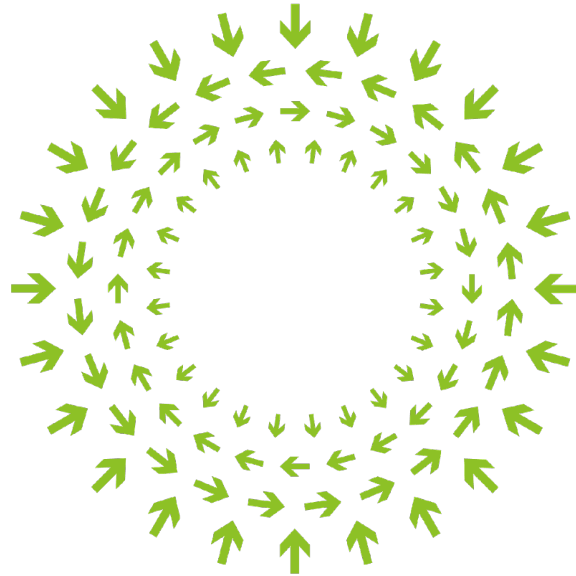




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## **DC-MHS Common Chassis Design for Differing HPM Thickness and CRPS Connector Offsets**

Version 2.0, Revision 1.0

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## Revision History

| Version | Revision | Date      | Notes                                                                                   |
|---------|----------|-----------|-----------------------------------------------------------------------------------------|
| 1.0     | 1.0      | 1/31/2024 | WIP; not released                                                                       |
| 1.0     | 2.0      | 3/12/2024 | Tweaks made to several sections based on team feedback and released for external review |
| 1.0     | 3.0      | 4/12/2024 | Added feedback from the MHS HPM group review                                            |
| 2.0     | 1.0      | 4/16/2024 | Release for OCP Review                                                                  |

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## **1.2. Acknowledgements**

With the hope of making this specification useful for the entire OCP community, we acknowledge and appreciate the contributions, review, and feedback of various individuals and companies that participated in DC-MHS.

## 2. Terminology

**Table 1: List of Standard Terms and Associated Meaning**

| Term            | Term Meaning                                                                                                                                                      |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| HPM             | (Host Processor Module). PCB or PCBA form-factor being defined by this spec                                                                                       |
| PCB             | Printed Circuit Board                                                                                                                                             |
| Datum           | A plane, axis or point location from which dimensions and tolerances are referenced.                                                                              |
| DC-SCM          | Datacenter Secure Control Module Rev 2.0 as defined by OCP DC-SCM Rev 2.0 spec                                                                                    |
| IO              | Input/Output, commonly referring to high speed connections to a CPU socket.                                                                                       |
| Tempan          | Bracket that attaches to a HPM assembly, that enables a variety of board outlines and hole locations to change over time, and still fit within same chassis base. |
| OCP             | Open Compute Project                                                                                                                                              |
| Compliant HPM   | An HPM which meets every item listed in the base specification compliance table.                                                                                  |
| Adapted HPM     | An HPM which has strong correlation to base spec requirements but does not meet every item in the base specification compliance table.                            |
| HPM Designer    | The person or organization designing an HPM (whether compliant or adapted which implements the HPM form factor specification.                                     |
| System Designer | The person or organization designing a system which incorporates HPMs whether compliant or adapted into the system design.                                        |
| DC-MHS          | Datacenter-Modular Hardware System                                                                                                                                |
| M-CRPS          | Modular- Common Redundant Power Supply. Also referenced as PSU                                                                                                    |
| PSU             | Power Supply Unit; see M-CRPS above                                                                                                                               |

### 2.1. Base Specifications

**Table 2: List of Base Specifications**

| Type          | Description               | Version   | Submit Date |
|---------------|---------------------------|-----------|-------------|
| Specification | M-FLW Base Spec           | v1.01 RC2 | 6/1/2023    |
| Specification | M-CRPS Base Specification | v1.03 RC2 | 12/15/2023  |
| Specification | OCP NIC 3.0 Specification | 1v30      | 11/1/2023   |
| Reference     | Current Connector List    | 1/18/2024 | 1/18/2024   |
| Specification | DC-SCM                    | R2v1      | 7/27/2022   |

### 3. Scope

M-FLW allows for HPM and system designer flexibility by allowing a range of HPM board thicknesses, CRPS connectors with different heights, and SCM2/NIC3 connectors with different heights. Unfortunately, the varying HPM thicknesses and connector heights lead to a large range of options which presents an integration challenge for a system “integrator” attempting to leverage one chassis that can be compatible with 3<sup>rd</sup> party HPM providers.

This document outlines a strategy an HPM integrator can employ for DC-MHS compliant HPM assemblies with the overarching goal of minimizing design and or cost related impacts to already existing chassis.

For this document, a design “integrator” maintains their own DC-MHS compliant chassis designs and associated HPM assembly designs, but also integrates HPM assemblies from external organizations to work with the integrator’s own chassis design. This assumes the “3<sup>rd</sup> party”, HPM assembly design is owned and managed by the 3<sup>rd</sup> party with the intent of compatibility with the integrators already existing chassis.

#### 3.1. Out of Scope

- HPM’s not compliant with M-FLW specification.
- HPM layout guidance.
- Specific component stack up heights. The component z-heights summarized within this specification are for reference only, and capture internal gaps and components based on a design snapshot in time. The intent of sharing specific component heights is to help convey the relationship between internal components and surrounding entities within the chassis and is not meant to drive other system designers to the numbers shared.
- SFF-TA-1002 4C+ straddle mount offset sizes outside the non-offset variant (connector centerline coplanar with the HPM centerline).

#### 3.2. Goals

- Share a strategy that enables chassis compatibility with 3<sup>rd</sup> party DC-MHS compliant HPM’s.
  - Avoid additional HPM assemblies with different connector variants. IE. HPM #1 with no offset NIC3/SCM2 4C+ straddle mount and HPM#2 with an offset variant of the 4C+ straddle mount connector.
- The strategy attempts to minimize cost and design impacts on a DC-MHS compliant chassis when integrating 3<sup>rd</sup> party HPMs with:
  - Different HPM board thicknesses
  - Different CRPS connector offsets
- Maintain acceptable assembly gaps within the chassis.

#### 3.3. Key Areas/Components

This section will cover the key areas and components along with associated figures that will be discussed in more detail in section 3.4.

### 3.3.1. Rack Compatibility

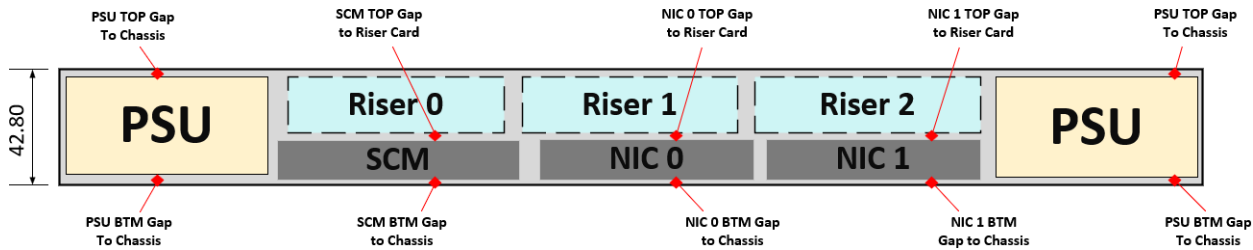
The chassis strategy outlined in this document is based on a EIA-310-D 1U form factor, compatible with a standard EIA/ECA-310e 19" rack. The integration strategy is also compatible with an EIA-310-D 2U form factor. However, since the Z dimension constraints described within this document mostly pertain to the 1U form factor, the scope of this document will mainly focus on the EIA-310-D 1U form factor and only describe 2U impacts when appropriate. As noted in section 3.1, the heights and gaps referenced within the preceding sections are for reference only.

### 3.3.2. Chassis Gaps

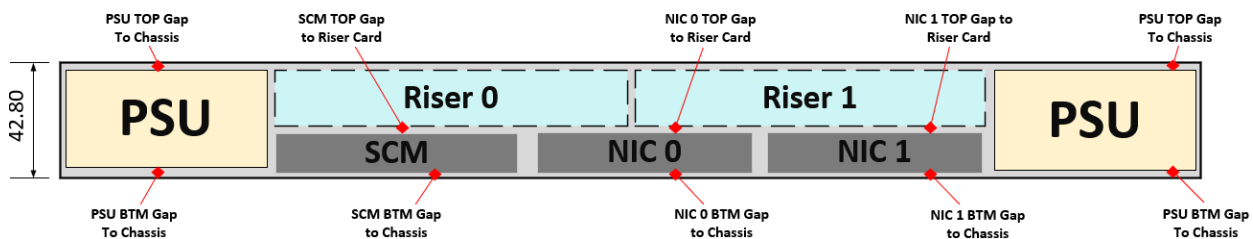
The Figures below illustrate the chassis gaps that were monitored when investigating numerous mounting scenarios which will be discussed in more detail in Section 3.4.

All gaps shown in the following figures below are summarized on Section 3.4 (Table 4), depending on the scenario assumptions. A 42.8mm height 1U chassis was assumed for this document.

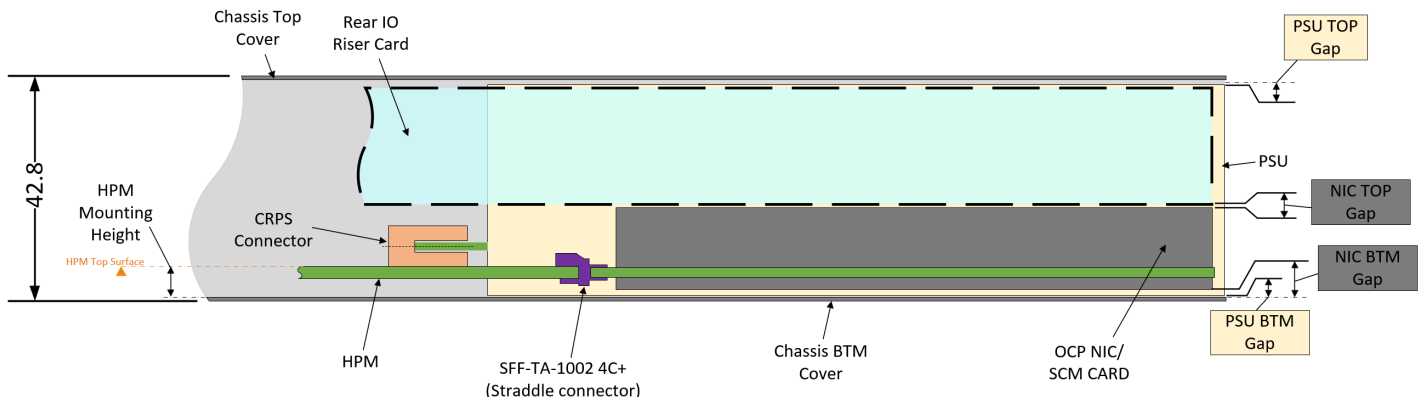
**Figure 1: 1U PSU and Rear IO Gaps with 3 Riser Cards**



**Figure 2: 1U PSU and Rear IO Gaps with 2 Riser Cards**



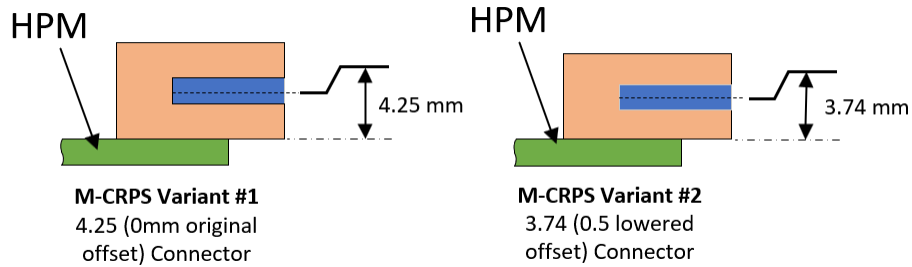
**Figure 3: 1U Cross Section of Rear IO Gaps**



### 3.3.3. M-CRPS Connector Variants

The figure below illustrates the M-CRPS connector variants per the “Current Connector List” as of 1/18/2024. This document will refer to these variants in preceding sections of this document to illustrate the impacts the connector variants have within the internal chassis gaps.

**Figure 4: M-CRPS Connector Variants**

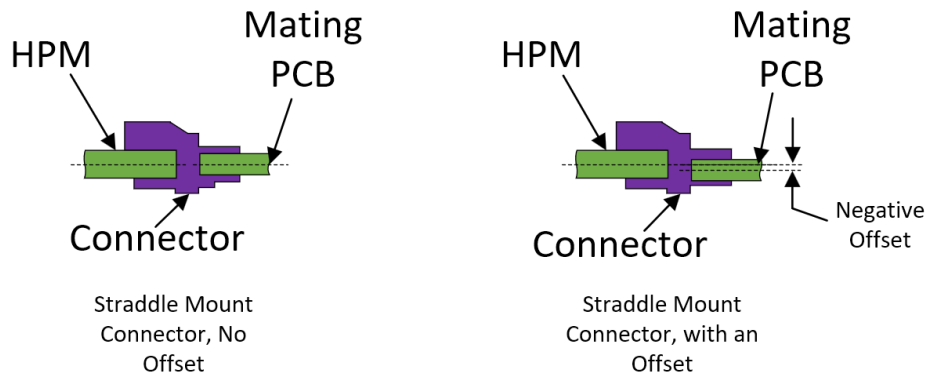


### 3.3.4. Straddle Mount Connector Offset Variants

Per the OCP NIC 3.0 specification (Section 3.2.3. – 3.2.4.), the straddle mount connector either has no offset or has an offset. The figure below illustrates both a straddle mount connector “without an offset” and a “with an offset”. The non offset variant maintains coplanarity between the HPM centerline and the mating PCB centerline. The offset variant shown in the figure below illustrates a “negative” offset.

For this document, Jabil did not assume offset variants as an option to maintain critical gaps as this would force additional HPM assemblies. As stated in the “Goals” section, the strategy in this document aims to keep costs down without adding HPM complexity.

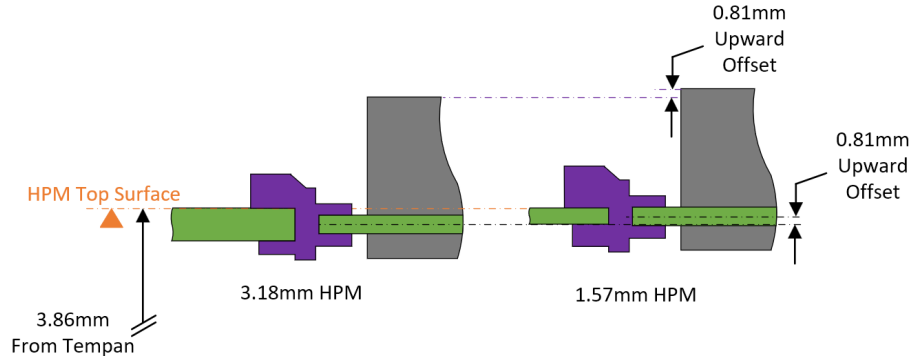
**Figure 5: Straddle Mount Connector Variants**



### 3.3.5. Rear IO Z-Height Impacts due to Varying HPM Board Thicknesses

The figure below illustrates the impact of a varying HPM board height. The figure illustrates the extreme delta from a 3.18mm thick HPM to a 1.57mm thick HPM. The results in an overall 0.81mm upward shift in the OCP NIC3 and SCM2 cards.

**Figure 6: Rear IO Z-Height Upward Shift Due to Different HPM Thickness**



### 3.4. Overview

The M-FLW specification and DC-SCM2 specifications mention a range of HPM thicknesses. Additionally, the CRPS specification references a 90-deg, top mount connector list with two different offsets: (1) a standard, 0mm offset and (2) a version with a -0.5mm offset. Section 10.15 of the M-FLW specification also specifies a MAX allowed HPM board thickness at 3.18mm nominal and an associated minimum 5.86mm board mounting height where the board mounting height is derived from measuring the bottom of the HPM temp to the top of the HPM board.

To account for varying HPM thicknesses AND varying CRPS connector offsets, the two options listed below are followed to enable a “one chassis” which is compatible with the varying attributes mentioned above.

The table below, summarizes two options to consider, depending on the situation.

**Table 3: List of Mounting/Connector Options for Varying HPM Board Thicknesses**

|            | HPM Mounting Height [mm] | M-CRPS Connector       |                       | NIC Straddle Mount Offset [mm] | HPM Thickness [mm]           |      |      |      |      |      |      |
|------------|--------------------------|------------------------|-----------------------|--------------------------------|------------------------------|------|------|------|------|------|------|
|            |                          | Connector Variant [mm] | Connector Offset [mm] |                                | 1.57                         | 1.93 | 2.11 | 2.36 | 2.55 | 2.79 | 3.18 |
| Option 1   | 5.36                     | 4.25                   | 0                     | 0                              | ← Green Arrow (Compatible) → |      |      |      |      |      |      |
| Option 2   | 5.86                     | 3.74                   | -0.5                  | 0                              | ← Red Arrow (Incompatible) → |      |      |      |      |      |      |
| Option 2B* | 6.2                      | 3.40                   | -0.84                 | -0.34                          | ← Red Arrow (Incompatible) → |      |      |      |      |      |      |

**\*NOTE:** Option #2B addresses a potential increase in the allowable HPM board mounting height within the M-FLW specification. As of writing this document, the M-FLW specification specifies 5.86mm. Future releases could raise this to 6.2mm. Option 2B captures the assumptions made to address the increased HPM board mounting height. Also note that the 3.4mm M-CRPS variant does not currently exist as of this writing and only represents a theoretical variant for Option 2B for purposes of this discussion.

To enable the options listed in Table 3, the following parts would require customization:

1. Customized tempan assembly with an appropriately adjusted standoff height. See section 4.2.1 for more details on this customization.
2. Mylar added to OCP NIC3 and SCM2 mounting rails. See section 4.2.2 for more details on this customization.
3. Rear wall opening for NIC3/SCM2 cards. This includes an increased card opening to allow for the CRPS offset shifts. A larger EMI gasket will be used to make up the resulting gap in the assembly. See section 4.2.4 for more details on this customization.
4. 2U riser card cage redesign to match the 5.36mm or 5.86mm mounting offset. A different riser cage required for each mounting height. This applies to the 2U chassis only. See section 4.2.5 for more details on this customization.

Option #1 is compatible with a 1.57 to 2.55mm HPM thickness range. This requires a 4.25mm M-CRPS connector (no offset) as well as a non-offset NIC3/SCM2 straddle mount connector. This configuration supports a **5.36mm** HPM mounting height.

Option #2 is compatible with a 2.36 to 3.18mm HPM thickness range. This requires a 3.74mm (-0.5mm offset) M-CRPS connector as well as a non-offset NIC3/SCM2 straddle mount connector. This configuration supports a **5.86mm** HPM mounting height.

Option #2B is compatible with a 2.36 to 3.18mm HPM thickness range. This requires a 3.4mm (-0.84mm offset) M-CRPS connector as well as a -0.34mm offset NIC3/SCM2 straddle mount connector. This configuration supports a **6.20mm** HPM mounting height.

Table 4 below simulates the impact on PSU chassis gaps as well as NIC3/SCM2 system gaps depending on the configuration scenario studied. This table was also used to help derive the options listed on Table 3 above.

Scenarios A, D, and F were deemed unacceptable since the PSU top or bottom gaps violated the allowable gap constraints.

**Table 4: List of Mounting Scenarios and Associated Component Gaps**

|            |               |            |              |                          |                      | M-CRPS Connector Variants |                       | PSU Cage     |              | NIC/SCM      |              | Standoff Height [mm] | NIC Offset [mm] |
|------------|---------------|------------|--------------|--------------------------|----------------------|---------------------------|-----------------------|--------------|--------------|--------------|--------------|----------------------|-----------------|
|            |               | HPM T [mm] | HPM T [MILs] | HPM Mounting Height [mm] | Space Below HPM [mm] | Connector Variant [mm]    | Connector Offset [mm] | Top Gap [mm] | BTM Gap [mm] | Top Gap [mm] | BTM Gap [mm] |                      |                 |
| Scenario A | Not an Option | 1.57       | 62           | 5.36                     | 2.99                 | 3.74                      | -0.5                  | 0.79         | -0.28        | 0.51         | 0.96         | 3.79                 | 0               |
|            |               | 1.93       | 76           | 5.36                     | 2.63                 |                           | -0.5                  | 0.79         | -0.28        | 0.70         | 0.79         | 3.43                 | 0               |
|            |               | 2.11       | 83           | 5.36                     | 2.45                 |                           | -0.5                  | 0.79         | -0.23        | 0.78         | 0.70         | 3.25                 | 0               |
|            |               | 2.36       | 93           | 5.36                     | 2.2                  |                           | -0.5                  | 0.79         | -0.28        | 0.91         | 0.57         | 3                    | 0               |
|            |               | 2.55       | 100          | 5.36                     | 2.01                 |                           | -0.5                  | 0.79         | -0.28        | 1.01         | 0.48         | 2.81                 | 0               |
|            |               | 2.79       | 110          | 5.36                     | 1.77                 |                           | -0.5                  | 0.79         | -0.28        | 1.13         | 0.36         | 2.57                 | 0               |
|            |               | 3.18       | 125          | 5.36                     | 1.38                 |                           | -0.5                  | 0.79         | -0.28        | 1.32         | 0.16         | 2.18                 | 0               |
| Scenario B | Option #1     | 1.57       | 62           | 5.36                     | 2.99                 | 4.25                      | 0                     | 0.29         | 0.22         | 0.51         | 0.96         | 3.79                 | 0               |
|            |               | 1.93       | 76           | 5.36                     | 2.63                 |                           | 0                     | 0.29         | 0.22         | 0.70         | 0.79         | 3.43                 | 0               |
|            |               | 2.11       | 83           | 5.36                     | 2.45                 |                           | 0                     | 0.29         | 0.22         | 0.78         | 0.70         | 3.25                 | 0               |
|            |               | 2.36       | 93           | 5.36                     | 2.2                  |                           | 0                     | 0.29         | 0.22         | 0.91         | 0.57         | 3                    | 0               |
|            |               | 2.55       | 100          | 5.36                     | 2.01                 |                           | 0                     | 0.29         | 0.22         | 1.01         | 0.48         | 2.81                 | 0               |
|            |               | 2.79       | 110          | 5.36                     | 1.77                 |                           | 0                     | 0.29         | 0.22         | 1.13         | 0.36         | 2.57                 | 0               |
|            |               | 3.18       | 125          | 5.36                     | 1.38                 |                           | 0                     | 0.29         | 0.22         | 1.32         | 0.16         | 2.18                 | 0               |
| Scenario C | Option #2     | 1.57       | 62           | 5.86                     | 3.49                 | 3.74                      | -0.5                  | 0.29         | 0.22         | 0.01         | 1.47         | 4.29                 | 0               |
|            |               | 1.93       | 76           | 5.86                     | 3.13                 |                           | -0.5                  | 0.29         | 0.22         | 0.20         | 1.29         | 3.93                 | 0               |
|            |               | 2.11       | 83           | 5.86                     | 2.95                 |                           | -0.5                  | 0.29         | 0.22         | 0.28         | 1.20         | 3.75                 | 0               |
|            |               | 2.36       | 93           | 5.86                     | 2.7                  |                           | -0.5                  | 0.29         | 0.22         | 0.41         | 1.07         | 3.5                  | 0               |
|            |               | 2.55       | 100          | 5.86                     | 2.51                 |                           | -0.5                  | 0.29         | 0.22         | 0.50         | 0.98         | 3.31                 | 0               |
|            |               | 2.79       | 110          | 5.86                     | 2.27                 |                           | -0.5                  | 0.29         | 0.22         | 0.63         | 0.85         | 3.07                 | 0               |
|            |               | 3.18       | 125          | 5.86                     | 1.88                 |                           | -0.5                  | 0.29         | 0.22         | 0.82         | 0.66         | 2.68                 | 0               |
| Scenario D | Not an Option | 1.57       | 62           | 5.86                     | 3.49                 | 4.25                      | 0                     | -0.21        | 0.72         | 0.01         | 1.47         | 4.29                 | 0               |
|            |               | 1.93       | 76           | 5.86                     | 3.13                 |                           | 0                     | -0.21        | 0.72         | 0.20         | 1.29         | 3.93                 | 0               |
|            |               | 2.11       | 83           | 5.86                     | 2.95                 |                           | 0                     | -0.21        | 0.72         | 0.28         | 1.20         | 3.75                 | 0               |
|            |               | 2.36       | 93           | 5.86                     | 2.7                  |                           | 0                     | -0.21        | 0.72         | 0.41         | 1.07         | 3.5                  | 0               |
|            |               | 2.55       | 100          | 5.86                     | 2.51                 |                           | 0                     | -0.21        | 0.72         | 0.50         | 0.98         | 3.31                 | 0               |
|            |               | 2.79       | 110          | 5.86                     | 2.27                 |                           | 0                     | -0.21        | 0.72         | 0.63         | 0.85         | 3.07                 | 0               |
|            |               | 3.18       | 125          | 5.86                     | 1.88                 |                           | 0                     | -0.21        | 0.72         | 0.82         | 0.66         | 2.68                 | 0               |
| Scenario E | Option 2B     | 1.57       | 62           | 6.2                      | 3.83                 | 3.4                       | -0.84                 | 0.29         | 0.22         | 0.01         | 1.47         | 4.63                 | -0.34           |
|            |               | 1.93       | 76           | 6.2                      | 3.47                 |                           | -0.84                 | 0.29         | 0.22         | 0.19         | 1.29         | 4.27                 | -0.34           |
|            |               | 2.11       | 83           | 6.2                      | 3.29                 |                           | -0.84                 | 0.29         | 0.22         | 0.28         | 1.20         | 4.09                 | -0.34           |
|            |               | 2.36       | 93           | 6.2                      | 3.04                 |                           | -0.84                 | 0.29         | 0.22         | 0.41         | 1.07         | 3.84                 | -0.34           |
|            |               | 2.55       | 100          | 6.2                      | 2.85                 |                           | -0.84                 | 0.29         | 0.22         | 0.50         | 0.98         | 3.65                 | -0.34           |
|            |               | 2.79       | 110          | 6.2                      | 2.61                 |                           | -0.84                 | 0.29         | 0.22         | 0.62         | 0.85         | 3.41                 | -0.34           |
|            |               | 3.18       | 125          | 6.2                      | 2.22                 |                           | -0.84                 | 0.29         | 0.22         | 0.82         | 0.66         | 3.02                 | -0.34           |
| Scenario F | Not an Option | 1.57       | 62           | 6.2                      | 3.83                 | 4.25                      | 0                     | -0.55        | 1.06         | 0.01         | 1.47         | 4.63                 | -0.34           |
|            |               | 1.93       | 76           | 6.2                      | 3.47                 |                           | 0                     | -0.55        | 1.06         | 0.19         | 1.29         | 4.27                 | -0.34           |
|            |               | 2.11       | 83           | 6.2                      | 3.29                 |                           | 0                     | -0.55        | 1.06         | 0.28         | 1.20         | 4.09                 | -0.34           |
|            |               | 2.36       | 93           | 6.2                      | 3.04                 |                           | 0                     | -0.55        | 1.06         | 0.41         | 1.07         | 3.84                 | -0.34           |
|            |               | 2.55       | 100          | 6.2                      | 2.85                 |                           | 0                     | -0.55        | 1.06         | 0.50         | 0.98         | 3.65                 | -0.34           |
|            |               | 2.79       | 110          | 6.2                      | 2.61                 |                           | 0                     | -0.55        | 1.06         | 0.62         | 0.85         | 3.41                 | -0.34           |
|            |               | 3.18       | 125          | 6.2                      | 2.22                 |                           | 0                     | -0.55        | 1.06         | 0.82         | 0.66         | 3.02                 | -0.34           |

**NOTE:** As noted in section 3.3.2; Chassis Gaps, the assumed overall 1U chassis height is 42.8mm when considering Scenarios A – F above.

## 4. Physical Specifications

This section summarizes the 4 parts that required system design customization to help enable the options listed in Table 3.

## 4.1. Mechanical

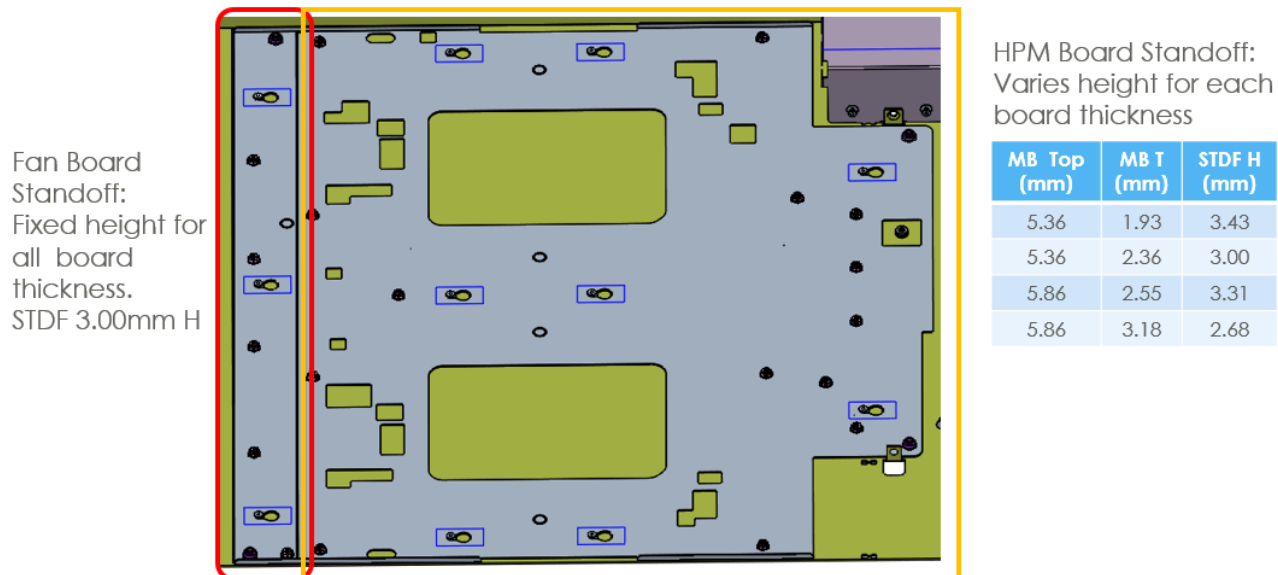
### 4.2. Mechanical Customizations

This section summarizes the customizations made on specific parts to enable a “one chassis” design for varying board heights and thicknesses. These customizations were necessary for Jabil specific part designs and may not be required for components designed by other organizations. These customizations are shared for reference only and pertain specifically to Jabil designed chassis.

#### 4.2.1. Tempan Assembly and HPM Standoff Heights

The figure below summarizes the tempan assembly impacts to maintain the options discussed in Table 3. For this situation, a different tempan assembly is required for each board thickness supported. Depending on the Z-stack-up, a different HPM standoff height is used for each HPM thickness to maintain the target HPM mounting height.

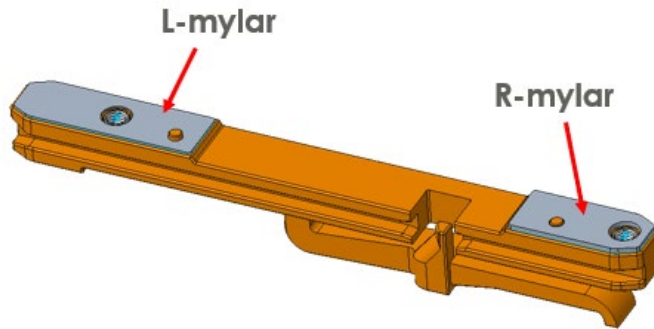
**Figure 7: Tempan Assembly**



#### 4.2.2. OCP NIC3/SCM2 Mounting Rails

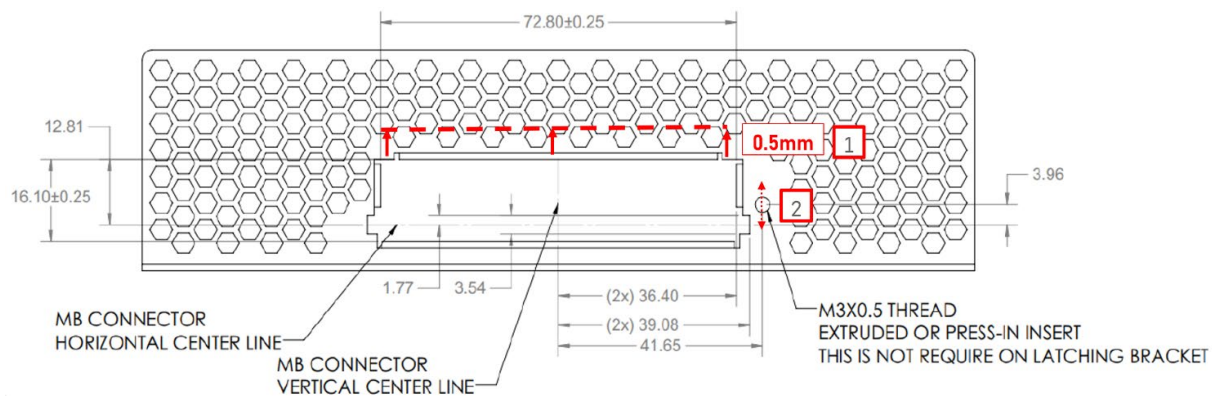
#### 4.2.3.

The figure below illustrates the usage of mylar spacers needed on the OCP NIC3/SCM2 card rail guides. The mylar spacers fill in assembly gaps created by the varying HPM thicknesses. Different mylar thicknesses will be employed depending on the HPM thickness used.

**Figure 8: OCP Card Rail Guide**

#### 4.2.4. Rear IO Chassis Wall

The figure below illustrates the changes made to the rear IO chassis wall. To allow for the two (2) different HPM mounting heights as summarized in Table 4, the card opening cutout was adjusted by the 2 different HPM mounting heights. In this case,  $5.86 - 5.36 = 0.5\text{mm}$ . To account for this wider opening, EMI gasketing is employed to fill any gaps to ensure overall chassis requirements are met.

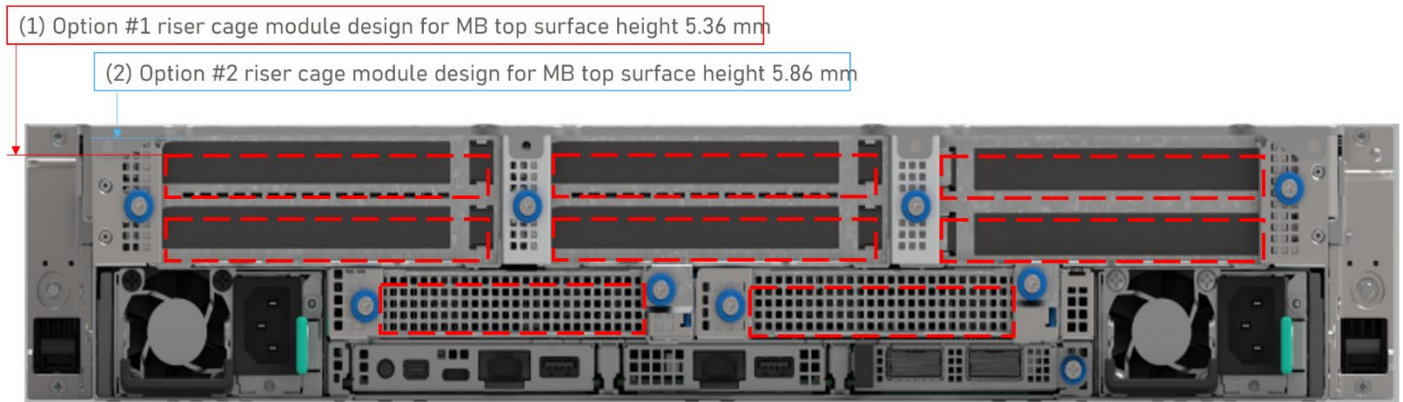
**Figure 9: Rear IO Design Changes**

#### 4.2.5. 1U Riser Card

To allow for the two (2) different HPM mounting heights as outlined in Table 4, two different riser cage designs would be employed depending on the HPM mounting height used within the 1U chassis.

Pictured below is a full assembly illustration of the differing IO openings as well as differing riser card locations on a 2U chassis.

**Figure 10: Illustration of 2U Chassis with Different Card Height Options**



## **5. Environmental Regulatory Compliance and Requirements**

No changes from the base specification

## **6. Electrical Requirements**

Not in scope of this document

## **7. Thermal Design Requirements**

Not in scope of this document

## **8. Interfaces**

No changes from the base specification

### **8.1. Signal List**

Not in scope of this document

### **8.2. Rear Side Power, I/O, Expansion Board and Midplane Subsystems**

Not in scope of this document

## **9. Onboard Power System**

Not in scope of this document

## **10. Prescribed Materials**

Not in scope of this document

## **11. System Firmware**

Not in scope of this document

## **12. Hardware Management**

Not in scope of this document

### **13.Security**

Not in scope of this document

### **14.Software Support (recommended)**

Not in scope of this document

### **15.Arm SystemReady (only for Arm-based Systems)**

Not in scope of this document