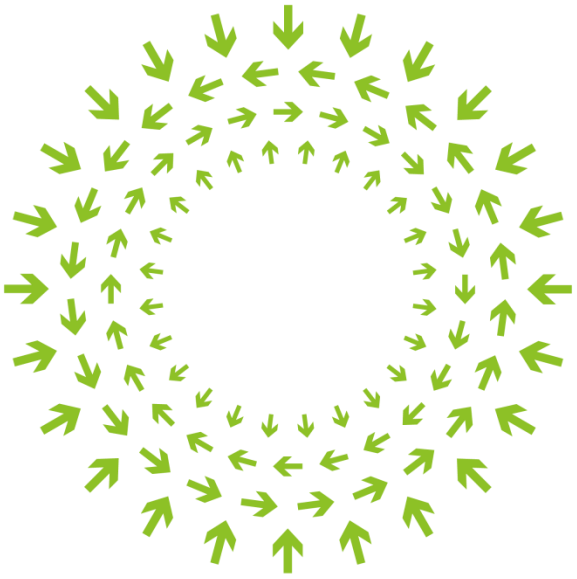

OPEN
Compute Project

Project Olympus
Server Power Supply
Specification

Author:
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Revision History

Date	Description
11/1/2017	Version 1.0 Released to Project Olympus github

Contents

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1 Scope

This document defines the functional requirements for a 1000W 12.25VDC output, power supply Unit (PSU) operating off an AC Hi-Line three phase input, intended for worldwide use in electronic data processing equipment.

2 Reference Documents

This section lists the applicable reference documents and defines the order of preference.

2.1 Applicable Documents

Table 1 lists the documents that form a part of this specification to the extent specified herein.

Table 1: Applicable Documents

Reference	Description
ANSI C63.4	"American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz." American National Standards Institute (ANSI).
AS/NZS CISPR 32	http://www.acma.gov.au
CISPR 32	"Limits and methods of measurement of radio interference characteristics of information technology equipment." International Special Committee on Radio Interference (C.I.S.P.R.),
CISPR 24	"Information technology equipment - Immunity characteristics - Limits and methods of measurement"
GB 17625.1	Electromagnetic compatibility - Limits - Limits for harmonic current emissions (equipment input current < 16 A per phase)
GB 9254	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
CFR 47, Part 15	"Unintentional Radiators". Title 47 of the Code of Federal Regulations, Part 15, FCC Rules, Radio Frequency Devices, Subpart B.
ICES-003	Information Technology Equipment — Limits and Methods of Measurement
CNS14336-1	"Information technology equipment – Safety – General requirements", Bureau of Standard, Metrology and Inspection
CNS13438	"Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment", Bureau of Standard, Metrology and Inspection

Reference	Description
EN 55032	Electromagnetic compatibility of multimedia equipment - Emission requirements
EN 55024	"Information technology equipment – Immunity characteristics – Limits and Methods of measurement." European Committee for Electro technical Standardization (CENELEC)
IEC/EN/UL/CSA 60950-1	"Safety of Information Technology Equipment – Safety – Part 1: General requirements",
IEC/EN/UL/CSA 62368-1	Audio/video, information and communication technology equipment - Part 1: Safety requirements
IS 13252-1	"Safety of Information Technology Equipment – Safety – Part 1: General requirements"
EN 61000-3-2	"Electromagnetic Compatibility (EMC) Part 3-2 Limits – Limits for Harmonics Current Emissions (Equipment input current ≤16A per phase)."
EN61000-3-3	"Electromagnetic compatibility (EMC) – Part 3-3 Limits – Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current <= 16 A"
GB 4943.1	"Safety of Information technology equipment", Standardization Administration of China
IEC 61000-4 Sections 2 – 6, 11	"Electromagnetic Compatibility (EMC) – Part 4: Testing and measurement techniques."
IPC-A-610	"Specification, Acceptability of Electronic Assemblies."
MIL HDBK 217F	"Reliability Prediction of Electronic Equipment." U.S. Military Standard.
Taiwan EMC Law	"Commodity EMC Regulation" (Taiwan EMC Law), Bureau of Standards, Metrology, and Inspection under auspices of the Ministry of Economic Affairs, URL:http://www.bsmi.gov.tw .

2.2 Order of Preference

In the event of a conflict between this specification and references cited herein, this specification shall take precedence.

3 General Functional Description

This specification describes the power supply requirements for the Project Olympus system. The power supply Unit shall be a dual three phase input and 1000W output. The system consists of an IVS section receiving dual inputs of three single phases (6 total) and three 340W power supply modules (PSM's) in parallel with a total maximum output of 1000W. Each PSM will be powered off of one of the three IVS outputs. The power supply load/output will not be hot pluggable but AC input will. There will be an optional battery that will be contained in the PSU chassis. Failure of a single PSM or loss of a single phase will not affect system operation for loads 680W and below. Power supply inputs will be hot swappable. Outputs will not be hot swapped. The power supply outer dimensions are depicted in section 9.1. If 2 PSM's fail and total load is equal to or less than 340W the remaining module should continue to operate.

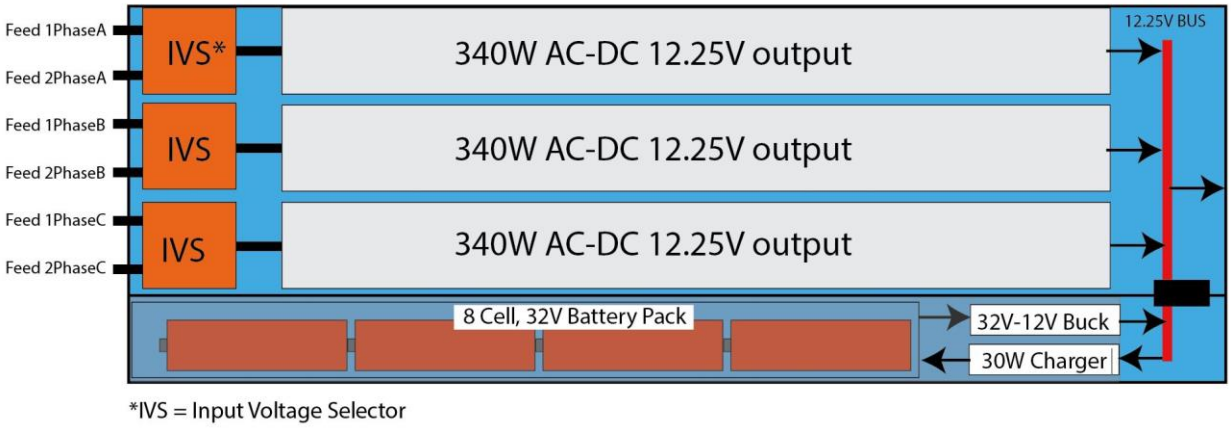


Figure 1. Block Diagram

3.1 System Implementations

3.1.1 Project Olympus Compute Server

The Project Olympus Server Power Supply will be installed in a compute server chassis and will blindmate to a managed PDU for input AC power and signals and communications between the rack manager and the compute server and PSU. Output Power and signals to server via power and signal harness.

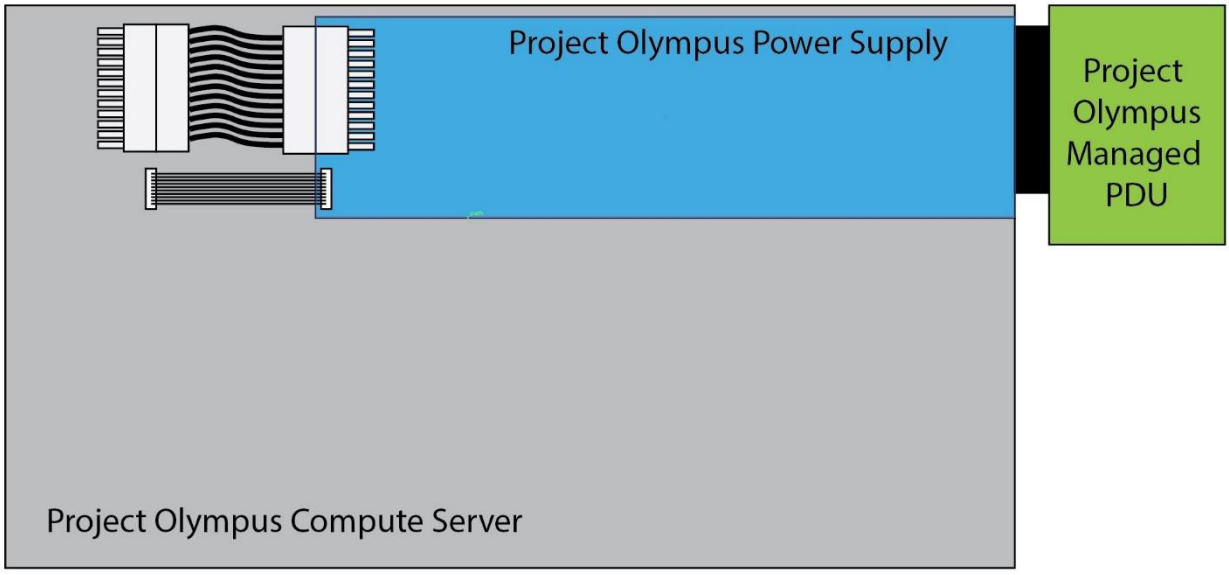


Figure 2. Project Olympus Server

4 Electrical Specification

This section details the electrical specification.

4.1 AC Input

AC input will be either 3 phase 415/400VAC Wye or 208VAC Delta with a single phase going to each of the three 340W modules. Note that the power supply needs to be able to operate under three single phases to each module with the three sine waves all in phase (no 120Hz lag).

4.1.1 Voltage, Current, and Frequency

The individual phase power supplies shall operate within all specified limits over the following input voltage range as defined below and in Table 2.

WYE: 311VAC-457VAC, 5 Wire 3L+N+PE, 47Hz-63Hz, 2.4 A Max

Delta: 187VAC-228VAC, 4 Wire 3L+PE 47Hz-63Hz, 2.4 A Max

Table 2: AC Input Rating per module

Parameter	Min	Rated	Max	340WPSU max input current at min V_{rms}
Voltage (240)	180 V_{rms}	200-240 V_{rms}	264 V_{rms}	2.4A_{rms}
Frequency	47 Hz		63 Hz	

4.1.2 Hold-Up Time

This section defines the hold-up time for version 1 (no Battery) and version 2 (With Battery).

4.1.2.1 No Battery installed

Each individual module shall operate at up to 340W with no interruptions for the following input variations:

20ms at 0V
500ms at 140VAC
10 Seconds at 160VAC

AC Line dropout is defined as input voltage drooping below minimum voltage thresholds as defined above down to 0VAC for an indefinite amount of time. An AC Line dropout shall not cause an AC line breaker to open. For line drops of less than 20ms the power supply shall operate normally. For line drops greater than the times listed above the power supply may shutdown and then shall recover and turn on normally consistent with turn on requirements specified in this document. An AC Line dropout shall not cause input current to exceed 120% of maximum rated steady state input current.

4.1.2.2 With Battery

The battery shall be able to supply enough energy for an output power of 680W for one second then operate for the specified times and loading given in the table below. Note that the power supply should continue to operate off of battery power after meeting the minimum timing below until the battery reaches it's minimum operating voltage or damage to the PSU or battery would occur if battery power continues.

Output Power Level (W)	Minimum Run time (s)	Energy (kJ)
100	800	80
150	533	80
200	400	80
250	320	80
300	267	80

4.1.3 AC Turn On Requirement

This section describes the AC turn on requirement for version 1 and version 2 with batteries disabled.

The power supply shall return to normal power up state after a slow recovery condition. The recovery shall be tested in all valid redundant power system configurations. With the test loads configured for 680W system DC output in resistive mode, the AC line voltage shall be increased

from 0VAC to 180VAC/60Hz at a constant rate over 30 minutes. When VAC input is within proper range the PSU shall turn on and assume full load consistent with the soft start requirements.

4.1.4 AC Turn Off Brownout Requirement

This section describes the AC turn off brownout requirement for version 1 and version 2 with batteries disabled.

The power supply shall return to normal power up state after a slow brownout condition. The brownout condition shall be tested with all valid redundant power system configurations using the end use system/s. While the power system is operating at full rated DC load, the AC line voltage shall be reduced from 180VAC/60Hz to 0VAC at a constant rate over a period of 30 minutes. The power shall be then reapplied at 180VAC/60Hz.

When VAC input is within proper range the PSU shall turn on and assume full load consistent with the soft start requirements. This requirement applies to single power supplies only.

4.1.5 ITIC Requirement

The power supply shall run without interruption when exposed to any of the power variations shown in the ITIC curve below. The transient portion of the chart depicted in red shall be instead as specified EN61000-4-4 Electrical Fast Transients and EN61000-4-5 Electrical Surge, 2000V L-PE, 1000V L-L.

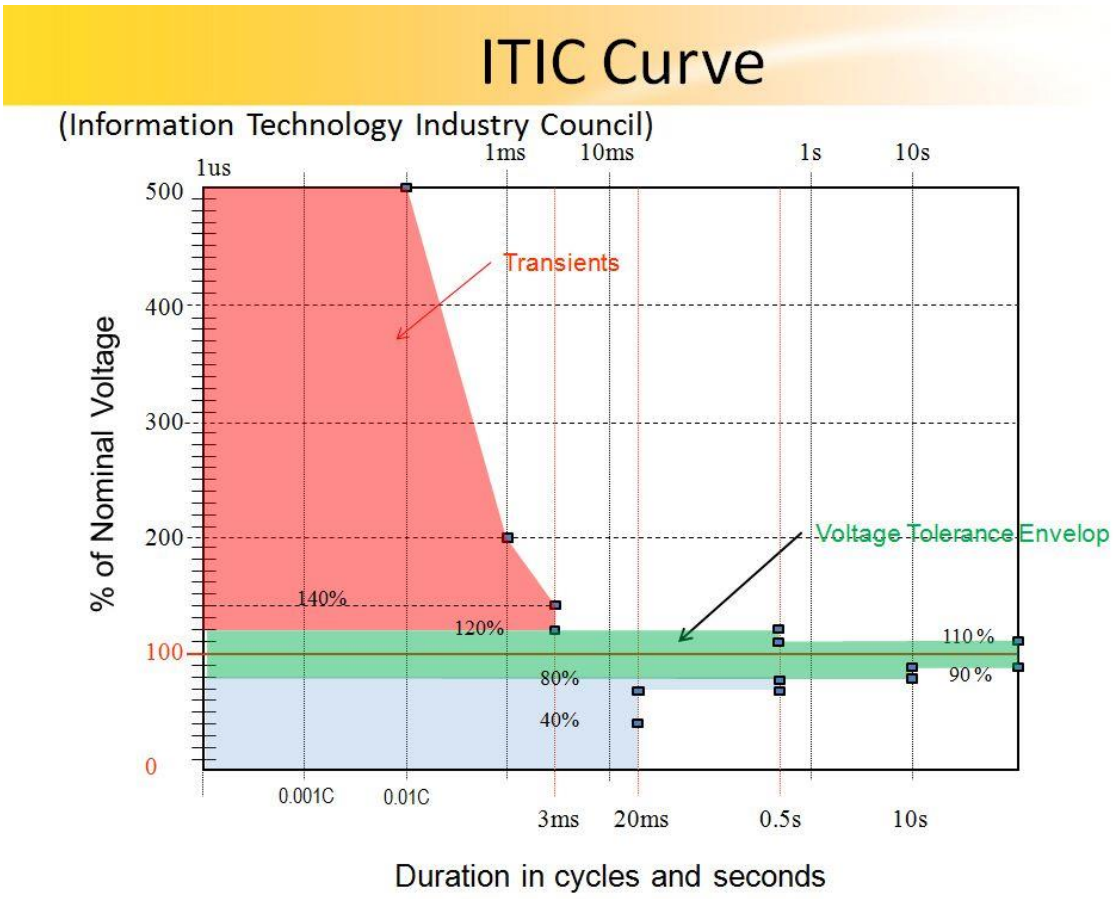


Figure 3. ITIC Curve

4.1.6 AC Line Fuses

The AC Line Fuses shall be acceptable for all safety agency requirements. The fuse shall be fast blow type. The fuse shall not blow unless component failure is encountered. The fuses shall not blow under all line and load conditions.

The AC Line Fuses shall be rated appropriately to prevent nuisance blows.

4.1.7 AC Inlet Connector

AC inlet connector shall be an FCI PwrBlade 12S+1P+12LP part number 10106262-IC03002C_A or 10106262-IC03002LF or similar competitor's connector. Drawing can be found in Project Olympus PSU AC Connector Specification.

4.1.7.1 AC Inlet Connector Pinout

AC inlet connector pinout is listed below:

Table 3. AC Inlet Connector Definition

	Description

Pin Number	WYE	Delta
P1	Safety Ground	Safety Ground
P2	Not Used	Not Used
P3	Backup Feed Neutral	Backup Feed Phase A
P4	Backup Feed Phase C	Backup Feed Phase C
P5	Default Feed Neutral	Default Feed Phase A
P6	Default Feed Phase C	Default Feed Phase C
P7	Backup Feed Neutral	Backup Feed Phase C
P8	Backup Feed Phase B	Backup Feed Phase B
P9	Default Feed Neutral	Default Feed Phase C
P10	Default Feed Phase B	Default Feed Phase B
P11	Backup Feed Neutral	Backup Feed Phase B
P12	Backup Feed Phase A	Backup Feed Phase A
P13	Default Feed Neutral	Default Feed Phase B
P14	Default Feed Phase A	Default Feed Phase A
A1	LR_SELECT	
A2	NODE_ID0	
A3	Analog Return	
B1	NODE_ID1	
B2	NODE_ID2	
B3	NODE_ID3	
C1	BLADE_THROTTLE#	
C2	BLADE_ENABLE#	
C3	BLADE_PRESENT#	
D1	PSKILL (Short Pin)	
D2	NODE_ID4	
D3	NODE_ID5	

4.1.8 Input Leakage Current

Maximum input leakage for each of the 3 340W PSU modules shall be less than 3.5 mA at 240VAC.

4.1.9 Input Power Rating

The power supply shall be rated for 1160W input power at 200VAC input (all three PSU's combined).

4.1.10 Input Power Sharing

The three input modules shall share the load so that input current sharing between modules meets the requirements in the table below:

Table 4. Input Power Sharing

Total Input Power	Input current share accuracy
0-100W	within 100mA
100W-325W	+/- 10%
325W-350W	+/- 7.5%
350W-400W	+/-5%
400W-1100W	+/- 3%

4.1.11 Inrush Current

AC line inrush current to each 340W module shall not exceed 9A peak at all line and load conditions for maximum of 5 msec. after application of AC input. Measurement shall be taken 0.2ms after application of AC input. The inrush current shall not exceed the 50% I2t derating of any component in series with the inrush current.

The power supply shall meet the inrush requirements for any rated AC voltage, during turn on at any phase of AC voltage, during hot plug, during any AC dropout condition, over the specified temperature range (Top), and during AC power cycling. The AC power cycling test condition is defined as cycling the AC power off and back on after the power supply has been operating at maximum load and has reached thermal stability.

Version 1: The period between the AC power cycles could be anywhere between 20 ms to 10 seconds. During a line drop out situation the peak inrush current may be violated but no damage or reliability reduction may occur to any components the power supply.

4.1.12 Power Factor

The power factor shall be equal to or greater than 0.98 when measured at 240VAC, 47Hz to 63 Hz input. Measurement shall be performed with maximum output load and with source impedance of

less than 0.1 Ω. It is expected that power factor shall be greater than 0.98 at line voltages less than 240VAC at maximum output load condition.

Power factor shall also meet requirements in table below:

Table 5 Power Factor Requirements

Output Current	Minimum Power Factor
8.3	.65
16.6	.8
41.5	.9
81.6	.98

4.1.13 Harmonic Susceptibility

Harmonic distortion of up to 10% THD must not cause the power supply to go out of specified limits. The power supply shall be capable of start-up (power-on) with full rated power load, at line input as low as 180VAC.

The power supply internal circuitry shall limit maximum input current to 150% max rated at all input and operating ambient conditions and output fault conditions.

4.1.14 Modified Sine Waves

The power supply shall operate when the AC input is a variant of a sine wave such as from a UPS (trapezoidal and square waves excluded). The output shall remain within regulation under all load conditions under modified sine wave. Under conditions below the power supply may disable the output:

- Rise time on the input exceeding 2V/us
- Input voltage zero crossing lasting greater than 4 ms.
- Peak of the modified sine wave voltages consistently exceeding 375V

Under modified sine wave conditions the power supply does not need to meet conducted EMI limits and harmonics.

4.1.15 Harmonic Emissions

The power supply shall incorporate universal input with active power factor correction, which shall reduce line harmonics in accordance with IEC EN61000-3-2 and JEIDA MITI standards. It is desired that the power supply also meet the THD requirements across the input voltage range shown in Table 6 below.

Table 6: THD Requirements

Output load (% of max output load)	**Maximum ITHD (%)**
5-15	20
15-30	10

30-100	5

4.1.16 Line Transient

The power supply shall operate within specifications under the following conditions:

- Transients as defined in IEC 61000-4-4.
- Transients as defined in IEC 61000-4-5.
  (Up to and including ±2 kV limits and phases 0^o, 90^o, 180^o, and 270^o.

4.1.17 Fast Transient Burst

The power supply shall comply with the limits defined in EN55024: 1998/A1: 2001/A2: 2003 using the IEC 61000-4-4: Second edition: 2004-07 test standard and performance criteria B defined in Annex B of CISPR 24.

4.1.18 Radiated Immunity

The power supply shall comply with the limits defined in EN55024: 1998/A1: 2001/A2: 2003 using the IEC 61000-4-3: Edition 2.1: 2002-09 test standard and performance criteria A defined in Annex B of CISPR 24.

4.1.19 Surge Immunity

The power supply shall be tested with the system for immunity to AC Unidirectional wave; 2kV line to ground and 1kV line to line, per EN 55024: 1998/A1: 2001/A2: 2003, EN 61000-4-5: Edition 1.1:2001-04. The pass criteria include: No unsafe operation is allowed under any condition; all power supply output voltage levels to stay within proper spec levels; No change in operating state or loss of data during and after the test.

4.1.20 Efficiency

The power supply shall meet the efficiency requirements given in Table 7.

** Efficiency is important and cost effective efficiency improvements shall be evaluated before the power supply design is finalized. The typical load range will be 50%- 80% PSU loading and 95% under system fault conditions. Special consideration will be given for efficiency improvements in this area of operation. Fan can be powered externally for efficiency test. IVS losses may be disregarded when calculating efficiency.

Table 7: Efficiency

Input voltage (VAC RMS)	Output load (A)	Minimum efficiency (%)
200	16.6	89
200	16.6	91
200	41.5	93

200	83	92
208	8.3	89
208	16.6	92
208	41.5	94
208	83	92
230	8.3	89
230	16.6	92
230	41.5	94
230	83	92
240	8.3	89
240	16.6	92
240	41.5	94
240	83	92

4.2 Input Voltage Selector (IVS) Operation

The PSU shall normally run off of Default Feed. When Default Feed drops below 180VAC for more than 8ms, the IVS will switch to Backup Feed within 12ms. The LEDs shall be driven green/yellow/green continuously while operating on Backup Feed as described in LED section. When AC voltage on Default Feed is back in regulation, there will be a 10-20 second delay and then power shall be switched back to Default Feed. Note that if any single phase on Default Feed drops out of regulation, all three phases must be switched to Backup Feed. In other words, all three IVS's will be synchronized so that all three switch together. Note that if while on Backup Feed, Default Feed comes back and Backup Feed experiences an interruption, the 10-20 second switchback delay is not required.

The power supply shall power up and operate normally when only one feed is initially applied. Whether Default Feed or Backup Feed.

Relay contact switching failure: If a feed is lost and the IVS switches to the other feed, if one of the 3 modules does not stay powered up, it will be assumed one of the relays operating on that module has a welded contact. Under this situation, the relays for the unpowered module shall be switched back to the unpowered feed. Upon PSON toggle or AC removal, the IVS can retry to operate all modules off the operating feed. If the module fails to operate, the relays for that module shall again be switched to the non-activated feed.

4.3 Battery Backup Operation

This section describes the battery backup operation.

Following are the battery backup requirements. Note that minimum battery operation ambient air temperature will be 20C.

1. The battery shall use 8 Panasonic UR18650RX cells or competitor's cells with similar or better performance with approval from Microsoft. Key parameters are Capacity, impedance, self-discharge, aging.
2. Partial discharge duty cycle shall be 1 discharges per year at a 5 second discharge.
3. Full discharge duty cycle shall be 1 discharge per 2 years for condition in 4.1.2.2.
4. The power supply shall be capable of, when given the command via PMBUS, to go to battery power for one to three seconds then return to AC power. This is to check for weak or bad cells within the battery pack. See firmware section 9 for specific command description and register location.

4.3.1 Battery Recharge Operation

4.3.1.1 Battery Recharge

The battery recharge shall be limited to 30W or higher approved Microsoft limit and is a function of Input Power Limit (IPL) Set Point. If the IPL is activated the battery recharge shall be disabled.

4.3.2 Battery Protection

If at any time during discharge the state of charge of any battery cell drops to a level equal to the minimum voltage allowed by the manufacturer, the 12V output should be disabled immediately to prevent battery damage.

4.3.3 Battery Self Discharge

The battery shall not self discharge more than 20% of its capacity annually when in storage.

4.4 DC Outputs, Signal Outputs, and Control Outputs

This section describes the DC outputs.

4.4.1 Output Power and Current

Across the nominal input voltage range, the PSU output power shall be as specified in Table 8. The power supply shall meet static and dynamic voltage regulations requirements across the load range.

Table 8: Output Power and Current

Output	Min	Max (N+1)	Max (N)	Unit
12.25VDC	0.1	56	83	A

4.4.2 Output ORing/Output Capacitor isolation

Not required

4.4.3 Standby Output

The power supply shall not provide a standby output.

4.4.4 Setpoint

The voltage setpoint shall be as specified in Table 9.

Table 9: Setpoints

Parameter	Min	Set point nominal	Max	Units	Current (A)
+12V	12.127	12.25	12.373	Vrms	5

4.4.5 Static Voltage Regulation

The output voltage regulation output must stay within the following voltage limits when operating at all load and input line voltages across the ambient temperature limits under steady state conditions.

Table 10: Static Voltage

Parameter	Min	Set point nominal	Max	Units
12V Output	12.00	12.25	12.5	Vrms

4.4.6 Ripple and Noise

The maximum allowed ripple/noise output of the power supply is defined in 120mVp-p. This is measured over a bandwidth of 10Hz to 20MHz at the power supply output connectors. A 10uF tantalum capacitor in parallel with a 0.1uF ceramic capacitor is placed at the point of measurement.

4.4.7 Dynamic Load Step

The output voltages shall remain within Dynamic voltage limits specified for the step loading and capacitive loading specified below. The load transient repetition rate shall be tested between 50Hz and 5kHz at duty cycles ranging from 10%-90%. The load transient repetition rate is only a test specification. The delta step load may occur anywhere within the MIN load to the MAX load conditions. Dynamic voltage limits are 11.70VDC-12.8VDC.

Table 11: Dynamic Load Step

Output	Delta step load	Transient load rate	Capacitance test load
+12V	60% of maximum rated load	0.25A/usec	3500uF +/-5%

	1%-61% and 40% to 100%		

4.4.8 Capacitive Loading

The power supply shall be stable and meet all requirements with the following capacitive loading ranges.

Table 12: Capacitive Loading

Output	Min	Max	Units
+12V	200	5000	uF

4.4.9 Closed Loop Stability

The power supply shall be unconditionally stable under all line/load/transient load conditions including capacitive load ranges specified in Section 4.6. A minimum of: 45 degrees phase margin and -10dB-gain margin is required. The power supply manufacturer shall provide proof of the unit's closed-loop stability with local sensing through the submission of Bode plots. Closed-loop stability must be ensured at the maximum and minimum loads as applicable.

4.4.10 Grounding

The output ground of the pins of the power supply provides the output power return path. The output connector ground pins shall be connected to the safety ground (power supply enclosure). This grounding should be well designed to ensure passing the max allowed Common Mode Noise levels.

The power supply shall be provided with a reliable protective earth ground. All secondary circuits shall be connected to protective earth ground. Resistance from the input receptacle to chassis shall not exceed 100 mΩs. This shall be tested 100%.

4.4.11 Common Mode Noise

The Common Mode noise on any output shall not exceed 350mV pk-pk over the frequency band of 10Hz to 20MHz. The measurement shall be made across a 100Ω resistor between each of DC outputs, including ground at the DC power connector and chassis ground (power subsystem enclosure).

4.4.12 Soft Start

The Power Supply shall contain control circuit which provides monotonic soft start for its outputs without overstress of the AC line or any power supply components at any specified AC line or load conditions.

4.4.13 Zero Load Stability

When the power subsystem operates in a no load condition, it does not need to meet the output regulation specification, but it must operate without any tripping of over-voltage or other fault circuitry. When the power subsystem is subsequently loaded, it must begin to regulate and source

current without fault. Continuous operation at no load shall not damage or reduce reliability of the power supply.

4.4.14 Hot Swap Requirements

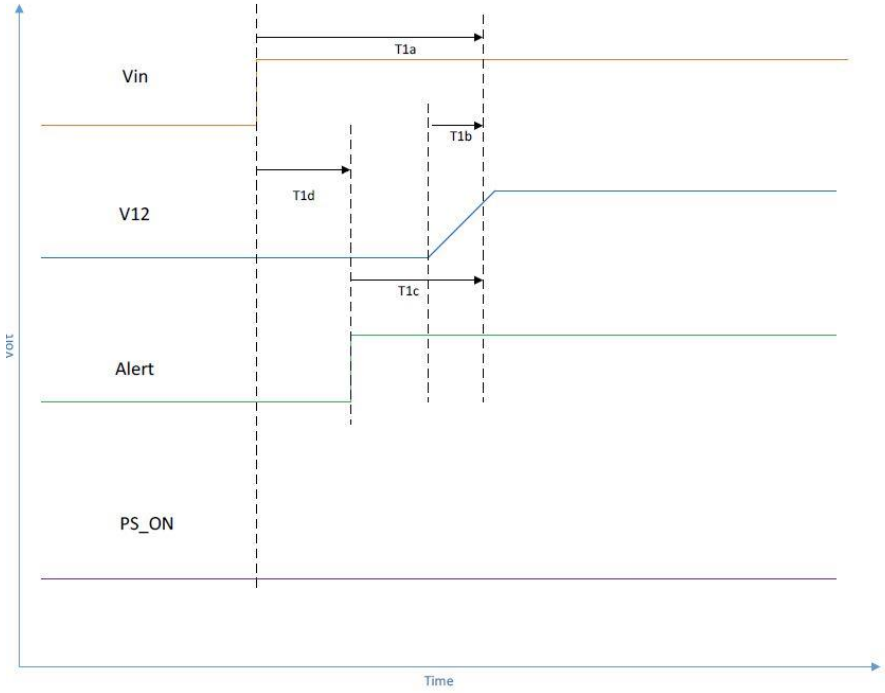
Hot swapping of the input is required. Output load will not be hotswapped.

4.4.15 Load Sharing

NA

4.4.16 Timing Requirements

TBD



Start up waveform (without battery)

T1a = Vin – V12 high
min: 500 mS
norm: 1000 mS
max: 3000 mS

T1b = V12 rise time (measured from 10% -90%)
min: 40 mS
norm: 45 mS
max: 50 mS

T1c = Alert – 12V high
min: N/A
norm: 100 mS
max: N/A

T1d = Vin – Alert
min: N/A
norm:
max: N/A

5 PSU System Interconnect

This section describes the PSU system interconnect.

5.1 Remote On/Off

The PSU shall be ON when PS_ON# is pulled low below 0.8VDC. PSON shall be 3.3V or 5V tolerant

Table 13: Power On/Off

Signal name	Input / outp	Open collector	3V3 or 5V logic	Signal pull up resistor value	Logic low max (V)	Logic high min (V)	Sink/ source current max	Rise time max (nsec)	Fall time max (nsec)	Cmax external to PSU	Peak noise (mVpk-pk)

	ut to PSU										
PS_ON#	In	NO	YES	49.9K +/- 5%	0.8	2.06	N/A	100	100	no	250

5.2 Fan Cooling, Speed Control

The PSU shall incorporate a fan(s) for PSU cooling. The PSU will monitor critical temperatures and adjust fan speed to prevent thermal damage but run a slow as possible to save energy. Note that two or more fans are required. The power supply shall be able to run indefinitely with one fan failure at 680W or below. Reliability and derating requirements do not have to be met while operating on one fan. Fans can be set to maximum speed during a fan fail event. Note also that cooling for the whole PSU must depend on internal fans only and cannot rely on any help from system fans. Also note that sheet metal on the battery side of PSU can have ambient air adjacent outside the PSU in the server up to 60C. It is recommended that some PSU airflow be directed between the battery and the chassis in this area to keep the battery cool.

5.3 Share

There is no sharing requirement between PSU's.

5.4 I2C/PMBus

No address pin is needed

Table 14: I2C/PMBus

Signal name	Input/ output to PSU	Open collector	3V3 logic	Signal pull up resistor value	Logic low max (V)	Logic high min (V)	Sink/ source current max (mA)	Rise time max (usec)	Fall time max (nsec)	Cmax external to PSU (pF)	Peak noise (mVpk-pk)
SDA	I/O	NO	YES	6.81K +/-20%	0.8	2.0	6	1	250	120	250mV
SCL	I/O	NO	YES	6.81K +/-20%	0.8	2.0	6	1	250	120	250mV
Alert	Out	YES	YES	100k +/-20%	0.8	2.0	N/A	1	250		250mV

5.5 PS_KILL

The power supply shall default to 12V being disabled between 180ms and 200ms of PS Kill going high. There will be a PS_KILL over ride register that can be written to that will change the power supply behavior to switch from AC mains to battery power within 750us of PS_KILL going high.

During this operation the PSU shall act as this is a normal loss of AC power and run as specified in 4.1.2.2.

Table 15: PS_Kill

Signal name	Input/ output to PSU	Open collector	3V3 logic	Signal pull up resistor value	Logic low max (V)	Logic high min (V)	Sink/ source current max (mA)	Rise time max (usec)	Fall time max (usec)	Cmax external to PSU (pF)	Peak noise (mVpk-pk)
PS_Kill _EPO	In	NO	yes	10KOhm	0.4	2.0V or NC	0.5	250	2.5	0	250mV

5.6 PSU Alert

The signal shall be high until status change of the PSU. The signal shall remain low until the port is read or contents of register returns to original state. By default PSU_ALERT is only asserted for an overcurrent event and event lasting longer than 10ms. Note that PSU Alert shall remain low until reset even if fault goes away. Reset is accomplished via “clear_faults” command or AC power cycling.

Table 16: PSU Alert

Signal name	Input/ output to PSU	Open collector	3V3 logic	Signal pull up resistor value	Logic low max (V)	Logic high min (V)	Sink current max (mA)	Rise time max (usec)	Fall time max (usec)	Cmax external to PSU (pF)	Peak noise (mVpk-pk)
Alert	Out	YES	YES	100k +/-20%	0.8V	2.0V	Note 1	1usec	250nsec		250mV

Note 1: Pull up to 3.3V through 100K ohms

5.7 Blade Present (BLADE_PRESENT#)

This signal will be pulled up to 3.3V through a 100K ohm resistor. It will be pulled low in the compute server.

5.8 Output Connector Pinout

5.8.1 Output Power Connector

The output power connector shall be a 24 pin molex minifit junior or equivalent.

Table 17 Output Power Connector Pinout

Output Power Connector Pinout

Power	PSU Pin	
12V	1	13
12V	2	14
12V	3	15
12V	4	16
12V	5	17
12V	6	18
Return	7	19
Return	8	20
Return	9	21
Return	10	22
Return	11	23
Return	12	24

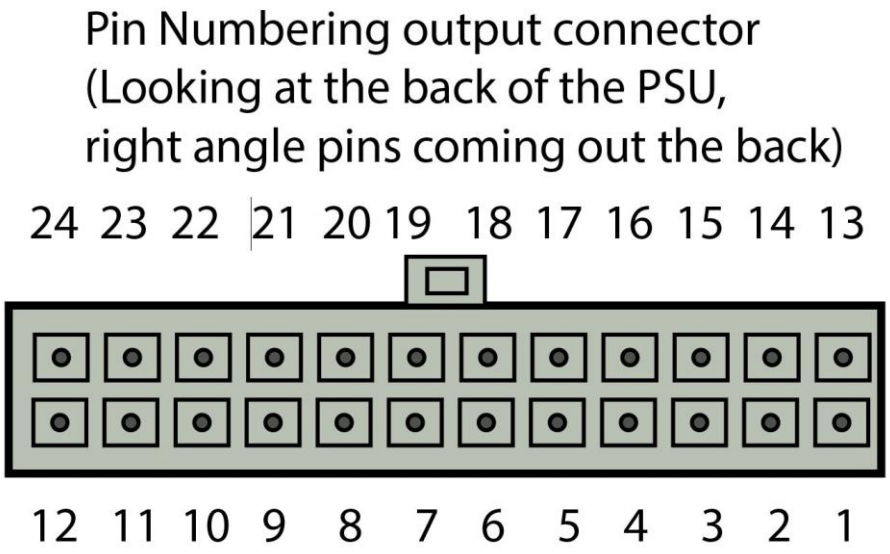


Figure 4. Output Power Connector Pinout

5.8.2 Output signal Connector

The output signal connector shall be a 18 pin molex milligrid series connector 878311828 or Microsoft approved equivalent. The drawing is contained in Project Olympus PSU Signal Connector Specification. Pin out below:

Table 18 Output Signal Connector

Pin Number	Signal Name	NOTES

1	BLADE_ENABLE#	Pass through from PMDU
2	LR_SELECT	Pass through from PMDU
3	NODE_ID0	Pass through from PMDU
4	NODE_ID1	Pass through from PMDU
5	BLADE_THROTTLE#	Pass through from PMDU
6	BLADE_PRESENT#	Pass through from PMDU
7	I2C_SCL	PSU-Blade Comm
8	I2C_SDA	PSU-Blade Comm
9	I2C_GND	PSU-Blade Comm
10	PS_ON#	
11	PSU_ALERT#	
12	PSU_LED0	Green LED
13	PSU_LED1	Yellow LED
14	NODE_ID2	Pass through from PMDU
15	NODE_ID3	Pass through from PMDU
16	NODE_ID4	Pass through from PMDU
17	NODE_ID5	Pass through from PMDU
18	Reserved	No Connection

5.8.3 Battery Connector

Battery connector can be any connector with final approval from Microsoft.

5.9 Protection Circuits

Protection circuits inside the power supply shall cause only the power supply's main outputs to shutdown. The PSU shall to continue operating under a fault protection condition and provide communication via I2C to the system and be reported out to the TBD infrastructure. Loss of internal communication shall be a condition for latching off the output.

When a protection circuit shuts down the power supply, green LED shall change to solid yellow if able otherwise unlighted status.

5.9.1 Over Current Limit (OCL)

The power supply shall provide limited output current to the load for protecting the power supply from damage under indefinite over load conditions. OCL shall be set between 115% and 130% of rated output current. Under an overcurrent condition for over 200ms, the power supply shall employ hiccup mode (200ms on and 2 seconds off) for 5 cycles and if overcurrent isn't cleared after the 5th cycle, the power supply shall latch off (All timing accuracy above is +/- 20%). For short circuit situations, the power supply may latch off immediately. PSU_ALERT shall be asserted after

10ms or longer of a current over limit of 31.0 A or greater in any individual PSU module. Overcurrent events under 10ms should be ignored.

5.9.2 Over Voltage Protection (OVP)

The power supply over voltage protection shall be shutdown in a latch off mode upon an over voltage condition. Over voltage is range is 13.6VDC to 15VDC.

5.9.3 Over Temperature Protection (OTP)

The power supply shall be protected against over temperature conditions caused by loss of fan cooling or excessive ambient temperature which could cause internal part failures. In an over temperature condition the PS shall shutdown protecting itself. When the temperature drops to within safe operating limit for internal parts, the power supply shall restore power automatically. The OTP circuit shall incorporate built in hysteresis such that the power supply does not oscillate on and off due to temperature recovering condition. The OTP event shall be reported as a fault condition.

6 FRU Requirements

The power supply FRU information shall reside on one of the PSU microcontrollers. Please refer to PMBUS specification for details.

7 Software Interface Requirements

The power supply shall meet the requirements of Microsoft document: TBD

Bootloader: Note that PSU shall be capable of bootloading new primary and secondary firmware without interruption of the 12V output. PSU output loading during bootloading shall be 680W or less.

8 LED Indicators

The PSU will have a 2 signals that will drive a 1 dual color LED mounted on the system chassis. Following are the LED drivers and power supply LED States:

- Power supply LED configuration
  The power supply will have a single bi-color (Green-Yellow) LED output.
- Power supply LED states
  Single bi-colored LED configuration:
  - AC_OK & DC_OK (Power Good: Solid Green (Bi-color LED)
  - Fault (fault of any kind): Solid Yellow (Bi-color LED)
  - Internal Battery Charging: Continuous Blinking green at 2Hz

- Operating off internal battery: Continuous blinking yellow at 2Hz
- One of two AC Feeds has failed: Yellow-Green-Yellow Continuous at 2Hz

Following is more detail about the LED indicators:

- **Fault indicator**
  This Bi-Color (Green-Yellow) LED is driven by internal circuitry and will illuminate yellow when a power rail has failed, or –FAN_FAULT is low. The LED should not be illuminated if the supply turns off due to PS_KILL. The LED will illuminate even if the power supply is in a latched state.
  3mm Green-Yellow, Bi-color, LED applications: SunLed: XLUGY34M or Kingbright: WP3WGYW or Microsoft approved equivalent.
  Note: LED's should be biased with a forward current (If) of 6 mA.
- **Power Good indicator**
  This Bi-Color Green-Yellow LED is driven by internal circuitry and will illuminate GREEN whenever POWER GOOD is asserted.
- **AC Good indicator**
  This green LED is driven by internal circuitry and will illuminate GREEN whenever VIN_GOOD is asserted.
- **Operating on internal battery**
  The Yellow LED will turn on and off at a 2 Hz rate whenever the power supply is operating from internal battery power. This LED operation has priority over other fault indicators.
- **Internal battery charging**
  The green LED will turn on and off at a 2 Hz rate when the internal battery is charging. This shall not occur during maintenance or top off charge. Other fault indicators will take priority over this LED behavior.
- **IVS switched to side B**
  The LED will Blink Yellow-green-yellow… at a 2 Hz rate when one of the AC feeds has failed.

9 Mechanical Specifications

This section describes the mechanical specifications.

9.1 Dimensions

See Figure 5for power supply dimensions.

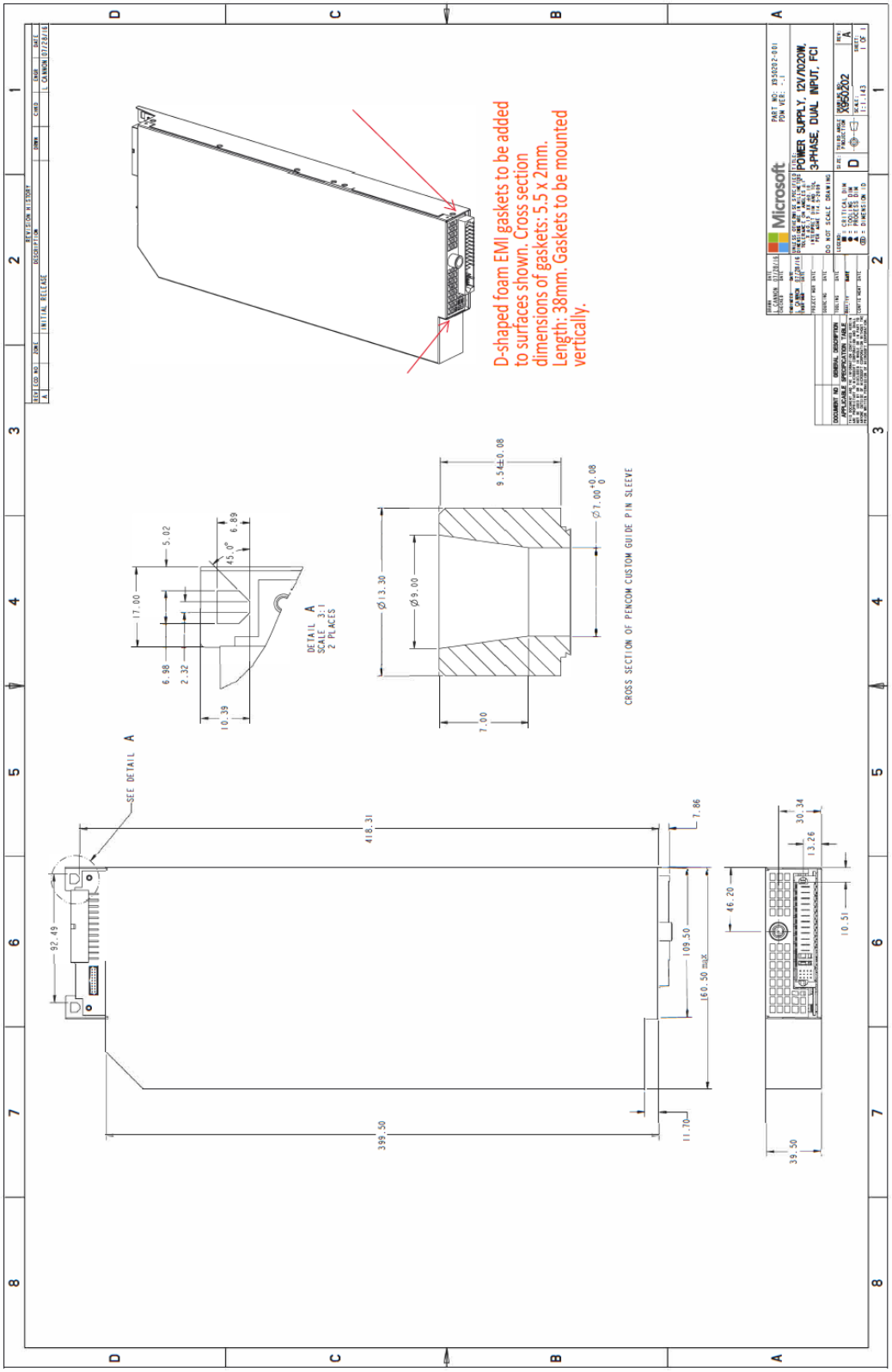


Figure 5 Power Supply Dimensions

9.2 Cord Handle Retention

NA

10 Environmental Requirements

All materials in the product must not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE) in excess of the limits specified in the Interim RoHS Compliance Specification Addendum to the XXX General Specification for the Environment (GSE), XXX-00011-00. Upon retirement of the Interim RoHS Compliance Specification Addendum, RoHS material restrictions will be specified directly in the GSE.

Documentation, test data, and certificates of compliance attesting to conformance to the RoHS directive must be provided to Microsoft on request. Documentation and data from the supplier's supply chain which demonstrates and verifies compliance to the RoHS directive will be kept on file and made available to XXX on request.

Table 19: Operating Environment Requirements

Specification		Requirement

Inlet Temperature	Operating	• 50°F to 118°F (10 °C to 48 °C), Battery 20°C-48°C
		• Yearly weighted average < 104 °F (37 °C)
		  • 90% of year: < 80 °F (37 °C)
		  • 10% of year: 80 °F (37 °C) to 108 °F (42 °C)
		  • 50 Year extreme: 108 °F (42 °C) to 118 °F (48 °C)
		• Maximum Rate of change: 18 °F (10 °C) / hour
		• Allowable Derating guideline of 1 °F / 550 ft (0.55 °C / 168 m) above 3000 ft

	Non-Operating	• -40 °F to 140 °F (-40 °C to 60 °C) • Rate of change less than 36 °F (20 °C) / hour

Exhaust Temperature	Operating	• Maximum values measured with an air-duct to prevent mixing of air from other sources.
		  • 115 °F (46 °C) , inlet <= 85 °F (29 °C)
		  • 120 °F (49 °C) , inlet 85 °F (29 °C) to 90 °F (32 °C)
		  • 125 °F (52 °C) , inlet 90 °F (32 °C) to 95 °F (35 °C)

Humidity	Operating	• 10% to 90% non-condensing
		• Yearly weighted average: < 80% RH
		  • 90% of year: < 80%
		  • 10% of year: 80% to 90%
		• Maximum dewpoint: 85 °F (29.4 °C)

Specification		Requirement
	Non-Operating	• 5% to 95% non-condensing • 100.4 °F (38 °C) maximum wet bulb temperature
Altitude	Operating	• 10000 ft (3050 m) maximum • Rate of change less than 1500 ft/min (457 m/min)
	Non-Operating	• 30000 ft (9144 m) maximum • Rate of change less than 1500 ft/min (457 m/min)

11 Reliability, Warranty, and Service

The following component de-rating guidelines shall be follow an approved Derating Guideline.

The power supply and battery shall a support 6 year life cycle .

The life calculated with the environmental inlet temperature and cycle at power loads of 75% of max continues load at a nominal of 230VAC input line voltage.

11.1 Reliability

The power supply and Battery shall have a minimum reliability at continuous operation of:

- 1,000,000 hours MTBF at 66% load and 30C as calculated by Bell core RPP for each individual 340W Module.
- Six (6) years operation life.

11.2 Serviceability

Field replacement of power supply is not planned.

11.3 Power Supply Returned for Repair

Power supplies returned to the vendor for repair, are returned for full credit.

Power supplies returned from vendor repair will be accepted by customer only after the vendor has performed an additional burn-in of 4 hours min. at 35°C ± 5°C at maximum load and has re-tested the power supply following the burn-in.

11.4 Cooling

The power supply will have at least 2 internal fans with fan speed control. The Fans will operate at the minimum speed needed to keep all components within the thermal derating levels for all loading and ambient conditions. Under fan fail condition the remaining fan(s) can be set to maximum speed. Upon loss of all fans the PSU should operate until overtemp is reached and then shall latch off.

Backflow prevention: In addition to varying the fan speed for protecting the internal components, the PSU shall also monitor inlet air temperature and if inlet temperature goes above 45C, fan speed shall increase to keep inlet air temperature at 45C or below.

11.5 Mechanical Shock

11.5.1 **Fixturing:** The power supply subassembly may be rigidly clamped directly to the shock equipment surface.

11.5.2 **Operating:** Half sine wave shock - 5 G, 11 ms duration, half sine wave shock in each direction of three mutually perpendicular axes. There shall be one shock input in each direction of three mutually perpendicular axes for a total of six shock inputs.

11.5.3 Non-Operating:

11.5.3.1 Half sine wave shock - 140 G, 2 ms duration, half sine wave shock in each direction of three mutually perpendicular axes. There shall be one shock input in each direction of three mutually perpendicular axes for a total of six shock inputs.

11.5.3.2 Square wave shock - 40 G, 166 in/sec velocity change, square wave shock in each direction of three mutually perpendicular axes. There shall be one shock input in each direction of three mutually perpendicular axes for a total of six shock inputs.

11.6 Vibration

11.6.1 **Fixturing:** The power supply subassembly may be rigidly clamped directly to the shock equipment surface.

11.6.2 Operating:

11.6.2.1 Sinusoidal Vibration: - 0.25 G zero-to-peak, 10 to 500 Hz, 0.25 oct/min in each of three mutually perpendicular axes. The test duration shall be one sweep from 10 to 500 to 10 Hz in each of three mutually perpendicular axes.

11.6.2.2 Random Vibration: Random Vibration - 0.002 G^2/Hz, 10 to 500 Hz, nominal 1.0 Grms in each of three mutually perpendicular axes. The test duration shall be one hour/axis for a total test duration of three hours.

11.6.3 Non-Operating:

11.6.3.1 Sinusoidal Vibration - 0.75 G zero-to-peak, 10 to 500 Hz, 0.5 oct/min. The test duration shall be one sweep from 10 to 500 to 10 Hz in each of three mutually perpendicular axes.

11.6.3.2 Random Vibration - 0.008 G2/Hz, 10 to 500 Hz, nominal 2.0 Grms in each of three mutually perpendicular axes. The test duration shall be one hour/axis for a total test duration of three hours.

11.7 Transportation and Handling Robustness

The power supply must have the ability to successfully pass shock and vibration tests. These tests are meant to simulate normal transportation and handling conditions that the server might encounter.

Table 20. Transportation and Handling Robustness

Specification (if applicable)	Packaged/unpackaged	Details	Pass criteria
NA	unpackaged	• Non-operational • Random vibration, 10-500Hz, 1.87Grms • 15min/side, 6 sides tested	No visible damage Server operational when tested after vibration
NA	unpackaged,	• Non-operational • Square wave • 32g peak • 6.85 m/s velocity change • 6 sides	No visible damage Server operational when tested after shock
Telcordia GR-63-CORE, Section 5.3.1	packaged,	• Non-operational • 1000mm drop • 13 drops on sides, edges and corners	No visible damage Server operational when tested after all shocks

Specification (if applicable)	Packaged/unpackaged	Details	Pass criteria

NA	packaged	• Non-operational
		• 1.146 Grms
		• Single server package
		  ○ 15 mins/side
		  ○ 6 sides tested
		• If bulk packaged
		  ○ 1 hour on normal rest surface
			No visible damage
			Server operational when tested after vibration

11.8 Electrostatic Discharge

The power supply shall withstand the following ESD conditions at any point on the power supply enclosure.

- ±8 kV with no abnormal operation, air discharge.
- ±8 kV with no damage to the power supply, air discharge.
- Transients as defined in IEC 801-2, Level 4

The storage capacitance shall be 150 pF and the discharge resistance shall be 330 Ωs. The tsupply shall meet all discharge requirements for the CE Mark designation.

12 Agency Approvals and Product Regulatory Requirements

Components of OCP Project Olympus shall be designed to comply with regulatory requirements mandated by countries where they are deployed.

- Safety Compliance: Components shall be designed to comply with safety requirements outlined in IEC 60950-1 and IEC 62368-1 (mandatory from 2019/6/20) standards, and applicable national deviations (i.e. EN, CSA, UL, etc.).
- EMC Compliance: Components shall be designed to comply with Class A emission limits and immunity requirements outlined in CISPR 32 and CISPR 24 standards, and applicable national regulations (i.e. FCC CFR 47, part 15 in the USA, ICES-003 in Canada, EN 55032 and EN 55024 in Europe, KN 32 and KN 35 in South Korea, etc.).
- Environmental Compliance: Components shall be designed to comply with all worldwide regulations that ban, restrict, or require reporting of hazardous substances (i.e. RoHS Directive 2011/65/EU, REACH Directive 2006/1907/EC (Annex XVII) and Battery Directive 2006/66/EC in Europe, California Proposition 65 in the USA) applicable to server finished goods.
- Energy Efficiency Compliance: Components shall be designed to comply with energy efficiency regulations (i.e. Ecodesign regulation 617/2013/EU, annex II, clause 5.2, as applicable to server power supply in Europe).

12.1 Safety Compliance

The following are the minimum product safety compliance regulations that must be met:

- NRTL certificate to UL/CSA 60950-1 and UL/CSA 62368-1 (USA / Canada)
- CB Certificate & Report, IEC/EN60950-1 and IEC/EN 62368-1 (CB report to include all country national deviations)
- GB4943.1- CNCA Certification (China)

Note: Certifications shall be done to the most recent standard editions

In addition to the above-mentioned standards, relevant safety certifications must be obtained according to the Country List separately provided by Microsoft.

Each supplier to provide Microsoft with official test reports and certificates.

Note that the PSU's will be downstream from a 50 Amp 3 phase breaker for Delta configurations and a 32A breaker for Wye and single phase configurations.

12.2 Energy Compliance

The power supply and LES shall meet energy requirements set in European regulation 617/2013, annex II, clause 5.2.

In addition to the above-mentioned standards, relevant safety certifications must be obtained according to the Country List separately provided by Microsoft.

Each supplier to provide Microsoft with either an internal or third party test report.

12.3 Component Requirements

Following are the component regulation requirements:

- Battery and Cell shall have the minimum safety and transportation certifications, as applicable from the table below:

Table 21: Component Requirements

	Standard/Cert	Required
Cell	IEC62133 (CB)	Yes
	UL 1642	Yes
	UN 38.3	Yes
	Korea (KC 62133)	(*)
	Taiwan (BSMI)	Yes
	China (GB 31241)	(*)
	India (IS 16046)	(*)

Note 1: at the time this spec is released, cell certification for countries marked with (*) is optional, however, several regulation and standards addressing directly batteries for stationary application are in progress and certification might be mandated.

Note 2: Battery pack/Cell assembly shall be evaluated and tested as part of the power supply evaluation according to IEC 60950-1 and IEC 62368-1.

- 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 IEC60950.
- 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.

12.4 EMC Requirements and Approvals

The product is required to comply with Class A emission requirements as the end system that it is configured into is intended for a commercial environment and market place. The power supply is to have minimum of 6db margin to Class A.

- FCC /ICES-003 - Emissions (USA/Canada) Verification
- CISPR 32 – Emissions (International) and CISPR 24 (Immunity)
- EN55032 - Emissions (Europe)
- EN55024 - Immunity (Europe)
    - EN61000-4-2 Electrostatic Discharge
    - EN61000-4-3 Radiated RFI Immunity
    - EN61000-4-4 Electrical Fast Transients
    - EN61000-4-5 Electrical Surge
    - EN61000-4-6 RF Conducted
    - EN61000-4-8 Power Frequency Magnetic Fields
    - EN61000-4-11 Voltage Dips and Interruptions
- *EN61000-3-2 - Harmonics (Europe)
- *EN61000-3-3 - Voltage Flicker (Europe)
- VCCI (Japan)
- KN 32 and KN35 (South Korea)

The EMC standards and regulations mentioned above shall be considered during the course of the design of the component power supply. The latest issued standards and amendments should be referred to in all cases.

While formal government, regulatory certification agency, or third party EMC test lab issued proof of compliance (i.e. certificate, license, etc.) is not required for items such as component power supplies that are not available off of the shelf, proof of compliance might be required for spare parts or components power supply shipped standalone; 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 component power supply causes the Microsoft end-use product to fail emissions and/or immunity testing, the supplier will be instructed to investigate and resolve the problem.

Each supplier to provide Microsoft with an official test report containing passing test results for the applicable emission and immunity standards.

12.5 Environmental Compliance

The finished product must comply with the latest editions of Microsoft specifications:

- H00594 MICROSOFT RESTRICTED SUBSTANCES FOR HARDWARE PRODUCTS, and
- H00642 MICROSOFT RESTRICTED SUBSTANCES CONTROL SYSTEM FOR HARDWARE PRODUCTS.

This Finished product must not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE) in excess of the limits specified in the EU Directive, 2011/65/EU, "Restriction of the use of Certain Hazardous Substances in Electrical and Electronic Equipment" and will not exceed a maximum unintentional or trace allowance defined by the EU Directive 2011/65/EU).

12.6 Markings and Identification

The power supply module nameplate label(s) shall have the following markings at a minimum.

- Supplier's Company (Name and Address)
- Regulatory Model Number (RMN)
- supplier's Generic Part Number:
- supplier's Part Number:
- supplier's Spares Part Number:
- Supplier Revision level
- Supplier Date Code of manufacture
- Commodity Tracking Label, OEM Sub-Assemblies
- Assembly Codes for this supply Country of Manufacture
- Country of Origin
- All Required AGENCY MARKINGS

- Multi-Lingual Hazardous Cautionary marking
- Electrical Rating: Output rating, Input rating in Volts, Amps, Hertz.
- Hipot marking
- Electric shock warning (lightning bolt marking)
- Crossed out screw driver marking
- All required environmental markings

13 Quality Assurance and Reliability Provisions

Following are the provisions for quality assurance and reliability.

13.1 AC Inlet and Exterior Face

13.2 Chassis and Chassis Finish

Sheet metal chassis shall be Hot Dipped Galvanized Steel (HDGS).

13.3 Power Supply Fan/Location/Orientation

The fan can be located anywhere in the PSU. Airflow will be from the output connector side to the AC input side.

13.4 Acoustic Requirement

Test condition is a power supply installed in the blade system chassis. Fan noise as measured from one-meter distance from the Blade shall be less than 60 dBA typical, 65 dBA maximum. The test setup shall be as follows: The blade is a desktop module with bystander locations only. The Blade is to be placed on a table 28 to 36 inches high with the position of four- (4) bystander microphones. The microphones will be one- (1) meter away, centered on each side, 1.5 meters high, as measured from the floor, and placed at a 30° down angle. The A-weighted (100 -10 kHz) sound pressure must be measured at the four- (4) bystander positions. Sound pressure is a measurement of the total noise at the specified microphone location in the room. Test shall be performed at 40°C inlet temperature and 680W load.

13.5 Materials

All polymeric parts within the enclosure shall be molded from Underwriters Laboratories, Inc. “Recognized” QMFZ2 polymeric material minimally rated 94 V-2.

13.6 Weight

The PSU with no battery shall not exceed 6 lbs 0 oz.

The PSU with a battery installed shall not exceed 7 lbs 6 oz.