Project Olympus DX-88 Disk Expansion Power Supply Specification

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Revision History

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1 Scope

This document defines the functional requirements for a 1650W 12.25VDC output, power supply module operating off an AC Hi-Line three phase input, intended for worldwide use in the Project Olympus DX-88 Disk Expansion Chassis.

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
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",

Reference	Description
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 Project Olympus DX-88 Power Supply Unit, DX-88 PSU. The power supply module shall be three single phase input and 1650W output. The power supply can be used in multiple Project Olympus systems/sub-assemblies. It may be standalone or used with up to four 1650W DX-88 PSU units in parallel. The system consists of inputs of three single phases (3 total) and three 550W power supply units (PSU’s) in parallel with a total maximum output of 1650W. Each PSU will be powered from one of the three phases. The power supply will be hot pluggable. Failure of a single PSU or loss of a single phase will not affect system operation for loads 1100W and below. With two phases loss, the lone phase shall be able to operate at 550W and below. Power supplies shall be hot swappable for up to four 4 in parallel. The power supply outer dimensions are below.

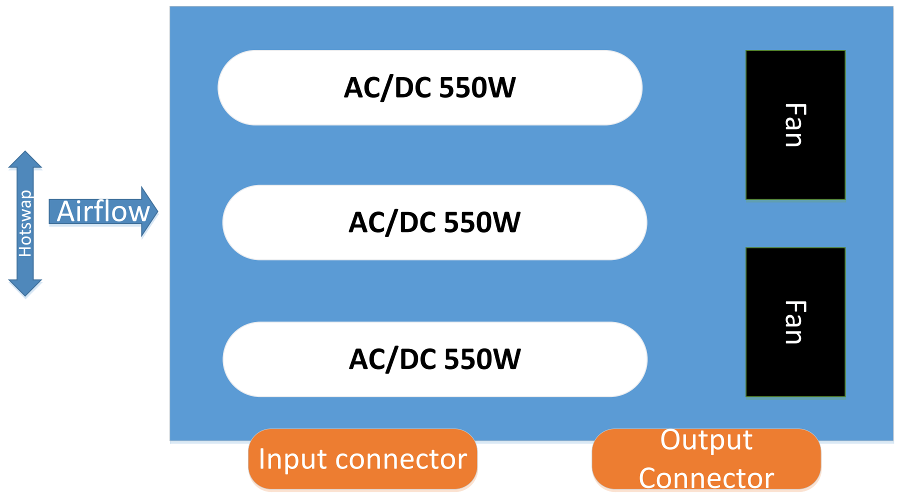


Figure 1: DX-88 PSU Block Diagram

3.1 System Implementations

3.1.1 Sub-assembly Application

The DX-88 PSU will be installed in a sub-assembly chassis and will blind-mate to a sub-assembly chassis and then to the managed PDU (PMDU) for input AC power and signals and communications between the rack manager and the sub-assembly and PSU. Output Power and signals to the sub-assembly via power and signal harness.

Top Load DX-88 PSU (Iso-view)

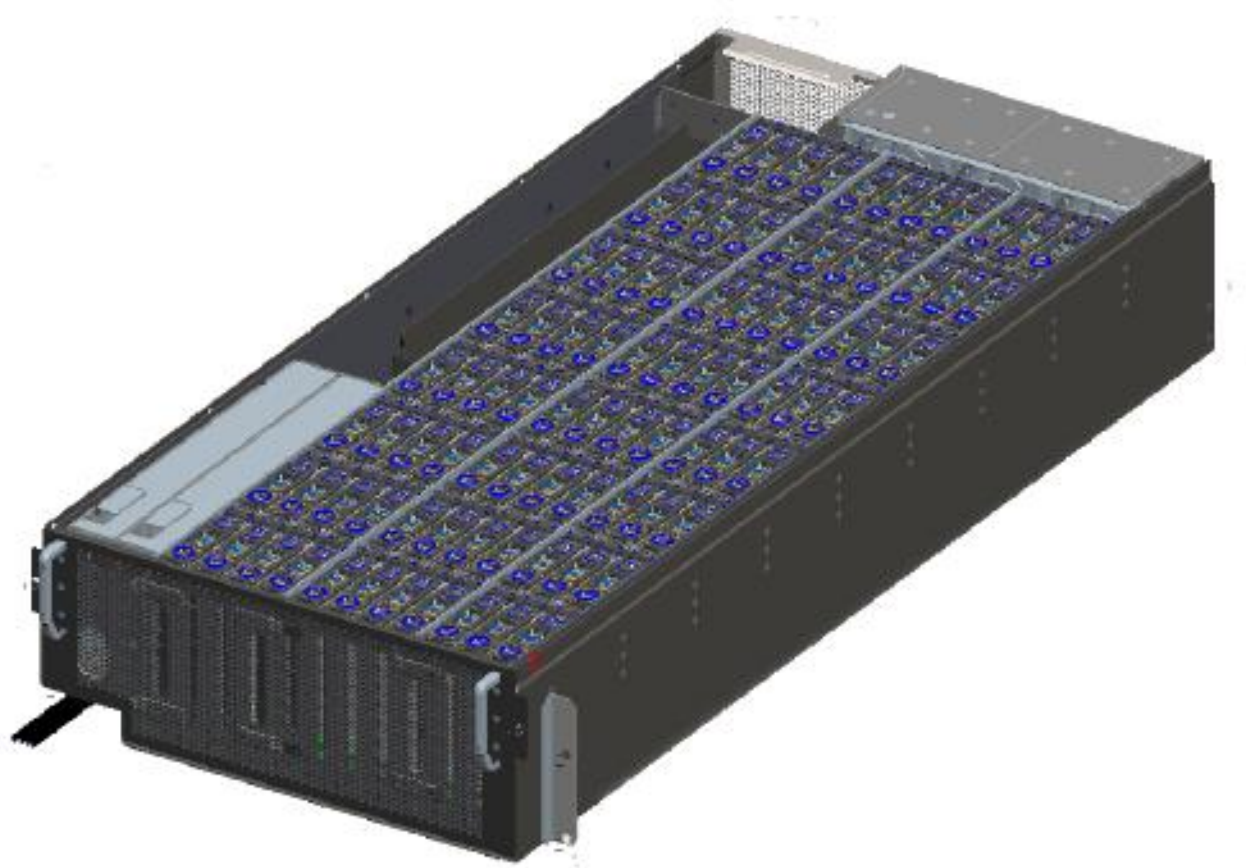


Figure 2: DX-88

4 Electrical Specification

This section details the electrical specification.

4.1 AC Input

AC input to the rack will be either 3 phase 415/400VAC Wye or 208VAC Delta connection and partitioned such that 3 single phase rated 200-240VAC – derive from either the WYE or Delta. The power supply shall be able to power up each phase being of different voltage and frequency.

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: AC Input Rating. Each module inside the PSU shall be derived as a single phase from either WYE or Delta connection.

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

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

Table 2: AC Input Rating

Parameter	Min	Rated	Max	550 WPSU max input current at min V_{rms}
Voltage (240)	180 V_{rms}	200-240 V_{rms}	264 V_{rms}	3.85 A_{rms}
Frequency	47 Hz		63 Hz	

4.1.2 PSU Hold-Up Time 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.

4.1.3 The worst case under voltage (sag) recovery requirement

The worst case under voltage % is shown below. Due to the wide array of data center distribution and back types the power supply shall operate with zero voltage for 20ms, 140VAC for 500ms, 160VAC for 10seconds before the input voltage return the minimum voltage of 190VAC.

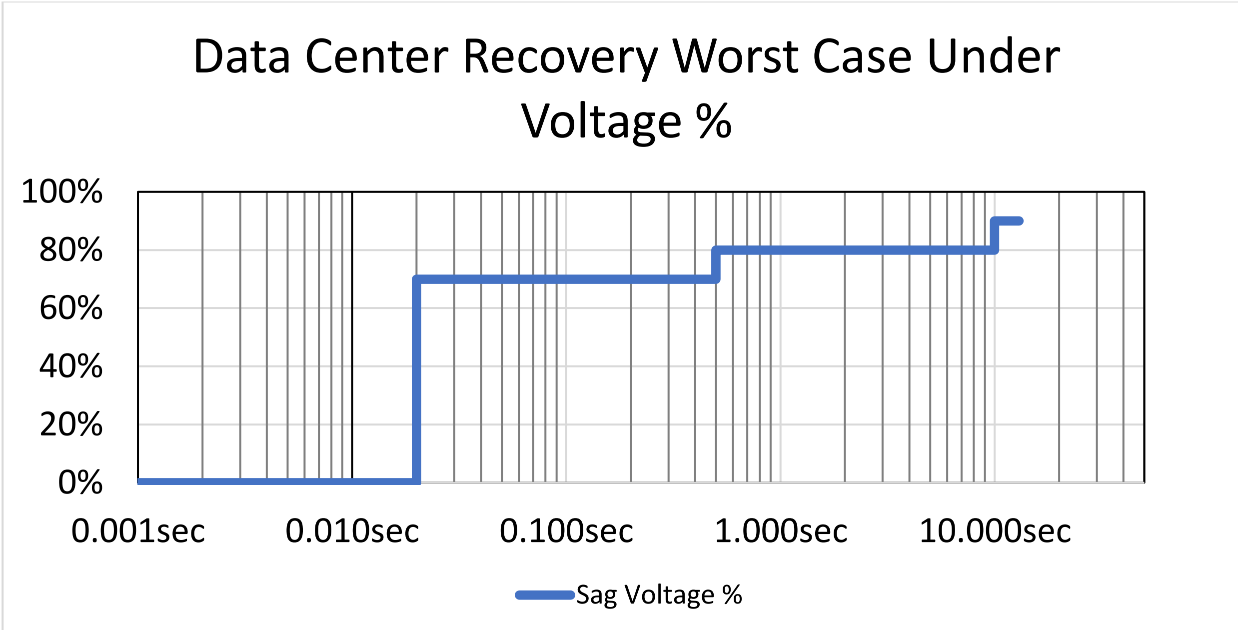


Figure 3: ITIC Curve

4.1.4 The worst case over voltage (surge) recovery requirement

In the event of an overvoltage input the power supply shall attempt to operate normally until input voltage returns to nominal input range. For guidance the ITIC Curve defines a 110% as upper nominal range with surges of up to 140% for 3mS and 120% for 500mS.

4.1.5 AC Turn On Requirement

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 1650W 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.

4.1.6 AC Turn Off Brownout Requirement

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.

4.1.7 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.

4.1.8 VAC Input fuse rating, interrupt capacity, maximum fuse rating.

The input fuse shall be a fast blow with greater than 1.5KAIC interrupt capacity no greater than 5A maximum.

4.1.9 AC Inlet Connector

AC inlet connector shall be an FCI PwrBlade 10106262-260001 or equivalent. Mating connector: FCI PwrBlade 10106268-2600001

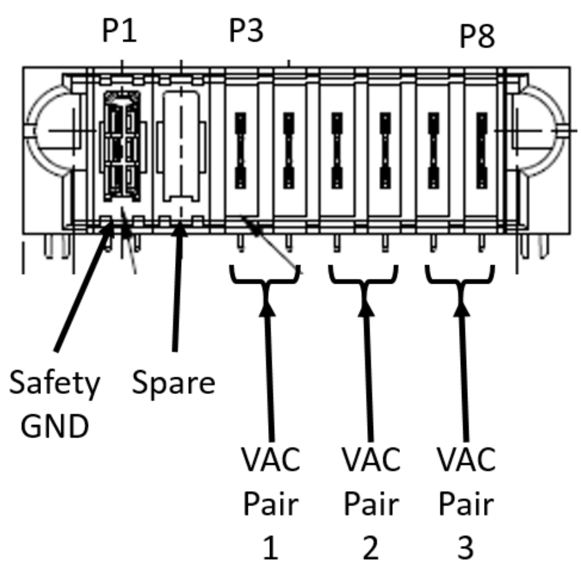


Figure 4: AC Inlet Connector

4.1.10 AC Inlet Connector Pinout

AC inlet connector pinout is listed below:

Table 3: AC Inlet Connector Pinout

Pin Number	Description	
	WYE	Delta
P1	Safety Ground	Safety Ground
P2	Not Used	Not Used
P3	Feed A Neutral	Feed A Phase A

P4	Feed A Phase C	Feed A Phase C
P5	Feed A Neutral	Feed A Phase C
P6	Feed A Phase B	Feed A Phase B
P7	Feed A Neutral	Feed A Phase B
P8	Feed A Phase A	Feed A Phase A

4.1.11 Input Leakage Current

Maximum input leakage for a single power supply shall be less than 2.0mA at 240VAC.

4.1.12 Input Power Rating

The power supply shall be rated for 1800W input power (efficiency and fan loss) at 200VAC input max system output 1650W (all three PSM's combined).

4.1.13 Dynanmic Maximum Input Power Limit (DMIPL)

DMIPL feature is preferred but optional. The goal is to have the lowest recovery current possible after an AC dropout. One method of DMIPL implementation is described below.

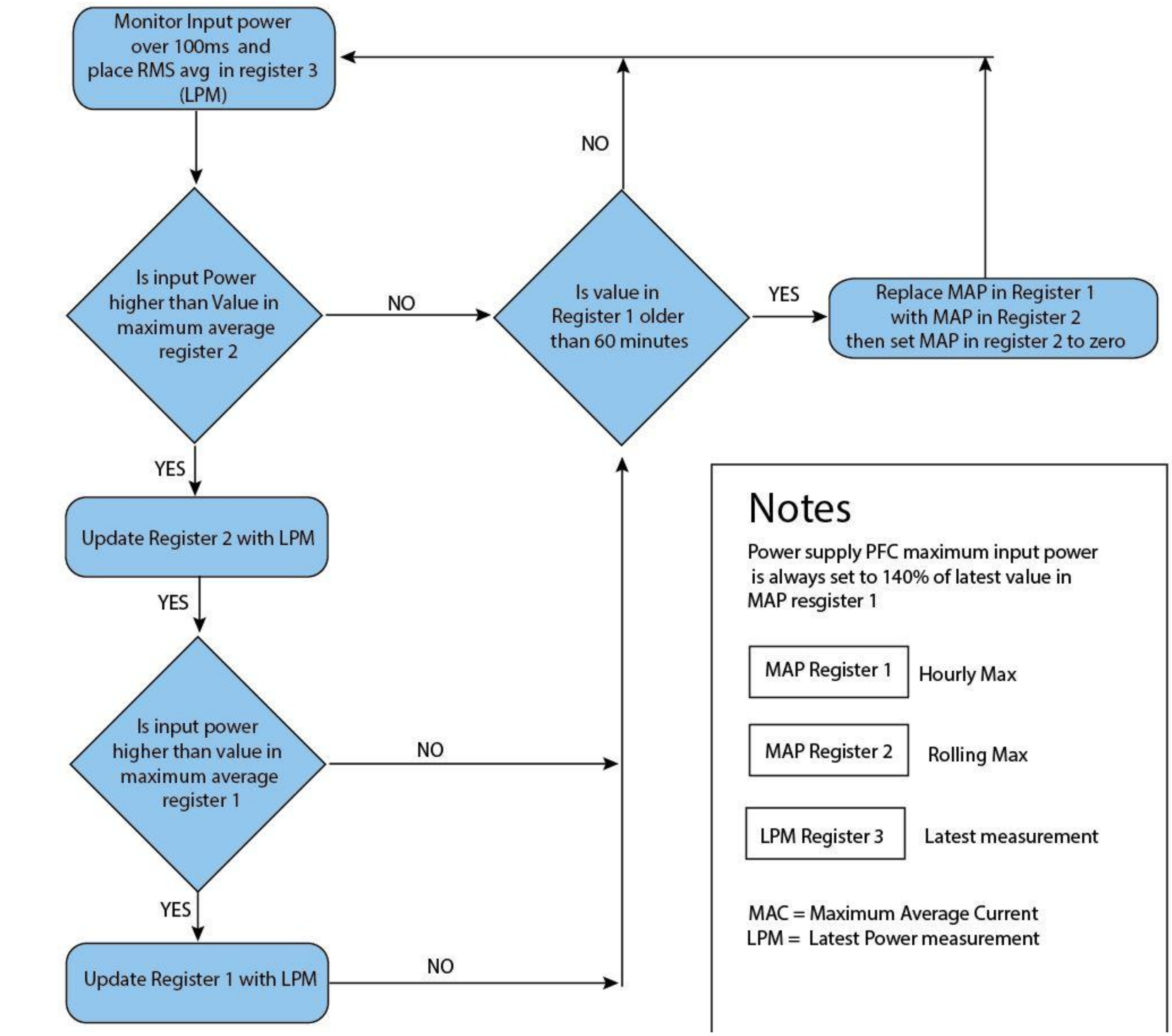
The power supply shall monitor input or output power to determine maximum input current allowed in order to meet the spec in section "Timing Requirements".

Below is one way to implement DMIPL is described below. Other methods may be used with Microsoft approval.

Please refer to flow chart below

1. PSU primary side will have three registers
    1. Maximum Average Power (MAP) Register 1 which stores the maximum power measured in the last 60 minutes.
    2. MAP Register 2 is the maximum power measured since Register 1 was updated.
    3. Latest Power Measurement (LPM) Register 3 is the current power measured over the last 100ms.
2. The flow chart should be self-explanatory but basically, the PSU will use the MAPR1 *130% to set maximum input current.
3. If the input power does not exceed this for 60 minutes, MAPR1 is lowered to the highest power in the last 60 minutes.
4. If LPM exceeds MAPR1, this value is loaded immediately into MAPR1 and 60-minute counter is reset.

Figure 5: DMIPL Flow



4.1.14 Input Power Sharing

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

Table 4: Input Power Sharing

Total Input Power	**Input currents share accuracy**
1-330W	< 100mA
330W-660W	+/- 5%
>660W	+/- 3%

4.1.15 Inrush Current

AC line inrush current to each 550W module shall not exceed 8A 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.

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.

4.1.16 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 (at 230V, 60Hz):

Table 5: Power Factor

Output Current	Minimum Power Factor
10%	NA
20%	.9
50%	.95
100%	.98

4.1.17 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.

4.1.18 Modified Sine Waves

The power supply shall operate when the AC input is a variant of a sine wave such as from a UPS. 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.

4.1.19 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

4.1.20 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°, 90°, 180°, and 270°.

4.1.21 Electrostatic Discharge Susceptibility

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

- ±15 kV air discharge with regards to Criteria C
- Transients as defined in IEC 801-2

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

**Refer to section 11.8 for full compliance/if there is inconsistency

4.1.22 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.

4.1.23 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.

4.1.24 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.

4.1.25 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 and for factory ATE/CPK value, we can use 93.8% (230V and 240V 50% loading) as spec for fan losses.

Table 7: Efficiency

Input voltage (VAC RMS)	Output load (A)	Minimum efficiency (%)
200	13.5 (10%)	85
200	27 (20%)	92
200	67.5 (50%)	93
200	135 (100%)	91
208	13.5 (10%)	85
208	27 (20%)	92
208	67.5 (50%)	93
208	135 (100%)	91
230	13.5 (10%)	85
230	27 (20%)	92

230	67.5 (50%)	94
230	135 (100%)	91
240	13.5 (10%)	85
240	27 (20%)	92
240	67.5 (50%)	94
240	135 (100%)	91

4.2 DC Outputs, Signal Outputs, and Control Outputs

This section describes the DC outputs.

4.2.1 Output Power and Current

Across the typical 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.

*e.g if we have 2 PSU in paralell, max would be 269.4A

Table 8: Output Power and Current

Output	Min	Max per working module	Max (3 modules) N+1	Unit
12.25VDC	1	44.9 A	134.7*	A

4.2.2 Output ORing/Output Capacitor isolation

Not required

4.2.3 Standby Output

The power supply shall not provide a standby output.

4.2.4 Setpoint

The voltage set-point shall be as specified in Table 9.

Table 9: Setpoints

Parameter	Min	Set point	Max	Units	Iout (A)
+12V	12.305	12.32	12.335	Vrms	40.41

4.2.5 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	Max	Units
12V Output	12.00	12.25	12.5	Vrms

4.2.6 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.

4.2.7 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 1%-61% and 40% to 100%	0.1 - .5 A/usec	3500uF +/-5%

4.2.8 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	2200uF	11000	uF

4.2.9 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.

4.2.10 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%.

4.2.11 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).

** PSU output return may be connected to the chassis ground inside the PSU. Common mode noise requirement shall not be applicable to PSU design with output connector ground pins connected to safety ground

4.2.12 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.

4.2.13 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.

4.2.14 Hot Swap Requirements

The PSU shall be hot swappable. Out ORing is not required. On power supply capacitance may require a series FET to enable clean hot swap. 12V main limits are the same as dynamic loading

4.2.15 Load Sharing

The 1650W power supply shall current share using voltage droop share. The failure of a module inside the PSU should not affect the load sharing or output voltages of the other supplies still operating. The supplies must be able to load share in parallel and operate in a hot-swap / redundant 1+1 configurations. Must fall within the specification of section 4.2.7 Dynamic Load step.

Table 13: Droop Share

Droop Slope per module
350mV/44.9A

Table 14: Load Sharing

Total output load	Max current difference between 2 PSU's
<54A/660W	+/- 8.1A
660W-1320W	+/- 15%
>1320W	+/- 10%

4.2.16 Timing Requirements

Figure 6: AC Start Up

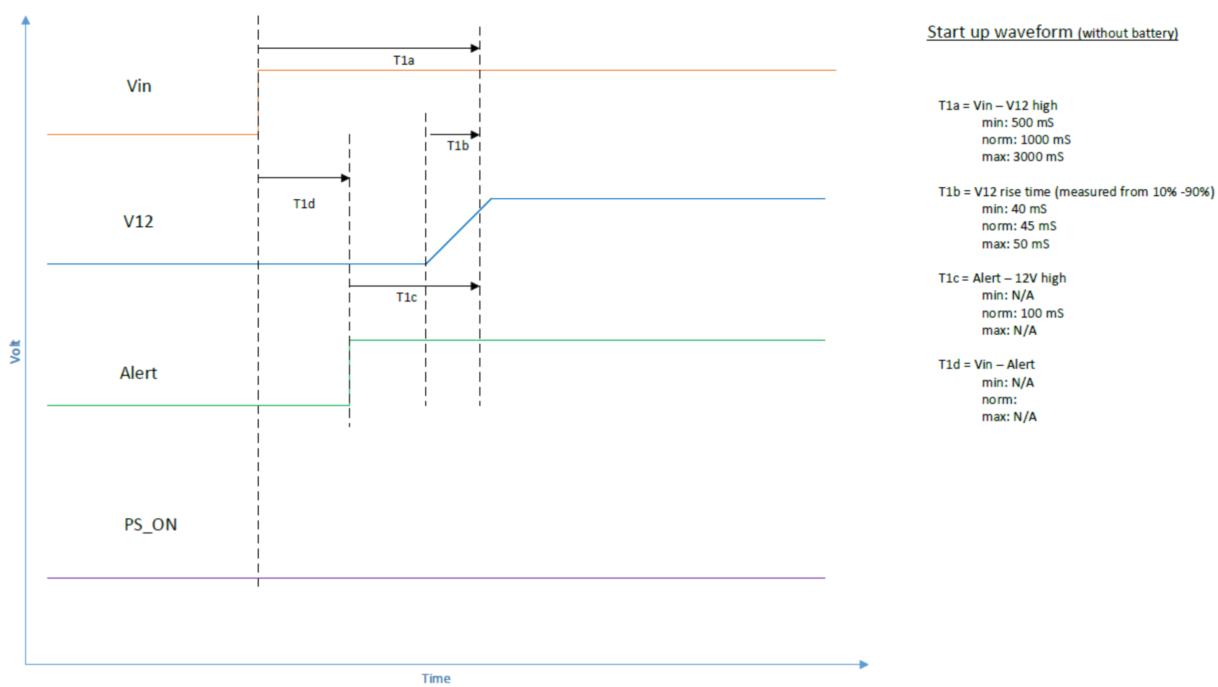
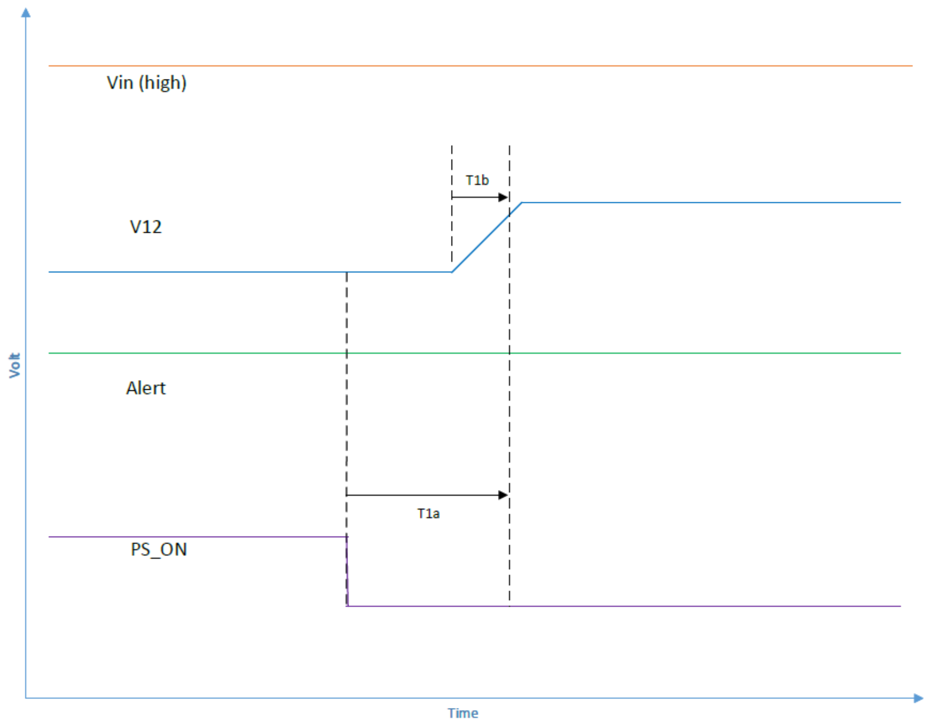


Figure 7: PS_ON Start Up



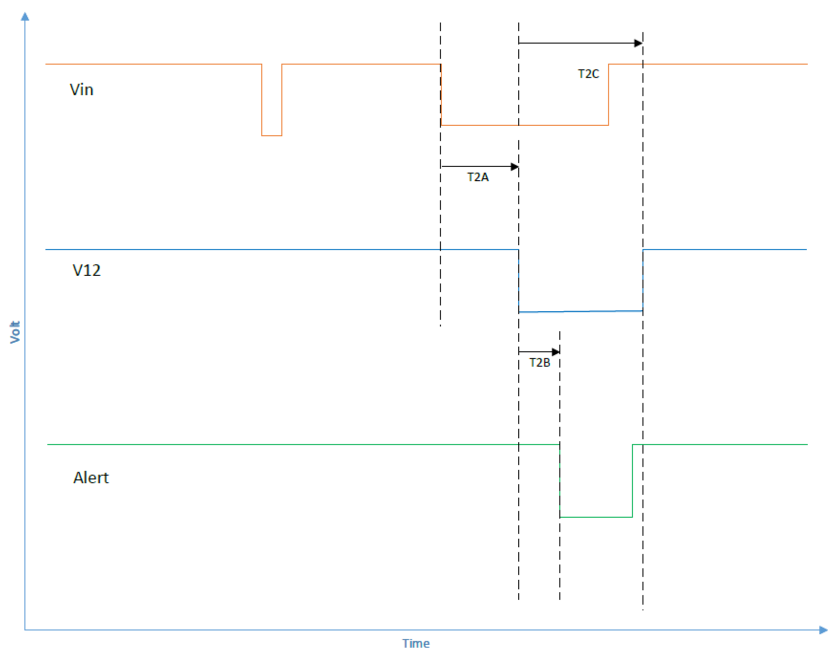
Start up waveform (cold start)

T1A = PS_ON – V12 high
min: 80 mS
norm: 100 mS
max: 120 mS

T1B = V12 rise time (10% to 90%)
min: 40 mS
norm: 45 mS
max: 50 mS

T1C = PS_ON – Alert high
min: N/A
norm:
max: N/A

Figure 8: Dropout



Hold up time (without battery):

T2a: AC loss to 12Vmain goes to 11.7V

All loading : >20mS

T2B: 12V – Alert dips because bulk completely discharged

T2C: refer to AC start up waveform

Figure 9: Re-rush Current Dropout Recovery

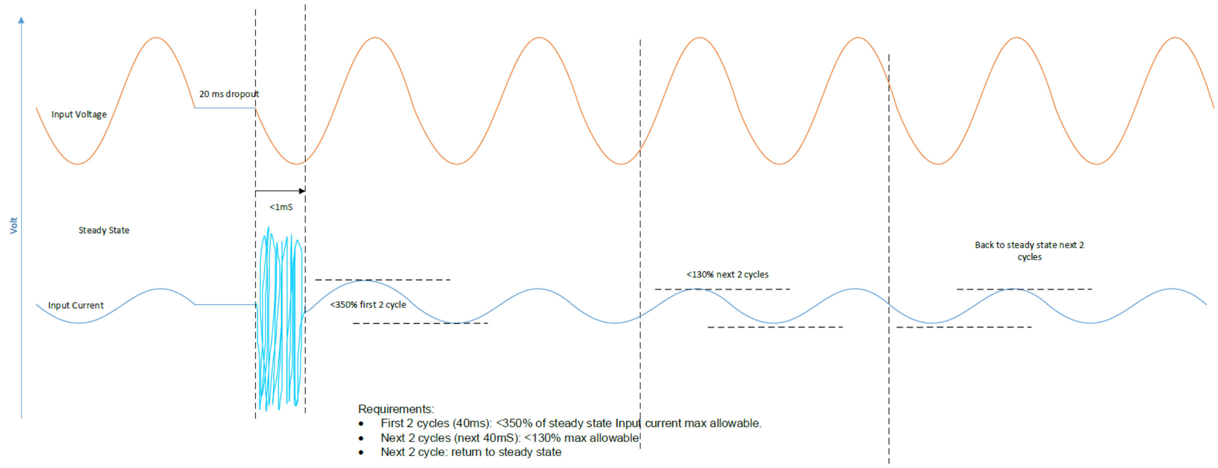


Figure 10: AC Turn Off

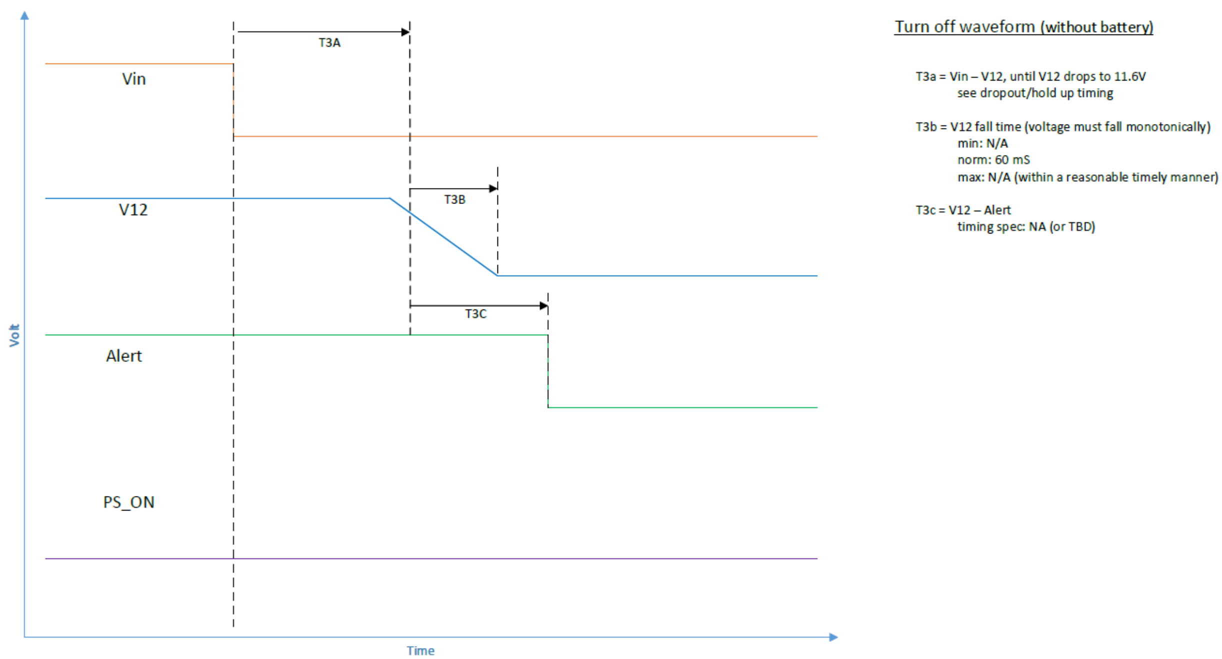
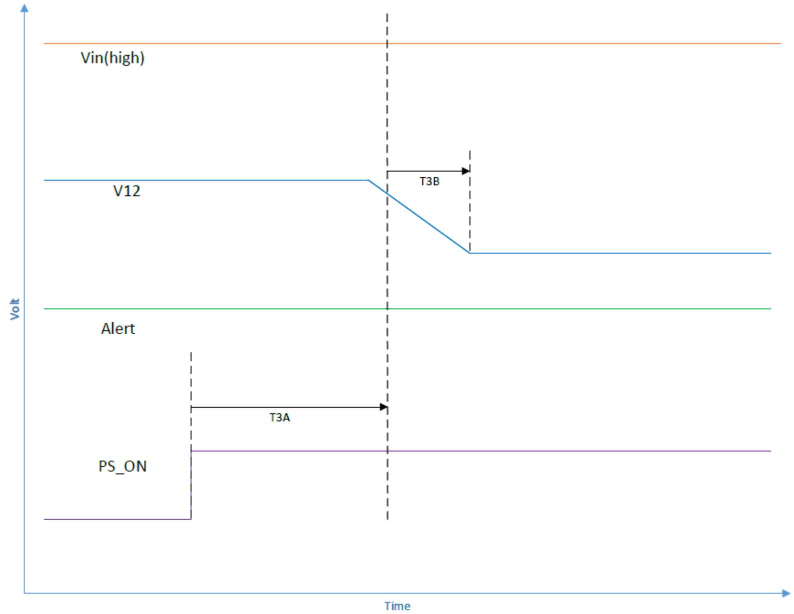


Figure 11: PS_ON Turn Off



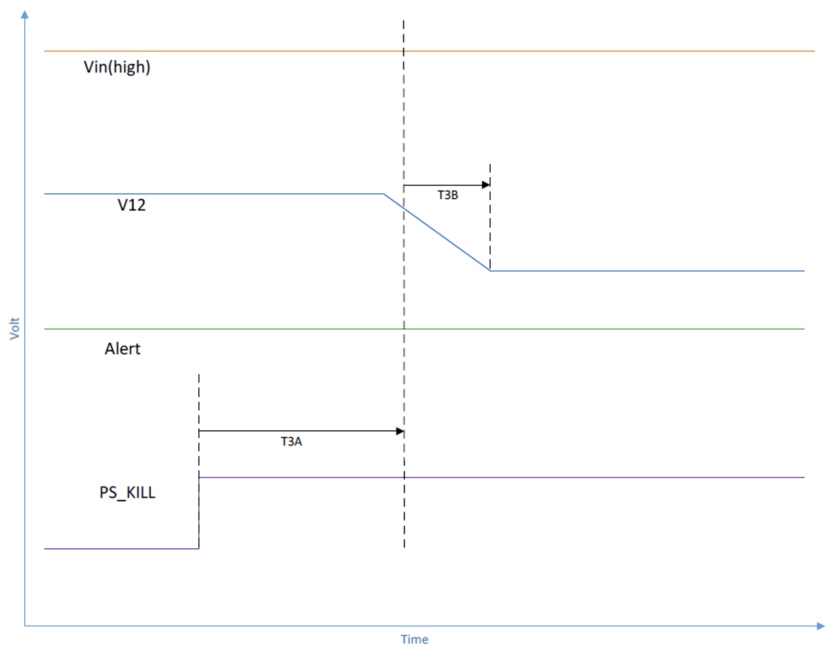
Turn off waveform (without battery)

T3a = PS_ON – V12, until V12 drops to 11.6V (test at 50% loading)
min: 30 mS
norm: 50 mS
max: 100 mS

T3b = V12 fall time (voltage must fall monotonically)
min: 1 mS
norm: 60 mS
max: N/A

T3c = V12 – Alert
timing is NA

Figure 12: PS_Kill

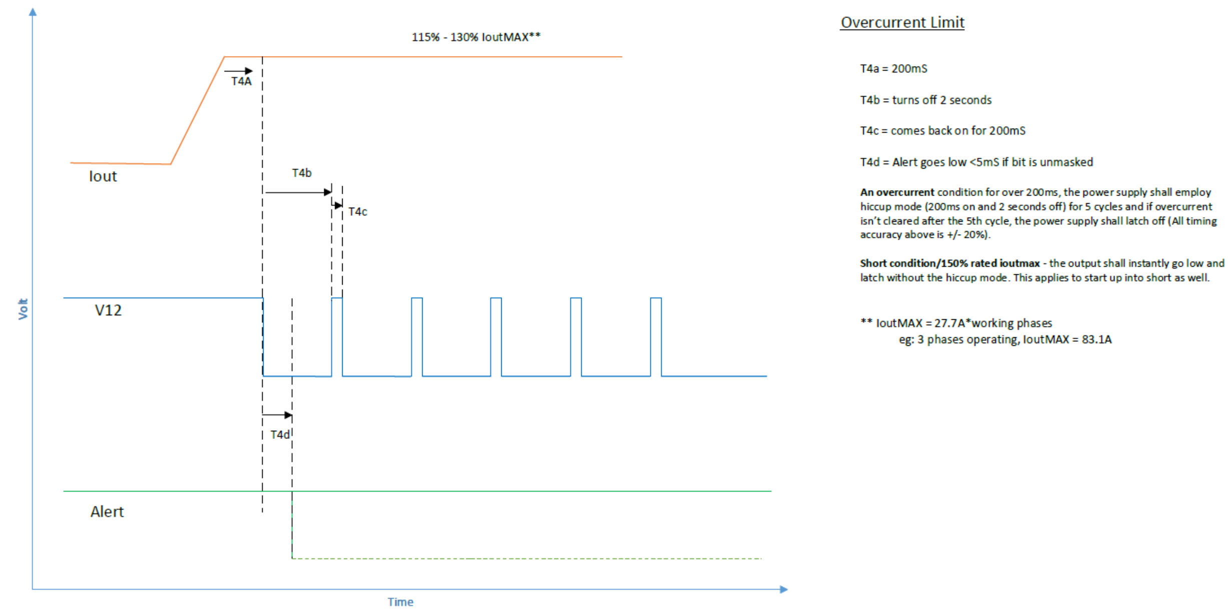


T3a = PS_Kill – V12, until V12 drops to 11.6V (test at 50% loading)
min: NA
norm: 5 mS for P2020 and 200mS for P2010
max: NA

T3b = V12 fall time (voltage must fall monotonically)
min: 1 mS
norm: 60 mS
max: N/A

T3c = V12 – Alert
timing is NA

Figure 13: Over Current Protection



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 at 1mA or less source current. The PSU shall be powered off when driven to 2.06VDC or higher. Toggling PS_ON will reset the latched fault that held 12V low. However, PS_ON will not reset the latched bits in the PMBUS register after 12V returns. PSON shall be 5V tolerant.

Table 15: Power On/Off

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	Rise time max (usec)	Fall time max (nsec)	Cmax external to PSU	Peak noise (mVpk-pk)
PS_On	In	NO	YES	49.9K	0.8	2.06	N/A	50	100	no	NA

5.2 I-Share

Not available – PSU shall be using voltage droop sharing.

5.3 I2C/PMBus

The I2C address of the PSU shall be 0xB0 when address is LOW(at default/open Address pin) and shall be 0xB2 when Address is pulled High (pull up to a 3.3V with a 1K resistor at the system board side).

Table 16: 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 extern al to PSU (pF)	Peak noise (mVpk-pk)
SDA	I/O	NO	YES	1K +/-20%	0.8	2.0	6	1	250	120	250mV
SCL	I/O	NO	YES	1K +/-20%	0.8	2.0	6	1	250	120	250mV
Alert	Out	YES	YES	100k +/- 20%	0.8	2.0	N/A	50	250		250mV
Addre ss	Input	No	Yes	20K+/- 20%(pull-down)	0.8	2.0	6	50	250		NA

5.4 PS_KILL

The power supply shall default to 12V being disabled within 5ms of PS Kill going high. It will be pulled low with 100 Ohm in the system board.

Table 17: 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	10KOh m	0.4	2.0V or NC	0.5	250	2.5	0	NA

5.5 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. Note that PSU Alert shall remain low until Clear_fault commands are sent via i2c to reset it (cycle AC or PS_ON doesn't clear it) even if fault goes away. For more information, refer to the "Project Olympus Power Supply Software Interface Specification"

Table 18: 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	50usec	250nsec		250mV

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

5.6 Power Supply Present (PRESENT#)

It will be pulled low/grounded with 100 ohm internal of PSU. The system board will be pulled up to a 10Kohm resistor.

5.7 Remote Sense

The power supply shall provide positive and negative voltage sense pins.

5.8 Output Connector Pinout

DC outlet and signal connector shall be an FCI PwrBlade 10106262-8004005LF 4HP + 16S +4HP or equivalent.

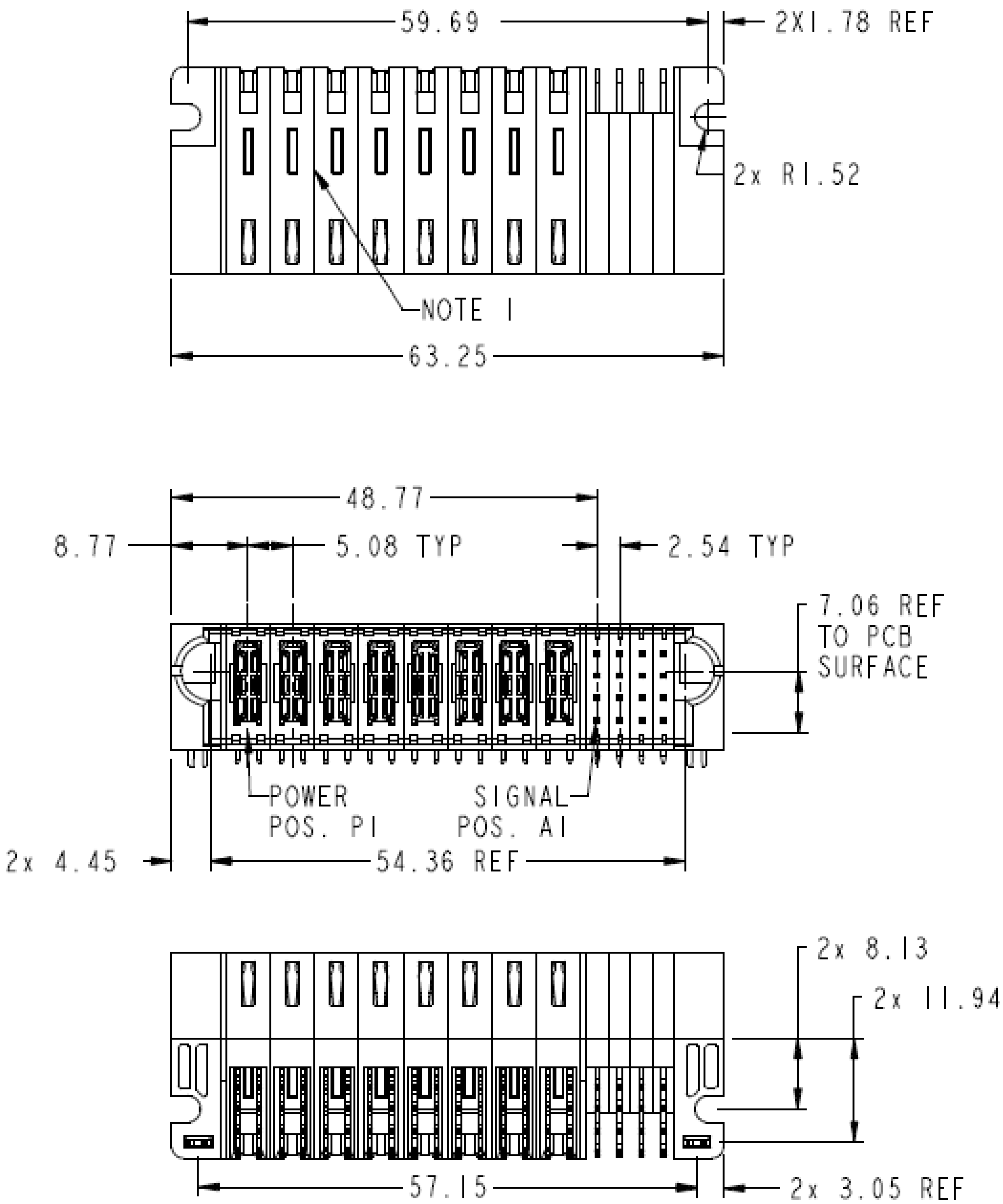


Figure 14: Output Connector

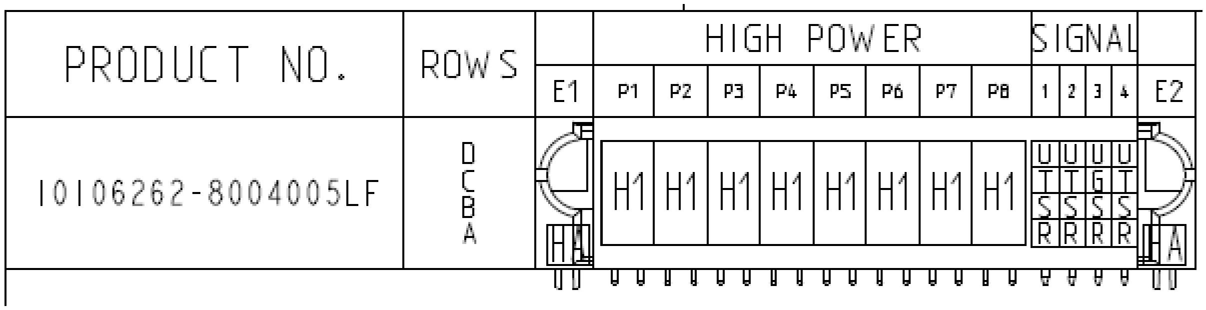


Figure 15: Pin Outs

PDF Dwg for connector

PDF Dwg chasis mating connector

Table 19: Output Connector Pinout

Pin Number	Description
P1	12.2VDC
P2	12.2VDC
P3	12.2VDC
P4	12.2VDC
P5	12_RTN
P6	12_RTN
P7	12_RTN
P8	12_RTN
A1	I2C_SCL
A2	Analog Return
A3	I2C_SDA
A4	PSU_ALERT# Reserved
B1	I2C Address
B2	Analog Return
B3	Reserved
B4	PSU_PRESENT#
C1	PS_ON#
C2	Not Populated
C3	PSKILL (Short Pin)
C4	Reserved
D1	VS(-)
D2	Not Populated
D3	VS(+)

D4	Reserved

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 BMC. 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 – Alert shall assert within 10mS when short circuit protection(SCP) happens.

5.9.2 Short Circuit Protection (SCP)

For short circuit situations, the power supply may latch off immediately – Alert shall assert right away when short circuit is detected.

5.9.3 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.

5.9.4 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

NA

7 Software Interface Requirements

The power supply shall meet the requirements of Microsoft document: Project Olympus Series PSU Software Interface Specification

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 1000W or less. If bootloading while loading is greater than 1000W, PSU may shutdown/12V go low.

8 LED Indicators

The PSU will have 1 dual color LED mounted on the PSU top panel. Following are the LED drivers and power supply LED States:

- Power supply LED states
  Single bi-colored LED configuration(orders by priorities):

  1) **Yellow-Green-Yelllow-green-repeat(Yellow1Hz,Green1Hz rate**): Primary side fault/bad AC input
  2) **Blinking Yellow @ 4Hz frequency**: Bootloading
  3) **Solid Yellow** : Secondary/Fan/bootloading Failure and/or loss of 12V
     - (refer to PSU PMbus registers for specific failures)
  4) **Solid Green** : AC_OK & DC_OK (PSU operating normally)
  5) No LED: Complete loss of AC power

- NOTE: toggling PS_ON/AC input power will reset the solid/blinking yellow fault light but will come up again if faults re-occur.
- Only one of the 5 conditions will be applied at ALL time.

Refer to the mechanical drawing for the location of the LED

9 Mechanical Specifications

This section describes the mechanical specifications.

9.1 Dimensions

The power supply outer dimensions are 40mm X 130mm X 330mm. These dimensions shall include any blind mate, guide, handle or removal feature.

Figure 16: PSU Outer Dimensions

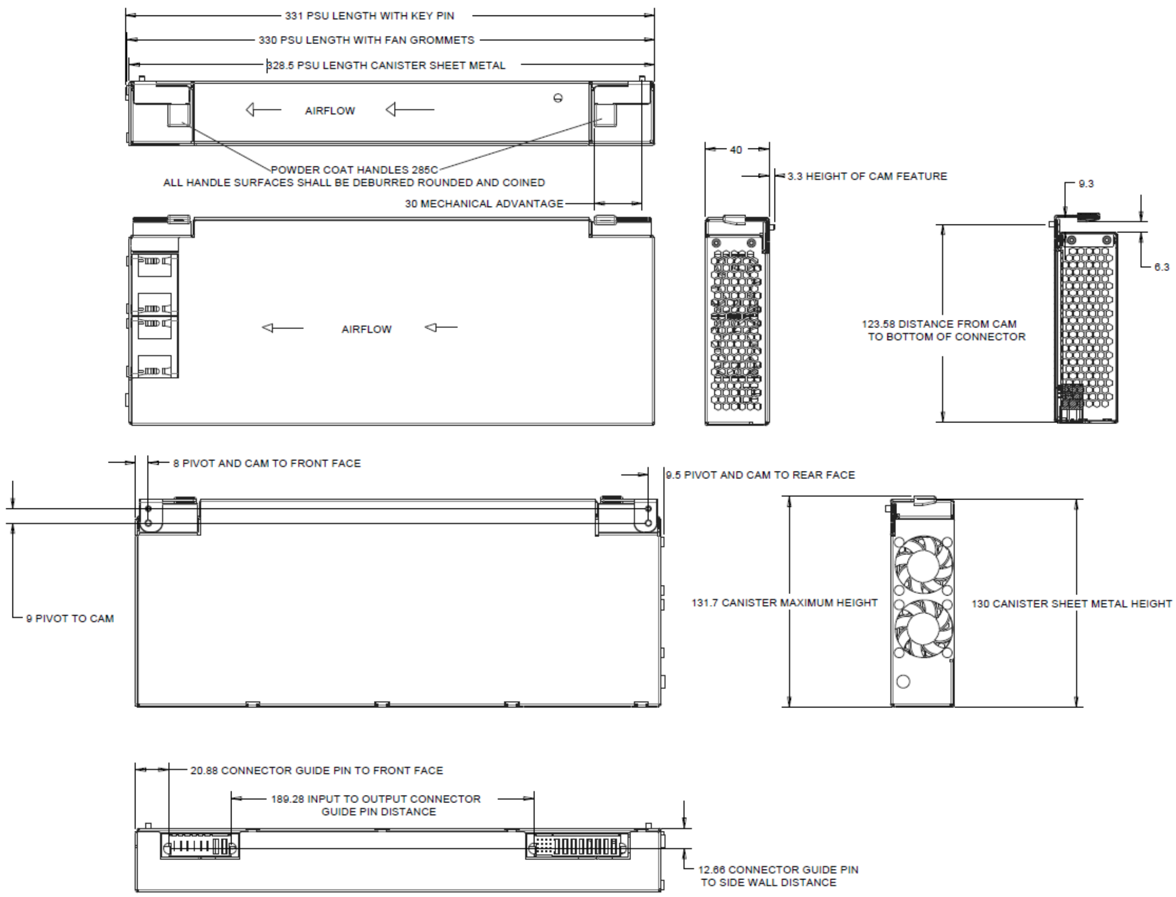
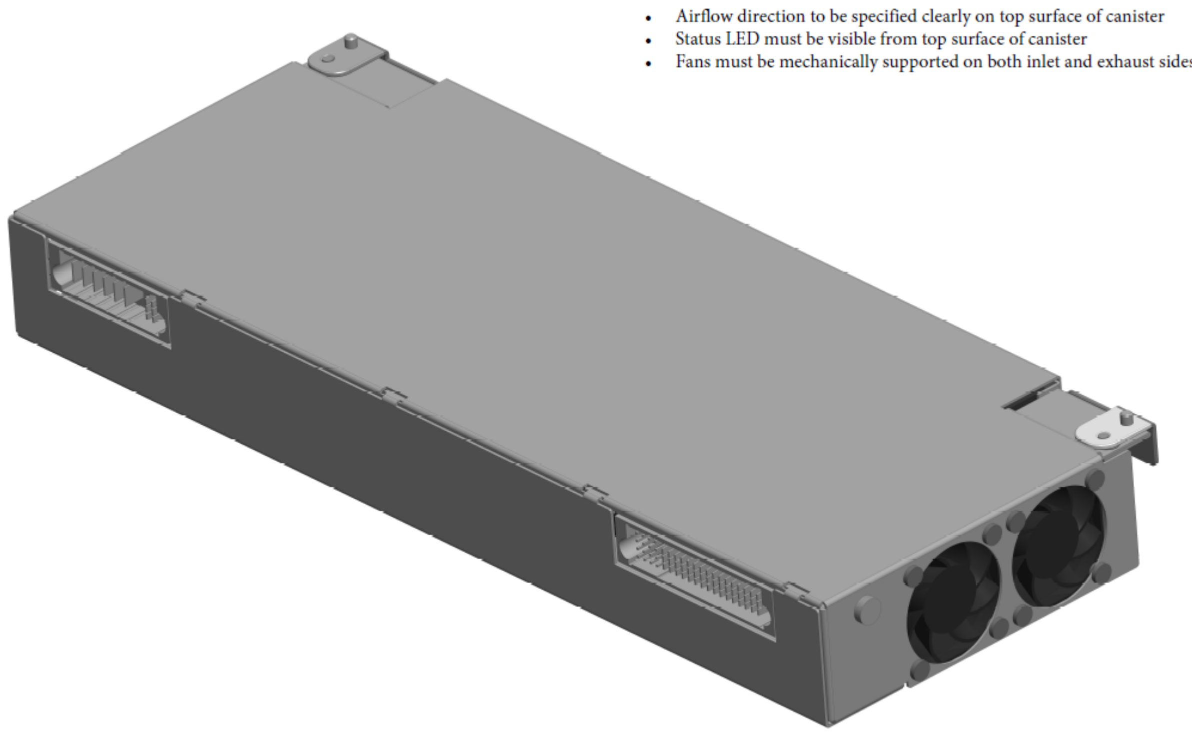


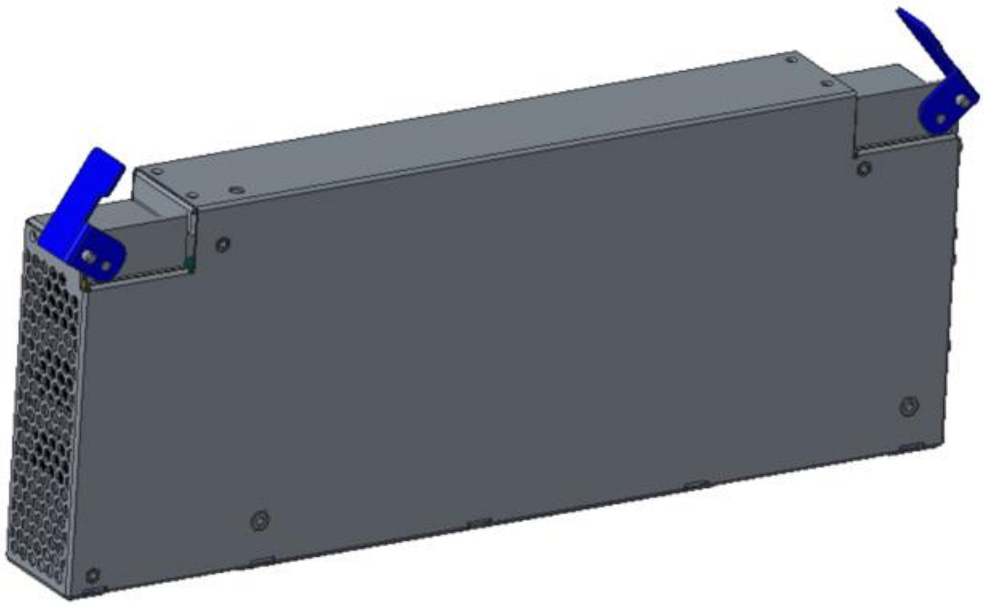
Figure 17: PSU picture back view



9.2 Lever Arm

The lever arm should be a single piece with the point of rotation near the center of the canister. A standoff on the lever arm will be used to transfer the insertion or removal force.

Figure 18: PSU levers



9.2.1 Over Rotation Prevention

The canister will prevent over-rotation of the lever arm, limiting it to 90° of travel

9.2.2 Handle Lock

The canister will have snap lock feature to retain the handle in the closed position. The lock will require no additional action to lock other than the closing motion of the lever arm. It is permitted to require an additional action to unlock the handle.

9.3 Connectors

9.3.1 Placement

The placement of the AC and DC connectors should follow the PCB drawing below. The connectors should be recessed within the canister to prevent damage during installation.

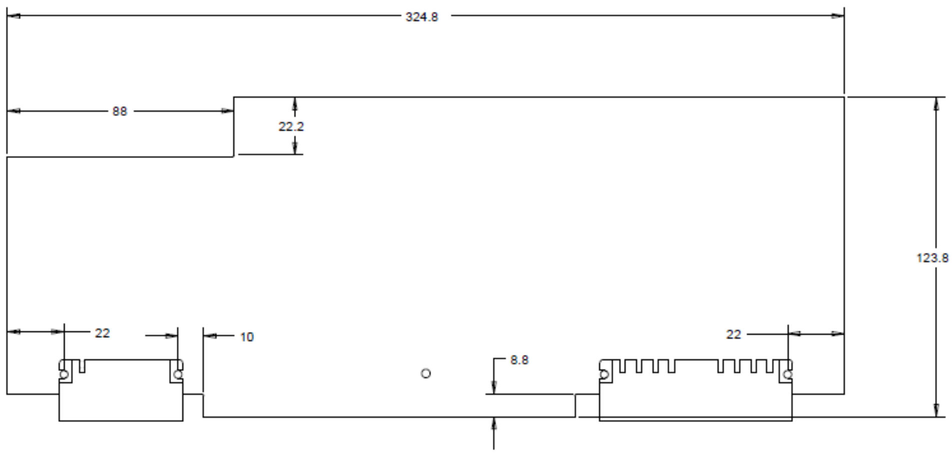


Figure 19: PSU Dimensions

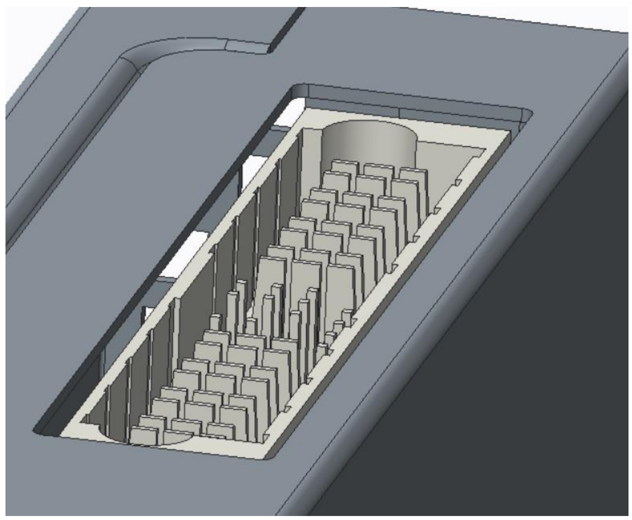


Figure 20: PSU Mechanical

10 Operating Environment Requirements

Table 20: Operating Environment Requirements

Specification		Requirement
Inlet Temperature	Operating	• 35 °F to 113 °F (10 °C to 45 °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

Specification		Requirement

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)

	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 life calculated with the environmental inlet temperature and cycle at power loads of 750W continues load at a nominal of 230VAC input line voltage.

11.1 Reliability

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

- For one power module: 1,000,000 hours MTBF at 275W load with one power supply fault and 30C. Use Telcordia Issue 3 Method 1 case 3 for the calculation.
- Six (6) years operation life.

11.2 Serviceability

Field replacement of power supply unit is required.

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 45°C ± 5°C at maximum load and has re-tested the power supply following the burn-in.

11.4 Cooling

11.4.1 Fan Speed Control

The PSU shall incorporate a fan(s) for PSU cooling. The Fan will operate at the minimum speed needed to keep all components within the thermal derating levels for all loading and ambient conditions.

11.4.2 Fan Redundancy

If a single fan failure occurs the PSU shall be able to operate up to 1100W. Reliability and derating requirements do not have to be met while operating with one fan.

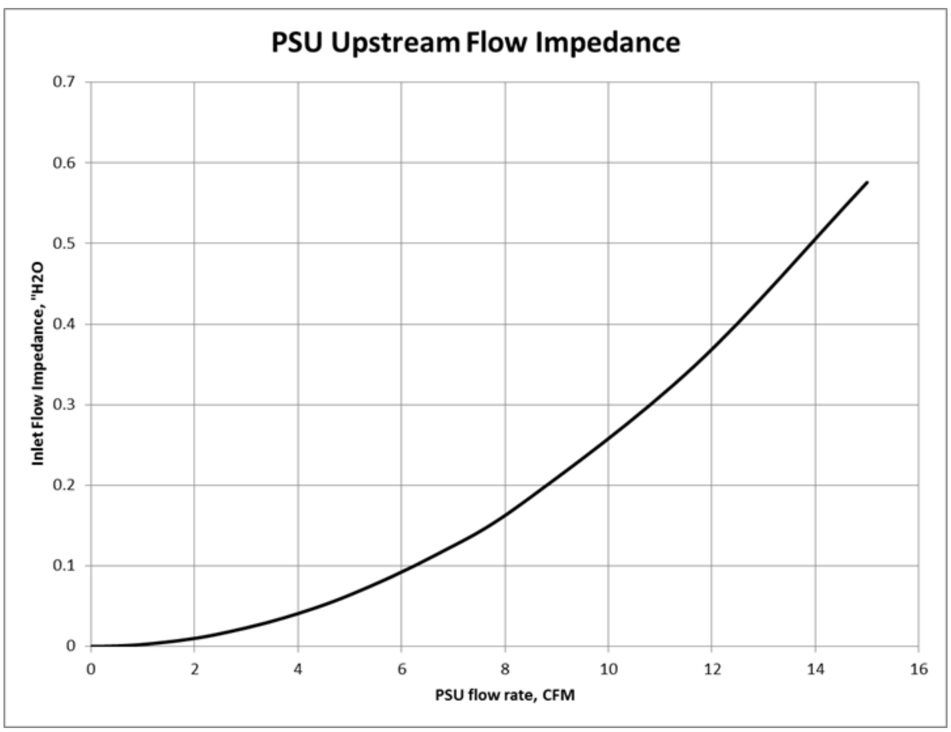


Figure 21: Example System Airflow Impedance

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

- 0.002 G2/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 blade might encounter.

Table 21: Transportation and Handling

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 Blade operational when tested after vibration
NA	unpackaged,	• Non-operational • Square wave • 32g peak • 6.85 m/s velocity change • 6 sides	No visible damage Blade 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 Blade operational when tested after all shocks

NA	packaged	• Non-operational
		• 1.146 Grms
		• Single blade package
		  ○ 15 mins/side
		  ○ 6 sides tested
		• If bulk packaged
		  ○ 1 hour on normal rest surface
			No visible damage
			Blade 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 Ω. The supply 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 Requirements

The following are the minimum product safety compliance regulations that must be met, refer to section 11.8 for full compliance:

- 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.

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:

- 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 Compliance

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

- 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
- 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

Table 22: Label

Max input current and input voltage per phase	200-240V derive from346-415V, 3ø Y, 3W+N+PE, 50/60Hz, **3.5A**
	200-240V derive from 3ø Δ, 3W+PE, 50/60Hz, **3.5A**

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

13.3 Power Supply Fan/Location/Orientation

The fan can be located anywhere in the PSU. Airflow will be from the front of the rack to the back end.

13.4 Acoustic Requirement

Fan noise as measured from one-meter distance from the power supply shall be 50 dBA typical, 58 dBA maximum. The test setup shall be as follows: The PS is a desktop module with bystander locations only. The PS 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.

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 shall not exceed 7 lbs 0 oz.