



OPEN

Compute Project

Open Rack V3 BBU Shelf

Rev: 0.2

Revision History

Revision	Date	Description	Authors
0.1	2020/03/25	first draft	David Sun
0.2	2020/04/10	Updated thermal, mechanical, compliance sections	Cheng Chen, Chenyu Xu, Ben Kim
0.3	2020/04/30	Section 6.2 Add BBU connector PN	Chenyu Xu

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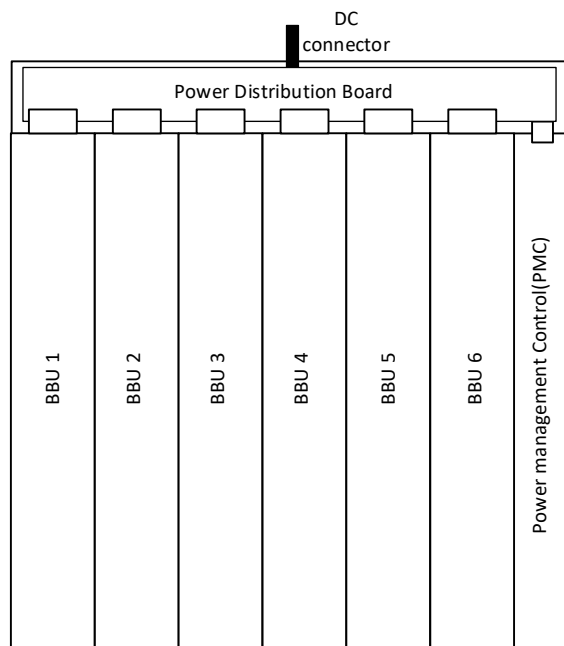
1. Scope

This document defines the technical specifications for Open Rack V3 BBU Shelves used in the Open Compute Project.

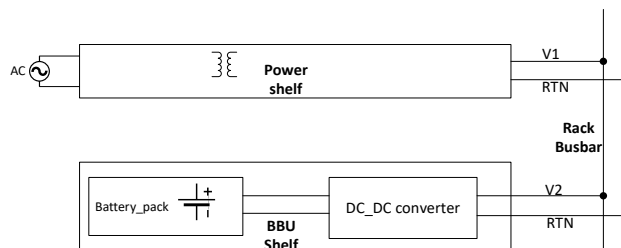
2. Introduction

The Open Rack Power Architecture is comprised of a centralized scalable power shelf and a BBU (Battery Backup Unit) shelf that distributes power over a common bus bar to the payload devices (IT Gear). This spec will define the BBU shelves that fits into the Open Rack. The BBU shelf shall house 6 BBU Modules with 5+1 redundancy to provide the DC power to all the payloads inside the rack. When there is an AC power outage, the BBU shelf shall be able to provide backup power up to the maximum rating of the power shelf for a specified backup time period. The BBU shelf backup time allows the rack to be switched between power sources (ex. utility source to utility source, or utility source to backup generator) with no disruption to the IT gears and allows drain/migrate applications before power loss.

Each BBU shelf consists of a PMC module and 6X 3KW BBU. Each BBU consists of a battery pack and a DC-DC charger/discharger.



BBU Shelf Overview (1)



BBU Shelf Overview (2)

3. Electrical requirements

3.1 Discharge mode output parameters

	Min	Nominal	Max	Peak	Unit	Note
Output voltage setpoint	48.4	48.5	48.6	-	V	@50% load
Output voltage total regulation	46.5	48.5	49.0	-	V	
Output current	0	-	300	Follow power shelf/rectifier	A	Peak load profile follow Power shelf/rectifier spec.
Output power	0	-	15,000	Follow power shelf/rectifier	W	
Battery backup time	300	-	-	-	seconds	Full power discharge time
Battery life	4	-	-	-	years	Full power discharge time >300s at the end of 4 years
Output ripple voltage	-	-	300	-	mV	Peak to peak
Transient load response	-3	-	+3	-	%	60% load step, 1A/us

See BBU specification for detailed requirements of discharge converter.

3.1.1 The BBU droop voltage (0%-100%) shall be 1.00% or 0.50V by default. The droop voltage can be programmed to 1%-5%.

3.1.2 SOH test

During SOH test, BBU shelf will turn on one BBU at a time and raise the voltage slightly above 50V in order to discharge the battery pack to a certain level.

Refer to BBU spec for details of SOH test.

3.2 Charge mode input parameters

	Min	Nominal	Max	Unit	Note
Input voltage	47.5	50	52.5	V	
Input current	0		33(5.5/BBUx6)	A	CC/CV mode charge and adjustable CC charge current
Input power	0		1650(275/BBUx6)	W	

See BBU specification for detailed requirements of charge converter.

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3.3 Power shelf to BBU shelf transition

When the power shelf loses AC input, the BBU shelf shall provide DC power to the rack. The busbar voltage dip shall be less than 2V during the transition. In other words, the busbar voltage shall remain above 46V during the transition from the power shelf to the BBU shelf.

3.4 Grounding

The BBU Shelf output return (negative) shall be grounded to the BBU shelf frame.

3.5 BBU Shelf operation modes

BBU operation mode	Description
Sleep mode	When BBU is in transportation or stock or is not attached to an active busbar, the cell discharge current is minimized for longer storage time. BBU monitoring/reporting is not available in sleep mode. The BBU will wake up and exit sleep mode when the busbar voltage is detected to be above 48V for >20ms (TBD).
Standby mode	The BBU is fully charged and healthy, constantly monitoring busbar voltage to be prepared for a discharge event. The BBU operates in this mode for the vast majority of its lifespan. The BBU's status and parameters are visible on the upstream rack monitor through the communication bus.
Discharge mode	When the busbar voltage drops below 48V(TBD) for >1ms (TBD), BBU discharge mode is activated. The BBU is expected to take over the busbar voltage within 2ms (TBD).
Charge mode	The BBU enables its internal charger to charge up its battery pack when all conditions are met. The charger current can be anywhere from 0A - 5.5A based on the previous depth of discharge of the battery capacity. It also allows the upstream system to override the charge current through the communication bus. There should be a charger timeout control scheme based on the calculated charge current.
Status of health check mode (SOH)	The BBU routinely tests battery pack capacity through forced discharge of the battery pack. The BBU shall perform the SOH test every 90 days to determine the battery's EOL status.
Periodical charge mode (PCM)	Because the BBU battery pack leaks current in standby mode, it needs to be periodically recharged.
Fault mode	In fault mode, the BBU is not allowed to charge/discharge and should be replaced as soon as possible.
System control mode	The BBU shall allow upstream system to control charger/discharger operation through communication bus.

3.6 BBU physical addressing

Four BBU signal pins are used for physical addressing. There are digital signals that should have internal pull up resistors inside the BBU. On the BBU shelf, these pins can be grounded (0) or left open (1) to determine rectifier location as below:

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Rectifier location 1-1 (row-column): 0001

Rectifier location 1-2: 0010

Rectifier location 1-3: 0011

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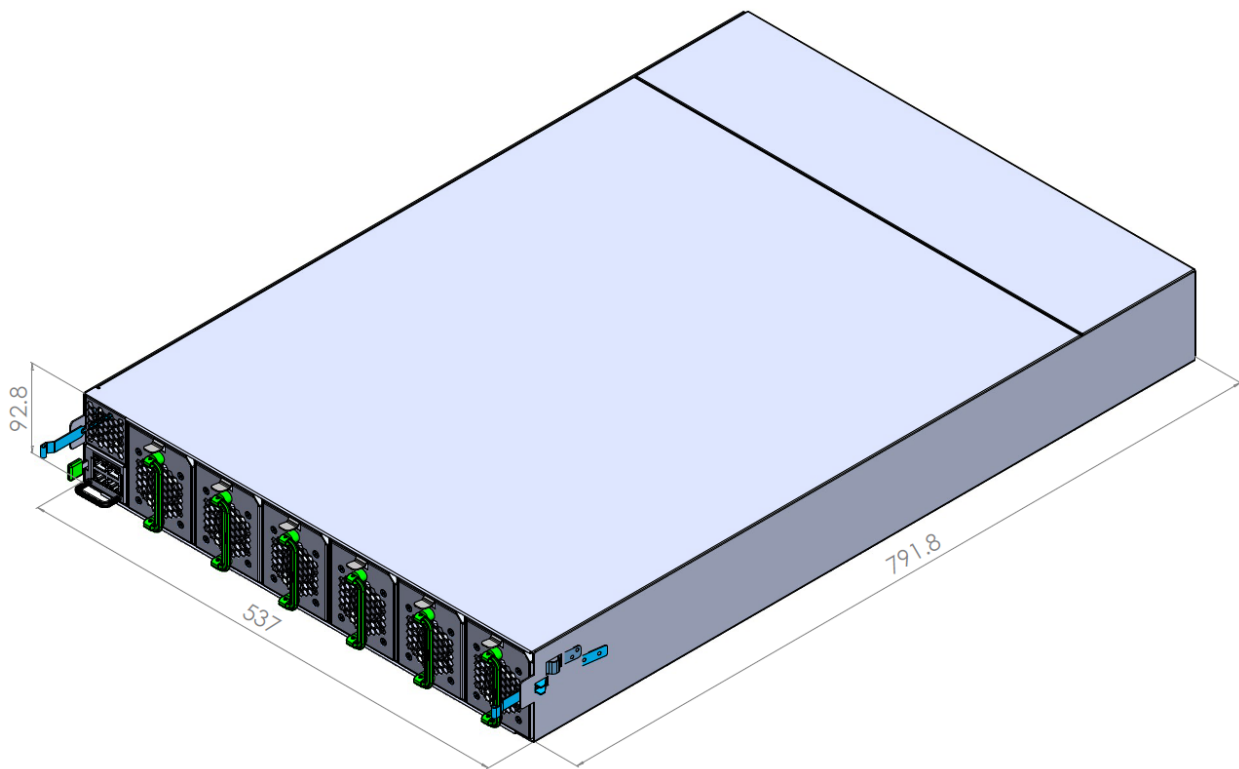
Rectifier location 2-1: 0111

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and so on.

4. Mechanical Requirements

4.1. BBU Shelf Assembly Dimension



The BBU shelf size is 537mm x 92.8mm x 791.8mm [Width x Height x Depth]

The power management controller (PMC) will be mounted within the power shelf.

4.2. Mounting

The BBU shelf will be front mounted anywhere in the rack.

4.3. Construction

The BBU shelf can be welded, riveted or screwed together, consistent with meeting shock, vibration and maximum allowable deflection requirements. There shall be no sharp corners or edges.

When assembled into a rack, with rectifiers installed, maximum deflection of the rectifier shelf shall be less

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than 1.3 mm.

4.4. Materials and Fasteners

Acceptable shelf materials include zinc plated CRS steel. Any plastic material used should meet UL 94-V0 specifications.

4.5. Labeling

Labels shall be provided that identify which terminal of the DC output on the shelf is - and which is +. Label shall be an assembly aid to ensure cables are assembled correctly.

5. Monitoring & Control Interface

Each BBU shelf shall include a power management controller (PMC) to monitor and control various BBU parameters and busbar voltage transition. PMC is connected to rack management controller or facility level monitoring through a monitoring & control interface. PMC communications are:

- Downstream communication: there is one communication bus for communication between the BBUs and PMC. Please refer to OCP ORv3 PMC for details.
- Upstream communication: there are several communications buses reserved for upstream communication. Please refer to OCP ORv3 PMC for details.

Note it is required that if the PMC fails, the power system shall be able to operate normally. PMC is directly powered from 50V bus.

6. Shelf Electrical Connections

6.1. Input/output power connector

The BBU shelf power connector is the output connector in discharge mode and input connector in charge mode. It is a DC floating connector that blindly mates to the busbar in the rear side of the BBU shelf. This enables flexibility in:

- Placing power and battery shelves at any desired location on the rack.
- Adding more power and/or battery shelves as needed.

For details, please refer to “OCP ORv3 output connector.”

6.2. BBU backplane connector

BBUs plug into the BBU shelf directly and they shall be hot swappable while the rack is powered. Amphenol 10127397-03h1510.

6.3. PMC backplane connector

PMCs plug into the BBU shelf directly and they shall be hot swappable while the rack is powered. Please refer to “OCP ORv3 PMC” for type of connector used.

7. Environment requirements

- Gaseous Contamination: Severity Level G1 per ANSI/ISA 71.04-1985
- Ambient operating temperature range: 0°C to 40°C

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- Long term standby mode ambient is 15°C to 35°C.
- Operating and Storage relative humidity: 10% to 90% (non-condensing)
- Storage temperature range: -20°C to +60°C
- Operating altitude with no de-ratings: 3000m (10000 feet)
- Air flow: refer to BBU module specification

7.1. Vibration & Shock

The BBU shelf shall meet shock and vibration test per EN 60068-2-6 and 60068-2-27 for both nonoperating and operating condition, with the specifications listed below. During operating vibration and shock tests, the BBU shelf shall exhibit full compliance to the specification without any electrical discontinuities.

During the non-operating tests, no damages of any kinds (included physical damages) should occur and they should not corrupt the functionalities of the PSU per the specifications.

- VIBRATION
 - Operating: 0.5g acceleration, 1.5mm amplitude, 5 to 500 Hz, 10 sweeps at 1 octave/minute per each of the three axes (one sweep is 5 to 500 to 5 Hz)
 - Non-Operating: 1g acceleration, 3mm amplitude, 5 to 500 Hz, 10 sweeps at 1 octave/minute per each of the three axes (one sweep is 5 to 500 to 5 Hz)
- SHOCK
 - Operating: 6g, half-sine 11mS, 5 shocks per each of the three axes
 - Non-Operating: 12g, half-sine 11mS, 10 shocks per each of the three axes

The BBU shelf shall meet Facebook rack level shock and vibration requirements.

8. Compliance requirements

The BBU shelf shall be designed for compliance to allow worldwide deployment. Additionally, the manufacturer is fully responsible for:

- ensuring the complete compliance of the BBU shelf in the environment it is intended to function (as described by the Rack Spec)
- maintaining and updating the BBU shelf safety reports to current requirements and all new released requirements.
- all design and recertification costs required to update the power supply to meet the new requirements.
- Meeting EMC requirements
- Meeting Safety requirements
- Meeting all applicable environmental compliance requirements

The manufacturer is responsible for obtaining the safety certifications specified below.

8.1. Safety Standards

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

UL1973 (Recognized Component)

IEC62133

62368-1 (UL/IEC)

UN38.3

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The manufacturer shall obtain the following safety certifications for the BBU shelf as applicable. Only requirements that absolutely rely on or are affected by the system may be left to the system level evaluation [i.e. minimize Conditions of Acceptability].

The BBU shelf safety test shall be performed together with Power/Battery Management Controller (PMC) and any component or signal that controls charging and discharging battery shall be evaluated under single fault condition per UL62368-1 Annex M. Below are common requirements for North America and Europe. For other countries, different certifications may be required:

- UL or an equivalent NRTL for the US with follow-up service (e.g. UL or CSA).
- CB Certificate and test report issued by CSA, UL, VDE, TUV or DEMKO
- CE Marking for EU

8.1.1. Component Safety requirements

Following are the safety requirements for major components:

- All Fans shall have the minimum certifications: UL and TUV or VDE.
- All current limiting devices shall have UL and TUV or VDE certifications and shall be suitable rated for the application where the device in its application complies with IEC/UL 62368-1.
- All printed wiring boards shall be rated UL94V-0 and be sourced from a UL approved printed wiring board manufacturer.
- All connectors shall be UL recognized and have a UL flame rating of UL94V-0.
- All wiring harnesses shall be sourced from a UL approved wiring harness manufacturer. SELV Cable to be rated minimum 80V, 130C.
- 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.

8.2. EMC Requirements

The BBU shelf shall meet the following requirements in the latest edition of standards when operating under typical load conditions and with all ports fully loaded;

The BBU integrated into the shelf is called the component battery backup unit. Manufacturer shall provide the proof of compliance for the component power supply that are required for spare parts shipment. The component power supply shall not contribute any noncompliant conditions to the end-use product. If at any time it is found that a supplier's BBU causes the end-use product to fail emissions and/or immunity testing, the supplier will be instructed to investigate and resolve the problem.

The BBU shelf shall have minimum 6dB margin from the Class A limit for the radiated and conducted emissions. Depending on the system manufacturer's design goals and business needs, more margin may be required when it is integrated into the final end system.

The following EMC Standards (the latest version) are applicable to the product.

- FCC /ICES-003
- CISPR 32/EN55032
- CISPR 35/EN55035 - Immunity
- EN61000-3-2 - Harmonics
- EN61000-3-3 - Voltage Flicker
- VCCI
- KN 32 and KN35

Each individual basic standard for immunity test has the following minimum passing requirement. Higher level of passing criteria may be applied depending on the system manufacturer's design goals and business needs.

- EN61000-4-2 Electrostatic Discharge Immunity

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- Contact discharge: >4kV
 - Air discharge: >8kV
- EN61000-4-3 Radiated Immunity
 - > 3V/m
- EN61000-4-4 Electrical Fast Transient Immunity
 - AC Power Line: >1kV
 - Signal Line: >0.5kV
- EN61000-4-5 Surge
 - AC Power Line: >1kV (Line-to-line), >2kV (Line-to-earth)
 - Signal Port: >1kV
- EN61000-4-6 Immunity to Conducted Disturbances
 - DC Power Line: > 3Vrms
- EN61000-4-8 Power Frequency Magnetic Field Immunity, when applicable
 - > 1A/m
- EN61000-4-11 Voltage dip and sag

8.3. Environmental Compliance

The BBU shelf (including all components inside) shall comply with the following minimum environmental requirement and manufacturer shall provide full material disclosure, Declaration of Conformity and technical documentations to demonstrate compliance. The system manufacture may have additional requirements depending on its design goals and business needs.

- RoHS Directive (2011/65/EU and 2015/863/EU); aims to reduce the environmental impact of EEE by restricting the use of certain substances during manufacture
- REACH Regulation (EC) No 1907/2006; registration with the European Chemicals Agency (ECHA), evaluation, authorization and restriction of chemicals.
- Halogen Free: IEC 61249-2-21, Definition of Halogen Free, 900ppm for Br or Cl, or 1500ppm combined
- US SEC conflict mineral regulation to source mineral materials from socially responsible countries, if applicable
- Waste Electrical and Electronic Equipment (“WEEE”) Directive (2012/19/EU) if applicable; aims to reduce the environmental impact of EEE by restricting the use of certain substances during manufacture

8.4. Documentation

The manufacturer shall provide reproducible copies of all pertinent documentation relating to the following:

- Product Information
- Schematics, PCB layout artwork and bill of material including key component specifications at each design phase
- Functional test report at each design phase
- Applicable compliance reports, certifications and declaration of conformance.
- Other applicable certificates required by the system manufacturer.