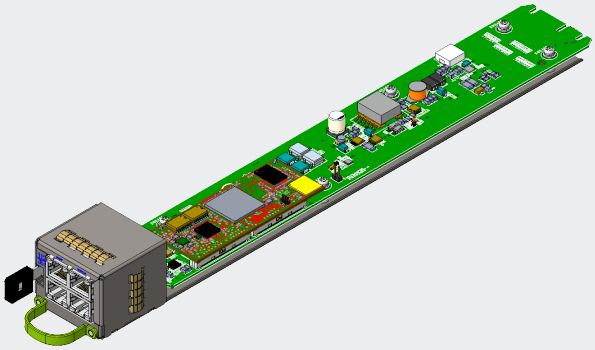
ARTESYN
ORV3 HPR PMC

For ORV3 HPR Power Shelf



Advanced Energy's ORV3 HPR Power Management Controller (PMC) is a hot-pluggable controller in the shelf that monitors and facilitates the monitoring and control of the power shelf through a 10/100/1000MB Base-T Ethernet port that can be connected directly to the rack switch. The PMC aggregates communications with the host controller and communicates with PSUs in the shelf through its backplane connector. The PMC provides ethernet connectivity and communications via the DMTF Redfish interface protocol.

A 4x RJ45 front connector provides one Ethernet port and one RS232 port for debugging and additional ports for daisy chaining in multiple shelf applications. PoE functionality is also provided in the event that 48 V power from the shelf bus is lost.

AT A GLANCE

Typical Application

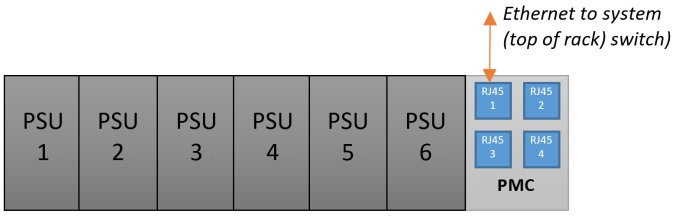
Control and Monitoring of ORV3 HPR Power Shelf

Input Voltage

48 VDC

Connector

4 x RJ45 Connectors



ELECTRICAL SPECIFICATIONS

System on Module (SOM) Core

All Artesyn current generation shelf and power management controllers utilize a shared SOM that fits onto a customer carrier. The SOM provides the core processing functionality along with storage. Communications from the SOM are routed by the carrier board which provides the mechanical form factor and connections for different shelves.

Microprocessor

The SOM is based on an ASPEED AST2620, which provides an ARM Cortex A7 core and a variety of peripherals.

Memory and Storage

The SOM provides the following storage:

- 1 GB of DDR4 Memory
- Two separate banks of 64 MB of SPI NOR Flash, for boot image storage and redundancy
- 8 GB of eMMC split into two redundant sections for the root file system, logging, etc

Connectivity

The SOM provides the following connectivity to the carrier although some products might repurpose some pins for different functionality.

Provided	Used	Primary Function	Alternate	Usage Breakdown
1	1	MAC	NA	1 - Front panel ethernet port
12	2	I2C	x4 GPIO	1 - Shelf peripherals (Reserved) 1 - PMC peripherals (EEPROM)
2	1	UART (flow control)	x4 GPIO	1 - Shelf Modbus (Shared PSU)
6	1	UART (no flow control)	x2 GPIO	1 - Debug UART (Front panel)
11	1	ADC	NA	1 - PMC temp sensor
53	24	GPIO	NA	6 - Module reset (Reserved) 6 - Module alert (Input) 1 - Vout select (Reserved) 3 - PCB revision 2 - Fronts LEDs 3 - Optional debug LEDs 3 - Optional debug inputs

PMC Carrier

The SOM is mounted on a carrier card that provides the connection between the SOM and the rest of the system.

PMC Carrier FRU

The PMC supports a 64 KB EEPROM for storage of manufacturing data.

PSU Control Signals

Item	Description
RS485/Modbus	The PMC supports one Modbus connection which is shared by all PSUs on the shelf.
Alert	The PMC supports an active low PSU_ALERT_N signal from each of up to 6 PSUs. The signals are available on the GPIOs of the processor.

Input Voltage

The PMC can be powered from a 48 V input from the power shelf itself.

The PMC should draw no more than 7 W when at absolute full performance.

ELECTRICAL SPECIFICATIONS

3.3 VDC Output

The PMC supports a 3.3 V power output from the edge connector to support the backplane FRU device. This output supports 3.3 V operation at up to 5 mA.

PMC Kill

PMC Kill is a mate-first, break-last pin to initiate connection to the PSUs through the backplane to safely connect the PMC. It is pulled low to the backplane.

PCB Revision

The PMC supports reading of a 3-bit PCB revision using GPIOs on the AST2600 processor. Revisions are set using strapping resistors. The purpose of the ID bits is to communicate to firmware the identity of the PMC in the event that different PCB revisions require different firmware features to be enabled or disabled. The ID should be incremented with each revision of the PCB.

ID	Description
000	EV
001	DV
010	PV
011	Reserved
100	Reserved
101	Reserved
110	Reserved
111	Reserved

Front Panel UART Connection

A debug UART connection is provided out the front panel on RJ45 port 3.

Hot Plug

The PMC is hot-pluggable. It can be removed and inserted without causing interference to the behavior of the shelf or any incorrect alerts or errors to be recorded. When inserted, the PMC will interface with the shelf and assume any defined functionality once synchronized with the PSUs.

Sensor

The PMC has a temperature sensor connected to the SOM via ADC. This current value is available from Redfish.

Miscellaneous Peripherals

Item	Description
I2C for Internal EEPROM	The PMC supports one I2C bus connection to the PMC carrier FRU.
I2C for Shelf EEPROM	The PMC supports one I2C bus connection to the PSU shelf FRU. (Reserved)

LAN Reset

The PMC provides a LAN reset option. This feature allows the user to reset the IP Address to default.

The LAN Reset can be triggered through an RS232 debug port command.

PMC CONNECTORS

RJ45 Connectors

The PMC contains four RJ45 connectors located on the bulkhead of the assembly. The RJ45 location is defined in the mechanical section. Looking from the front, top left RJ45 is #1, top right is #2, bottom left is #3, bottom right is #4.

The pinouts of the four connectors are shown below.

RJ45#1 - Ethernet (10/100/1000 MB Base-T) and Power over Ethernet (PoE)

It requires external magnetics on the carrier as they are not included in the RJ45 2x2 block as they're not needed for the other connections.

This pinout is Power over Ethernet 'mode B' [PoE on pins 4,5,7,8]. Ideally it would be possible to support 'mode A' [PoE on pins 1,2,3,6] either as part of a single hardware solution or as hardware configuration.

Pin #	Wire Color	Function	I/O	Description
1	White/Orange	TRD_D1+	I/O	Bi-directional Data +/PoE DC+
2	Orange	TRD_D1-	I/O	Bi-directional Data -/PoE DC+
3	White/Green	TRD_D2+	I/O	Bi-directional Data +/PoE DC-
4	Blue	TRD_D3+	I/O	Bi-directional Data + /PoE DC +
5	White/Blue	TRD_D3-	I/O	Bi-directional Data - /PoE DC +
6	Green	TRD_D2-	I/O	Bi-directional Data -/PoE DC-
7	White/Brown	TRD_D4+	I/O	Bi-directional Data +/PoE DC -
8	Brown	TRD_D4-	I/O	Bi-directional Data +/PoE DC -

RJ45#2 - Modbus Through Connection (reserved)

RJ45#3 - Alternate Debug Functionality

The alternate debug functionality of RJ45#3 is activated via SW1.

Pin #	Wire Color	Function
1	White/Orange	ISHARE
2	Orange	GND
3	White/Green	SYNC_START_L
4	Blue	CAN_H
5	White/Blue	CAN_L
6	Green	SYNC_STOP_L
7	White/Brown	SOH_L
8	Brown	TX (Debug)

Pin #	Wire Color	ALT Function through SW1
1	White/Orange	GND (Debug)
2	Orange	RX (Debug)
3	White/Green	SYNC_START_L
4	Blue	CAN_H
5	White/Blue	CAN_L
6	Green	SYNC_STOP_L
7	White/Brown	SOH_L
8	Brown	TX (Debug)

RJ45#4

Pin #	Wire Color	Function
1	White/Orange	ISHARE
2	Orange	GND
3	White/Green	SYNC_START_L
4	Blue	CAN_H_OUT
5	White/Blue	CAN_L_OUT
6	Green	SYNC_STOP_L
7	White/Brown	SOH_L
8	Brown	No Connect

Backplane Shelf Edge Connector

The reserved signals have no use-case currently, for future expansions. All other signals are routed in the power/battery shelf backplanes. See next page for the pin assignment.

PMC CONNECTORS

Pin #	Signal Name	I/O	Description	Pin #	Signal Name	I/O	Description
A1	ADDR_ID_0	I	Shelf ID	A18	Shelf_Addr2	O	PSU/BBU Shelf Modbus Address
B1	ADDR_ID_1	I	000 1U Power Shelf	B18	RS485A_Int	I/O	Shared PSU/BBU Modbus (to PSU/BBU Modules)
A2	ADDR_ID_2	I	001 Battery Shelf	A19	RS485B_Int	I/O	Shared PSU/BBU Modbus (to PSU/BBU Modules)
B2	GND	I	Ground	B19	I2C_SDA_0	I/O	PSU/BBU #0 PMBus
A3	ALERT_0_N	I	PSU/BBU Alert	A20	I2C_CLK_0	I/O	PSU/BBU #0 PMBus
B3	ALERT_1_N	I	PSU/BBU Alert	B20	I2C_SDA_1	I/O	PSU/BBU #1 PMBus
A4	ALERT_2_N	I	PSU/BBU Alert	A21	I2C_CLK_1	I/O	PSU/BBU #1 PMBus
B4	ALERT_3_N	I	PSU/BBU Alert	B21	I2C_SDA_2	I/O	PSU/BBU #2 PMBus
A5	ALERT_4_N	I	PSU/BBU Alert	A22	I2C_CLK_2	I/O	PSU/BBU #2 PMBus
B5	ALERT_5_N	I	PSU/BBU Alert	B22	I2C_SDA_3	I/O	PSU/BBU #3 PMBus
A6	ALERT_6_N	I	PSU/BBU Alert	A23	I2C_CLK_3	I/O	PSU/BBU #3 PMBus
B6	ALERT_7_N	I	PSU/BBU Alert	B23	I2C_SDA_4	I/O	PSU/BBU #4 PMBus
A7	ALERT_8_N	I	PSU/BBU Alert	A24	I2C_CLK_4	I/O	PSU/BBU #4 PMBus
B7	ALERT_9_N	I	PSU/BBU Alert	B24	I2C_SDA_5	I/O	PSU/BBU #5 PMBus
A8	ALERT_10_N	I	PSU/BBU Alert	A25	I2C_CLK_5	I/O	PSU/BBU #5 PMBus
B8	ALERT_11_N	I	PSU/BBU Alert	B25	I2C_SDA_shelf	I/O	I2C for Shelf Temp and FRU
A9	GND	I	Ground	A26	I2C_CLK_shelf	O	I2C for Shelf Temp and FRU
B9	RESET_0	O	PSU/BBU Reset	B26	Shelf_Addr3	I/O	Add One Bit to PSU/BBU Shelf Address, Connect to BBU Slot Address A3
A10	RESET_1	O	PSU/BBU Reset	A27	GPIO3	I/O	PRESENT_L for Slot 1[1]
B10	RESET_2	O	PSU/BBU Reset	B27	GPIO4	I/O	PRESENT_L for Slot 2[1]
A11	RESET_3	O	PSU/BBU Reset	A28	GPIO5	I/O	PRESENT_L for Slot 3[1]
B11	RESET_4	O	PSU/BBU Reset	B28	GPIO6	I/O	PRESENT_L for Slot 4[1]
A12	RESET_5	O	PSU/BBU Reset	A29	GPIO7	I/O	PRESENT_L for Slot 5[1]
B12	RESET_6	O	PSU/BBU Reset	B29	GPIO8	I/O	PRESENT_L for Slot 6[1]
A13	RESET_7	O	PSU/BBU Reset	A30	CAN_H	I/O	PSU CAN
B13	RESET_8	O	PSU/BBU Reset	B30	CAN_L	I/O	PSU CAN
A14	RESET_9	O	PSU/BBU Reset	A31	SYNC_STOP_L	I/O	PSU Sync Stop
B14	RESET_10	O	PSU/BBU Reset	B31	GND	O	Ground
A15	RESET_11	O	PSU/BBU Reset	A32	ISHARE	A	PSU/BBU Current Sharing
B15	GND	I	Ground	B32	SYNC_START_L	I/O	PSU/BBU Sync Start
A16	PLS	I	PSU/BBU Power Loss Siren	A33	SOH_L	O	BBU SOH_L
B16	BKP	I	PSU/BBU BKP, Removed from Module	B33	P3V3_Shelf	O	3.3 V for Shelf I2C
A17	Shelf_Addr0	O	PSU/BBU Shelf Modbus Address	A34	GND	O	Ground
B17	Shelf_Addr1	O	PSU/BBU Shelf Modbus Address	B34	ADC0	A	Reserved

Note 1: Pull high through 4.7 kohm resistor.

PMC CONNECTORS CON'T

Pin #	Signal Name	I/O	Description	Pin #	Signal Name	I/O	Description
A35	ADC1	A	Reserved	A39	RSVD	-	Reserved
B35	ADC2	A	Reserved	B39	RSVD	-	Reserved
A36	ADC3	A	Reserved	A40	P48V_RTN (GND)	I	Ground
B36	ADC4	A	Reserved	B40	P48V_RTN (GND)	I	Ground
A37	(ADC5) CAN_H_OUT	A	CAN Bus Loop Back from Far End Module via 0 ohm Resistor	A41	NC (Clearance)	-	No Connect
B37	(ADC6) CAN_L_OUT	A		B41	NC (Clearance)	-	No Connect
A38	(ADC7) Shelf_EEPROM_WP	A	Shelf EEPROM Write Protection	A42	P48V_IN	I	48V Power In
B38	Power_Kill	I	Power Kill, Short Pin[2]	B42	P48V_IN	I	48V Power In

Note 2: Connected to 3.3 V via 1 kohm resistor DNI; connect to GND via 10 ohm on shelf.

PMC SOFTWARE

The PMC software runs on Yocto Linux combining open source packages with customized driver and application software.

PMC Boot and Software / Firmware Update

Update via RedFish

The PMC software must allow update of all images in the system via the RedFish Update Service. These images include, but not limited to:

- uBoot images and other code in SPI flash
- Kernel and filesystem in eMMC
- PSU firmware images

It must be possible to download the new image while maintaining full functionality of the shelf. It is permissible to reboot into the newly downloaded image - i.e. no 'live' update required.

Update via Command Line / Debug

It must be possible to update all the same images via command line over the SSH or debug UART connection.

Firmware Rollback

After updating the PMC firmware, it must be possible to rollback to the previous version easily, without downloading more images. This should be done automatically if the new images fail to boot. It must also be possible to trigger this rollback manually. Ideally via Redfish but certainly via the command line.

PMC Connected Shelf Monitoring

Redundancy Status

The PMC can be configured to have an expected number of active supplies. It will signal an alert via RedFish if the available number drops below that is configured.

Communication Fault

The PMC will indicate through the attention LED if there is a communication error between the PMC and PSUs.

PMC SOFTWARE CON'T

PMC System Communications

RedFish

The system provides a full Redfish interface aligned with the Redfish 2021.4 version. Where functionality is not available in Redfish OEM extensions may be used. OEM extensions appear under the OEM name Advanced Energy.

Redfish is available over HTTP or HTTPS but HTTP can be disabled in the configuration. HTTPS certificates are self-signed.

SSH Command Line and Tools

The system provides a Linux command line with a standard set of configurations, diagnostic and debug tools. These are aligned with other hyperscale products.

Other PMC Functionality

Network Configuration

The PMC Ethernet configuration can be configured into DHCP or Static address mode either via Redfish, the command line or the web interface. All normal network settings should be configurable.

Logging

The PMC should store logs from its various processes at different logging levels following the Linux standard. The default logging level should be ERROR and this can be read and configured via Redfish or the command line.

The logs should be available via Redfish or the command line.

FRU Information

The PMC and shelf FRU information is programable via a command line tool. Rack and CDU information can be read/written via Redfish. The command line tool provides direct read access to the EEPROMs.

Vout Select (SW Control)

The PMC supports a PSU_VOUT_SEL SW command to the collective PSU group for setting PSU Vout between 48 and 51 V (default).

Board Interface ID (SW)

The PMC supports reading of a 3-bit interface ID.

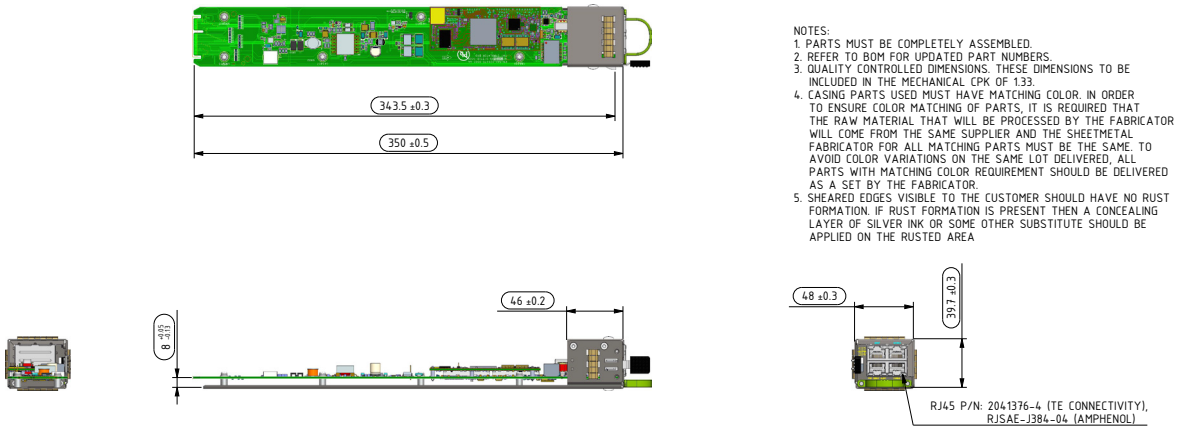
ID	Description
000	1U power shelf
001	Reserved
010	Reserved
011	Reserved
100	Reserved
101	Reserved
110	Reserved
111	Reserved

MAC Address Information

The MAC address labels includes MAC OID D8:97:3B prefix.

MECHANICAL DRAWING

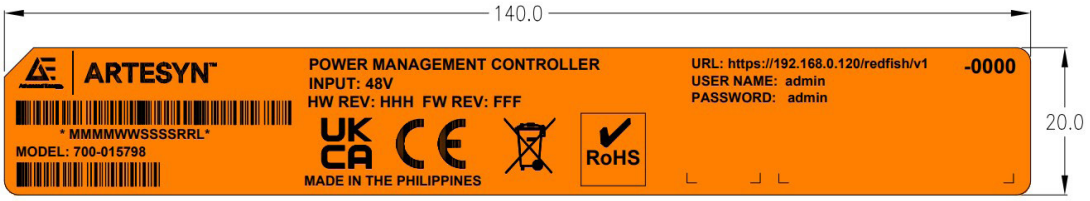
Mechanical Drawing



NOTES:
1. PARTS MUST BE COMPLETELY ASSEMBLED.
2. REFER TO BOM FOR UPDATED PART NUMBERS.
3. QUALITY CONTROLLED DIMENSIONS. THESE DIMENSIONS TO BE INCLUDED IN THE MECHANICAL CPK OF 1.33.
4. CASING PARTS USED MUST HAVE MATCHING COLOR. IN ORDER TO ENSURE COLOR MATCHING OF PARTS, IT IS REQUIRED THAT THE RAW MATERIAL THAT WILL BE PROCESSED BY THE FABRICATOR WILL COME FROM THE SAME SUPPLIER AND THE SHEETMETAL FABRICATOR FOR ALL MATCHING PARTS MUST BE THE SAME. TO AVOID COLOR VARIATIONS ON THE SAME LOT DELIVERED, ALL PARTS WITH MATCHING COLOR REQUIREMENT SHOULD BE DELIVERED AS A SET BY THE FABRICATOR.
5. SHEARED EDGES VISIBLE TO THE CUSTOMER SHOULD HAVE NO RUST FORMATION. IF RUST FORMATION IS PRESENT THEN A CONCEALING LAYER OF SILVER INK OR SOME OTHER SUBSTITUTE SHOULD BE APPLIED ON THE RUSTED AREA

Unit: mm

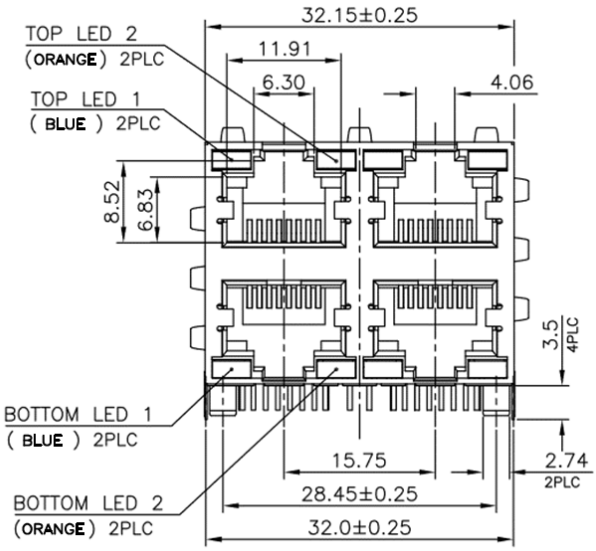
Label



MECHANICAL DRAWING

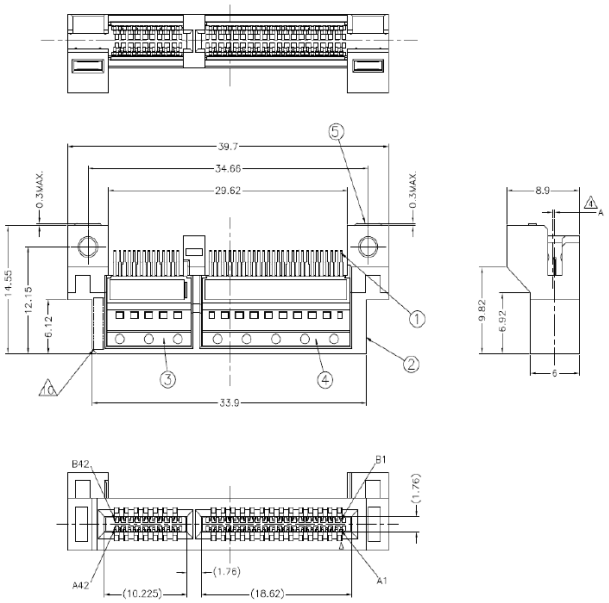
RJ45 Connector

The MPN is TE 2041276-2 or equivalent. The connectors come with spring fingers. They must contact the chassis in order to provide good EMI sealing. The reserved port 2# and 4# should be plugged with a connector cap.



Blind Mate

The PCB (card edge) of the PMC module plugs into a 2C connector on the chassis side. This connector should be a TE Sliver 2.0 Straddle Mount cable or PCB-mounted connector, TE 2340326-1 or equivalent, and can be customized for the particular power shelf.



SERVICEABILITY

Required Collateral

Include (at minimum) schematics, CAD, block diagrams, I2C diagram, switch and jumper settings, service/repair/assembly/disassembly instructions (if applicable), LED definitions.

FRU Information

FRU labels include part number and serial number.

Default Static IP Address

The default static IP address should be included on the label. Default static IP address is "192.168.0.120" across all units.

PCB Information

PCBs have silkscreen markings for jumpers, LEDs, and FRUs

LED Information

Power Status LED

One bi-color LED (blue and AMBER (602 to 610 nm) is incorporated into the front face plate of equipment indicating the power-on, power-off & standby states as follows:

Color	Power Status	Description
Solid Blue	Power-on	All of the power rails are good.
Blinking Blue	Power-on	PoE source, no shelf source.
Amber	Attention	A fault has occurred.
Off	Power-off	Power is off.

Management Ethernet Port LED

Two separate blue LEDs are incorporated into the front face plate of equipment for the management Ethernet port to indicate activity and speed as follows:

LED	LED Location	Color	Description
Activity LED	Left side of connector	Solid Blue	Link established
		Blinking Blue	Transmitting
Speed LED	Right side of connector	Solid Amber	1 GBPS

Programmable Updates

Non-disruptive (no reboot required) update capability is desired where possible for all programmable devices. Where this is not possible it must be possible to do the bulk of the update (download/write) while still running and reboot into the new firmware.

Utilities are provided with the capability to up and down-rev each article of firmware in the equipment. For the PMC this includes:

- All SPI flash devices
- eMMC storage

Update is preferred via the Ethernet Redfish interface but should also be possible via the Ethernet and debug command lines.

Cold Aisle Repairs

PMC should be serviced from the cold aisle.

Additional Service Requirements

Additional equirements might be added based on Safety and Data Center requirements. Contact specification owner for latest requirements.

ENVIRONMENTAL SPECIFICATIONS

Thermals

Thermal specification should exactly match OCP spec (PMI and PMC) - current version v67 section 9.

Environmental

Operational:

- Cold aisle (inlet) temperature: -5°C to 45°C
- Relative humidity: 10% to 90%, non-condensing
- Altitude: up to 3050m (10,000ft)

Thermal Requirements

Operational:

Reserving adequate thermal margins on components is critical. These margins should be defined with respect to de-rated values, as appropriate.

Thermal Margin Requirements
Component thermal margin of ≥7% or ≥5°C up to 30°C inlet/ambient and 3050m (10,000ft) above sea-level. Target whichever value is larger.
Component thermal margin of ≥4% or ≥3°C at greater than 30°C inlet/ambient and up to 3050m (10,000ft) above sea-level. Target whichever value is larger.
Margin to de-rated temperatures should account for associated differences in reading and measurement location. Impact to reliability should also be considered when determining required margin.

Themal Kit:

- To target an accuracy of ≤±5°C (≤±2°C is preferred). Thermal margin requirements defined above should account for sensor inaccuracy for a temperature sensitive component.
- Surface temperature: To make the PMC safe for handling in-operation, accessible surfaces shoud not exceed a temperature of 70°C.

Vibration and Shock

The PMC meets vibration and shock test per EN 60068-2-6 and 60068-2-27 respectively and is to be performed at system shelf level (i.e. power shelf installed with PSUs and PMI/PMC module).

Compliance

Safety, EMC, environmental and document compliance specification should exactly match OCP spec (PMI and PMC) - Current version v67 section 10.

ORDERING INFORMATION

Model	Description
TBD	Standard ORV3 HPR Power Management Controller

ABOUT ADVANCED ENERGY

Advanced Energy (AE) has devoted more than three decades to perfecting power for its global customers. AE designs and manufactures highly engineered, precision power conversion, measurement and control solutions for mission-critical applications and processes.

Our products enable customer innovation in complex applications for a wide range of industries including semiconductor equipment, industrial, manufacturing, telecommunications, data center computing, and medical. With deep applications know-how and responsive service and support across the globe, we build collaborative partnerships to meet rapid technological developments, propel growth for our customers, and innovate the future of power.

PRECISION | POWER | PERFORMANCE | TRUST

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ENG-1OU OCP PMC-235-1.09.23.24