



**OCCP** | **SUMMIT** | **2018**  
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# Project Gemini 15kW, 12VDC Flexible Rack Power Distribution Unit

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# Overview

Gemini Power Shelf is part of novel Power System Distribution Architecture consisting of modularized power shelf and battery shelf that enables **maximum flexibility in power capacity, back up energy and redundancy levels.**

- 20U, 12.5VDC 15kW N+1 or 9kW N+N
- Six power modules in increments of 3 kW
- Integrated ATS allows dual AC feed for the 15kW N+1 configuration.
- Independent Li-Ion battery shelves can be added for back up or power peak shaving
- It can be configured to operate in programmable CV or CI mode
- Integrated RMC module allows direct interfacing with PSU modules, rack sensors, fan control, battery shelves (BBS) and host interface
- It can operate in stand-alone mode during RMC failure or temporary loss of communication.

# Project Gemini – Redundant 15kW Rack Power Shelf

## Electrical efficiency

- 80 Plus Platinum efficiency – 94%
- Load sharing power management for optimized efficiency

## Operational efficiency

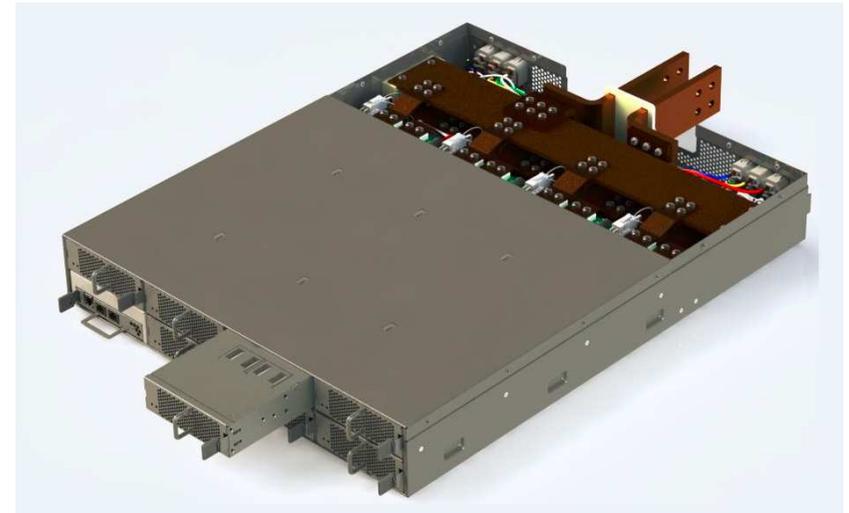
- Hot swappable power modules
- Hot swappable RMC
- Replaceable ATS module

## Space efficient

- 15kW N+1 in 2OU
- Battery charger located within BBU, reducing materials and cost for PSU only deployments.

## Power Scaling

- Scales in six 3kW power increments to match different rack power requirements
- Matches 1 to 1 battery shelf power modularity
- Can be used with or without battery back up units
- Can support multiple battery shelves for extended run time or peak shaving
- Flexible input: single or double feed
- Scaling the capacity in discrete power increments enabling low initial investment in the system



# Project Gemini - Redundant 15kW Rack Power Shelf

## Software Defined Power (SDP) compatibility

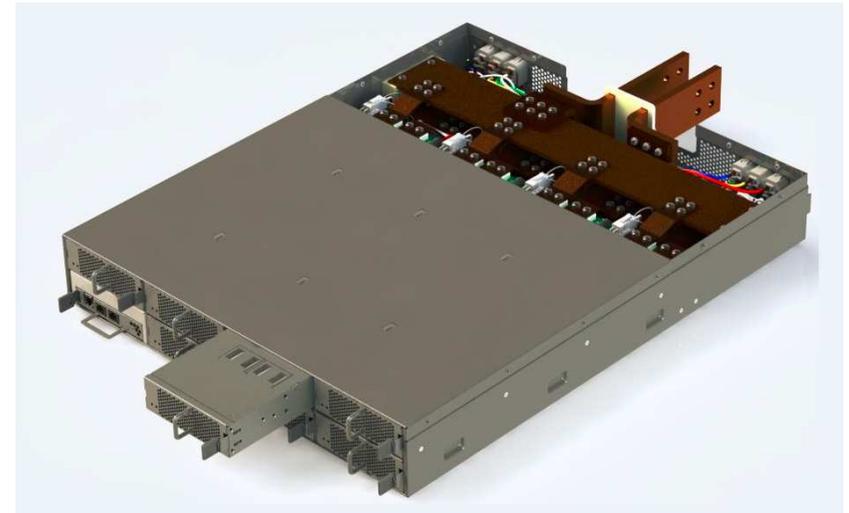
- Supports constant current mode allowing peak shaving via batteries
- Supports multiple battery packs

## Flexible Configuration

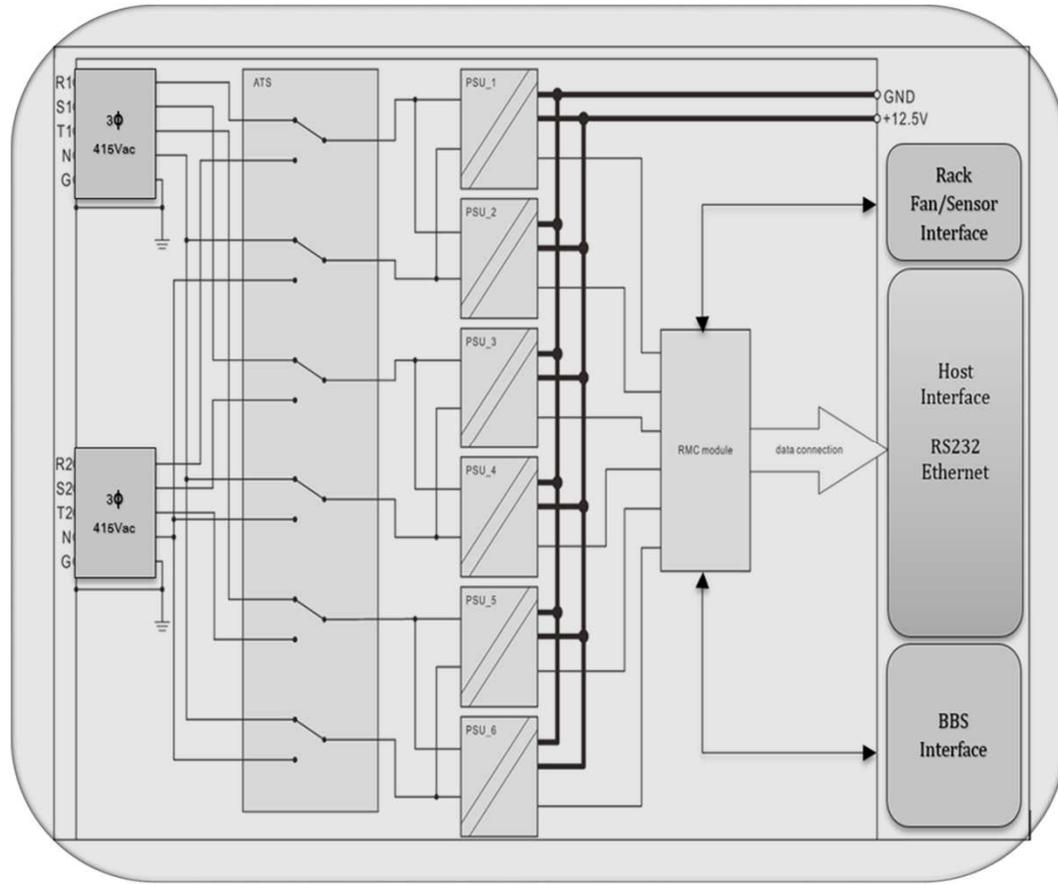
- Can be configured for N+N @ 9KW output
- Input ATS allows for 2N power feeds in 15kW N+1 configuration
- Multiple redundancy levels 15kW N+1, 12kW N+2, 9kW N+3
- Multiple battery packs can be added for additional runtime or peak shaving

## MFG and Cost Effectiveness

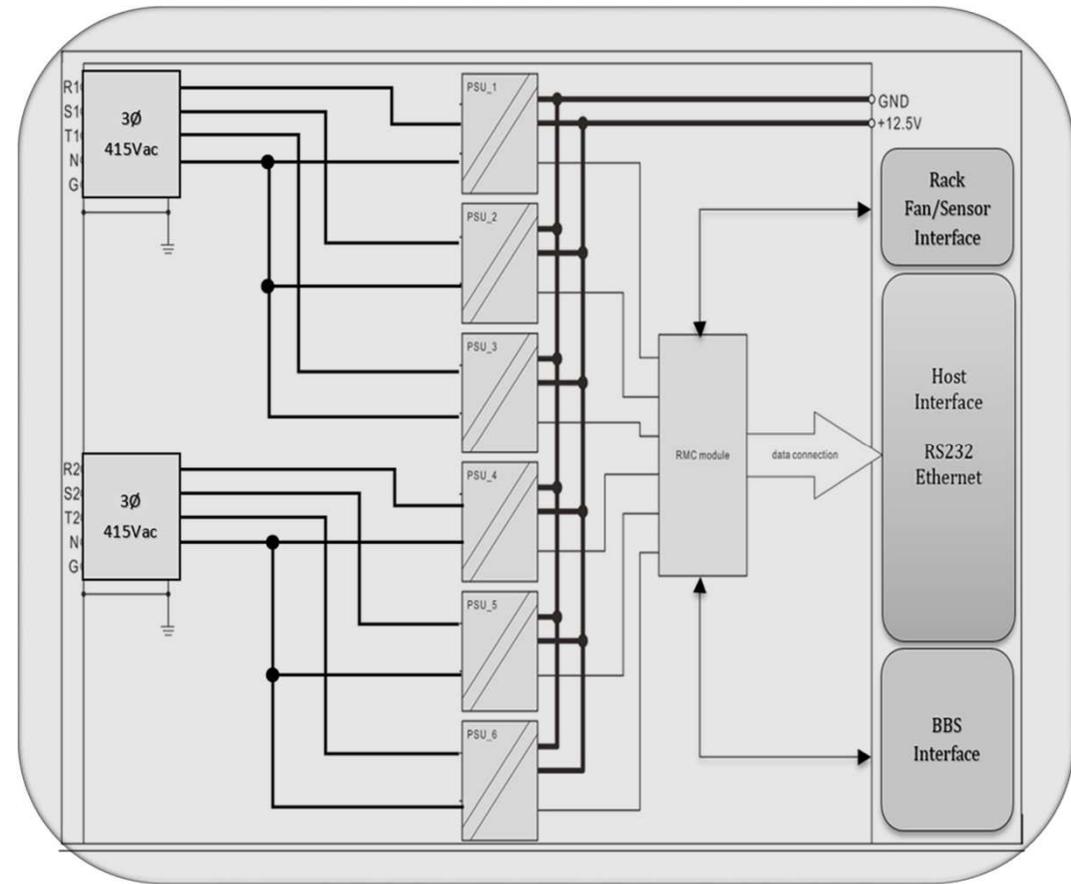
- The design is optimized for manufacturing cost effectiveness and delivery



# Project Gemini - Dual input configurations



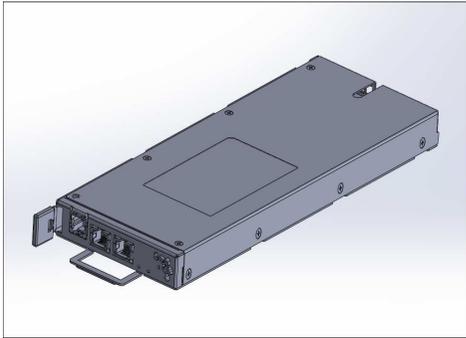
15kW 5+1 Power Shelf Block Diagram



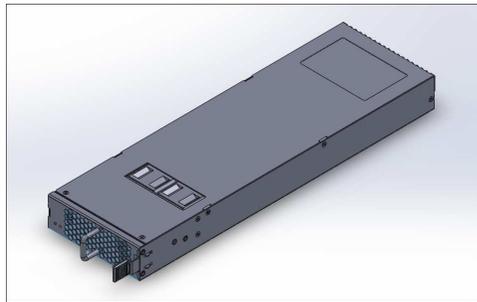
9kW 3+3 Power Shelf Block Diagram

# Project Gemini – Complete Rack Power Solution

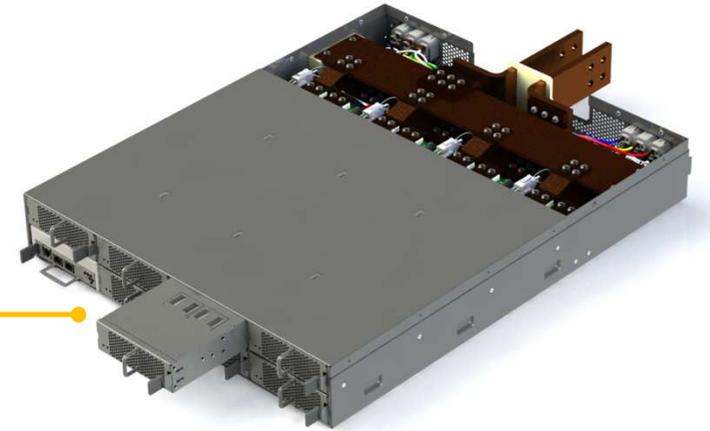
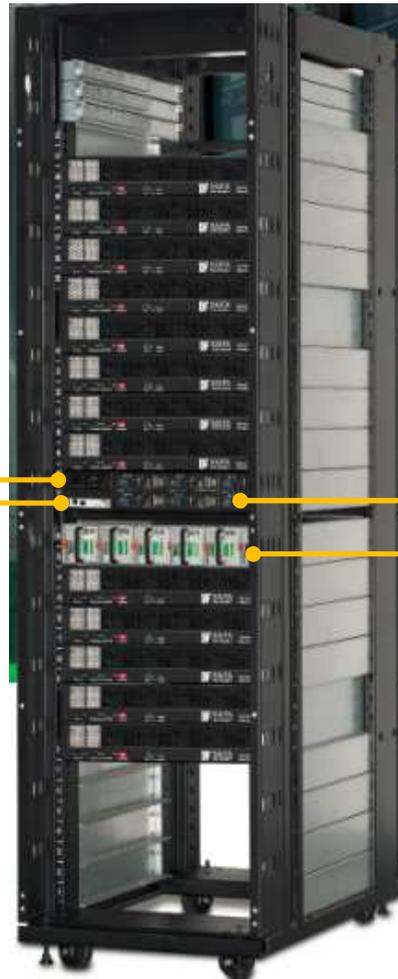
15kW, N+1, System with Battery Back Up



ATS



RMC



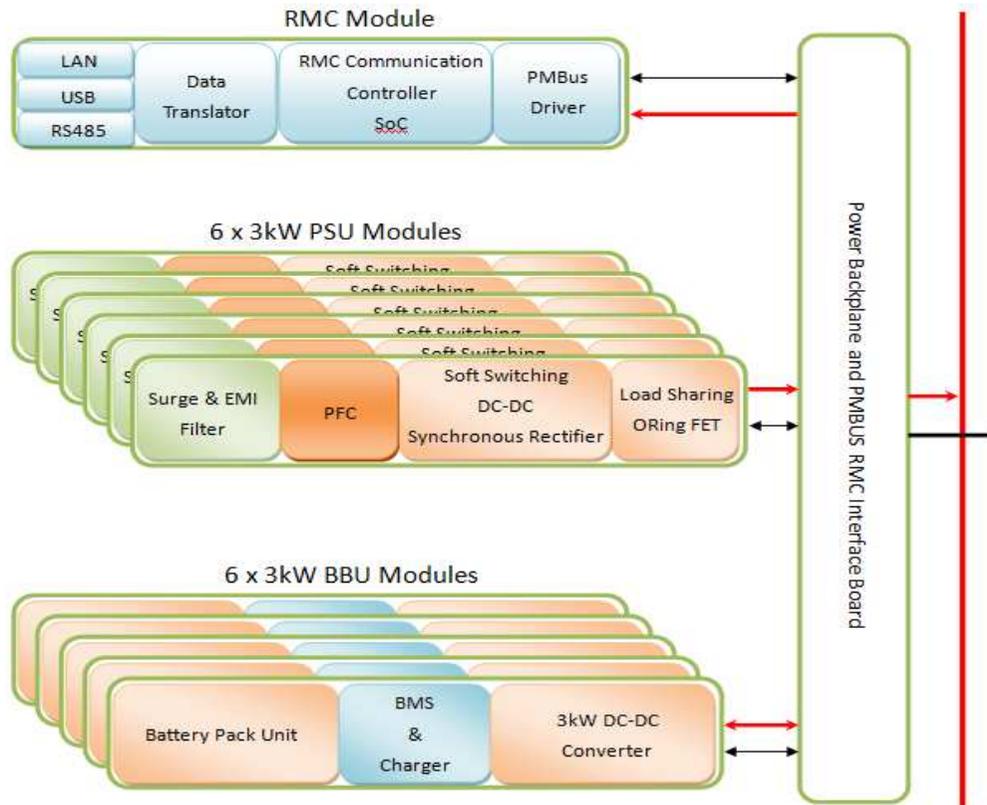
Power Shelf  
15kW N+1



Battery Shelf  
15kW N+1

# Project Gemini – System Block Diagram

## System Block Diagram



Possible system configurations with flexible redundancies  
15kW N+1, 12kW N+2, 9kW N+3 or 9kW N+N

- Battery and PSU shelf directly connected to 12V bus

- Both shelves controlled from RMC module

- Each power module and battery module could be independently controlled

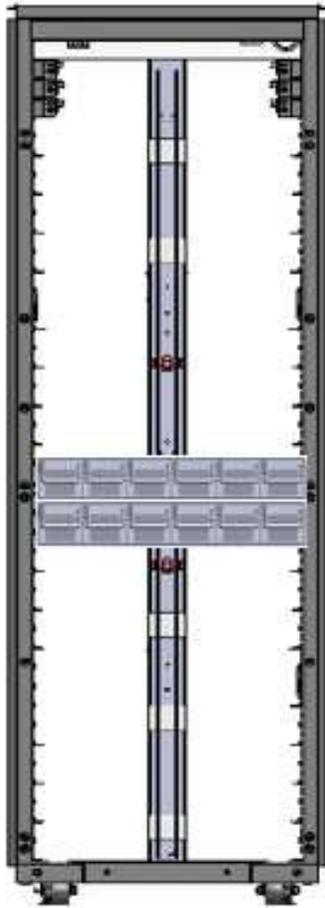
- Power shelf control via PMBus over I2C

- Utilization of battery modules in discrete increments or as a bulk battery bank.

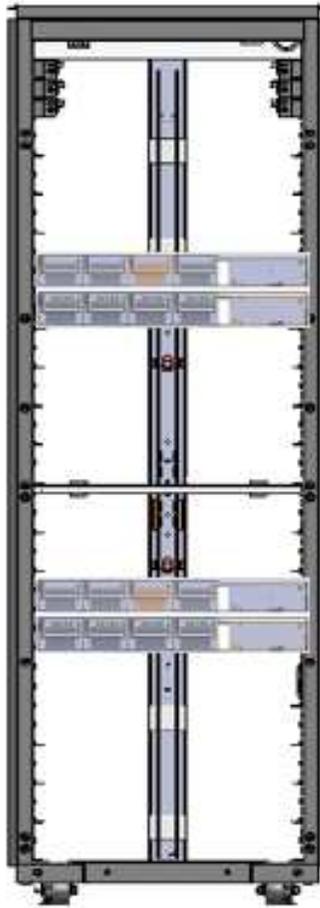
- Ethernet communication

# Project Gemini – Rack Configurations

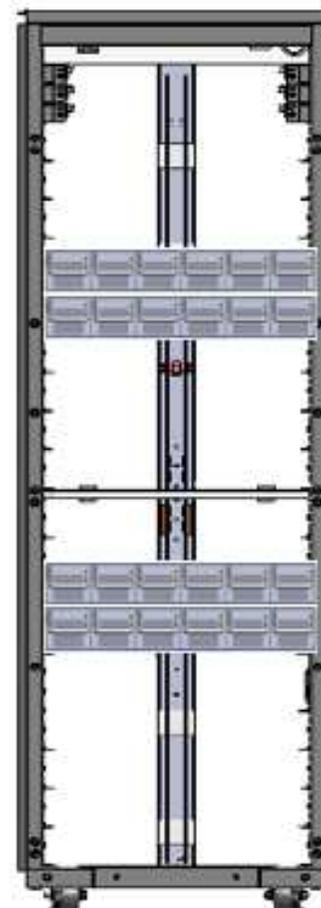
## Flexible Rack Configurations



Up to 15kW N+1  
Rack Config



Up to 18kW N+1  
Rack Config

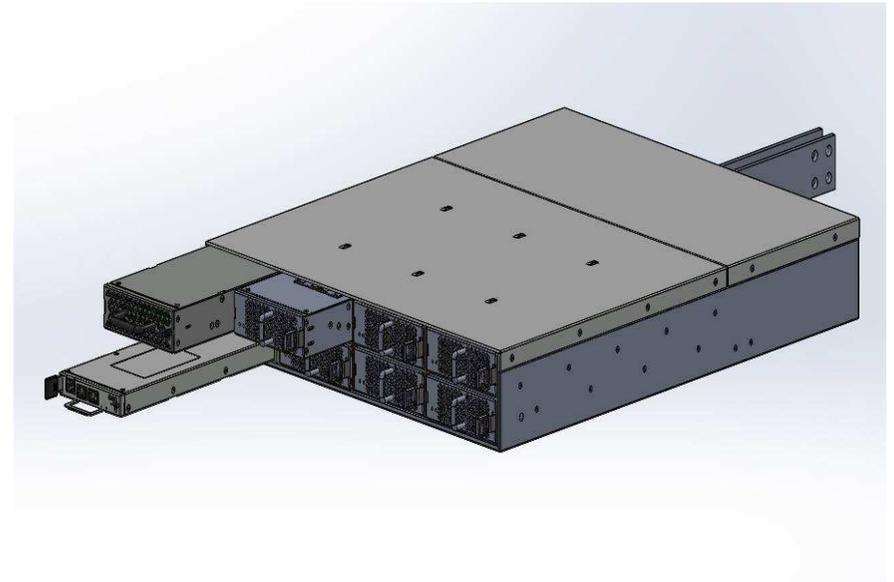


Up to 30kW N+1  
Rack Config

# Project Gemini –Power Shelf Specifications

## Shelf specifications

PARAMETER	DESCRIPTION
Input Range	3-Phase, 5 Wire, 380/400 /415VAC
AC Inlet Configuration	Single input or dual input with Integrated Automatic Transfer Switch
Redundant Configuration	Single input path 3-Phase feed: 15kW N+1, 12kW N+2 or 9kW N+3 Dual input path: 15kW N+1 (with ATS) or 9kW 3+3 double redundancy w/o ATS
Integrated RMC Module	Direct Interface to PSU Modules, Fan Controller, Rack Sensor and Host Interface
Rated Power	15kW (5+1 configuration with ATS) 9kW (3+3 Configuration without ATS)
Efficiency	Meet 80 Plus Platinum Energy Efficiency Standard
Output Connection	1 set of output blades for 12V DC output
+12VSB Standby Output	60W (Standby output 12.5V/5A)
BBS Interface	Dual BBS Interface for Backup and Grid Peak Shaving
RMC Power module Interface	3-Channels I <sup>2</sup> C PMBus (CH1: PSU Modules, CH2: BBS1 Shelf, CH3: BBS2 Shelf)
Dimensions (WxHxD)	534.3x93x650mm (overall: 534.3x93x889.5)



# Project Gemini – Power Shelf Efficiency

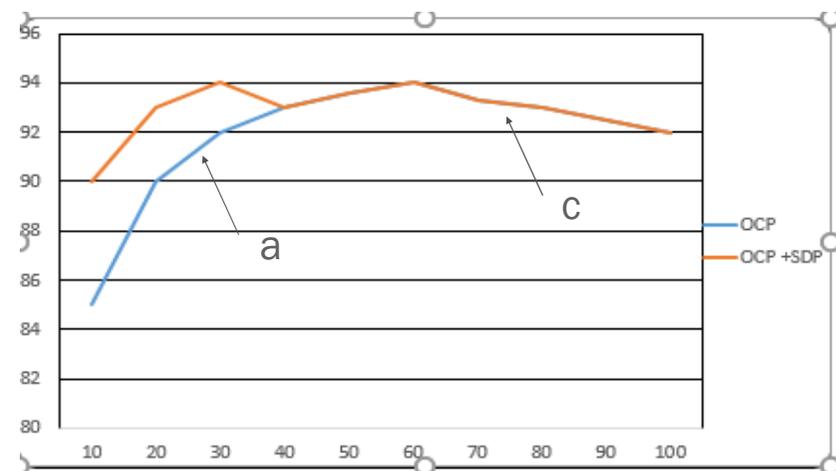
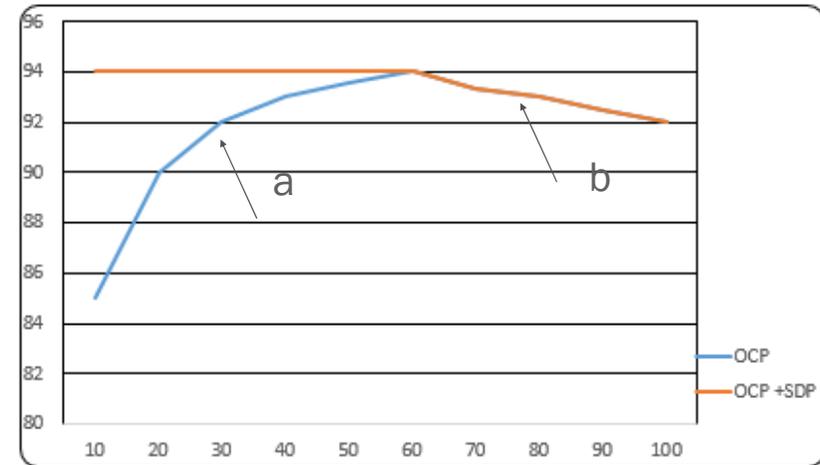
## Power Shelf Efficiency

### Maximum efficiency Load Sharing Control (LSC)

– load sharing algorithm which optimizes overall efficiency of the system by configuring optimal number of power supply modules to be connected to the load. Number of PSU modules is determined based on PSU efficiency curve, so that each PSU is operating near it's maximum efficiency.

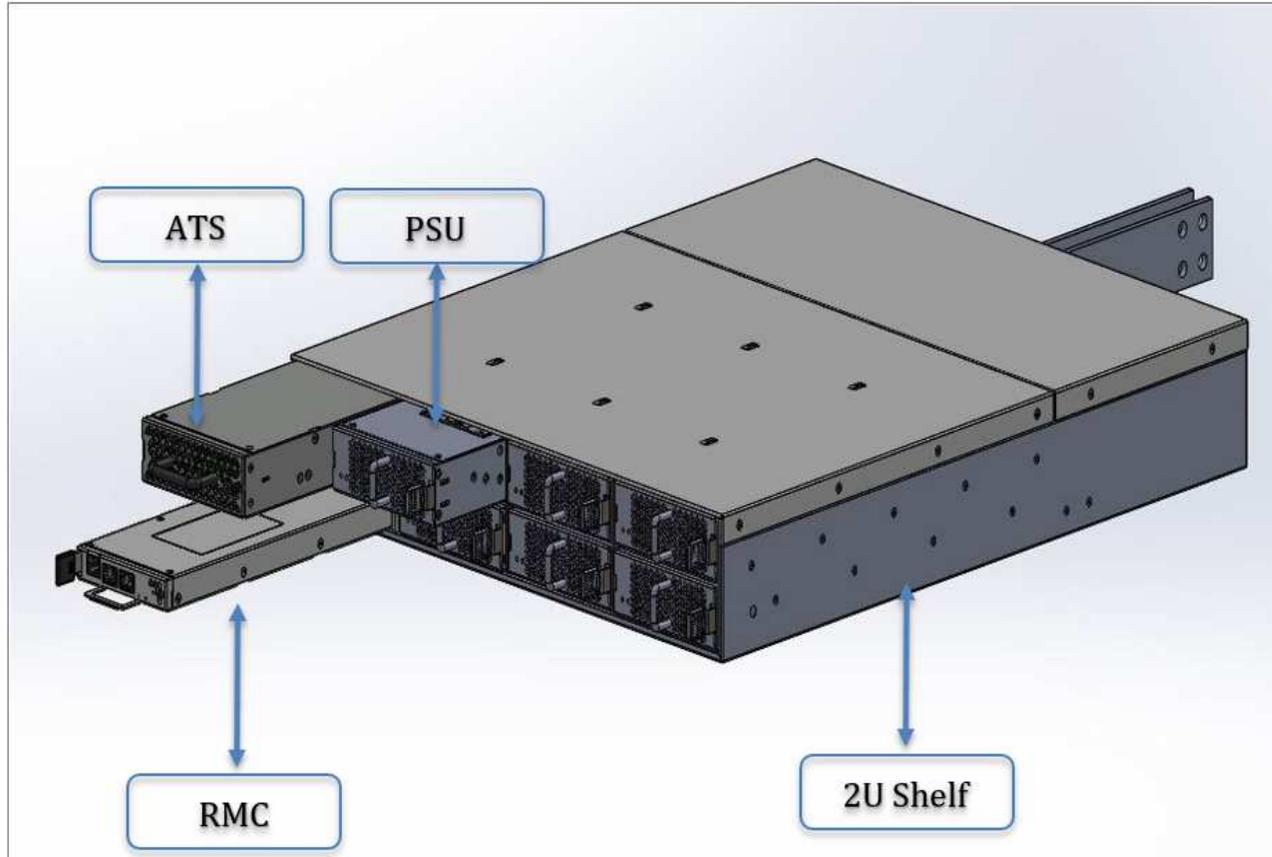
### Efficiency Graphs with Load Sharing Control

- a – power shelf efficiency curve w/o LSC
- b - power shelf efficiency with LSC and rack cluster phase balancing
- c – power shelf efficiency with LSC and rack phase balancing



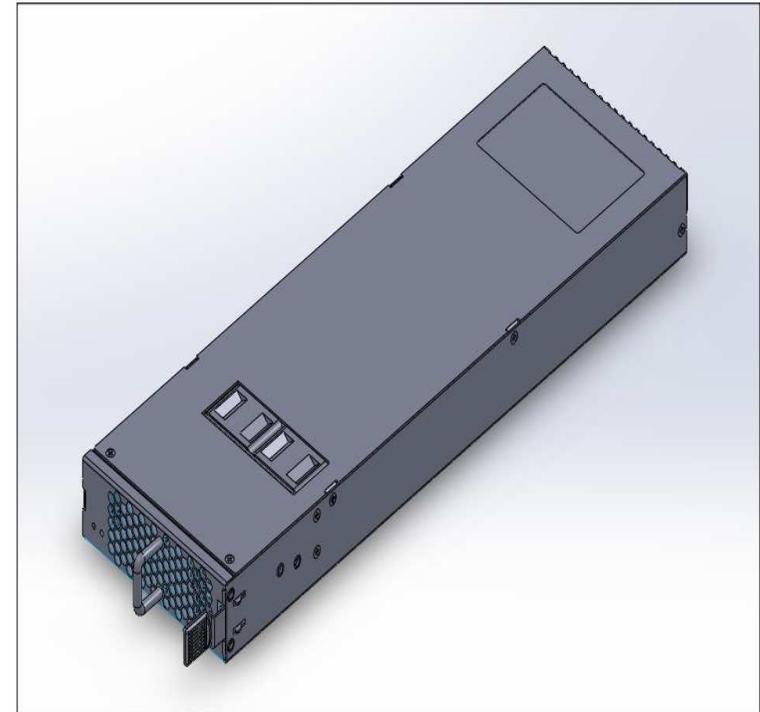
# Project Gemini – Power Shelf Components

Major components



# Project Gemini – Power Supply Unit (PSU)

- 12.5Vdc Output/ 12Vdc Standby
- Hot-plug capable
- Parallel operation
- 1U x 3U 3000W
- High density design: 26 W/in<sup>3</sup>
- Small/Slim form factor: 125 x 39 x 405 mm
- I<sup>2</sup>C communication interface for control, programming and monitoring with PMBus™
- 94% Platinum Plus Efficiency



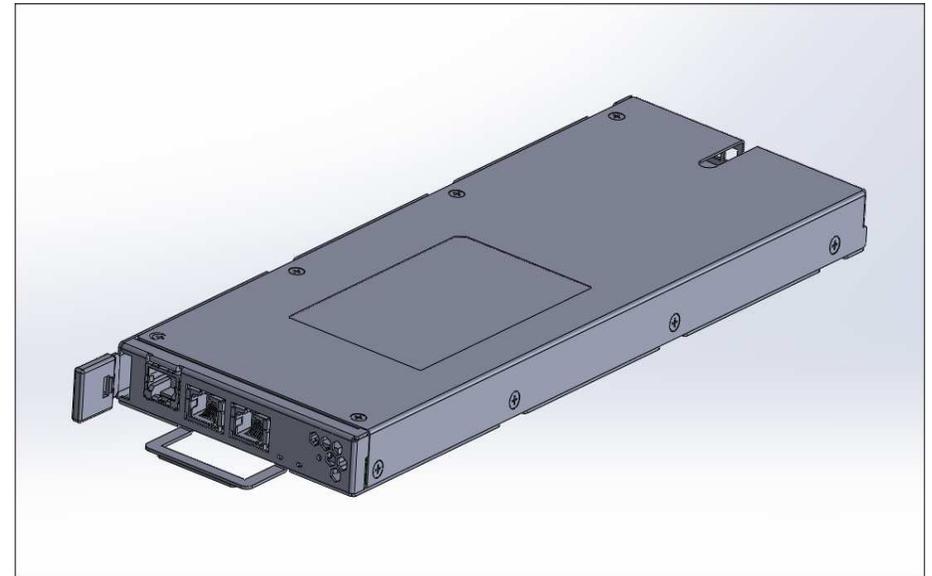
Life Is On

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# Project Gemini – Rack Management Controller (RMC)

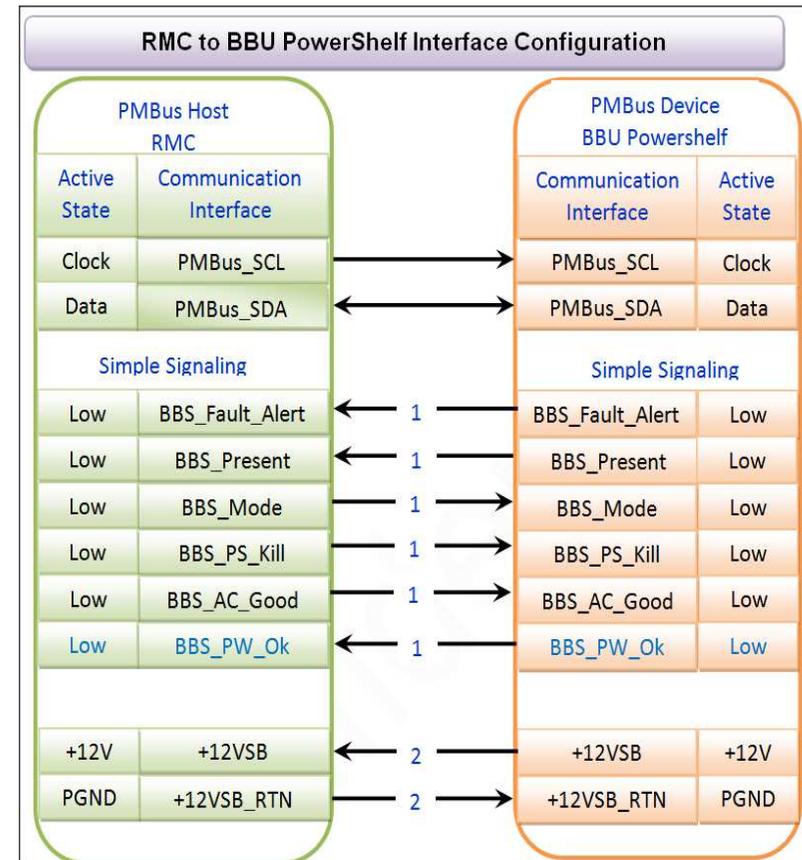
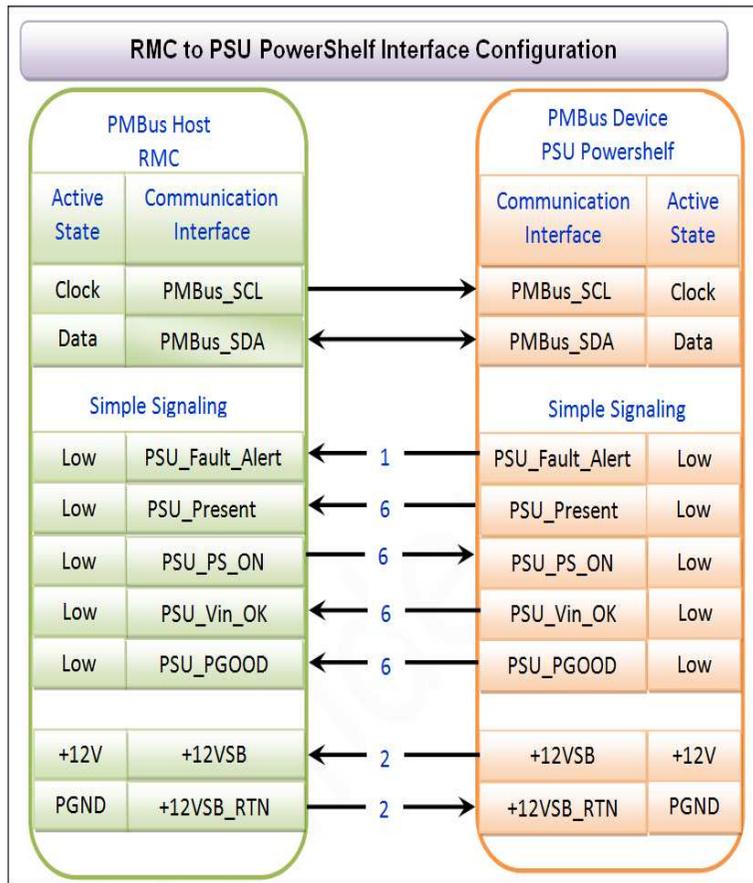
## Major components - RMC

- Integrates directly into OCP Power Shelf
- Interface for monitoring and control of PSU modules, battery shelves, rack sensors and DCM
- Communicates to the individual PSU modules via PMBus/I2C Channel 1 using PMBus 1.2 protocol and RMC simple signaling for PSU controls
- Communicates to the BBS1 shelf via PMBus/I2C Channel 2 and BBS2 Shelf via PMBus/I2C Channel 3 using PMBus 1.2 protocol and simple signaling for BBS controls.



# Project Gemini – RMC Interface

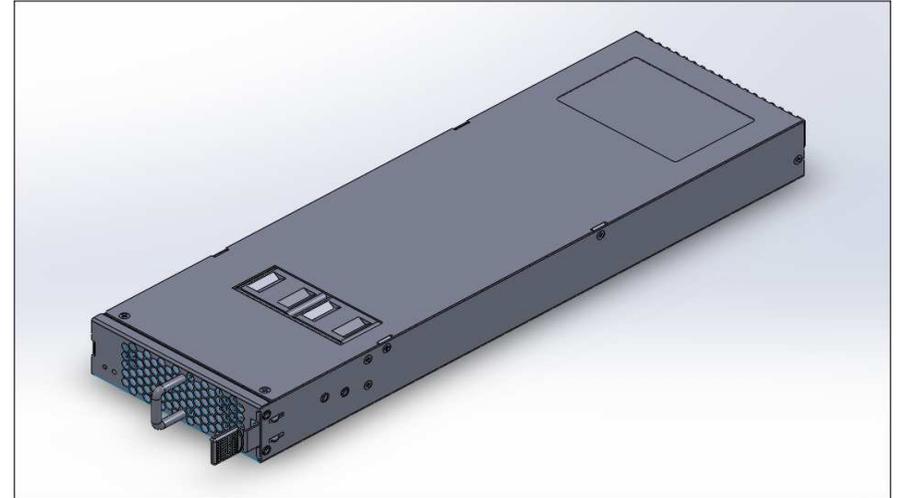
## RMC -Interface



# Project Gemini – Automatic Transfer Switch (ATS)

## Major Components - ATS

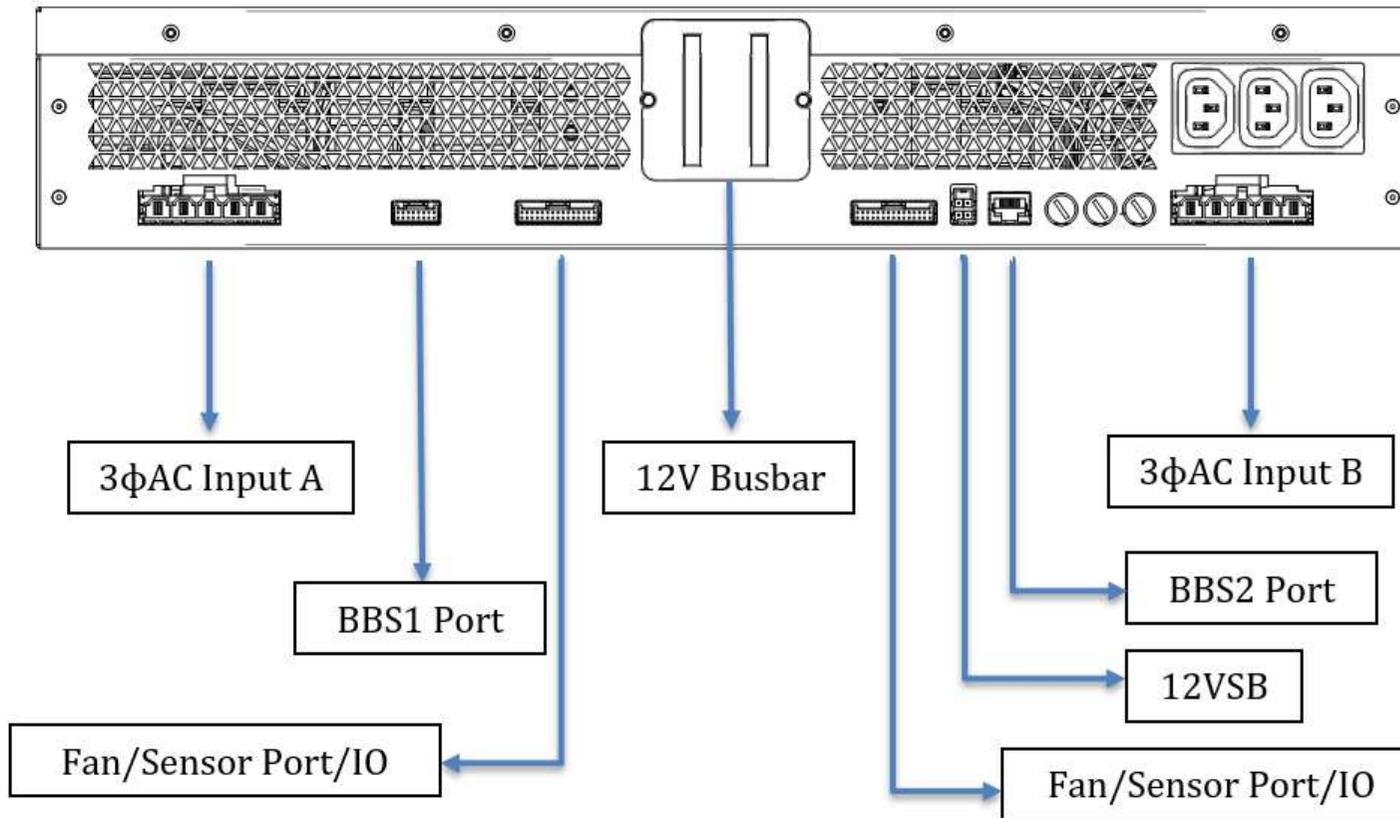
- ATS enables dual AC feed for the 15kW N+1 configuration
- Modular design
- Replaceable
- Interface to RMC



PARAMETER	DESCRIPTION/CONDITION	MIN	NOM	MAX	UNIT
AC Input Configuration	3 $\phi$ 5-Wire				VAC
AC Nominal Input Voltage	Line to Line input		400		VAC
AC Input Voltage Range		300		456	VAC
Max Input Current	Per line			17	Arms
Input Frequency		47	50/60	63	Hz
ATS Transfer Time			8	<10	ms

# Project Gemini – Shelf Output Configuration

Rear View



# Project Gemini

## Submitted for “ Inspired” designation

- Specification submission and Licence Agreements - March 2018
- Review for approval – April 2018
- Acceptance – May 2018



# OOCF SUMMIT

