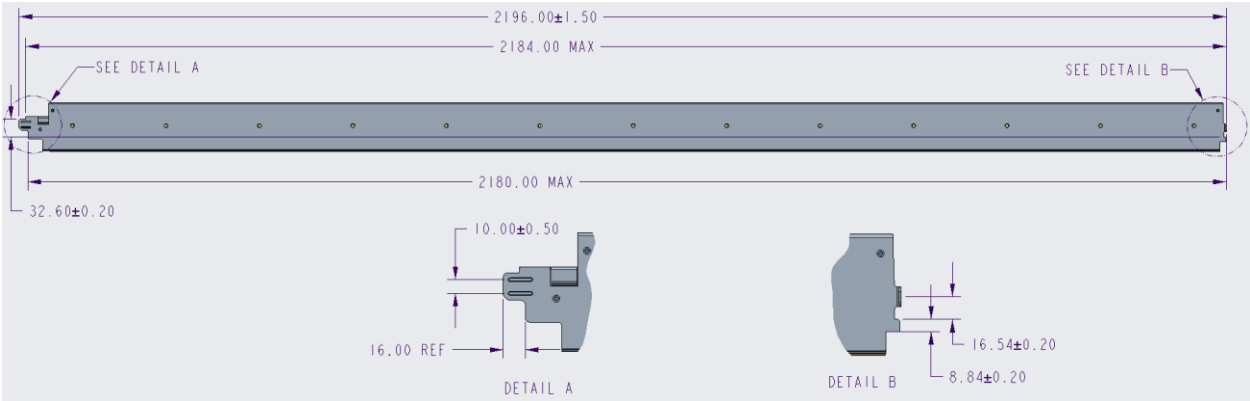


Figure 31: Key busbar dimensions to ensure interoperability across ORV3 and MGX racks

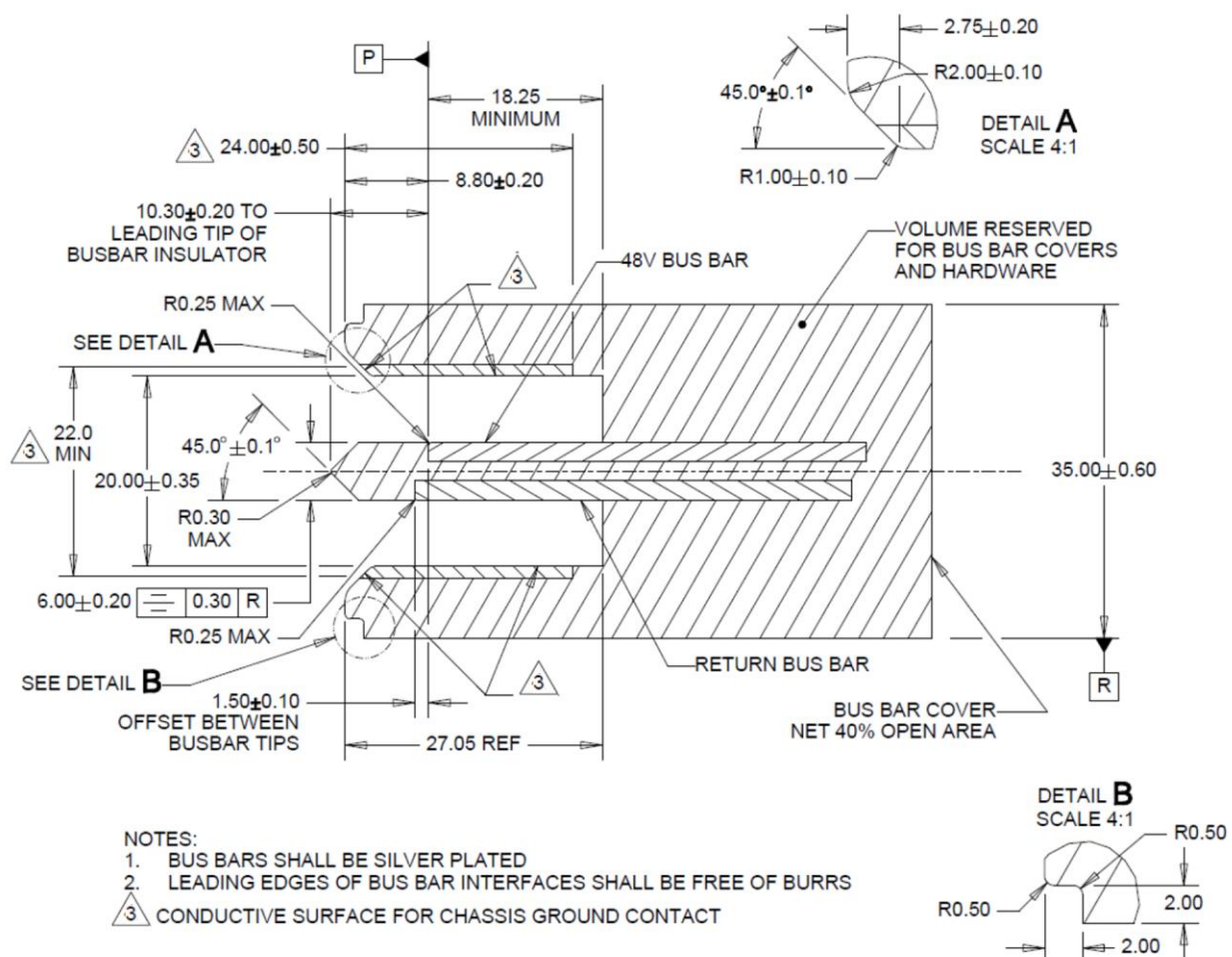


Figure 32: Busbar Cross Section Dimensions

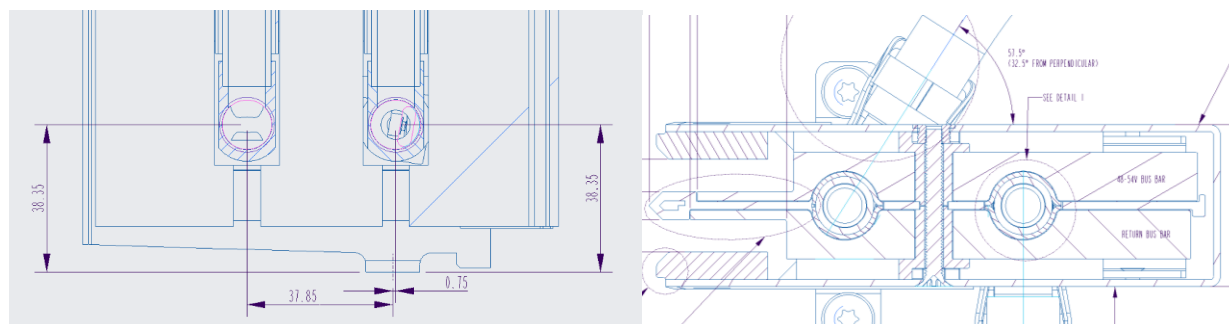


Figure 33: 2D excerpts showing inlet/outlet nominal center locations, and exit angle of inlet to allow screw access for rack installation

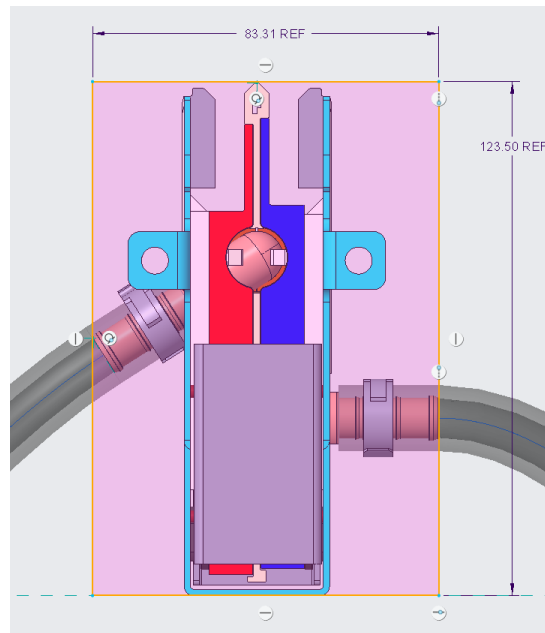


Figure 34: Keep-in zone for Busbar, inclusive of barbed fittings but not flexible hose extent

The reference design shows an insulating layer of GTS 348151 HTS and a thermal layer of TGP3500. The latter is compressed to 1mm from an initial 1.5mm. The total fastening strategy and locations must be sufficient to achieve the required thermal material compression and properly retain all components while avoiding copper removal on the high-power connection positions. Minor changes to the insulating cross section to guarantee Hi-Pot test, thermal performance and manufacturability may be possible.

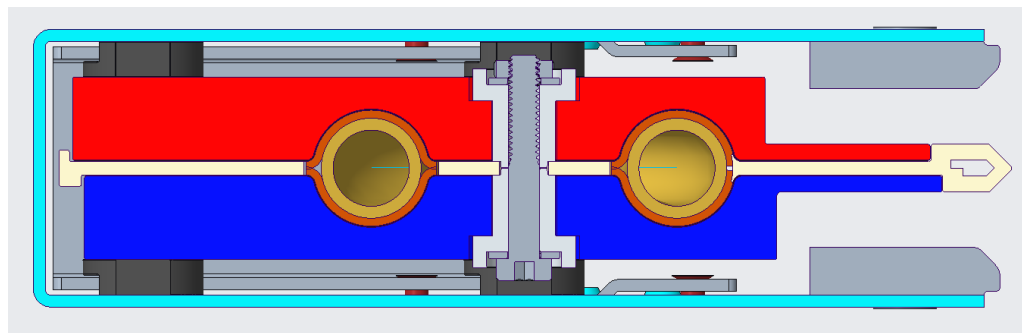


Figure 35: Cross sections of liquid cooled busbar including the different bolting geometries, TGP in orange and the GTS insulator in black

6.4. Busbar Thermal Requirements

Under the system's worst case thermal conditions, the finger and hand accessible surfaces shall be within the touch temperature limits.

The internal busbars shall be sized to keep their maximum temperature below the busbar clip temperature rating. This shall be evaluated on a system-by-system basis. The busbar shall have perforations on all 3 sides to maximize airflow over the busbar. The perforations shall be in a pattern to comply with touch requirements to not be accessible to user.

- On the back surface of the busbar enclosure the perforations should be at least ~30% of the total surface area
- On the side surfaces of the busbar enclosure the perforations should be at least ~15% of the total surface area

6.4.1. Busbar Liquid Cooling Requirements

Liquid inlet and outlet are positioned at the bottom of the rack. There is one QD for liquid input and one QD for liquid output.

Table 4: Liquid Cooling Requirements

Parameter	Requirements
Working fluid	PG25
Quick Disconnect	MQD-04, Right Angle
Maximum normal operating pressure	72psig
Maximum burst pressure	217psig
Minimum liquid inlet temperature	17C
Maximum liquid inlet temperature	45C
Maximum liquid outlet temperature	65C
Flow requirement at maximum liquid inlet temperature	Up to 6.5 LPM
Pressure drop	10psi at 6.5 LPM

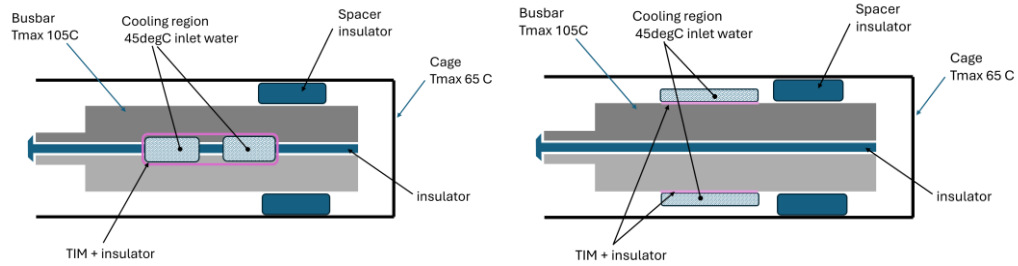


Figure 36: Busbar Cross Section Cooling regions temperature limits

[Left] inner core cooling

[Right] outer side cooling

The liquid inlet and outlet shall be positioned at the bottom of the rack. There shall be one QD each for liquid input output in a loopback configuration. There should be an intermediate flexible hose connection between the QD and the cold plate. The QD shall be an MQD-04, Right Angle, to connect directly to the compatible fitting on the rack manifold. The QD placement is shown in its connected position in the reference CAD.

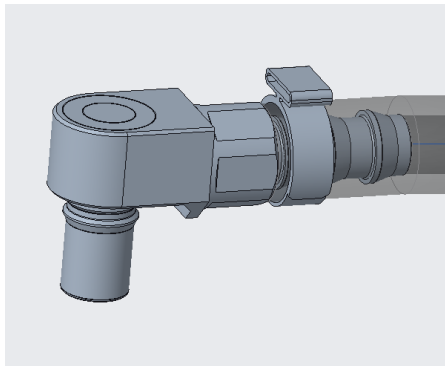


Figure 37: MQD-04 Right-Angle Plug, required for manifold interface, shown here with barb and 3/8 tubing, secured with crimped clamp



Figure 38: Manifold inlet/outlet connections shown. Nominal positions provided in 3D CAD.
Drip/leak tray is also shown, in beige

The cooling pipe shall make a right angle or attach to a right angle fitting at the inlet and outlet position. The reference CAD model assumes a brazed/soldered connection. The right-angle fitting shall have hose barbs directly integrated and be soldered/brazed onto the coldplate. The material selection should balance reliability, cost, and structural robustness of the protruding fitting. Vendor shall follow industry best practices for soldered/brazed joint detailed design. The sheet metal cutout shall be structurally bridged via a minimum of one M4 fastener directly above and below the cutout into the ground bumpers.

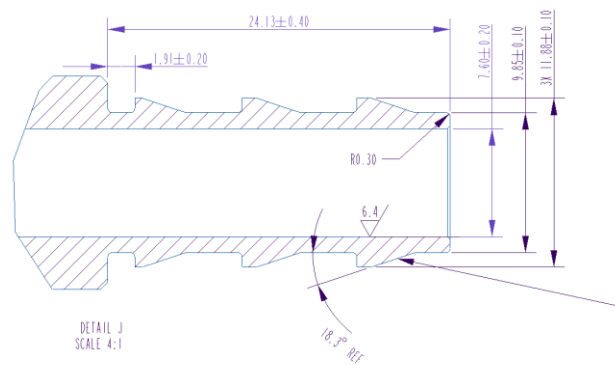


Figure 39: Reference fitting barb profile for 3/8" EPDM hose

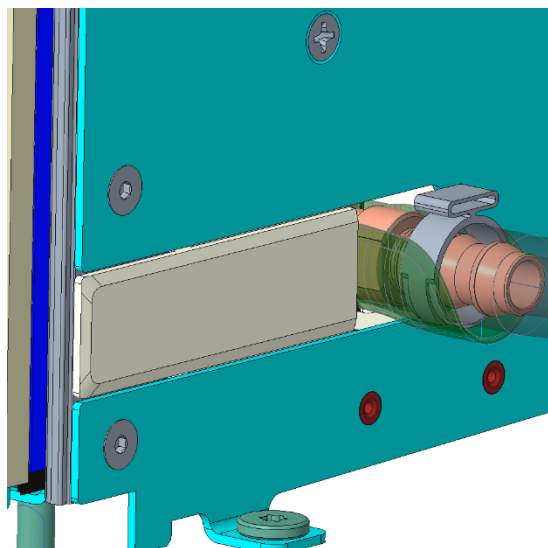


Figure 40: Fitting exit from busbar, showing structural bolts into ground bumper, ear type hose clamp and drip “boot” in green

Refer to 2D for recommended barb geometry. The barbs shall be designed to meet the selected hose specification at the required max temperature and pressure operating conditions of the fluid. Ear clamps are recommended, follow supplier recommendations for sizing and application; 40% to <100% closure of the ear is recommended to ensure adequate tension. Worm-gear hose clamps should not be used. Clamp-less hose types may be used but geometry must be confirmed by the hose supplier and tested.

The busbar power map can be seen below. Cooling design should be sufficient to keep the maximum temperature at 105 C or below. The busbar heat dissipation is calculated by assuming 2 $\mu\Omega$ electrical resistance per RU of each busbar (return or power).

Table 5: Heat dissipation including both power and return busbar losses per RU for example configuration

RU	Elevation	Power (W)	Load Demand (A)	Busbar Current (A)	Busbar Dissipation (W)	Connector Dissipation (W)
48		0	0	0	0.0	0.0
47		0	0	0	0.0	0.0
46	Switch	110	2	0	0.0	0.0
45	Switch	110	2	2	0.0	0.0
44		0	0	4	0.0	0.0
43	Power Shelf	0	0	835	5.6	0.0
42	Power Shelf	0	0	1669	22.3	0.0
41	Power Shelf	0	0	2504	50.1	133.2
40	Power Shelf	0	0	3338	89.2	133.2
39	Power Shelf	0	0	4173	139.3	133.2
38	Power Shelf	0	0	5007	200.6	133.2
37		0	0	5007	200.6	0.0
36	Tray	25000	510	4497	161.8	44.3
35	Tray	25000	510	3987	127.2	44.3
34	Tray	25000	510	3477	96.7	44.3
33	Tray	25000	510	2967	70.4	44.3
32	Tray	25000	510	2456	48.3	44.3
31	Tray	25000	510	1946	30.3	44.3
30	Tray	25000	510	1436	16.5	44.3
29	Tray	25000	510	926	6.9	44.3
28	Tray	25000	510	416	1.4	44.3
27	Tray	25000	510	0	0.0	44.3
26	Tray	4500	92	99	0.1	1.4
25	Tray	4500	92	131	0.3	1.4
24	Tray	4500	92	283	0.6	1.4
23	Tray	4500	92	375	1.1	1.4
22	Tray	4500	92	467	1.7	1.4
21	Tray	4500	92	558	2.5	1.4
20	Tray	4500	92	650	3.4	1.4
19	Tray	4500	92	742	4.4	1.4
18	Tray	4500	92	834	5.6	1.4
17	Tray	25000	510	926	6.9	44.3
16	Tray	25000	510	1436	16.5	44.3
15	Tray	25000	510	1946	30.3	44.3
14	Tray	25000	510	2456	48.3	44.3
13	Tray	25000	510	2967	70.4	44.3
12	Tray	25000	510	3477	96.7	44.3
11	Tray	25000	510	3987	127.2	44.3
10	Tray	25000	510	4497	161.8	44.3
9		0	0	5007	200.6	0.0
8	Power Shelf	0	0	5007	200.6	0.0
7	Power Shelf	0	0	4173	200.6	133.2
6	Power Shelf	0	0	3338	139.3	133.2
5	Power Shelf	0	0	2504	89.2	133.2
4	Power Shelf	0	0	1669	50.1	133.2
3	Power Shelf	0	0	835	22.3	0.0
2		0	0	0	5.6	0.0
1		0	0	0	0.0	0.0
Total Load (kW)		490.72 kW		Total Busbar Dissipation (W)	2752.9	1875.1

6.4.2. Busbar Leak Containment and Detection

The busbar shall contain a base pan for leak containment. In the event of base pan overflow the fluid should be directed to the back of the rack away from the IT gear.

The busbar shall also contain a leakage sensor for leak detection. Location and mechanism are design specific.

6.5. Busbar Installation

Busbar Assembly Process

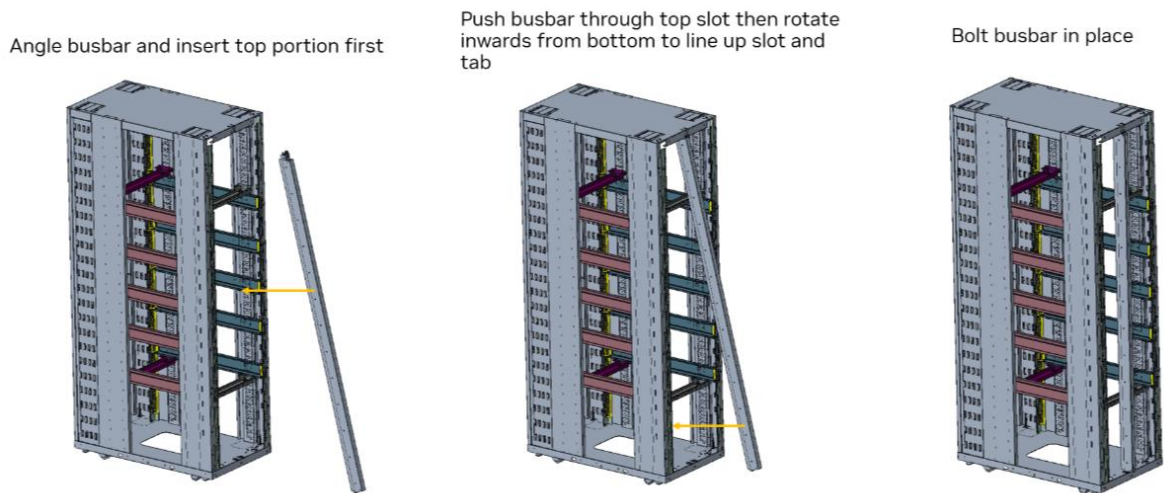


Figure 41: MGX Rack Busbar Installation Steps

6.6. Busbar Testing

6.6.1. Recommended Minimum Validation

Suppliers shall conduct a comprehensive test plan to their own standards to guarantee all specifications and reliability requirements over the lifetime of the product. A full test report should be provided for evaluation and approval.

Table 6: Recommended Minimum Testing on standalone busbar

Test Item	Test Standard
Temperature Rise vs. Current	UL 857, Clause 8.2.1
Voltage Drop	<0.25V at busbar current rating Source should be placed at the top of the busbar and loopback at the bottom of the busbar. Measure total busbar send and return
Dielectric withstand test (Hi-Pot)	See below
Vibration	EIA364-28
Mechanical Shock	EIA364-27
Durability	EIA-364-09D-2018
Painting Cross Hatch	ISO 2409
Plating Thickness	ISO 3497
Surface Roughness	ISO 4287
Purity of Silver	ASTM B700
Burnish Test	ASTM B571
Thermal shock test	ISO 2819:2017
Salt Spray	EIA-364-26C
UL Flammability	UL 60950-1
Damp Heat Test	IEC 60068-2-67
Thermal Cycling Test	IEC 60068-2-30

6.6.2. Rack Level System Integration Testing

During rack system integration testing a full rack operating at maximum load shall be tested for the busbar temperature rises. Enough time shall be given to reach the thermal steady state of the system. Thermocouples shall be placed on both the outer surface at the maximum hotspot for touch temperature as well as internal to the busbar near the hottest spot for the busbar clip connector.

6.6.3. Manufacturing Testing

Liquid Testing:

Pressure test requirements burst pressure 217 psig.

Hi-Pot Requirements:

The assembly must comply with the following HiPot requirements on 100% of Busbar assemblies.

Measured from power busbar to return busbar:

Minimum of 1.2 kV, 10 second ramp, 30 second hold with a maximum leakage of 10 μ A.

Measured from power busbar to chassis ground and return busbar to chassis ground (Not applicable to the hard grounded versions):

Minimum of 1.2 kV, 10 second ramp, 30 second hold with a maximum leakage of 10 μ A.

6.7. Busbar Environmental Requirements

The busbar shall meet the below required operating conditions.

Table 7: Busbar operating conditions

Test Item	Min	Typ	Max	Units
Operating Temperature	5	35	40	C
Storage Temperature	-40	25	70	C
Operating and Storage Humidity	8%	50%	85%	
Elevation			3050	m

6.8. Busbar Reliability Requirements

The busbar shall withstand 50 cycles of mating and un-mating with the specified IT connector in the Mechanical section of this document without wearing out the plating.

6.9. Busbar Labeling Requirements

100% of units shall be labeled with the following markings

- Part Number / Revision
- Date Code
- Hi-pot Stamp

6.10. Busbar Compliance Requirements

The product is to be designed to comply with the latest edition, revision, and amendment of the following standards. The product should be designed such that the end user could obtain the safety certifications: UL 62368-1 Edition 4, IEC 62368-1 Edition 4 and EN 62368-1 Edition 2; hazard-based performance standard for Audio video, IT & Communication Technology Equipment.

The manufacturer shall obtain the following safety certificates for the Liquid cooled rack busbar as applicable. Only requirements that absolutely rely on or are affected by the system may be left to the system level evaluation. Below are common requirements for North America and Europe. For other countries, different certifications may be required:

1. UL listed or an equivalent NRTL for the US with follow-up service (e.g. UL or CSA).
2. CB Certificate and test report based on IEC 62368-1 Edition 4 issued by CSA, UL, VDE, TUV or DEMKO.
3. CE Marking for EU

Following (but not limited) safety requirements are also applicable.

1. Liquid Cooling System shall pass IEC 62368-1 G.15 testing as a modular LFC. (All item number is referenced to IEC 62368-1 Edition 4)
 - a. Pass Hydrostatic Pressure test, IEC 62368-1 G.15.3.2 and Creep Resistance test, IEC 62368-1 G.15.3.3 with the highest pressure of following:
 - 3 times the maximum working pressure at normal operating conditions.
 - 2 times the maximum working pressure under abnormal operating conditions and single fault conditions.
 - 1.5 times the rated maximum working pressure of the rated pressure of Liquid Cooling System.
 - 345 kPa (50 psi).
 - b. Pass Tubing and fittings (O-ring and other associated fittings made from non-metallic materials) compatibility test, IEC 62368-1 G.15.3.4. Lead time 45 days is expected.
 - c. Pass Thermal Cycling test, IEC 62368-1 G.15.3.5.
 - d. Pass Force test, IEC 62368-1 G.15.3.6.

- e. Reinforced insulation shall be maintained between hazardous voltage (60 Vdc above or 42.4 V_{peak} above) and parts of Liquid Cooling System.
- f. Ground all metal parts of the liquid cooling system to prevent electrochemical decomposition of coolant (H₂O might be decomposed to O₂ and H₂).
2. The cooling liquid shall be accompanied by an MSDS (Material Safety Data Sheet) or documentation certifying its flash point, non-combustibility, and its compatibility with the equipment's materials shall be confirmed.
3. All connectors shall be UL recognized and have a UL flame rating of UL94 V-0.
4. All insulators, insulation coating or tape shall be UL recognized and have a UL flame rating of UL94 V-1, and pass IEC 62368-1 Electric strength test (Hi-Pot).
5. All hose shall be UL recognized and have a UL flame rating of UL94 V-2 or UL 1581 VW-1.
6. All other internal plastic parts shall be UL recognized and have a UL flame rating of UL94 V-1.
7. The metal chassis and its opening shall comply with IEC 62368-1 Edition 3 and Edition 4 fire enclosure requirements.
8. All creepage / clearance shall be determined according to IEC62368-1 at 3050m.

		Creepage	Clearance
1	Busbar and Cold plate	1.25 mm	0.6 mm
2	Busbar and Busbar		
3	Busbar and Cage		

9. Product safety label must be printed on UL approved label stock and printer ribbon. Alternatively, labels can be purchased from a UL approved label manufacturer. The product must be marked with the correct regulatory markings to support the certifications that are specified in this document.

7. Compute Tray Board and IO Form Factors

The following sections specify the Board and IO bays for the compute tray. These form factors are derived from the MGX architecture to enable modularity and re-usability. The board form factors employed in this specification are termed the “MGX board” (a full tray width form factor) and the “micro MGX” board (a half width form factor that allows two assemblies to be place side by side in a 19” EIA standard tray). This form factor shares common elements with OCP DC-MHS form factors as described below.

7.1 Board Form Factors

The micro MGX board is compliant with the outline and mounting holes defined in the DC-MHS DNO Type 2 specification. The following figure shows the approximate locations of major parts of the micro MGX motherboard.

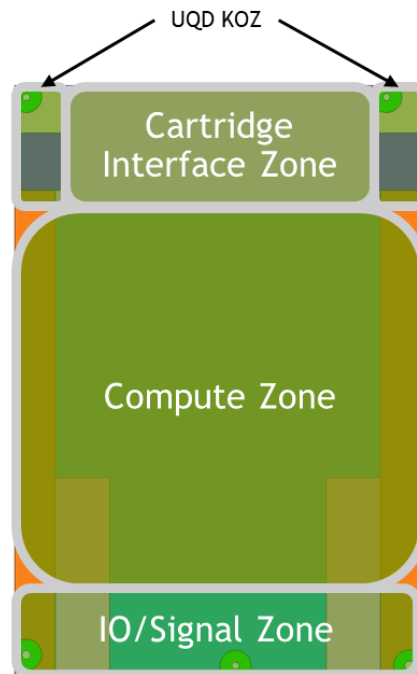


Figure 42: Micro MGX Board Overview

7.2 Micro MGX Outline

The micro MGX board outline is shown in below. The units are in millimeters. Refer to 3D models provided for design details not shown here.

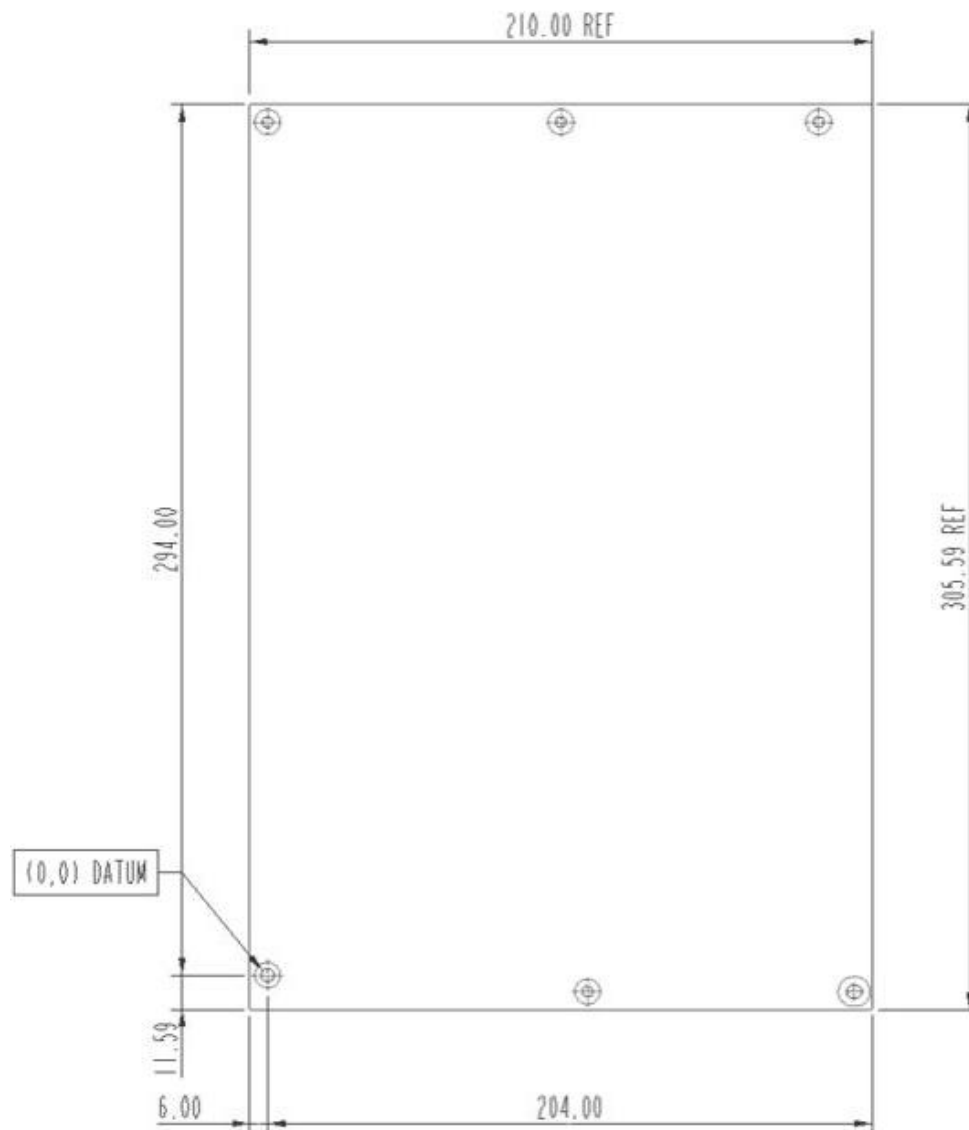


Figure 43: Micro MGX Board Outline

7.2.1. Micro MGX Mounting Holes

The following figure defines the required mounting hole locations and sizes. Additional mounting holes may be necessary for mechanical stability based on technological and design needs. The implementer of this specification may introduce additional mounting holes as needed. All fasteners or mounting methodologies contacting the motherboard must stay within the ground pad diameter as shown in the following figure.

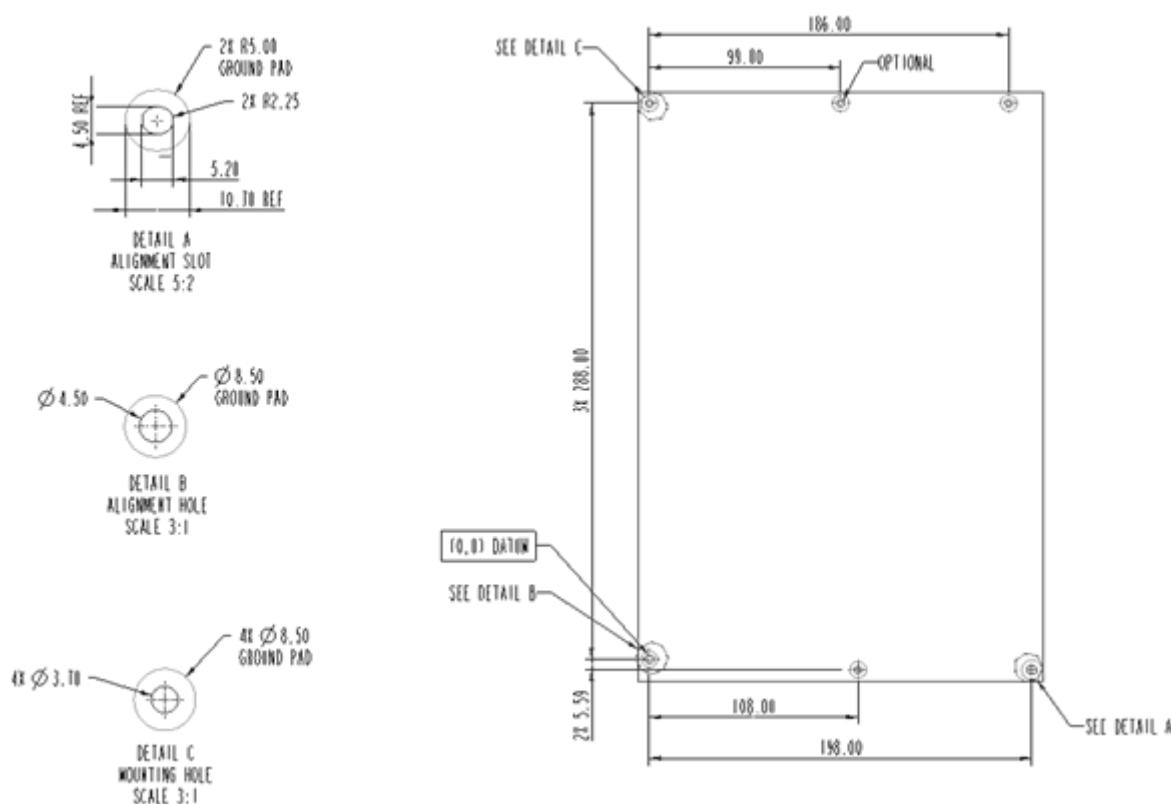


Figure 44: Micro MGX Board Mounting Holes

7.2.2. Micro MGX Keepout Zones

Maximum component height restrictions define an absolute maximum height of components terminated to the PCB post processing for both the primary and the secondary sides of the board. Implementers must use best practices for supporting other components within the system added after the board process. Examples of these types of components include, but are not limited to, heat sinks, air baffles, cable management hardware, and so on.

There are two options available for the primary side keepout zone. The first, a more generic option, considers DIMM based HPMs and provides a large region suitable for placing DIMMs. The second option is more detailed and intended to be used for non-DIMM layouts. The CAD contributed with this specification includes the micro MGX non-DIMM layout. Other options specified here are for the purpose to show other possible implementations.

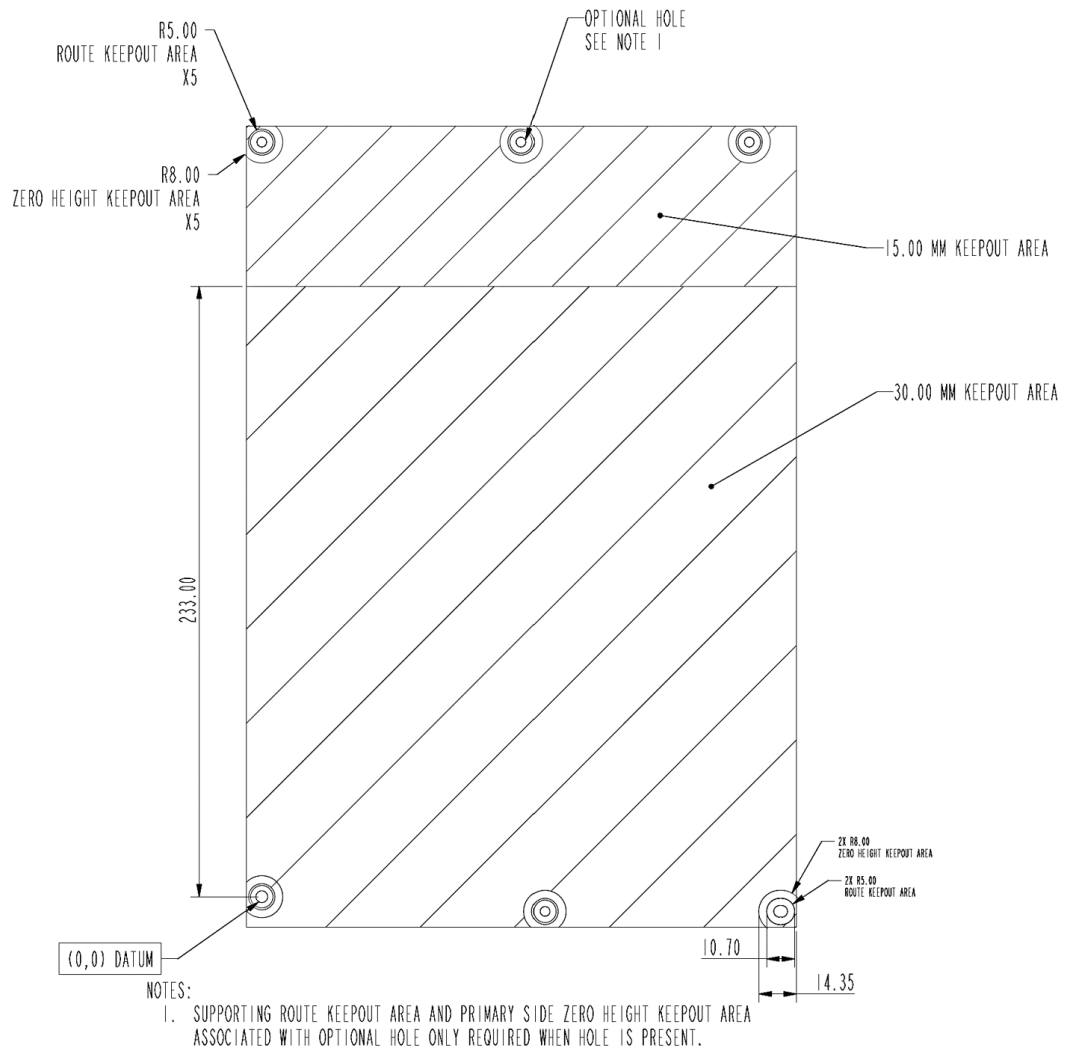


Figure 45: Micro MGX Primary Side Maximum Component Height Keepouts DIMM Based HPM Option

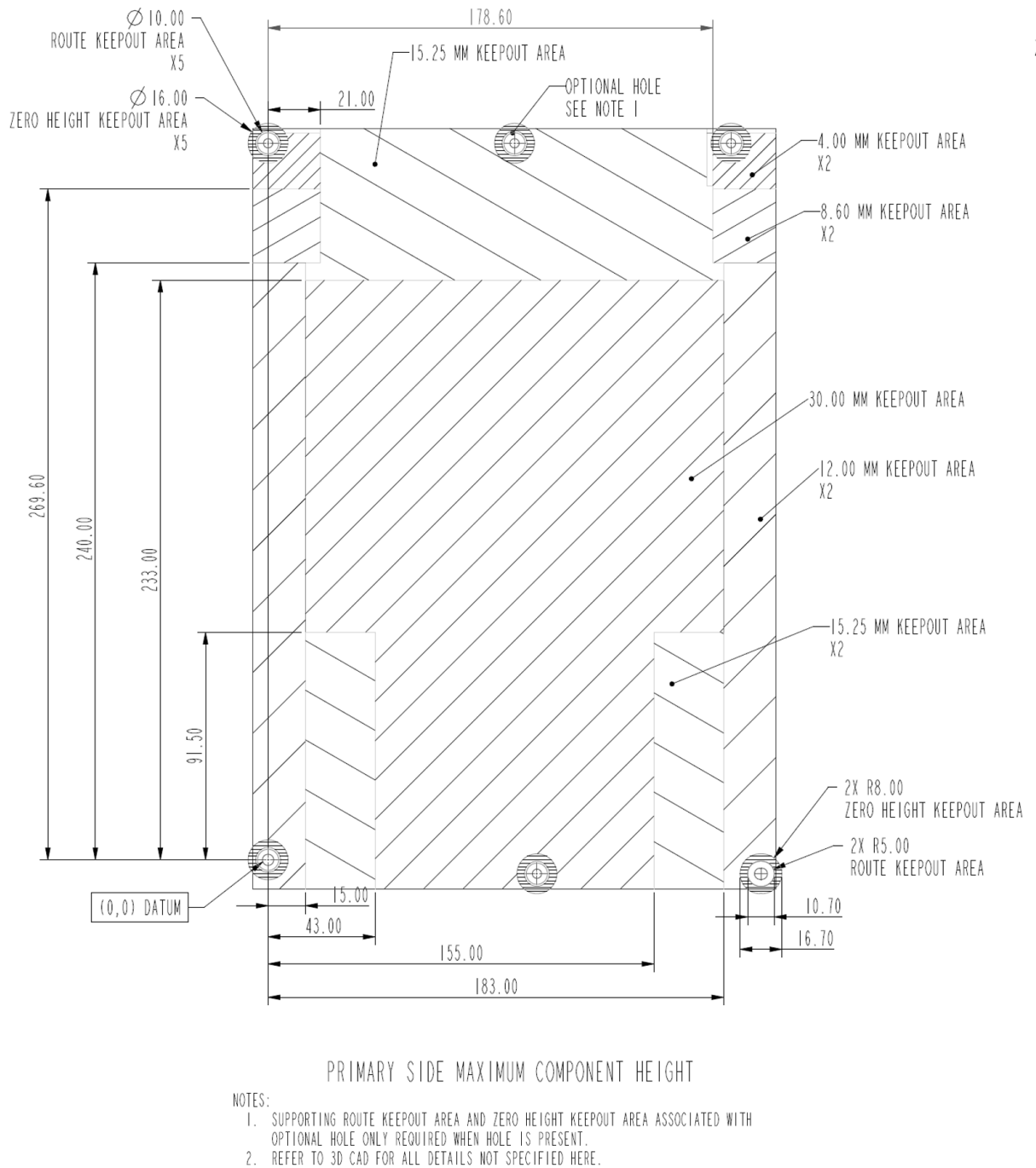
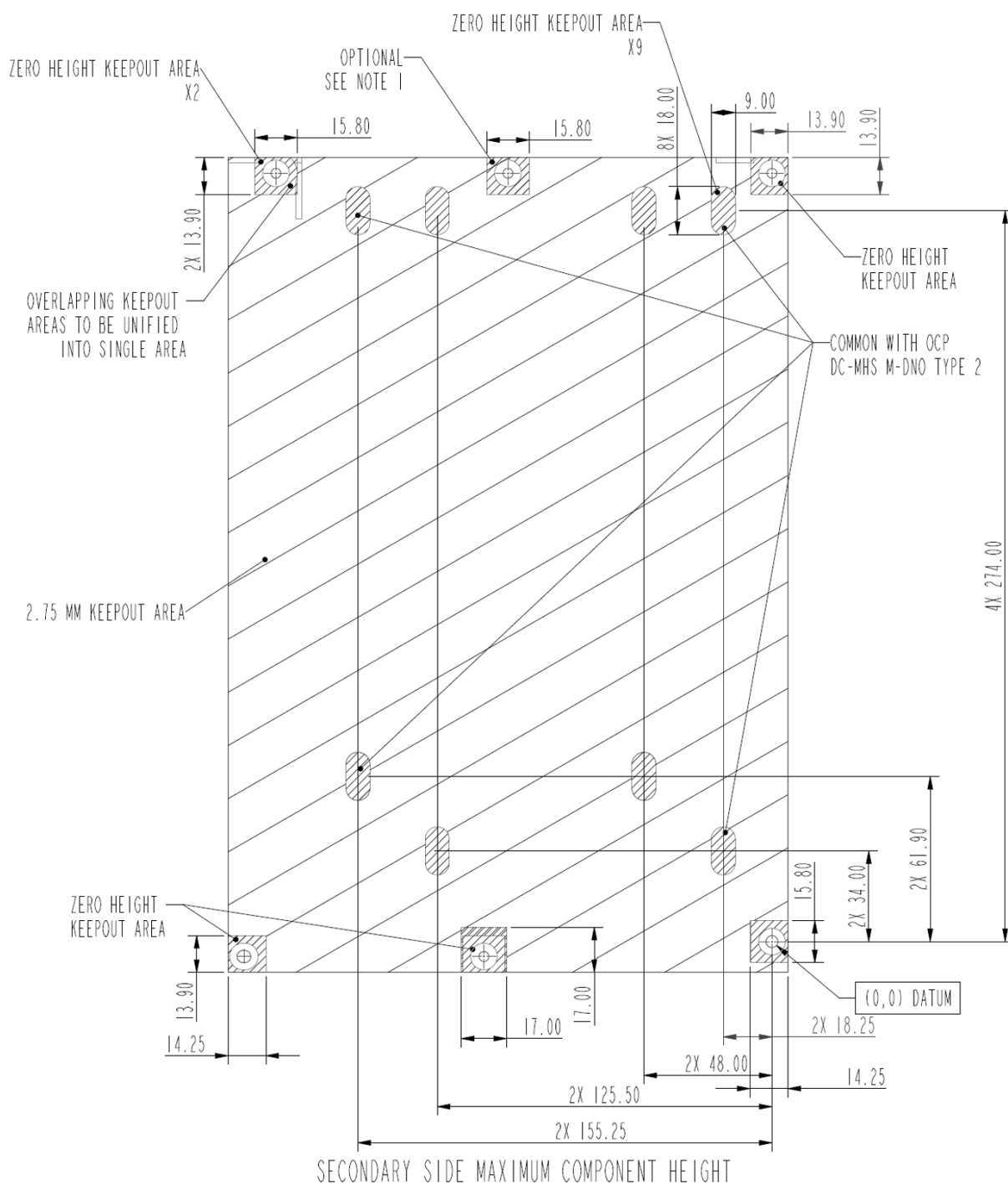


Figure 46: Micro MGX Primary Side Maximum Component Height Keepouts Non-DIMM Based Option

Component height restrictions on the secondary side of the PCB do not include supporting mechanical structures that may be necessary for the motherboard (such as, sub-pans, stiffening plates, or other mechanical parts). If this additional hardware is required in the design, necessary keep-in or keepout zones should be added as

required. However, there are predefined areas where zero height is required to be compatible with other systems based on an OCP DC-MHS architecture for M-DNO.



NOTES:

1. SUPPORTING ROUTE KEEPOUT AREA AND ZERO HEIGHT KEEPOUT AREA ASSOCIATED WITH OPTIONAL HOLE ONLY REQUIRED WHEN HOLE IS PRESENT.
2. REFER TO 3D CAD FOR ALL DETAILS NOT SPECIFIED HERE.

Figure 47: Micro MGX Board Secondary Side Maximum Component Height Definition

7.2.3. Micro MGX Board Pan

The micro MGX board allows use of a supporting board pan. The micro MGX board secondary side component height constraints assume using this pan as a part of an overall assembly accounting for compatibility to a common chassis. The board pan design may vary based on implementation.

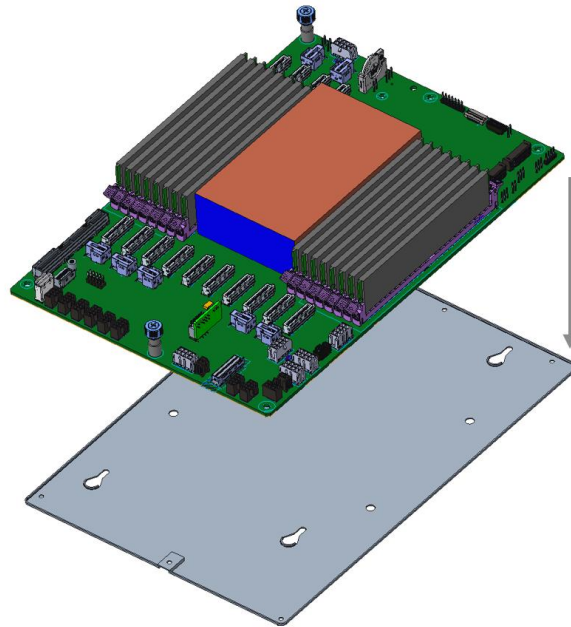


Figure 48: Micro MGX Board Pan Example

7.3 MGX Board Outline

The MGX board defined in this specification takes advantage of the allowable motherboard zone in the chassis to maximize available board space. The following figure shows the approximate locations of major parts of the MGX motherboard. Refer to 3D models provided for design details not shown here.

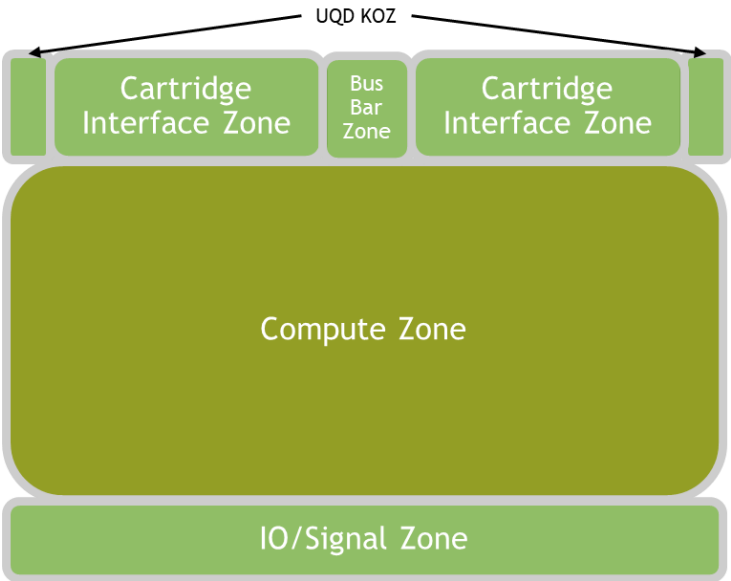


Figure 49: MGX Board Overview

7.3.1. MGX Board Outline

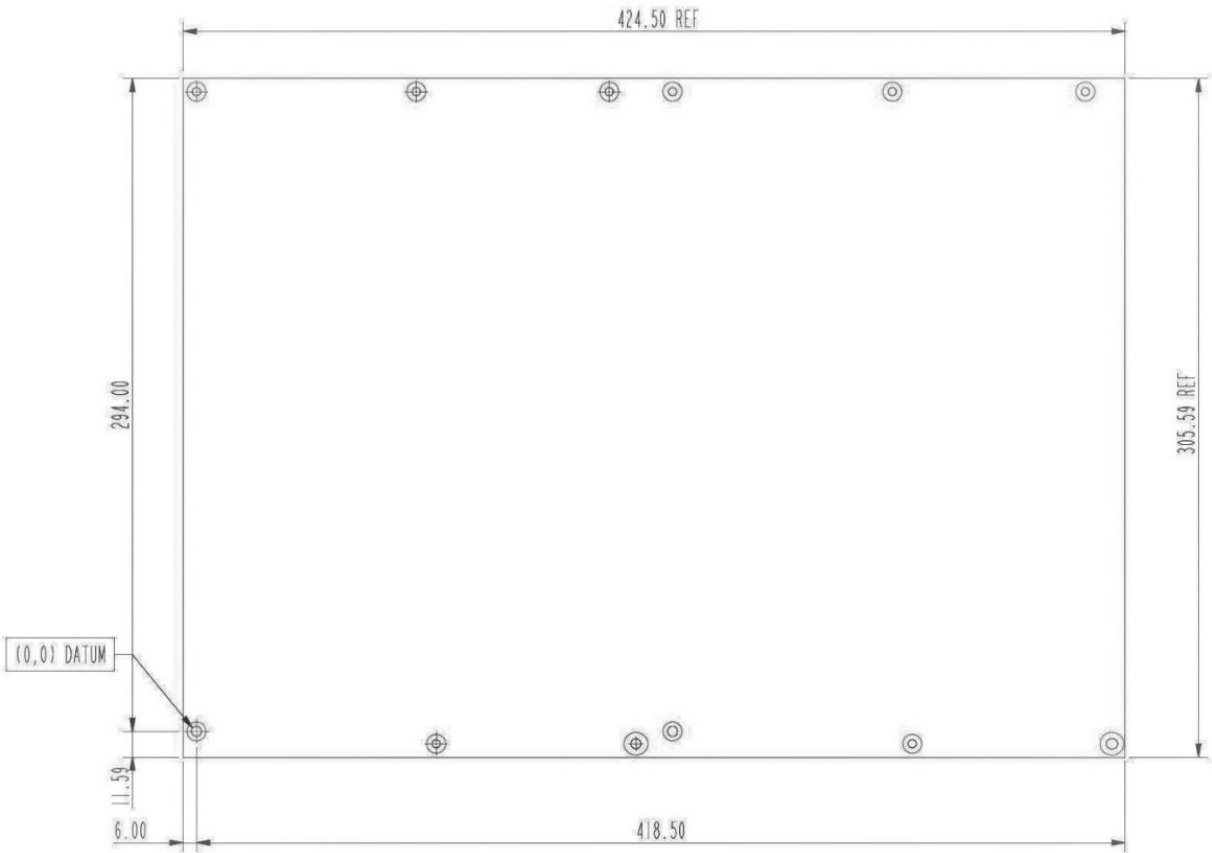


Figure 50: MGX Board Outline, units in mm

7.3.2. MGX Board Mounting Holes

The following figure defines the required mounting hole locations and their sizing. Additional mounting holes may be necessary for mechanical security based on technological and design needs. The designer may introduce additional mounting holes as needed. All fasteners or mounting methodologies contacting the motherboard must stay within the ground pad diameter as shown in the following figure.

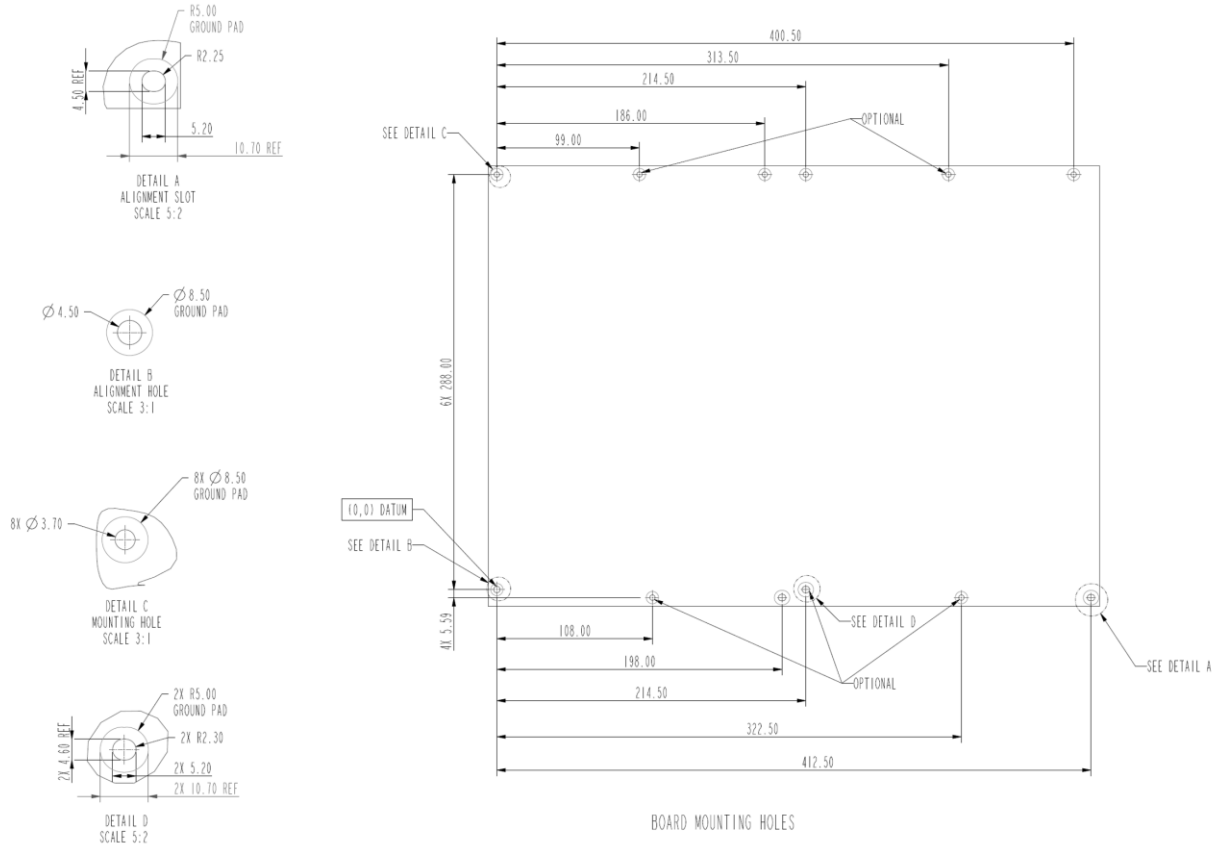


Figure 51: MGX Board Mounting Holes

7.3.3. MGX Board Keepout Zones

Maximum component height restrictions define an absolute maximum height of the components terminated to the PCB following the processing for both the primary and secondary sides of the board. The designer must use best practices for supporting other components within the system added in the post board process. Examples for these types of components include, but are not limited to, heat sinks, air baffles, cable management hardware, and so on.

Again, there are two options available for the primary side keepout zone. The first, a more generic option, considers DIMM based HPMs and provides a large region suitable for placing DIMMs. This board form factor is defined here to show additional implementation options of the compute tray HPM.

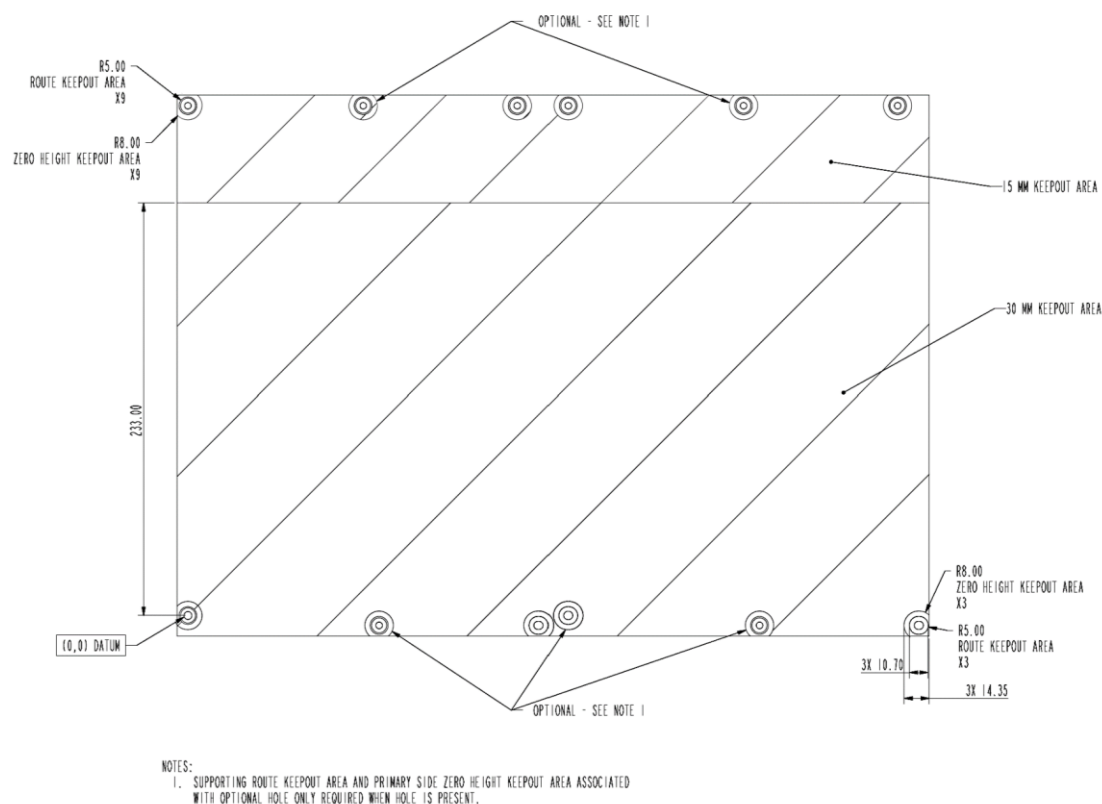


Figure 52: MGX Board Primary Side Maximum Height Component Height Keepouts DIMM Based HPM Option

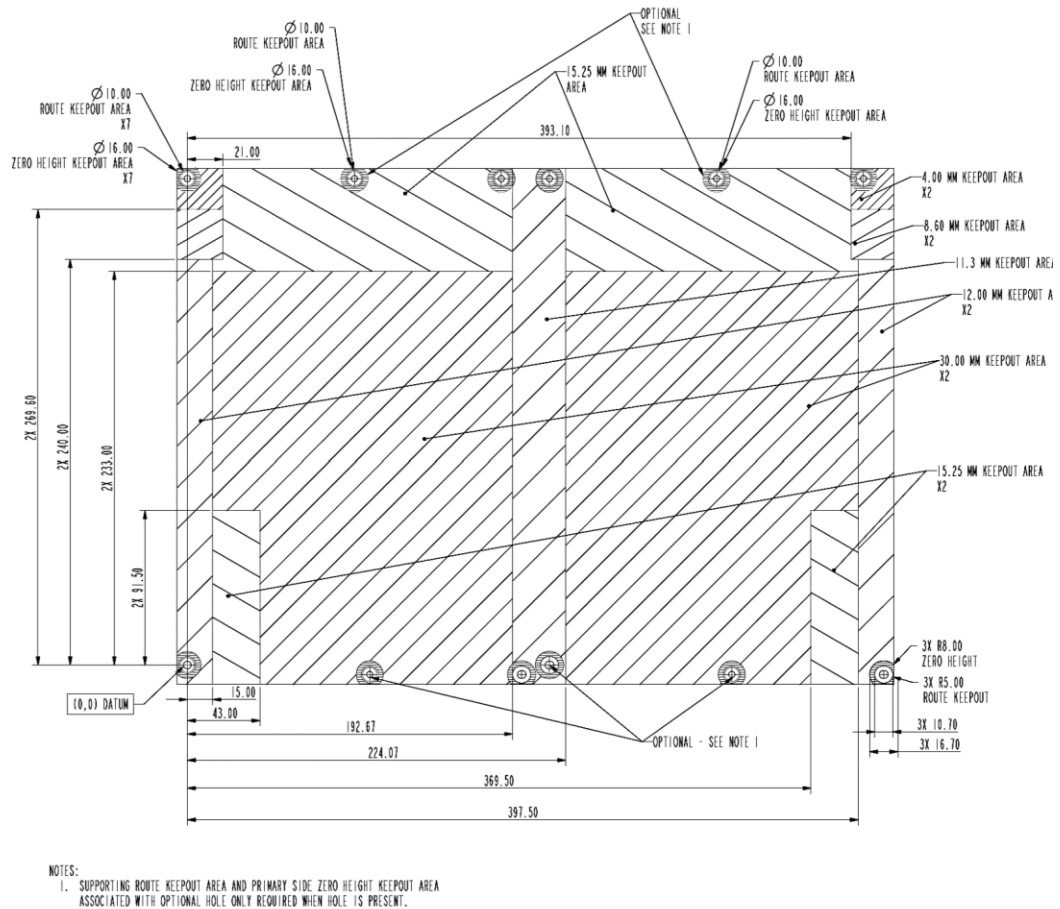


Figure 53: MGX Board Primary Side Maximum Component Height Keepouts Non-DIMM Based Option

Component height restrictions on the secondary side of the PCB do not include supporting mechanical structures that may be necessary for the motherboard (such as subpans, stiffening plates, or other mechanical parts). If this additional hardware is required, necessary keep-in or keepout zones should be added as required. However, there are predefined areas where zero height is required to be compatible with other systems based on an OCP DC-MHS architecture for M-FLW.

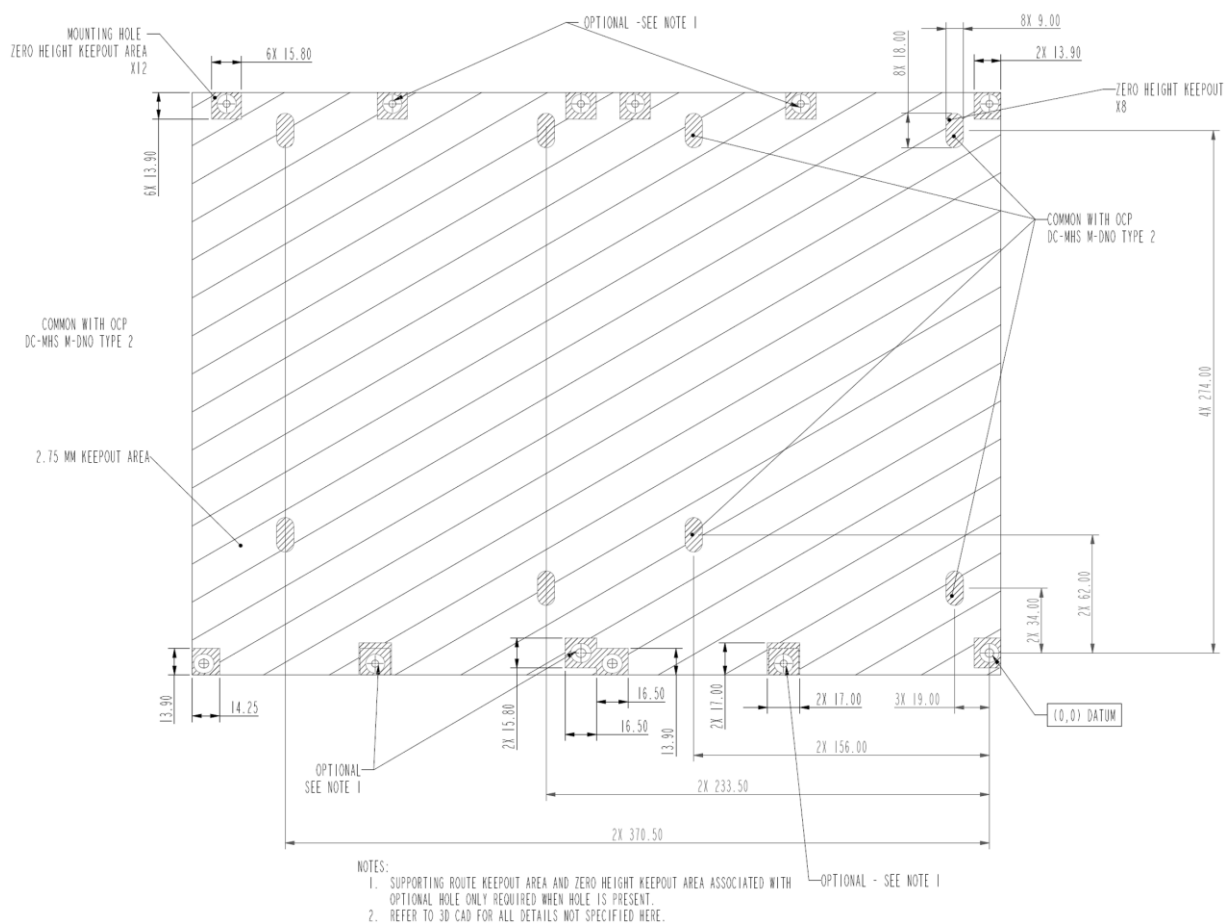


Figure 54: MGX Board Secondary Side Maximum Component Height Definition

7.3.4. MGX Board Pan

Like the micro MGX board, the MGX board form factor allows for a supporting board pan. Its secondary side component height constraints assume that the pan is part of an overall assembly accounting for compatibility to a common chassis.

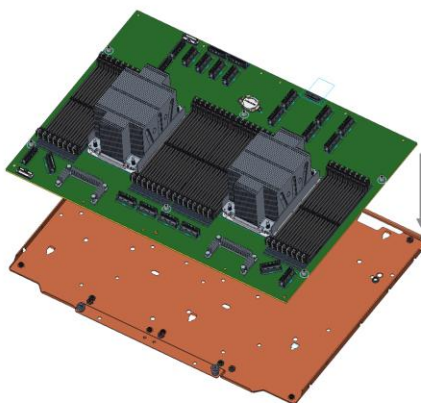


Figure 55: MGX Board Pan Example

7.4 IO Bay Form Factor

The MGX architecture from which the Compute Trays are derived contains several sizes of bay modules that are suitable for many chassis lengths, chassis heights, and desired system technology layout configurations. The configuration shown below is the example implementation in the CAD of this contribution. This configuration supports 4 air cooled OSFP transceivers, 2 PCIe card slots, 8 E1.S SSDs, Power buttons, status LEDs, a MGMT port and serial pull tab. Refer to 3D models provided for design details not shown here.

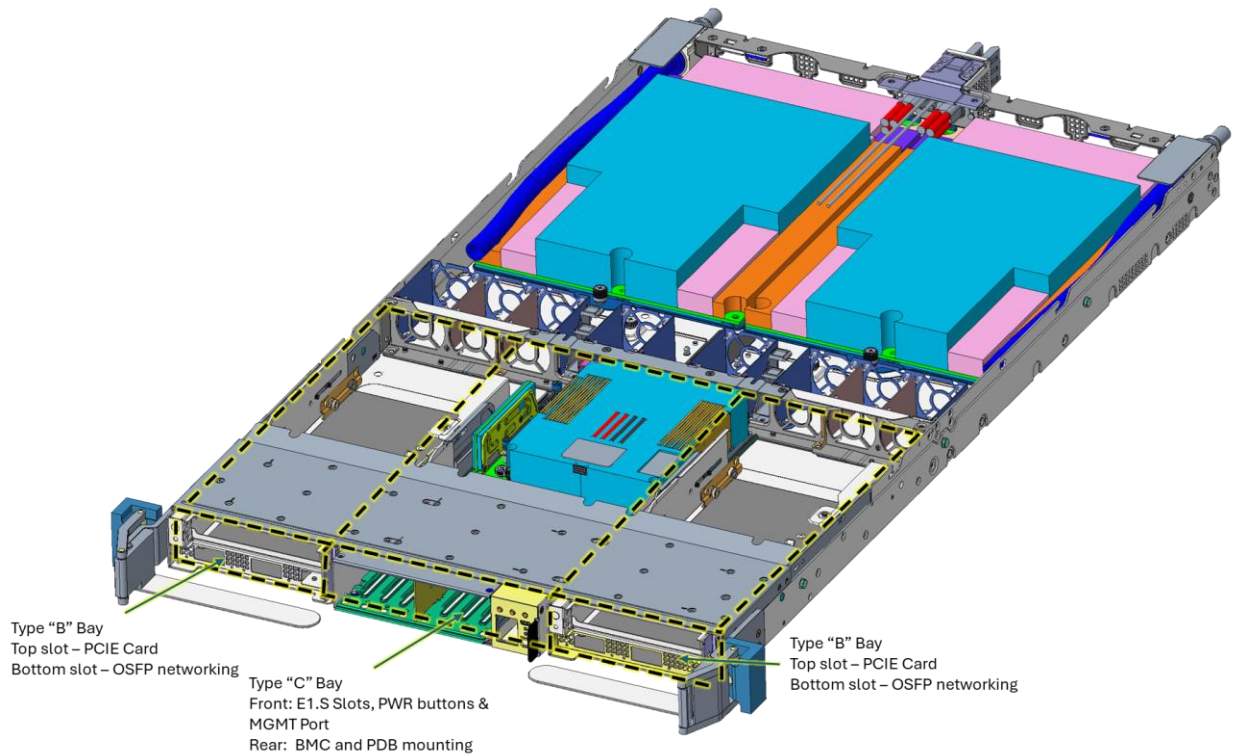


Figure 56: Compute Tray IO Bay Examples

However, many options are available so that implementers may customize the front configuration to meet their specific IO needs. The following section details the options for IO configurations and defines the architecture around them.

Across the various modular bay types are common interfaces within the system to permit compatibility of a short bay module within the same space required for a long bay module, the use of two 1RU bay modules within the space of a single 2RU bay module, or the use of wider bays in place of narrower options. An overview of each bay module is described in this section for reference and to show all available options when implementing a compute tray to this specification.

Table 8: Bay Module Attribute Description

Bay Module Attribute	Background
Type A	Description of bay module width. Width inspired to support E1.s EDSFF storage or power input connectors.
Type B	Description of bay module width. Width inspired to support full-height PCIe AIC with standard faceplate.
Type C	Description of bay module width. Width inspired to span the width of a Type A, Type B, and the divider. It will also support two CRPS units side by side with room for pass-through power cable.

Bay Module Attribute	Background
Type D	Description of bay module width. Width inspired to span the width of two Type B bays and the divider. It can support designs requiring more space than standard PCIe AIC widths.
Type E	Description of bay module width. Width inspired to span the width of a Type B and Type C bay and the divider. It is able to support designs requiring more space than a standard double width Type B bay.
Short	Description of bay depth. Short depth bays can be used in bays designated as short or long and may support storage devices such as NVMe E1.S, E3.S, U.2
Long	Description of bay depth. Long bays can only be used in bays designated as long and cannot be used in short bay locations. Depth inspired to support a long PCIe AIC length.

7.4.1. Bay Design and Location

As described in the table above, five different bay types are possible. Each bay type has a required width dimension but can support different heights and depths. The bay depth is classified as either short or long depending upon the max depth dimension of the bay and the height can vary in increments of an RU (for example, 1RU, 2RU, 4RU, and so on).

The bays can be placed in a system in many configurations, but the location is restricted by its type and depth. These restrictions, along with the chassis design, will dictate the bay quantities and locations allowed in a system and are interfaced with a bay naming methodology. The bay naming assumes that every system has four bay locations across the width in both the front and back labeled 1 through 4. The height of the chassis is designated by rows with every row number indicating 1RU of height. The bay name then communicates depth, chassis location, and type as follows:

Bay Location = Row Location + Depth (Short/Long) + Location (1,2,3,4) + Type (A,B,C,D,E)

When using one of the wide bays, types C, D, or E bays, the 1 through 4 chassis location numbering system is still maintained by listing all the chassis locations the bay uses. For example, a Type D long bay located on the leftmost chassis location in the bottom RU would be assigned the name 'Row 1 - Long 1.2.D.' The name communicates that the Type D Bay uses locations 1 and 2 in the chassis and is located on the bottom RU of height. In a similar fashion, if using a bay taller than 1RU, the bay name would list all the rows the bay uses. For example, if the bay just discussed was 2RU in height, the

assigned name would be 'Row1.2 – Long 1.2.D.' Other bay numbering examples and an illustration of row locations in a 2RU system are provided in the following figures.



Figure 57: Example Bay Location Names

7.4.2. Type A Bay Module

The Type A Bay module is sized to support the width necessary for existing standard form factors such as an E1.S EDSFF device or an input power connection enabling pass through PDU to PSU connectivity. However, the use of this bay module is not limited to these form factors.

The Type A Bay can be constructed into any RU height with the 1RU form factor being the main use case. It can also come in either a short or long depth with the short bay having a max dimension of 132.8 mm and long bay 318 mm. However, the width of the bay of 29.8 mm is a requirement. The module envelope dimensions shown here are nominal outside envelope dimensions.



Figure 58: Bay Type A Dimensional Envelope

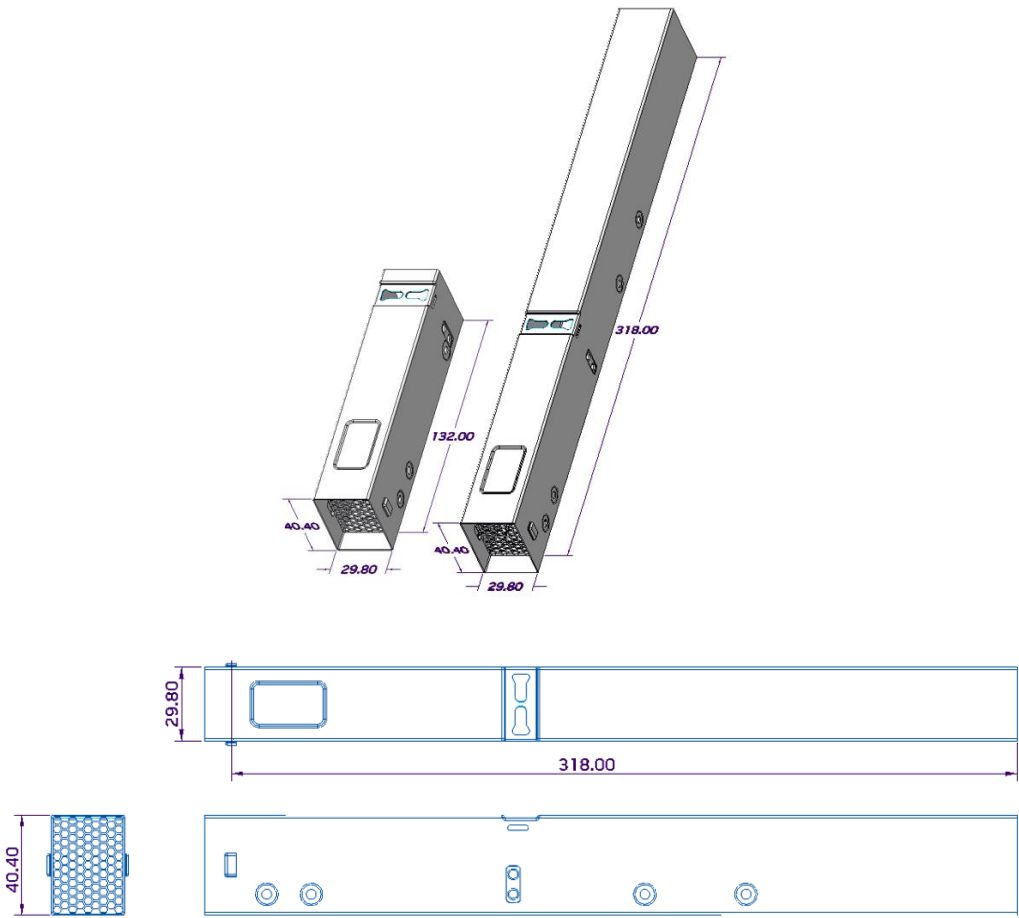


Figure 59: Bay Type A Detail

7.4.3. Type B Bay Module

The Type B Bay module is sized to support the depth necessary for a full-length PCIe AIC form factor. However, the use of this bay module is not limited to a PCIe AIC form factor. Other form factors available within the industry may be supported. In addition, should there be a need for a unique I/O board, or other technology, the developer is able to support this implementation within the envelope of the bay module form factor.

Like the Type A Bay, a Type B Bay can be constructed into any RU height with the 1RU form factor being the main use case. It can also come in either a short or long depth with the short bay having a max dimension of 132.8 mm and long bay 318 mm. The required width of the Type B Bay is 129.5 mm.

Width : 129.5 mm
Short Depth: 132.8 mm Max
Long Depth: 318 mm Max

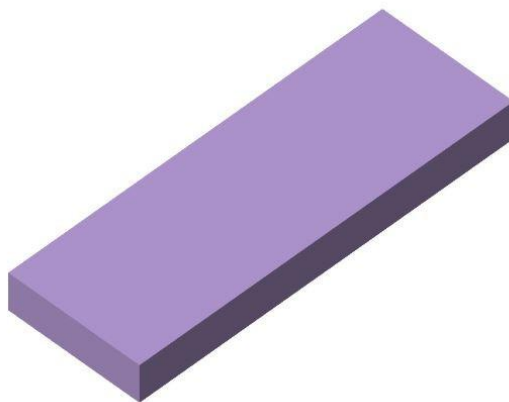


Figure 60: Bay Type B Dimensional Envelope

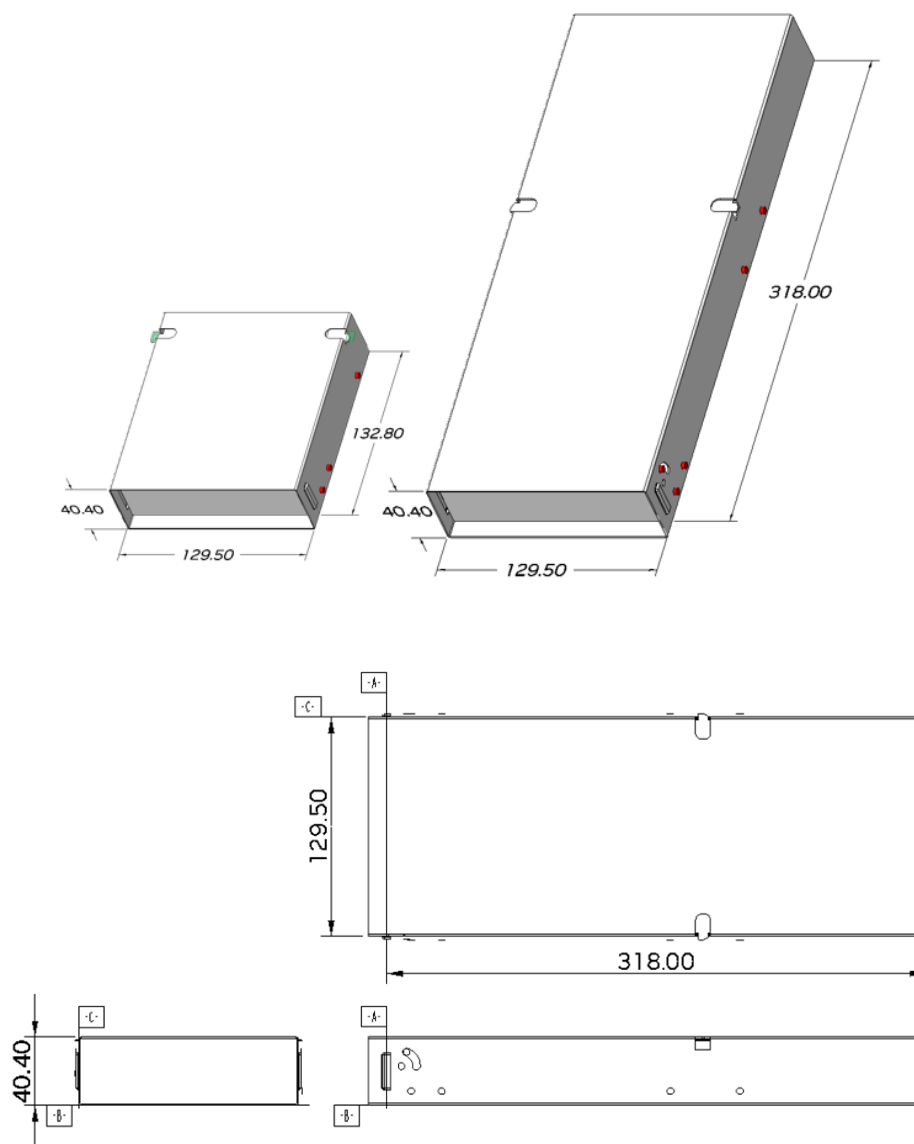


Figure 61: Bay Type B Detail

Some form factors (such as PCIe AICs) may include geometry that must extend beyond the datum surface. Any protrusion beyond the datum surface is the responsibility of the system designer.

7.4.4. Type C Bay Module

The Type C Bay module is sized to support the depth necessary for a full-length PCIe AIC form factor but with a greater allowable width than the Type B Bay. It is sized to

accommodate two CRPS units side by side. The Type C Bay module consumes the same width as a Type A and a Type B Bay module together.

The Type C Bay can also be constructed into any RU height and can be made in either short, CRPS optimized short or long depth. The max dimension for the short bay is the same as the other short bays. However, the Type C Bay has a CRPS optimized option which allows for a longer depth due to it being used for standard CRPS power supplies. The optimized short bay max dimension is 185 mm. The width of the bay is 163.5 mm.

Bay Type C

(Requires Same Width as Type A+ Type B)
Width : 163.5 mm
Short Depth: 132.8 mm Max
Short CRPS Optimized Depth: 185 mm Max
Long Depth: 318mm Max

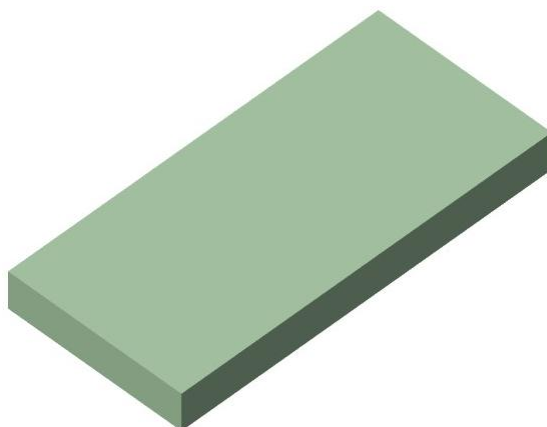


Figure 62: Bay Type C Dimensional Envelope

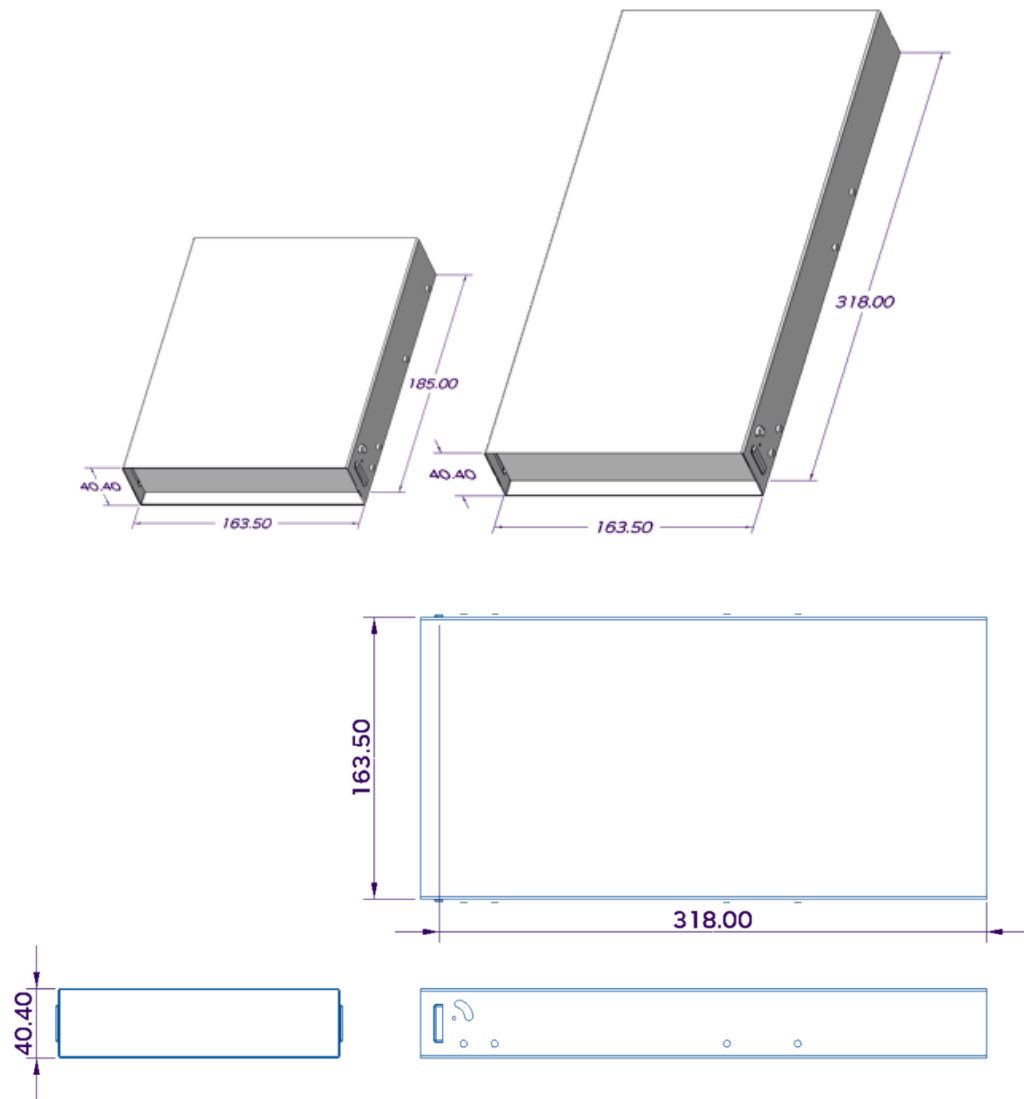


Figure 63: Bay Type C Detail

Some form factors (such as PCIe AICs) may include geometry that must extend beyond the datum surface. Any protrusion beyond the datum surface is the responsibility of the system designer.

7.4.5. Type D Bay Module

The Type D Bay module is sized to be the equivalent width of two Type B bays plus the divider. It is sized to accommodate two PCIe full-height cards side by side or for a micro-MGX motherboard. However, the use of this bay can be used for other content if the overall dimensional requirements are satisfied.

The Type D Bay can also be constructed into any RU height. It can be made in either a short or long depth with the short bay having a max dimension of 132.8 mm and long bay 318 mm. The required width of the Type D Bay is 263.2 mm.

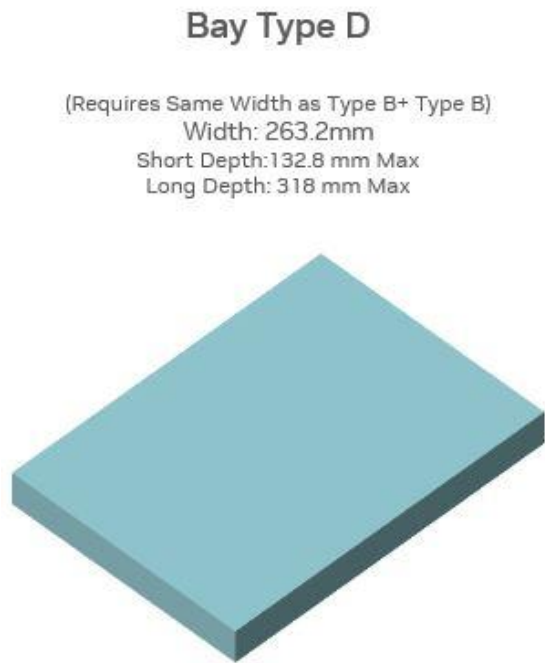


Figure 64: Bay Type D Dimensional Envelope

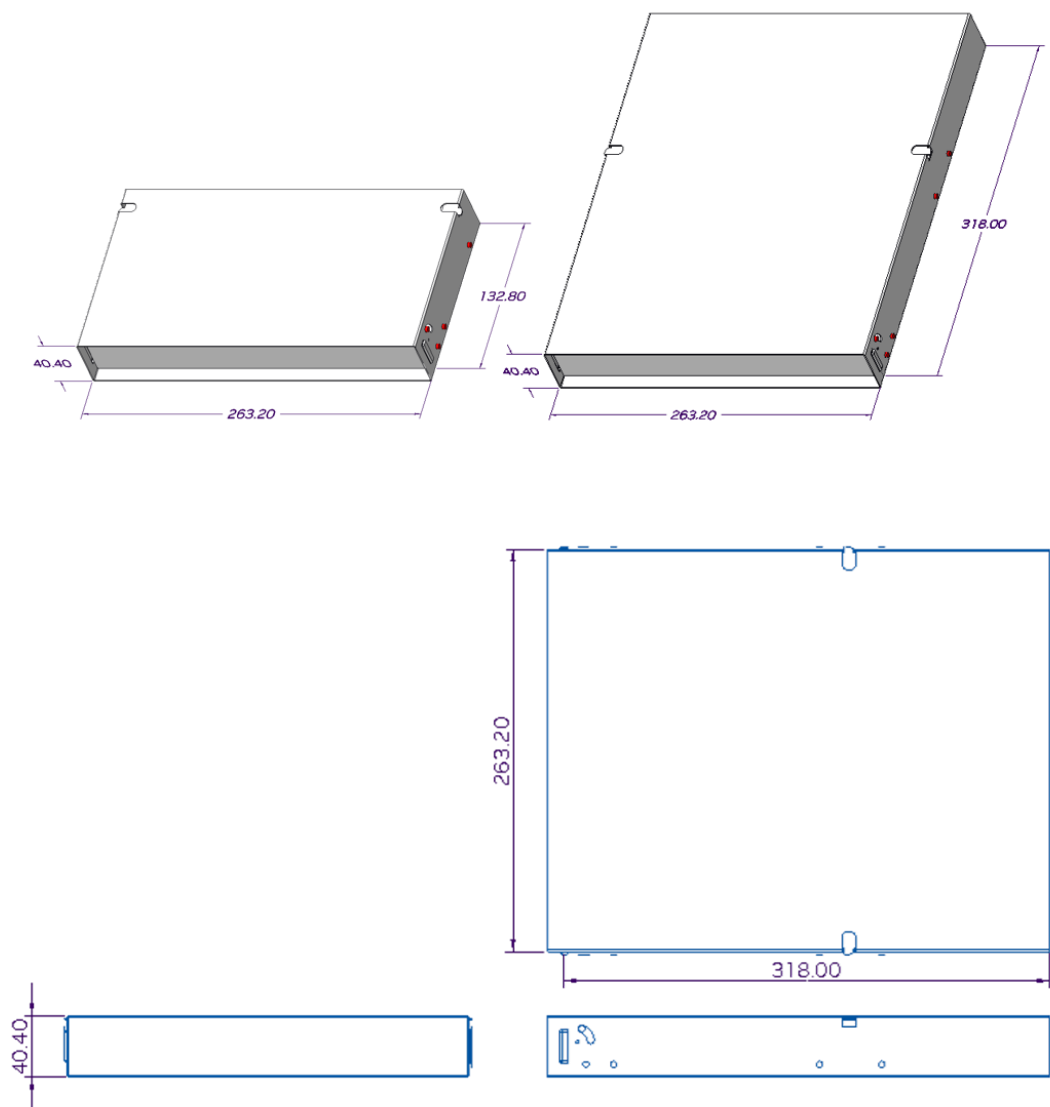


Figure 65: Bay Type D Detail

7.4.6. Type E Bay Module

The Type E Bay module is sized to be the equivalent width of a Type B plus a Type C Bay with the divider. It can be constructed into any RU height and can be made in either a short or long depth with the short bay having a max dimension of 132.8 mm and long bay 318 mm. The required width of the Type E Bay is 297.2 mm.

Bay Type E

(Requires Same Width as Type B+ Type C)

Width : 297.2 mm

Short Depth: 132.8 mm Max

Long Depth: 318 mm Max

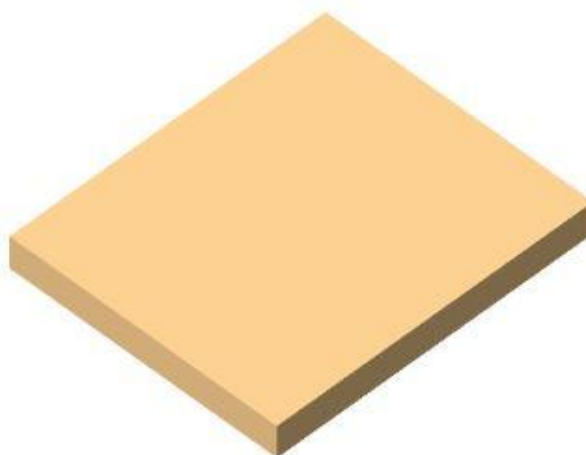


Figure 66: Bay Type E Dimensional Envelope

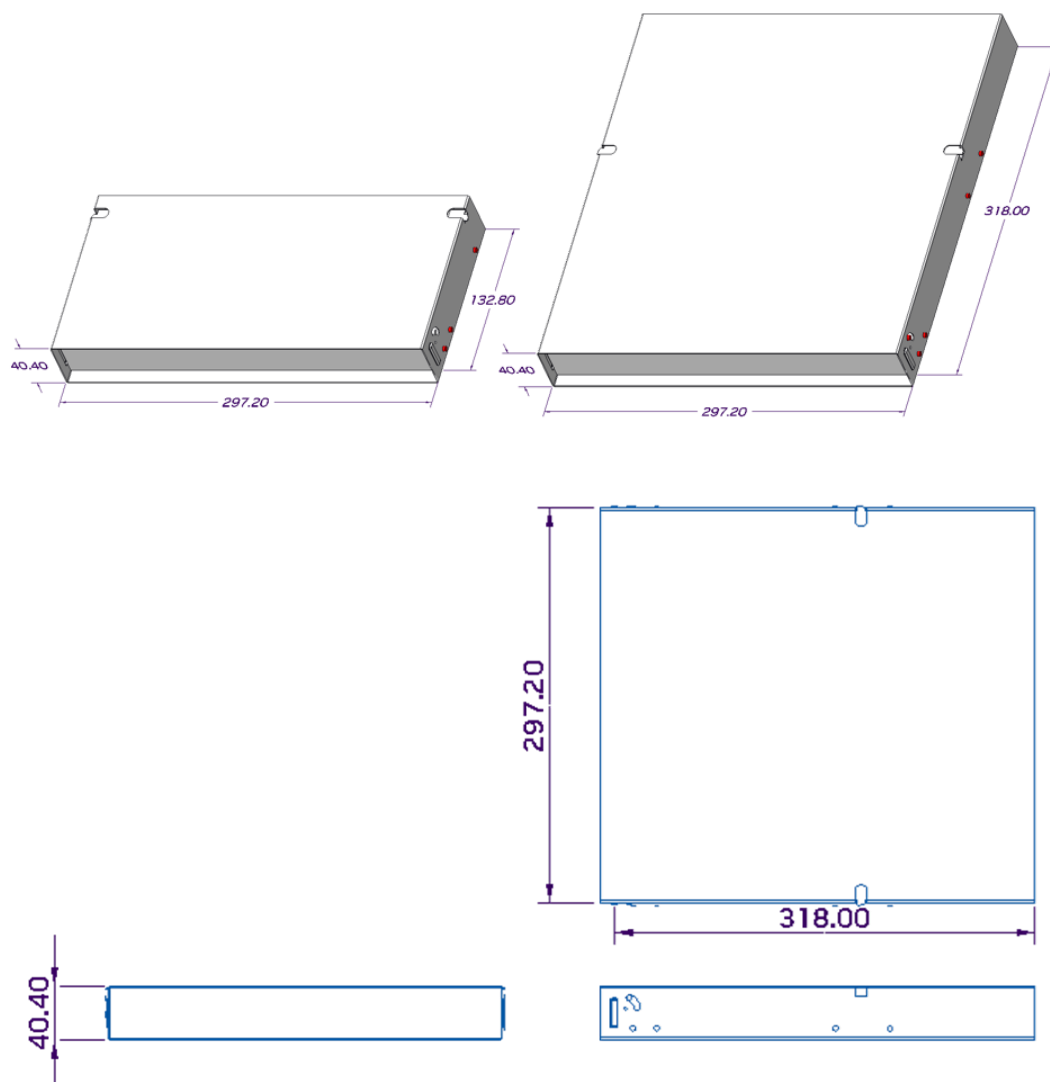


Figure 67: Bay Type E Detail

7.4.7. Bay Chassis Interface

Each bay module is secured to the chassis during configuration assembly using one of two methodologies. A single spring latch and catch, internal to the system, or a camming latch handle (external to the system), retains the bay in place. Each bay in the chassis may be designed to support a short bay, long bay, or both by allowing for spring or camming latch positions as shown in the following figures. Refer to 3D models provided for design details not shown here.

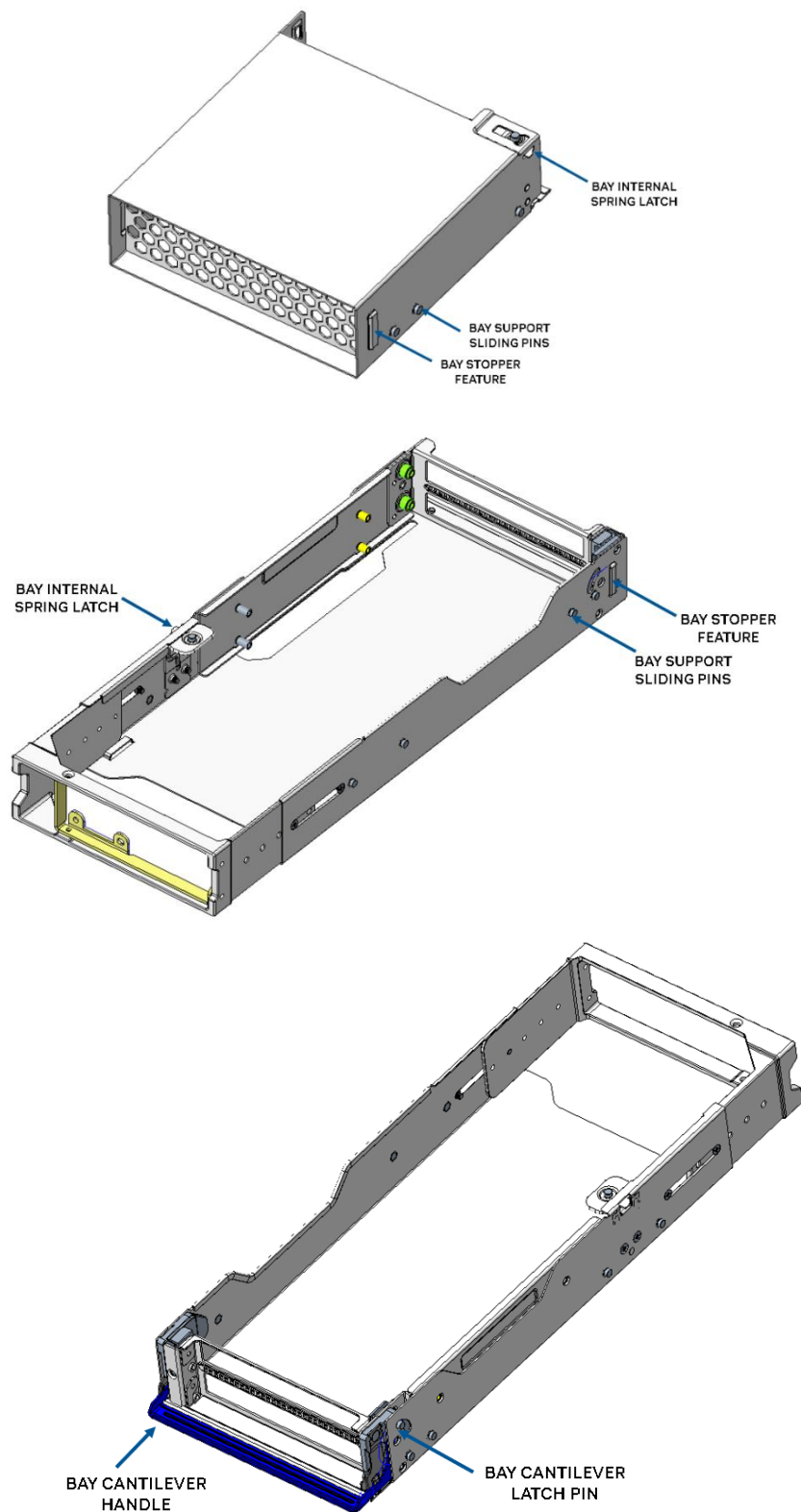


Figure 68: Bay Module Retention to Chassis Detail

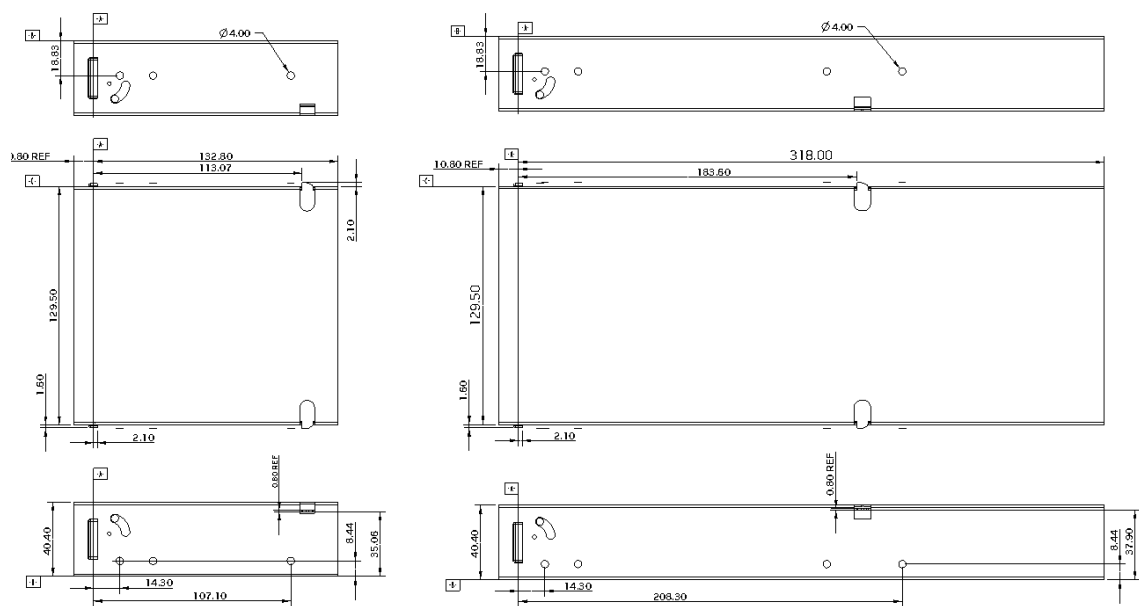


Figure 69: Spring Latch Location from Bay Datum

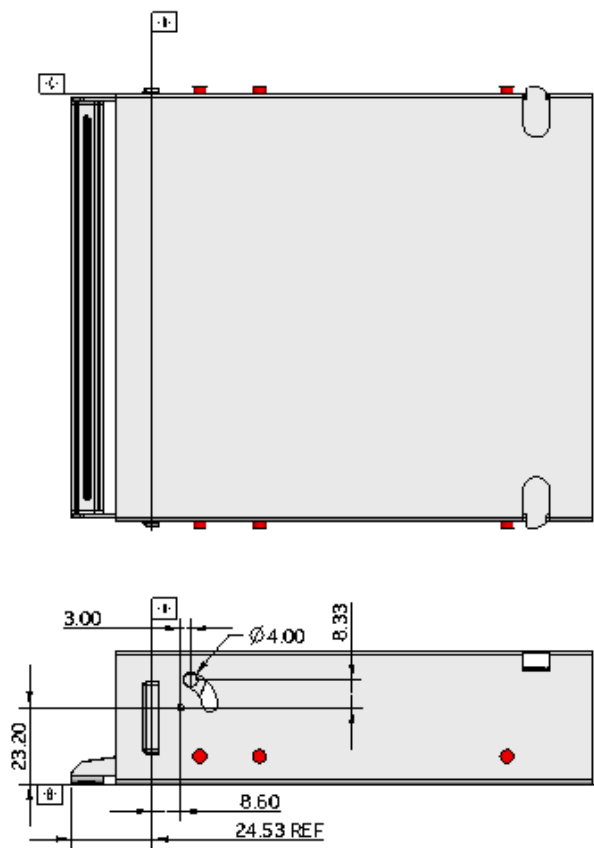


Figure 70: Cantilever Latch Location from Bay Datum

7.4.8. Fanless and Cable-less Bay Dimensions

The two bay form factors shown below support blind mate liquid cooling through MQD-03 quick disconnects and the MGX IO connector as specified. Bay widths are identical to hybrid cooled bays previously specified.

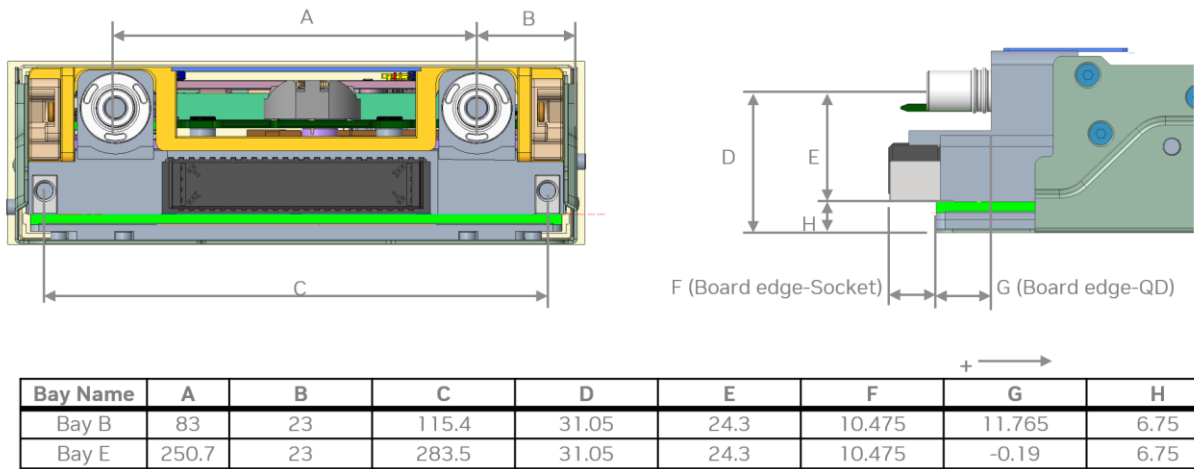


Figure 71: Fanless and Cableless Bay IO Dimensions (mm)

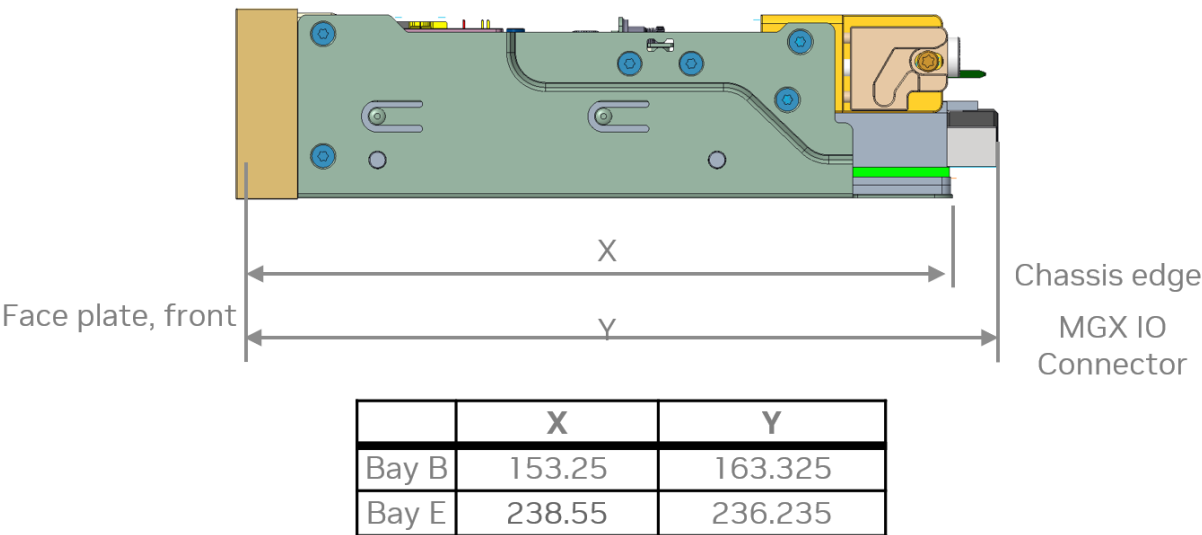


Figure 72: Fanless and Cableless Bay Enclosure Dimensions (mm)

8. Interconnect and Liquid Cooling Interfaces

The following section specifies the interfaces for the interconnect cartridge and blind mate liquid cooling in the tray and rack.

8.1 Universal Quick Disconnect Interface

The following section specifies the blind mate interface designed around the OCP UQD 2.0 specifications.

8.1.1. Blind Mate Float Mechanism Overview

The figure below illustrates the key components and dimensions of the blind mate float mechanism. The mechanism employs the UQD-08 2.0.0 insert on the tray side and captures it on a hose adaptor between two washers with a pre-loaded spring. This allows simultaneous rotational and radial motion. On the rack manifold side, a UQDB-08 2.0.0 socket is mounted to a thread adaptor that contains a slot on which a lead-in cap is mounted to increase gatherability of the socket.

Blind Mate Float Mechanism Primary components

- UQD-08 2.0.0 Insert – Off the shelf UQD from supply base
- UQDB-08 2.0.0 Socket – Off the shelf UQD from supply base w/ lead-in
- Hose and Thread Adaptor – Adapts thread to hose and manifold
- Coil Spring and Washers – Ensures full mate, allows for angular and linear misalignment
- Chassis Mount – Mechanical support and connection to chassis
- Lead-in Cap – Increases socket gatherability

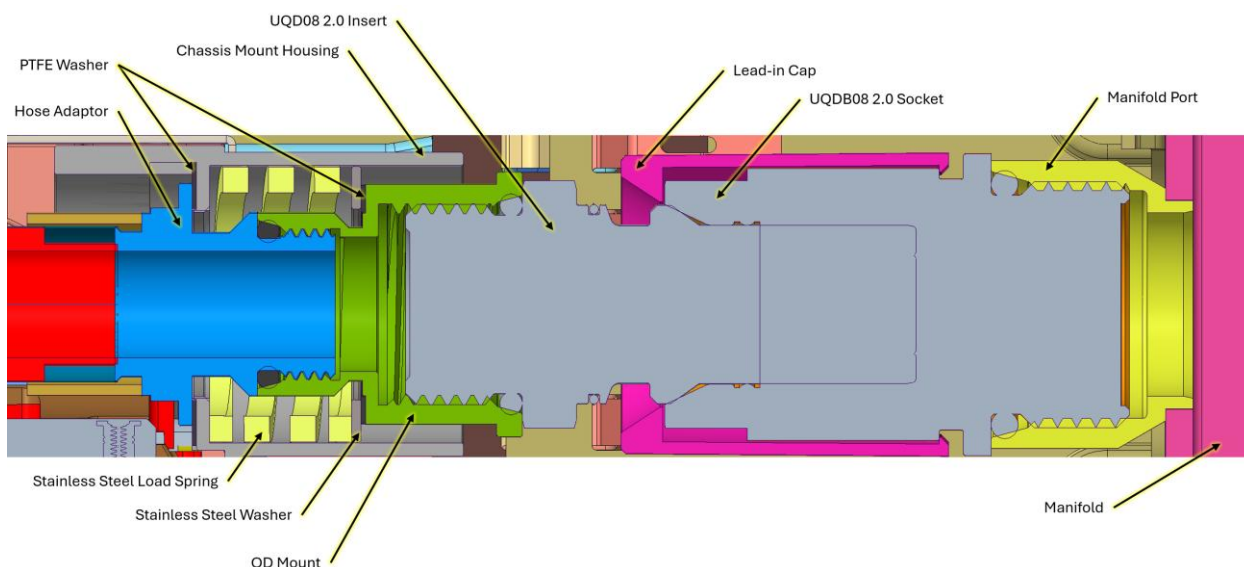


Figure 73: UQD08 2.0 Float Mechanism Overview

8.1.2. UQD Component Design Requirements

This specification uses the UQD 2.0.0 specification published by OCP.

8.1.3. Blind Mate Mechanism Mechanical Features

This section describes the features of the blind mate float mechanism.

Z-Float, Pre-load and Nominal Engagement Position:

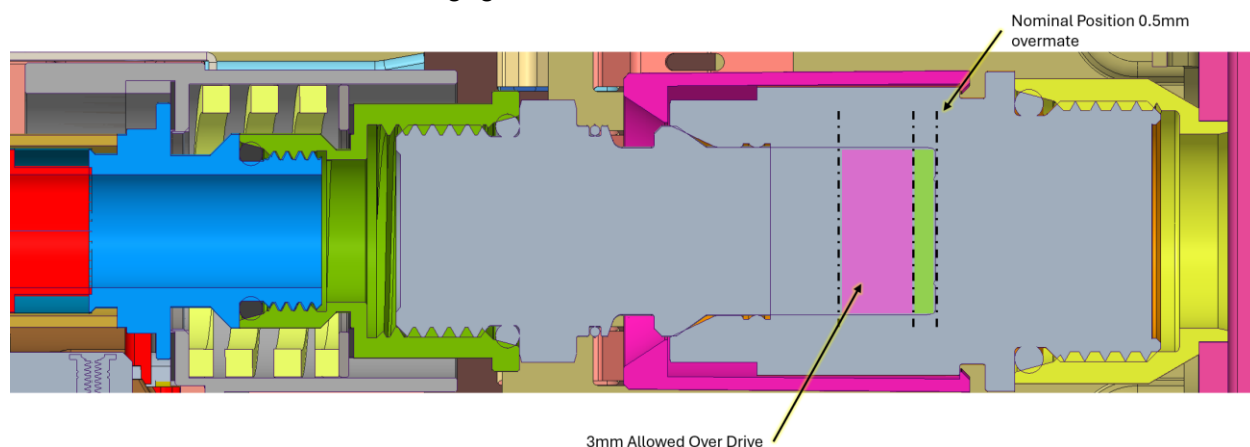


Figure 74: UQD Z-Float and nominal position

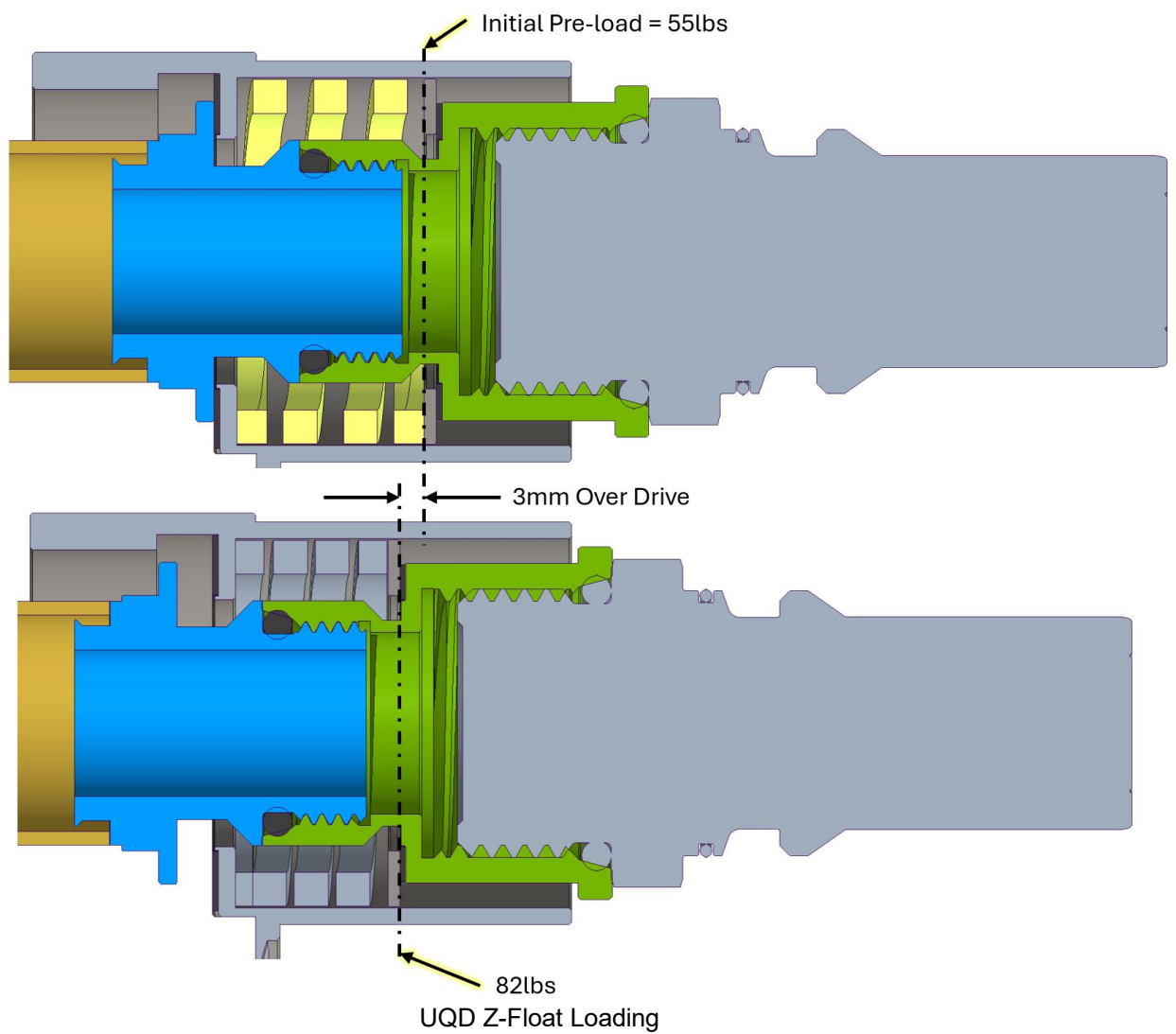


Figure 75: Load Spring – See figure above for preload and estimated maximum load.

8.1.4. Compute Tray Liquid Cooling Interface

The figure below specifies the location of the UQD assemblies on the compute and switch tray.

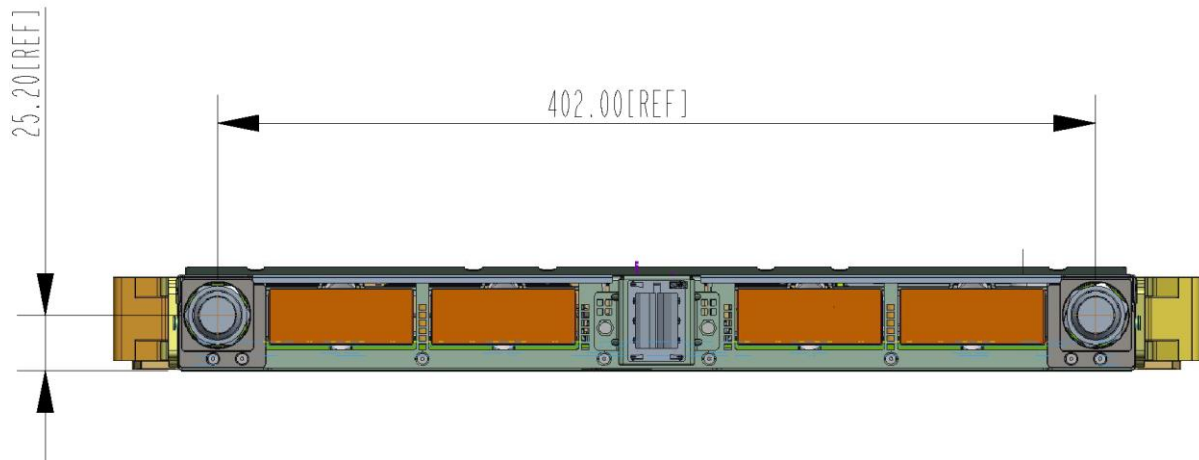


Figure 76: UQD Locations in 1RU Chassis

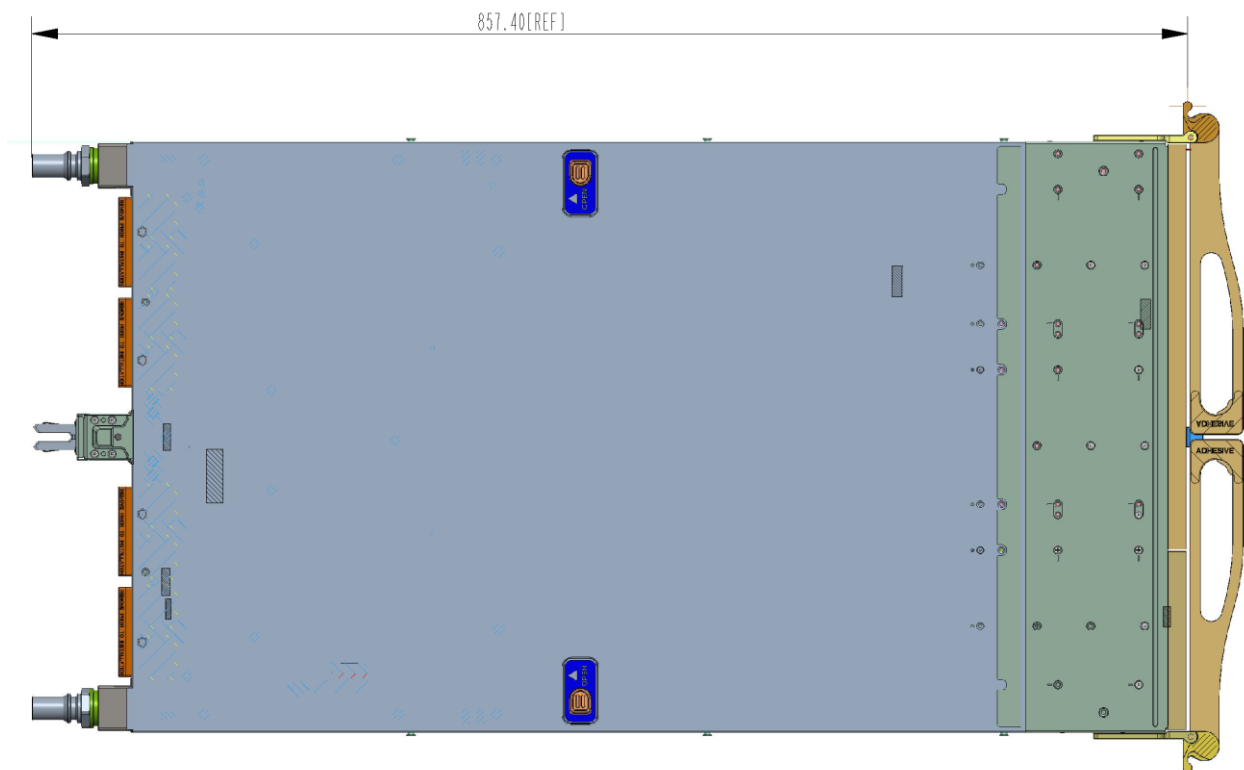


Figure 77: UQD Locations in 1RU Chassis

8.2 Interconnect Cartridge Definition

This section defines the interconnect cartridge volumetric and mounting locations within the MGX 1.2.0 rack.

8.2.1. Interconnect Cartridge Drawings

The drawings below specify the mounting and alignment locations of a 27RU Interconnect Cartridge volumetric and a 36RU Interconnect Cartridge.

Note that specific connectors, guide pins etc. are not specified in document as design will vary based on specific interconnect. Details of the interconnect architecture are dependent upon specific accelerator and system architecture and are not specified in this document. Other implementations of an Interconnect Cartridge are possible due to the configurability and scalability of the MGX rack supports and braces.

These 2D drawings are provided as an example implementation and recommended datum structure and tolerancing scheme.

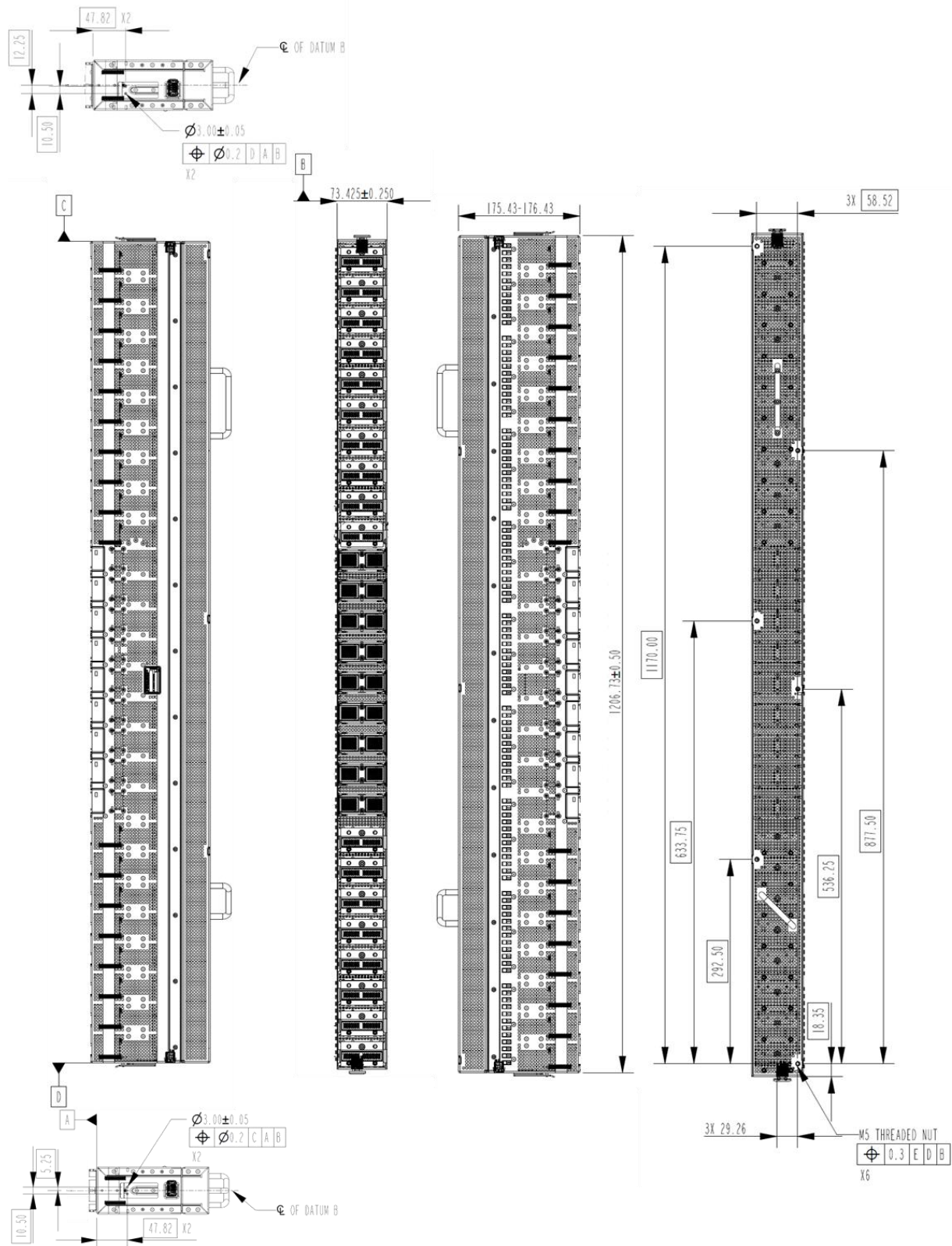


Figure 78: 27RU Interconnect Cartridge dimensions

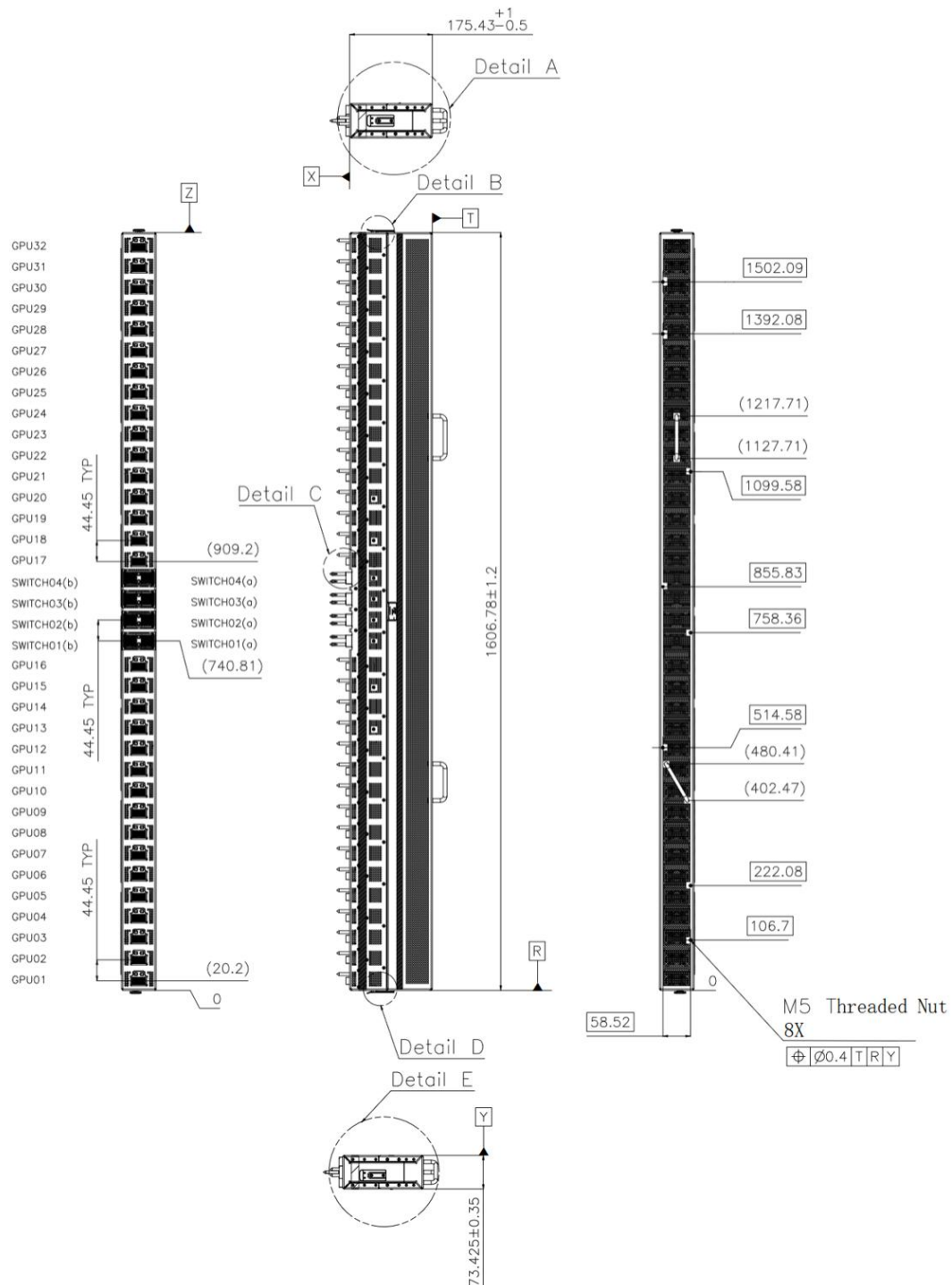


Figure 79: 36RU Interconnect Cartridge Detailed Dimensions

8.2.2. Interconnect Cartridge Loading and Support

The following figures describe the cartridge mounting, loading and support structure for the 27RU tall example cartridge.

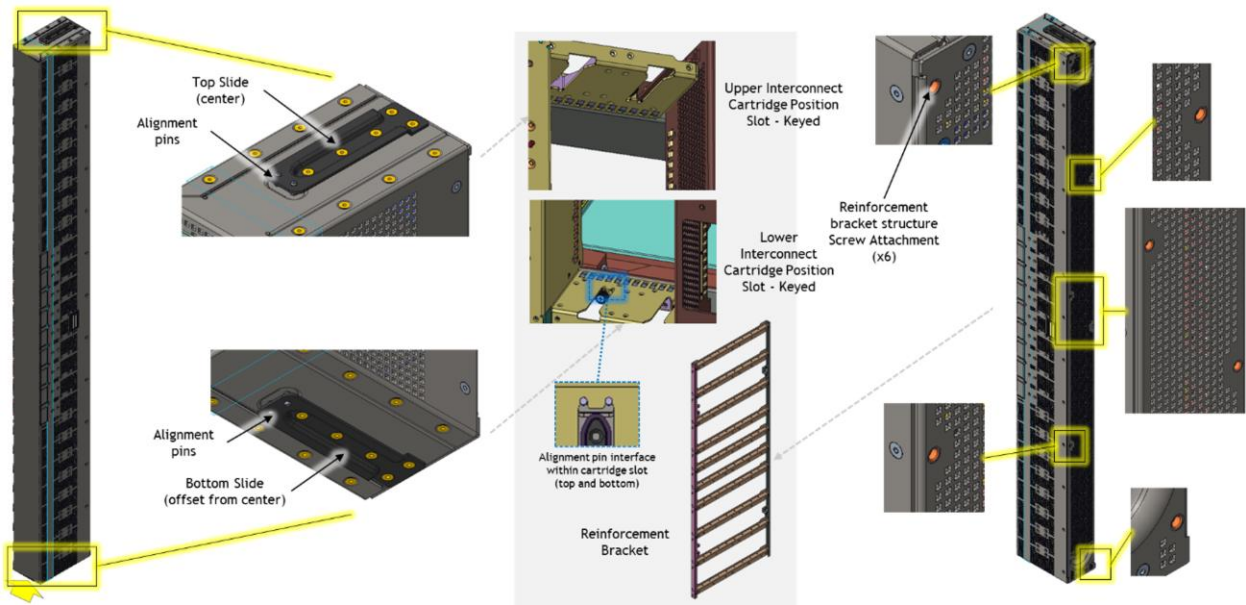


Figure 80: Cartridge loading and support overview

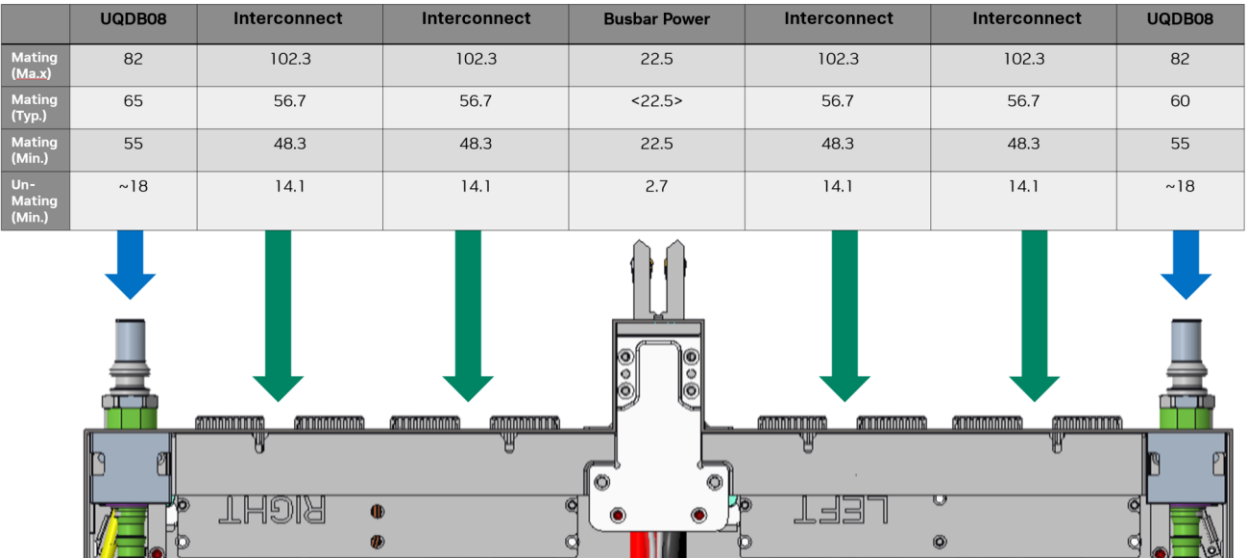


Figure 81: 27RU Switch tray interface loading (lbs.)

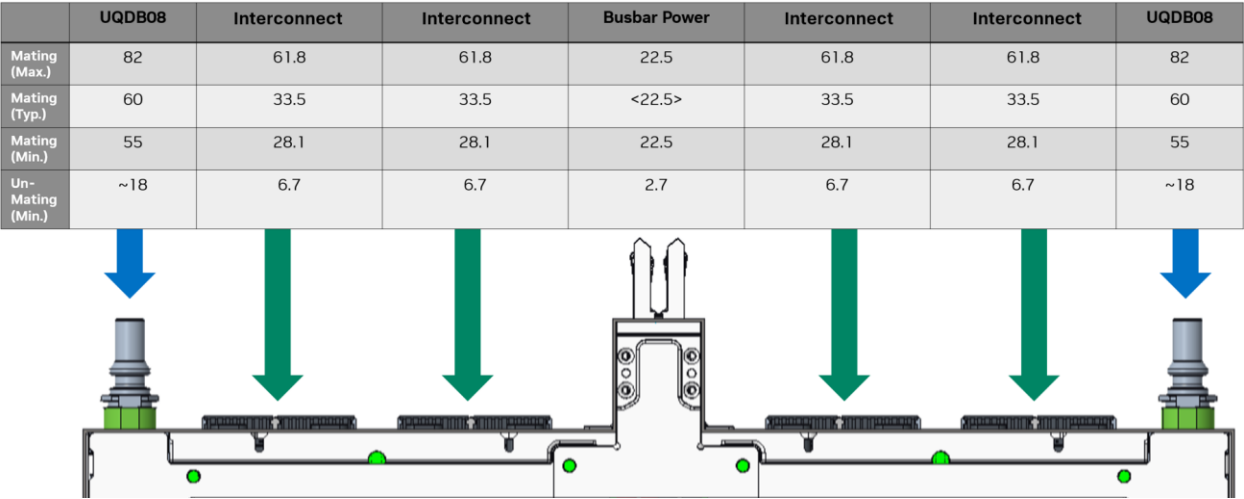


Figure 82: 27RU Compute Tray Loading (lbs.)

The following figures describe the cartridge mounting, loading and support structure for the 36RU tall example cartridge.

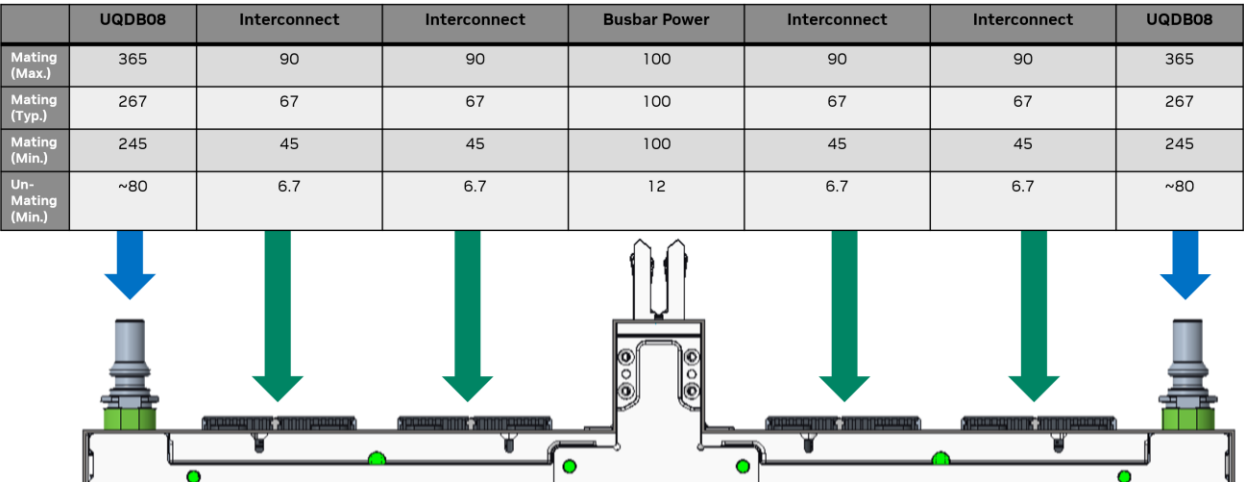


Figure 83: 36RU Cartridge Switch tray interface loading (N)

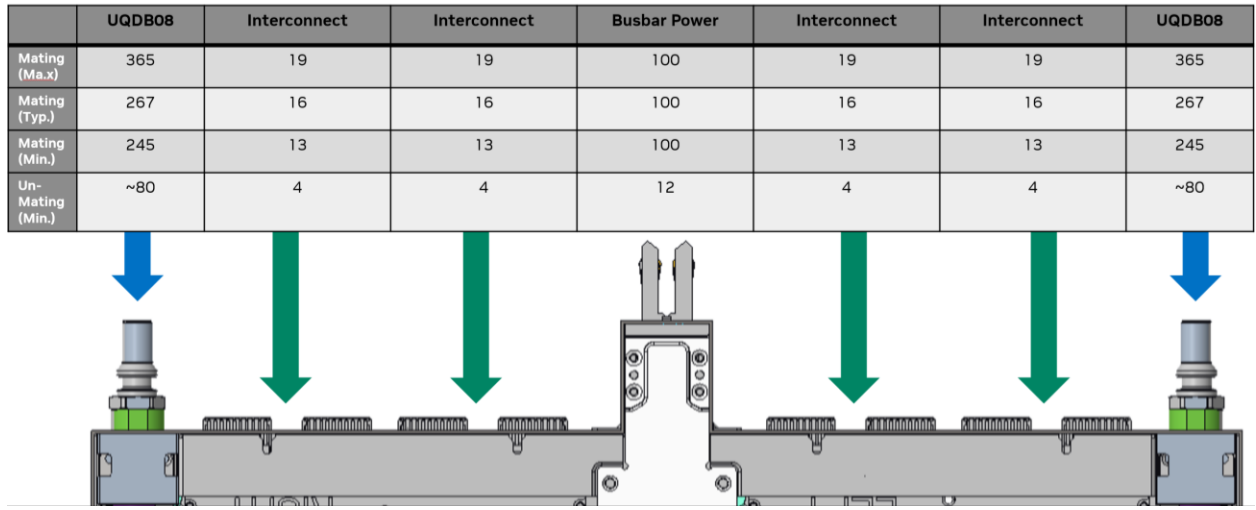


Figure 84: 36RU Cartridge Compute Tray Loading (N)

8.2.3. Key Bracket and Support 2D

Refer to the drawing package attached to this specification for details of the critical to function dimensions and tolerances of the key support and alignment components of the rack for the manifolds and interconnect cartridges. Refer to the 3D CAD for additional details not specified.

9. Rack and Tray Thermal Requirements

The following section specifies the requirements for air and liquid cooling of individual trays and rack assembly.

Table 9: Rack Level Requirements for Liquid Cooling

Requirement	Value
System Target Sustained Flow Rate (lpm)	Up to 350 LPM
Differential Pressure of Node at Target Flow Rate, 1x mated UQD pair	~10 psid
Max Rack Power Dissipation	250kW
Rack Level Liquid Heat Capture Ratio	85%
Max Operating Pressure (gauge)	5 bar (72 psig)
Min Burst Pressure (gauge)	15 bar (217 psig)
Filtration	25um and 50um

10. Prescribed Materials

The system must meet all local laws and regulations for material content such as ROHS. Refer to the table below for approved wetted materials for the liquid cooling loop.

Table 10: Rack Level Requirements for Liquid Cooling

Material	Notes
Metals	
Brass with, 15% zinc content	
Copper	CDA110, CDA1020, CDA1220, CDA110
Steels - Stainless	Most common SS alloys acceptable, including 410, 204L, 316L, or higher grades
Titanium Grade 2 (UNS R50400)	
Plastics and Rubbers	
EPDM	Peroxide Cured required for hoses
FEP	
HDPE – High Density Polyethylene	
PEEK	
PP - Polypropylene	
Viton A	
Viton ETP	
Viton GF	
Sealants and Lubricants	
Parker Super O Lube	This lubricant has been proven to be materials compatible with the above list. Other equivalent lubricants may be used based on compatibility testing
Staubli G11	This lubricant has been proven to be materials compatible with the above list. Other equivalent lubricants may be used based on compatibility testing
Brazing Materials	
BCuP-2: Cu93/P7	
BCuP-3: Cu89/Ag5/P6/Other0.15	
BCuP-4: Cu87/Ag6/P7	
BCuP-5: Cu80/Ag15/P6	
B-Ni-6: Ni88.9/P11	

Material	Notes
TF-H600F: Cu74.9/Sn15.6/P5.3/N4.2	
Materials to Avoid	
Aluminum	Avoid
ABS	Avoid
CR	Avoid
CPVC	Avoid
Hastelloy B	Avoid
Lead	Avoid
Non-stainless steels	Avoid
PVC	Avoid
Zinc	Avoid

11. References

“Open Rack V3 Base Specification” [Link](#):

“Open Rack Busbar Specification” [Link](#):

“Universal Quick Disconnect (UQD/UQDB 2.0.0) Specification” [Link](#):

“MGX Quick Disconnect” (MQD/MQDB OCP 1.0.0) Design Specification in OCP contribution process:

“OCP DC-SCM Specification” [Link](#):