

Power Supply Design Guideline for 2008 Dual-Socket Servers and Workstations

A Server System Infrastructure (SSI) Specification

Version 1.2.1

Power Supply Design Guideline for 2008 Dual-Socket Servers and Workstations, V1.2.1

Orig./Rev.	Description of Changes
0.7	Initial release for 2008/2009 Dual-Socket Servers and Workstation platforms
1.0	Updated efficiency recommendations. Update PMBus* section. Added ERP1U form factor. Added 5VSB current to rack and pedestal configuration tables. Added EPS1U-HD form factor.
1.1	Change to 95W processors in performance server configurations. Fixed T_{pwok_on} timing requirements in PWOK characteristics table. Updated turn on timing requirements.
1.2	Fixed 550W 1U loading table to add the +12V4 rail.
1.2.1	Updated Terms and Conditions for public release

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1 Purpose

This design guide defines power supply requirement supporting the Tylersburg-EP platform. Form factors included support rack mount and pedestal system form factors, redundant and non-redundant power supplies, as well as server and workstation market segments. The parameters of this supply are defined in this specification for open industry use.

2 Definitions/Terms/Acronyms

Required	The status given to items within this design guide, which are required to meet SSI guidelines and a large majority of system applications
Recommended	The status given to items within this design guide which are not required to meet SSI guidelines, however, are required by many system applications
Optional	The status given to items within this design guide, which are not required to meet SSI guidelines, however, some system applications may optionally use these features
Power distribution board (PDB)	The board that connects redundant power supplies together and interfaces them to the rest of the system. This PDB usually provides wire harness interface to the system components, splits the 12V rail for 240VA limiting, and power converters providing 3.3V, 5V, and -12V converters.
Autoranging	A power supply that automatically senses and adjusts itself to the proper input voltage range (110 VAC or 220 VAC). No manual switches or manual adjustments are needed
CFM	Cubic Feet per Minute (airflow)
Dropout	A condition that allows the line voltage input to the power supply to drop to below the minimum operating voltage
Latch Off	A power supply, after detecting a fault condition, shuts itself off. Even if the fault condition disappears the supply does not restart unless manual or electronic intervention occurs. Manual intervention commonly includes briefly removing and then reconnecting the supply, or it could be done through a switch. Electronic intervention could be done by electronic signals in the Server System
Monotonically	A waveform changes from one level to another in a steady fashion, without intermediate retracement or oscillation
Noise	The periodic or random signals over frequency band of 0 Hz to 20 MHz
Overcurrent	A condition in which a supply attempts to provide more output current than the amount for which it is rated. This commonly occurs if there is a "short circuit" condition in the load attached to the supply
PFC	Power Factor Corrected
Ripple	The periodic or random signals over a frequency band of 0 Hz to 20 MHz
Rise Time	Rise time is defined as the time it takes any output voltage to rise from 10% to 95% of its nominal voltage
Sag	The condition where the AC line voltage drops below the nominal voltage conditions
Surge	The condition where the AC line voltage rises above nominal voltage
VSB or Standby	An output voltage that is present whenever AC power is applied to the AC inputs of the supply

Voltage	
MTBF	Mean time between failure
PWOK	A typical logic level output signal provided by the supply that signals the Server System that all DC output voltages are within their specified range

3 Platform Configuration Matrix

Table 1 and Table 2 show the system and power supply configurations supported by this design guide.

Table 1 Tylersburg-EP Rack Mount Server Configurations

	1U rack mount server			2U rack mount server		
	Value	Volume	Performance	Value	Volume	Performance
Non-redundant power supply form factor	EPS1U			EPS2U		
Redundant power supply form factor	ERP1U			ERP2U		
12V rails	4	4	4	4	4	4
Wattage	450W	550W	700W	550W	650W	750W
5VSB current	3.0A	3.0A	3.0A	3.0A	3.0A	3.0A
Processor	dual 80W	dual 80W	dual 95W	dual 80W	dual 80W	dual 95W
Memory ¹	6xDIMMs ²	12xDIMMs	12xDIMMs	12xDIMMs	12xDIMMs	12xDIMMs
PCI cards	1	1	1	3	3	6
Hard Drives	2x3.5"	3x3.5"	8x2.5"	4x3.5"	6x3.5"	12x2.5"
Graphics Card	none	none	none	none	none	none
12V5 connector	none			none		
Cooling	Non-redundant		Redundant	Non-redundant	Redundant	

Table 2 Tylersburg-EP Pedestal Configurations

	Pedestal server			Workstation	
	Value	Volume	Performance	Volume	Performance
Non-redundant power supply form factor	EPS12V			EPS12V	
Redundant power supply form factor	ERP12V			Not available	
12V rails	4	4	5	4	5
Wattage	450W	700W	900W	700W	900W
5VSB Current	3.0A	3.0A	3.0A	4.0A	5.0A
Processor	dual 80W	dual 95W	dual 95W	dual 80W	dual 130W
Memory ¹	6xDIMMs	12xDIMMs	12xDIMMs ³	12xDIMMs	12xDIMMs
PCI cards	3	6	6	4	2
Hard Drives	4x3.5" or 6x2.5"	6x3.5" or 10x2.5"	10x3.5" or 16x2.5"	2x3.5"	4x3.5"
Graphics Card	none	none	none	1x150W	2x150W
12V5 connector	none			none	yes
Cooling	Non-redundant		Redundant	Non-redundant	

1. Dual rank x4 memory DIMMs unless otherwise noted
2. Single rank x8 memory DIMMs
3. Quad rank x4 memory DIMMs

4 Mechanical

4.1 AC Inlet Connector

STATUS
Required

The AC input connector shall be an *IEC 320 C-14* power inlet. This inlet is rated for 15 A/250 VAC.

4.2 Output Connectors

The power supply shall have the following output connectors.

4.2.1 Baseboard power connector

STATUS
Required

Connector housing: 24-Pin Molex 39-01-2240 or equivalent

Contact: Molex 44476-1111 or equivalent

There is a main 2x12 power connector used to delivery power to the motherboard.

Table 3: P1 Baseboard Power Connector

Pin	Signal	18 AWG Color	Pin	Signal	18 AWG Color
1	+3.3 VDC ¹	Orange	13	+3.3 VDC	Orange
2	+3.3 VDC	Orange	14	-12 VDC	Blue
3	COM	Black	15	COM	Black
4	+5 VDC	Red	16	PS_ON	Green
5	COM	Black	17	COM	Black
6	+5 VDC	Red	18	COM	Black
7	COM	Black	19	COM	Black
8	PWR OK	Gray	20	Reserved (-5 V in ATX)	N.C.
9	5 VSB	Purple	21	+5 VDC	Red
10	+12 V4 ²	Yellow	22	+5 VDC	Red
11	+12 V4 ²	Yellow	23	+5 VDC	Red
12	+3.3 VDC	Orange	24	COM	Black

1. 3.3V remote sense signal double crimped with 3.3V contact.
2. If 240VA limiting is not a requirement for the power supply then all +12V outputs are common.

4.2.2 Processor / Memory Power Connectors

STATUS
Required

Connector housing: 8-Pin Molex 39-01-2080 or equivalent

Contact: Molex 44476-1111 or equivalent

There are two 2x4 power connectors for delivering powering to dual processor sockets and associated memory. One connector powers processor 0 and its associated memory DIMMs, the other connector powers processor 1 and its associated memory.

12V3 is split on the motherboard into 12V3a and 12V3b. If the combined current for these rails is less than 18A (the 240VA limit) these may be powered from a common 12V rail on the power supply. For larger memory configurations these rails will need to be powered from separate 240VA rails; as in the performance server configurations using quad ranks DIMMs.

Table 4: Processor 0 / memory power Connector

Pin	Signal	18 AWG color	Pin	Signal	18 AWG Color
1	COM	Black	5	+12 V1	Yellow
2	COM	Black	6	+12 V1	Yellow
3	COM	Black	7	+12 V3a	Yellow
4	COM	Black	8	+12 V3a	Yellow

Table 5: Processor 1 / memory power Connector

Pin	Signal	18 AWG color	Pin	Signal	18 AWG Color
1	COM	Black	5	+12 V2	Yellow
2	COM	Black	6	+12 V2	Yellow
3	COM	Black	7	+12 V3b	Yellow
4	COM	Black	8	+12 V3b	Yellow

If 240VA limiting is not a requirement for the power supply then all +12V outputs are common.

12V3a and 12V3b need to be split into separate 240VA rails only for memory configurations exceeding 12 dual rank DIMMs using x4 DRAMs.

4.2.3 +12V5 Baseboard Power Connector

STATUS
+12V5 Required for greater than 150W graphics cards

Systems that require more then 16A of +12V current to the baseboard will require this additional 2x2 power connector. This is due to the limited +12V capability of the 2x12 baseboard power connector.

Connector housing: 4-Pin Molex 39-01-2040 or equivalent

Contact: Molex 44476-1111 or equivalent

Table 6 12V5 Power Connectors

Pin	Signal	18 AWG color	Pin	Signal	18 AWG Color
1	COM	Black	3	+12 V5	Yellow
2	COM	Black	4	+12 V5	Yellow

If 240VA limiting is not a requirement for the power supply then all +12V outputs are common.

4.2.4 Peripheral Power Connectors

STATUS
Optional

Connector housing: Amp 1-480424-0 or equivalent

Contact: Amp 61314-1 contact or equivalent

Table 7: Peripheral Power Connectors

Pin	Signal	18 AWG Color
1	+12 V4	Yellow
2	COM	Black
3	COM	Black
4	+5 VDC	Red

1. If 240VA limiting is not a requirement, all +12V outputs are common.

4.2.5 Floppy Power Connector

STATUS
Optional

Connector housing: Amp 171822-4 or equivalent

Table 8: Floppy Power Connector

Pin	Signal	22 AWG Color
1	+5 VDC	Red
2	COM	Black
3	COM	Black
4	+12 V4	Yellow

1. If 240VA limiting is not a requirement for the power supply then all +12V outputs are common.

4.2.6 Serial ATA Power Connector

STATUS
Optional

This is a required connector for systems with serial ATA devices.

The detailed requirements for the serial ATA connector can be found in the “Serial ATA : High Speed Serialized AT Attachment “ specification at www.serialata.org.

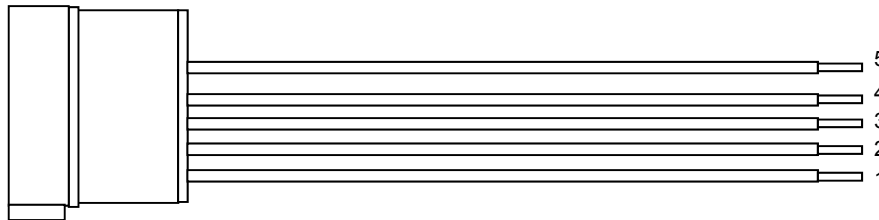
Molex Housing #675820000

Molex Terminal #67510000

Table 9: Floppy Power Connector

Pin	Signal	18 AWG Color
5	+3.3VDC	Orange
4	COM	Black
3	+5VDC	Red
2	COM	Black
1	+12V4	Yellow

Serial ATA Connector



4.2.7 Server Signal Connector

STATUS
Optional

For server systems with SMBus features, the power supply may have an additional connector, which provides serial SMBus for FRU data and remote sense on 3.3V and Return.

If the optional server signal connector is not used on the power supply or the connector is unplugged, the power supply shall utilize the 3.3RS on the baseboard connector (Pin 1).

Connector housing: 5-pin Molex 50-57-9405 or equivalent

Contacts: Molex 16-02-0088 or equivalent

Table 10: Server Signal Connector

Pin	Signal	24 AWG Color
1	SMBus Clock	White/Green Stripe
2	SMBus Data	White/Yellow Stripe
3	SMBAlert	White
4	ReturnS	Black/White Stripe
5	3.3RS	Orange/White Stripe

4.2.8 Workstation Power Connector for High Power Graphics Cards

STATUS
Optional

For workstation systems with high-power graphics cards additional power connectors will be needed. The +12V4 connector is needed for powering a system with a single 150W graphics card. +12V4 and +12V5 connectors are needed for powering a system with dual 150W graphics cards.

Connector housing: 6-pin Molex 45559-0002 or equivalent

Contacts: Molex 39-00-0207 or equivalent

Table 11 PCI Express Graphic Card Power Connector(s)

PIN	SIGNAL	18 AWG Colors	PIN	SIGNAL	18 AWG Colors
1	+12V4 / +12V5	Yellow	4	COM	Black
2	+12V4 / +12V5	Yellow	5	COM	Black
3	+12V4 / +12V5	Yellow	6	COM	Black

4.3 Temperature Requirements

STATUS
Recommended

The power supply shall operate within all specified limits over the T_{op} temperature range. The average air temperature difference (ΔT_{ps}) from the inlet to the outlet of the power supply shall not exceed the values shown below in Table 12. All airflow shall pass through the power supply and not over the exterior surfaces of the power supply.

Table 12: Thermal Requirements

ITEM	DESCRIPTION	MIN	MAX	UNITS
T_{op}	Operating temperature range.	0	45	°C
T_{non-op}	Non-operating temperature range.	-40	70	°C

The power supply must meet UL enclosure requirements for temperature rise limits. All sides of the power supply with exception of the air exhaust side, must be classified as “Handle, knobs, grips, etc. held for short periods of time only”.

5 AC Input Requirements

STATUS
Required

The power supply shall incorporate universal power input with active power factor correction, which shall reduce line harmonics in accordance with the EN61000-3-2 and JEIDA MITI standards.

5.1 AC Input Voltage Specification

STATUS
Required

The power supply must operate within all specified limits over the following input voltage range. Harmonic distortion of up to 10% THD must not cause the power supply to go out of specified limits. The power supply shall operate properly at 85 VAC input voltage to guarantee proper design margins.

Table 13: AC Input Rating

PARAMETER	MIN	RATED	MAX
Voltage (110)	90 V_{rms}	100-127 V_{rms}	140 V_{rms}
Voltage (220)	180 V_{rms}	200-240 V_{rms}	264 V_{rms}
Frequency	47 Hz		63 Hz

5.2 Input Under Voltage

STATUS
Required

The power supply shall contain protection circuitry such that application of an input voltage below the minimum specified in Section 5.1 shall not cause damage to the power supply.

5.3 AC Line Dropout

STATUS
Required

An AC line dropout is defined to be when the AC input drops to 0 VAC at any phase of the AC line for any length of time. During an AC dropout of one cycle or less the power supply must meet dynamic voltage regulation requirements over the rated load. An AC line dropout of one cycle or less shall not cause any tripping of control signals or protection circuits. If the AC dropout lasts longer than one cycle, the power supply should recover and meet all turn on requirements. The power supply must meet the AC dropout requirement over rated AC voltages, frequencies, and 75% or less of the rated output loading conditions. Any dropout of the AC line shall not cause damage to the power supply.

5.4 AC Line Fuse

STATUS
Required

The power supply shall incorporate one input fuse on the LINE side for input over-current protection to prevent damage to the power supply and meet product safety requirements. Fuses should be slow blow type or equivalent to prevent nuisance trips. AC inrush current shall not cause the AC line fuse to blow under any conditions. All protection circuits in the power supply shall not cause the AC fuse to blow unless a component in the power supply has failed. This includes DC output load short conditions.

5.5 AC Inrush

STATUS
Required

The power supply must meet inrush requirements for any rated AC voltage, during turn on at any phase of AC voltage, during a single cycle AC dropout condition, during repetitive ON/OFF cycling of AC, and over the specified temperature range (T_{op}). The peak inrush current shall be less than the ratings of its critical components (including input fuse, bulk rectifiers, and surge limiting device).

STATUS
Recommended

An additional inrush current limit is recommended for some system applications that require multiple systems on a single AC circuit. AC line inrush current shall not exceed 50 A peak for one-quarter of the AC cycle, after which, the input current should be no more than the specified maximum input current from Table 13.

5.6 AC Line Transient Specification

STATUS
Recommended

AC line transient conditions shall be defined as “sag” and “surge” conditions. Sag conditions (also referred to as “brownout” conditions) will be defined as the AC line voltage dropping below nominal voltage. Surge will be defined as the AC line voltage rising above nominal voltage.

The power supply shall meet the requirements under the following AC line sag and surge conditions.

Table 14: AC Line Sag Transient Performance

AC Line Sag				
Duration	Sag	Operating AC Voltage	Line Frequency	Performance Criteria
Continuous	10%	Nominal AC Voltage ranges	50/60 Hz	No loss of function or performance
0 to 1 AC cycle	100%	Nominal AC Voltage ranges	50/60 Hz	No loss of function or performance
>1 AC cycle	>10%	Nominal AC Voltage ranges	50/60 Hz	Loss of function acceptable, self recoverable

Table 15: AC Line Surge Transient Performance

AC Line Surge				
Duration	Surge	Operating AC Voltage	Line Frequency	Performance Criteria
Continuous	10%	Nominal AC Voltages	50/60 Hz	No loss of function or performance
0 to ½ AC cycle	30%	Mid-point of nominal AC Voltages	50/60 Hz	No loss of function or performance

5.7 AC Line Fast Transient Specification

STATUS
Recommended

The power supply shall meet the *EN61000-4-5* directive and any additional requirements in *IEC1000-4-5:1995* and the Level 3 requirements for surge-withstand capability, with the following conditions and exceptions:

- These input transients must not cause any out-of-regulation conditions, such as overshoot and undershoot, nor must it cause any nuisance trips of any of the power supply protection circuits.
- The surge-withstand test must not produce damage to the power supply.
- The supply must meet surge-withstand test conditions under maximum and minimum DC-output load conditions.

6 DC Output Specification

6.1 Grounding

STATUS
Required

The ground of the pins of the power supply wire harness provides the power return path. The wire harness ground pins shall be connected to safety ground (power supply enclosure).

6.2 Remote Sense

STATUS
Optional

The power supply may have remote sense for the +3.3V (3.3VS) and return (ReturnS) if the Optional Server Signal connector is implemented. The remote sense return (ReturnS) is used to regulate out ground drops for all output voltages; +3.3V, +5 V, +12V1, +12V2, +12V3, -12 V, and 5 VSB. The 3.3V remote sense (3.3VS) is used to regulate out drops in the system for the +3.3 V output. The remote sense input impedance to the power supply must be greater than 200 W on 3.3 VS and ReturnS. This is the value of the resistor connecting the remote sense to the output voltage internal to the power supply. Remote sense must be able to regulate out a minimum of 200 mV drop on the +3.3 V output. The remote sense return (ReturnS) must be able to regulate out a minimum of 200 mV drop in the power ground return. The current in any remote sense line shall be less than 5 mA to prevent voltage sensing errors. The power supply must operate within specification over the full range of voltage drops from the power supply's output connector to the remote sense points.

6.2.1 Standby Outputs

STATUS
Required

The 5 VSB output shall be present when an AC input greater than the power supply turn on voltage is applied.

6.3 Efficiency

STATUS
Recommended

6.3.1 ON State

The following table provides recommended efficiency levels. These are provided at three different load levels; 100%, 50% and 20%.

Efficiency shall be tested at AC input voltages of 115VAC for non-redundant power supplies (EPS12V, EPS1U, and EPS2U) and 230VAC for redundant power supply modules (ERP1U, ERP2U, and ERP12V). Refer to www.efficientpowersupplies.org for details on proper efficiency testing methods.

Redundant power supplies shall be tested with only the module, not the power distribution board (PDB). Efficiency shall be measured at the AC input to the module output connector.

Table 16: On State Efficiency

Loading of power sub-system	VAC	100% of maximum	50% of maximum	20% of maximum	10% of maximum
EPS12V, EPS1U, EPS2U	115VAC	82%	85%	82%	NA
ERP12V, ERP1U, ERP2U ¹	230VAC	85%	89%	85%	77%

1 Redundant power supplies are tested with only the module; no PDB.

6.3.2 Standby State

When the power supply is in standby mode; only the 5VSB output is powered on, the power supply should meet the following requirements for meet Energy Star* and to help reduce power in server systems.

Table 17: Standby State Efficiency

Load	Efficiency
100mA	≥ 50%
250mA	≥ 60%
≥ 1A	≥ 70%

6.4 Voltage Regulation

STATUS
Required

The power supply output voltages must stay within the following voltage limits when operating at steady state and dynamic loading conditions. These limits include the peak-peak ripple/noise specified in Section 6.7. All outputs are measured with reference to the return remote sense (ReturnS) signal. The 5 V, 12V, -12 V and 5 VSB outputs are measured at the power supply connectors referenced to ReturnS. The +3.3 V is measured at it remote sense signal (3.3VS) located at the signal connector if this connector is available.

Table 18: Voltage Regulation Limits

Parameter	MIN	NOM	MAX	Units	Tolerance
+3.3 V	+3.14	+3.30	+3.47	V _{rm}	+/-5%
+5 V	+4.75	+5.00	+5.25	V _{rms}	+/-5%
+12V	+11.40	+12.00	+12.60	V _{rms}	+/-5%
-12 V	-10.80	-12.20	-13.20	V _{rms}	+/-10%
+5 VSB	+4.75	+5.00	+5.25	V _{rms}	+5/-5%

STATUS
Optional

Some system applications may require tighter regulation limits on the outputs. The optional regulation limits are shown below.

Table 19: Optional Regulation Limits

Parameter	MIN	NOM	MAX	Units	Tolerance
+3.3V	+3.20	+3.30	+3.47	V _{rms}	+5/-3%
+5 V	+4.85	+5.00	+5.25	V _{rms}	+5/-3%
+12V1,2,3,4,5	+11.64	+12.00	+12.60	V _{rms}	+5/-3%
-12V	-11.40	-12.00	-13.08	V _{rms}	+9/-5%
+5 VSB	+4.85	+5.00	+5.25	V _{rms}	+5/-3%

6.5 Dynamic Loading

STATUS
Required

The output voltages shall remain within the limits specified in Table 18 for the step loading and within the limits specified in Table 20 for the capacitive loading specified in below. The load transient repetition rate shall be tested between 50 Hz and 5 kHz at duty cycles ranging from 10%-90%. The load transient repetition rate is only a test specification. The Δ step load may occur anywhere within the MIN load to the MAX load range.

Table 20: Transient Load Requirements

Output	Δ Step Load Size	Load Slew Rate	Capacitive Load
+3.3 V	30% of max load	0.5 A/ μ s	1000 μ F
+5 V	30% of max load	0.5 A/ μ s	1000 μ F
12V1+12V2+12V3+12V4+12V5	65% of max load	0.5 A/ μ s	2200 μ F
+5 VSB	25% of max load	0.5 A/ μ s	1 μ F

6.6 Capacitive Loading

STATUS
Required

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

Table 21: Capacitive Loading Conditions

Output	MIN	MAX	Units
+3.3 V	10	12,000	μ F
+5 V	10	12,000	μ F
+12 V	10	11,000	μ F
-12 V	1	350	μ F
+5 VSB	1	350	μ F

6.7 Ripple / Noise

STATUS
Required

The maximum allowed ripple/noise output of the power supply is defined in Table 22. This is measured over a bandwidth of 0 Hz to 20 MHz at the power supply output connectors. A 10 μ F tantalum capacitor in parallel with a 0.1 μ F ceramic capacitor are placed at the point of measurement.

Table 22: Ripple and Noise

+3.3 V	+5 V	+12 V	-12 V	+5 VSB
50 mVp-p	50 mVp-p	120 mVp-p	120 mVp-p	50 mVp-p

6.8 Timing Requirements

STATUS
Required

These are the timing requirements for the power supply operation.

The output voltages must rise from 10% to within regulation limits (T_{vout_rise}) within 5 to 70 ms; except for 5VSB which is required to rise from 10% to regulation limits within 1 to 25ms.

There must be a smooth and continuous ramp of each DC output voltage from 10% to 90% of its final set point within the regulation band, while loaded as specified. All outputs must rise monotonically. The smooth turn-on requires that, during the 10% to 90% portion of the rise time, the slope of the turn-on waveform must be positive and have a value of between 0 V/ms and $[V_{out, nominal} / 0.1]$ V/ms.

For the 5VSB output, any 5 ms segment of the 10% to 90% rise time waveform, a straight line drawn between the end points of the waveform segment must have a slope $\geq [V_{out, nominal} / 20]$ V/ms. The main outputs are not required to meet this minimum slope requirement.

Each output voltage shall reach regulation within 50 ms (T_{vout_on}) of each other during turn on of the power supply. Each output voltage shall fall out of regulation within 400 ms (T_{vout_off}) of each other during turn off. Figure 1 and Figure 2 show the turn ON and turn OFF timing requirements. In Figure 2 the timing is shown with both AC and PSON# controlling the ON/OFF of the power supply.

Table 23 Output Voltage Timing

Item	Description	MIN	MAX	Units
T_{vout_rise}	Output voltage rise time from each main output.	5	70	ms
	Output voltage rise time for the 5VSB output.	1	25	ms
T_{vout_on}	All main outputs must be within regulation of each other within this time.		50	ms
T_{vout_off}	All main outputs must leave regulation within this time.		400	ms

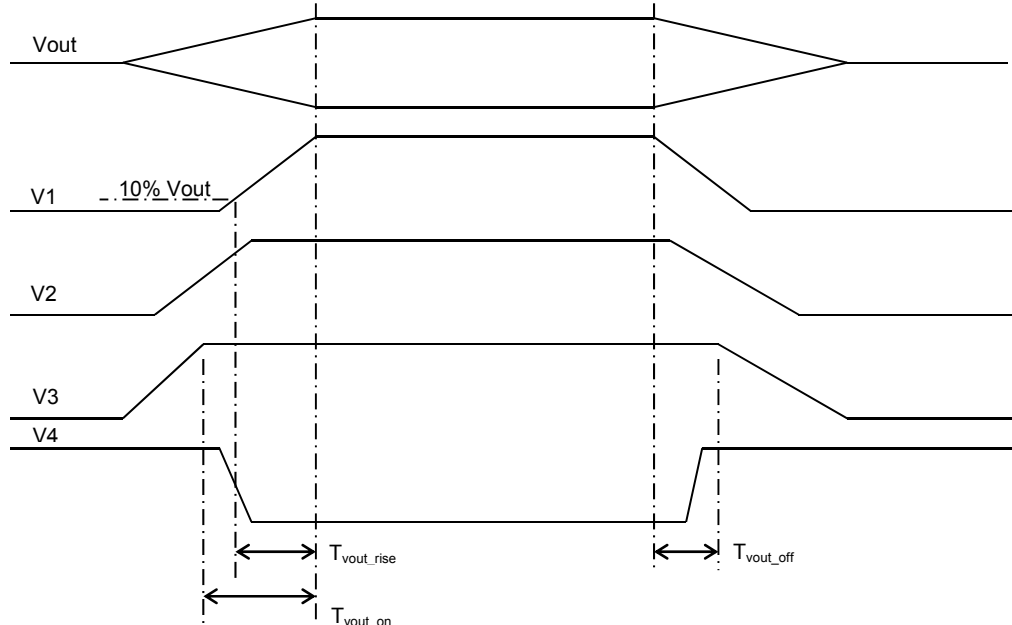


Figure 1: Output Voltage Timing

Table 24: Turn On/Off Timing

Item	Description	MIN	MAX	UNITS
$T_{sb_on_delay}$	Delay from AC being applied to 5 VSB being within regulation.		1500	ms
$T_{ac_on_delay}$	Delay from AC being applied to all output voltages being within regulation.		2500	ms
T_{vout_holdup}	Time all output voltages stay within regulation after loss of AC. Tested at 75% of maximum load and over 100-240VAC input.	18		ms
T_{pwok_holdup}	Delay from loss of AC to deassertion of PWOK. Tested at 75% of maximum load and over 100-240VAC input.	17		ms
$T_{pson_on_delay}$	Delay from PSON# active to output voltages within regulation limits.	5	400	ms
T_{pson_pwok}	Delay from PSON# deactive to PWOK being deasserted.		50	ms
T_{pwok_on}	Delay from output voltages within regulation limits to PWOK asserted at turn on.	100	500	ms
T_{pwok_off}	Delay from PWOK deasserted to output voltages (3.3 V, 5 V, 12 V, -12 V) dropping out of regulation limits.	1		ms
T_{pwok_low}	Duration of PWOK being in the deasserted state during an off/on cycle using AC or the PSON# signal.	100		ms

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T _{sb_vout}	Delay from 5 VSB being in regulation to O/Ps being in regulation at AC turn on.	50	1000	ms
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STATUS
Recommended

Item	Description	MIN	MAX	UNITS
T_{vout_holdup}	Time all output voltages stay within regulation after loss of AC.	21		ms
T_{pwok_holdup}	Delay from loss of AC to deassertion of PWOK.	20		ms
T_{sb_holdup}	Time 5VSB output voltage stays within regulation after loss of AC.	70		ms

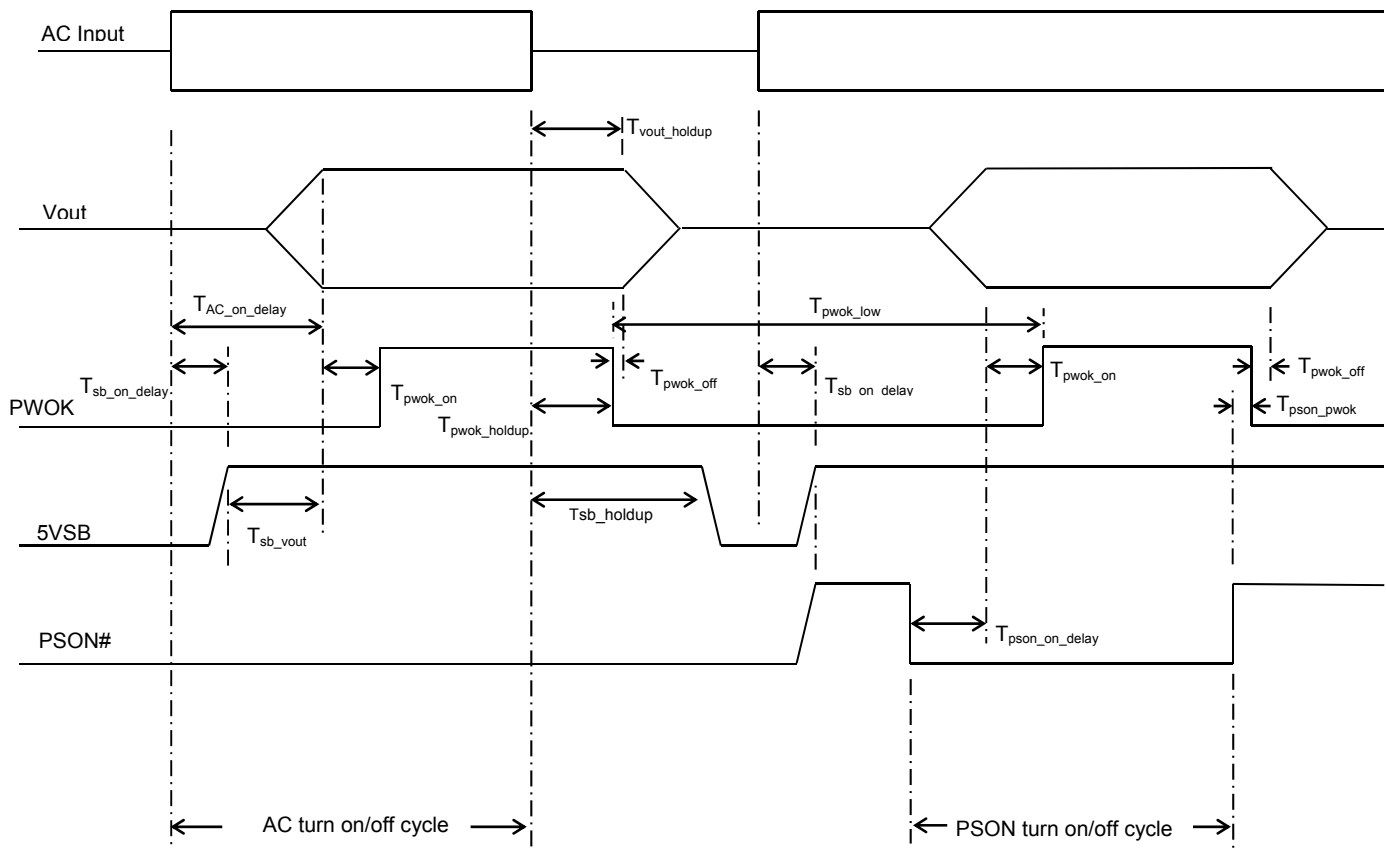


Figure 2: Turn On/Off Timing (Single Power Supply)

7 Protection Circuits

STATUS
Required

Protection circuits inside the power supply shall cause only the power supply's main outputs to shutdown. If the power supply latches off due to a protection circuit tripping, an AC cycle OFF for 15 s and a PSON[#] cycle HIGH for 1 second must be able to reset the power supply.

7.1 Current Limit

STATUS
Required

The power supply shall have current limit to prevent the +3.3 V, +5 V, and +12 V outputs from exceeding the values shown in Table 25. If the current limits are exceeded the power supply shall shutdown and latch off. The latch will be cleared by toggling the PSON[#] signal or by an AC power interruption. The power supply shall not be damaged from repeated power cycling in this condition. -12 V and 5 VSB shall be protected under over current or shorted conditions so that no damage can occur to the power supply. All outputs shall be protected so that no damage occurs to the power supply under a shorted output condition.

Table 25: Over Current Protection

Voltage	Over Current Limit (I _{out} limit)
+3.3 V	110% minimum; 150% maximum
+5 V	110% minimum; 150% maximum
+12V	110% minimum; 150% maximum

Note: If the power supply supports 240VA protection, section 7.2 should be used instead to determine over current protection requirements.

7.2 240VA Protection

STATUS
Recommended

System designs may require user access to energized areas of the system. In these cases the power supply may be required to meet regulatory 240VA energy limits for any power rail. Since the +12V rail combined power exceeds 240VA it must be divided into separate channels to meet this requirement. Each separate rail needs to be limited to less than 20A for each +12V rail. The separate +12V rails do not necessarily need to be independently regulated outputs. They can share a common power conversion stage. The +12V rail is split into four rails. Refer to section 11.5 for how the 12V rail is split between different output connectors.

Table 26: Over Current Limits

Voltage	Over Current Limit (I _{out} limit)
+3.3 V	110% minimum; 150% maximum
+5 V	110% minimum; 150% maximum
+12V	Peak current minimum; 20A maximum

7.3 Over Voltage Protection

STATUS
Required

The power supply over voltage protection shall be locally sensed. The power supply shall shutdown and latch off after an over voltage condition occurs. This latch shall be cleared by toggling the PSON[#] signal or by an AC power interruption. Table 27 contains the over voltage limits. The values are measured at the output of the power supply's connectors. The voltage shall never exceed the maximum levels when measured at the power pins of the power supply connector during any single point of fail. The voltage shall never trip any lower than the minimum levels when measured at the power pins of the power supply connector.

Table 27: Over Voltage Limits

Output Voltage	MIN (V)	MAX (V)
+3.3 V	3.9	4.5
+5 V	5.7	6.5
+12V1,2,3,4,5	13.3	14.5
-12 V	-13.3	-14.5
+5 VSB	5.7	6.5

7.4 Over Temperature Protection

STATUS
Recommended

The power supply will be protected against over temperature conditions caused by loss of fan cooling or excessive ambient temperature. In an OTP condition the PSU will shutdown. When the power supply temperature drops to within specified limits, the power supply shall restore power automatically. The OTP circuit must have built in hysteresis such that the power supply will not oscillate on and off due to temperature recovering condition. The OTP trip level shall have a minimum of 4 °C of ambient temperature hysteresis.

8 Control and Indicator Functions

The following sections define the input and output signals from the power supply.

Signals that can be defined as low true use the following convention:

signal[#] = low true

8.1 PSON#

STATUS
Required

The PSON# signal is required to remotely turn on/off the power supply. PSON# is an active low signal that turns on the +3.3 V, +5 V, +12 V, and -12 V power rails. When this signal is not pulled low by the system, or left open, the outputs (except the +5 VSB) turn off. This signal is pulled to a standby voltage by a pull-up resistor internal to the power supply. Refer to Figure 2 for timing diagram.

Table 28: PSON# Signal Characteristic

Signal Type	Accepts an open collector/drain input from the system. Pull-up to VSB located in power supply.	
PSON# = Low	ON	
PSON# = Open or High	OFF	
	MIN	MAX
Logic level low (power supply ON)	0 V	1.0 V
Logic level high (power supply OFF)	2.0 V	5.25 V
Source current, V_{pson} = low		4 mA
Power up delay: T_{pson on delay}	5 ms	400 ms
PWOK delay: T_{pson pwok}		50 ms

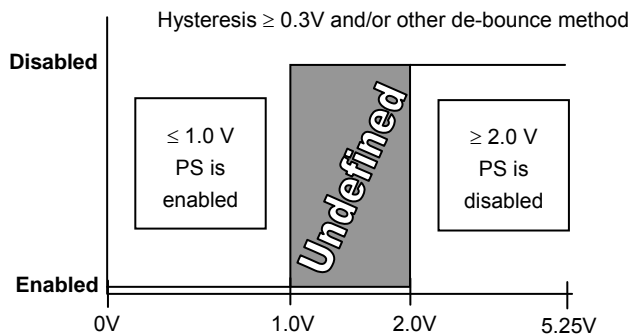


Figure 3: PSON# Signal Characteristics

8.2 PWOK (Power OK)

STATUS
Required

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PWOK is a power OK signal and will be pulled HIGH by the power supply to indicate that all the outputs are within the regulation limits of the power supply. When any output voltage falls below regulation limits or when AC power has been removed for a time sufficiently long so that power supply operation is no longer guaranteed, PWOK will be deasserted to a LOW state. See Figure 2 for a representation of the timing characteristics of PWOK. The start of the PWOK delay time shall be inhibited as long as any power supply output is in current limit.

Table 29: PWOK Signal Characteristics

Signal Type	+5V TTL Compatible output signal	
PWOK = High	Power OK	
PWOK = Low	Power Not OK	
	MIN	MAX
Logic level low voltage, Isink = 4 mA	0 V	0.4 V
Logic level high voltage, Isource=200 μA	2.4 V	5.25 V
PWOK delay: T_{pwok on}	100 ms	500 ms
PWOK rise and fall time		100 μ s
Power down delay: T_{pwok off}	1 ms	

8.3 SMBus Communication

STATUS
Optional

The serial bus communication devices for PMBus* and FRU data in the power supply shall be compatible with both SMBus 2.0 'high power' and I²C V_{dd} based power and drive. This bus shall operate at 3.3V but tolerant of 5V signaling. The SMBus pull-ups are located on the motherboard and may be connected to 3.3V or 5V. No pull-ups shall be located in the power supply.

Two pins are allocated on the power supply. One pin is the Serial Clock (PSM Clock). The second pin is used for Serial Data (PSM Data). Both pins are bi-directional and are used to form a serial bus. The circuits inside the power supply shall derive their power from the 5VSB bus. No pull-up resistors shall be on SCL or SDA inside the power supply. These pull-up resistors should be located external to the power supply.

8.4 PMBus* Interface

STATUS
Optional

The PMBus* device in the power supply shall derive its power off of the 5VSB output and grounded to ReturnS. Refer to the PMBus* AC/DC Power Supply Application Profile for details.

Note: As of October 2007 the PMBus* AC/DC Power Supply Application Profile is still in development by the working group. Target completion is December 2007.

8.5 Field Replacement Unit (FRU) Signals

STATUS
Optional

The FRU circuits inside the power supply must be powered off of 5 VSB output and grounded to ReturnS (remote sense return). The Write Control (or Write protect) pin should be tied to ReturnS inside the power supply so that information can be written to the EEPROM.

8.5.1 FRU Data

FRU data shall be stored starting in address location 8000h through 80FFh. The FRU data format shall be compliant with the IPMI specifications. The current versions of these specifications are available at: <http://developer.intel.com/design/servers/ipmi/spec.htm>.

8.5.2 FRU Data Format

Table 30: FRU Device Information

Area Type	Description
Common Header	As defined by the FRU document
Internal Use Area	Not required, do not reserve
Chassis Info Area	Not applicable, do not reserve
Board Info Area	Not applicable, do not reserve

8.5.2.1 Product Info Area

Implement as defined by the IPMI FRU document. Product information shall be defined as follows:

Table 31: FRU Device Product Information Area

Field Name	Field Description
Manufacturer Name	{Formal name of manufacturer}
Product Name	{Manufacturer's model number}
Product part/model number	Customer part number
Product Version	Customer current revision
Product Serial Number	{Defined at time of manufacture}
Asset Tag	{Not used, code is zero length byte}
FRU File ID	{Not required}
PAD Bytes	{Added as necessary to allow for 8-byte offset to next area}

8.5.2.2 MultiRecord Area

Implement as defined by the IPMI FRU document. The following record types shall be used on this power supply:

- Power Supply Information (Record Type 0x00)
- DC Output (Record Type 0x01)
- No other record types are required for the power supply.

MultiRecord information shall be defined as follows:

Table 32: MultiRecord information Area

Field Name (PS Info)	Field Information Definition
Overall Capacity (watts)	550 {Low power version would be 450}
Peak VA	610 {Low power version would be 490}
Inrush current (A)	50
Inrush interval (ms)	5
Low end input voltage range 1	90
High end input voltage range 1	140
Low end input voltage range 2	180
High end input voltage range 2	264
A/C dropout tol. (ms)	20
Binary flags	Set for: Hot Swap support, Autoswitch, and PFC
Peak Wattage	Set for: 10 s, 610 W {Low power version would be 490 W}
Combined wattage	Set for 5 V & 3.3V combined wattage of 115 W {Low power version would be 115 W}
Predictive fail tach support	Not supported, 00h value
Field Name (Output)	Field Description
Five outputs are to be defined from #1 to #5, as follows: +3.3 V, +5 V, +12 V, -12V, and +5 VSB.	
Output Information	Set for: Standby on +5 VSB, No Standby on all others.
All other output fields	Format per IPMI specification, using parameters in the EPS12V specification.

9 MTBF

STATUS
Recommended

The power supply shall have a minimum MTBF at continuous operation of 1) 50,000 hours at 100% load and 50 °C, as calculated by Bellcore RPP, or 2) 100,000 hours demonstrated at 100% load and 50 °C.

10 Agency Requirements

STATUS
Recommended

The power supply must comply with all regulatory requirements for its intended geographical market. Depending on the chosen market, regulatory requirements may vary. Although a power supply can be designed for worldwide compliance, there may be cost factors that drive different versions of supplies for different geographically targeted markets.

This specification requires that the power supply meet all regulatory requirements for the intended market at the time of manufacturing. Typically this includes:

- UL
- CSA
- A Nordic CENELEC
- TUV
- VDE
- CISPR Class B
- FCC Class B

The power supply, when installed in the system, shall meet immunity requirements specified in EN55024. Specific tests are to be EN61000-4-2, -3, -4, -5, -6, -8, -11, EN61000-3-2, -3, and JEIDI MITI standard. The power supply must maintain normal performance within specified limits. This testing must be completed by the system EMI engineer. Conformance must be designated with the European Union CE Marking. Specific immunity level requirements are left to customer requirements.

11 EPS12V & ERP12V Specific Guidelines

11.1 EPS12V Form Factor for Pedestal Servers and Workstations

STATUS
Required

Three enclosure size options are defined to accommodate various power levels. Recommended power levels for each enclosure length are shown below. Refer to Figure 4 for details. The two rear mounting tabs on the enclosure are OPTIONAL and may not be required for many systems.

Length	Recommended power levels
140mm	< 450W
180mm	450W to 750W
230mm	> 800W

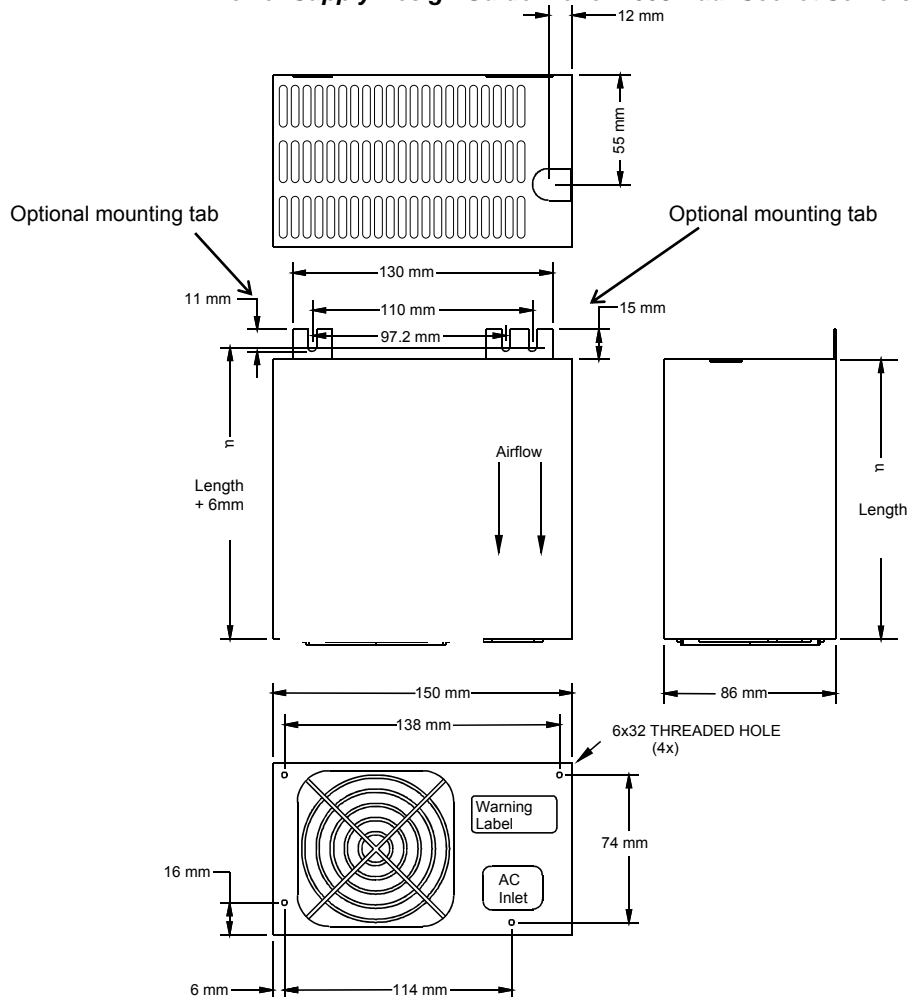
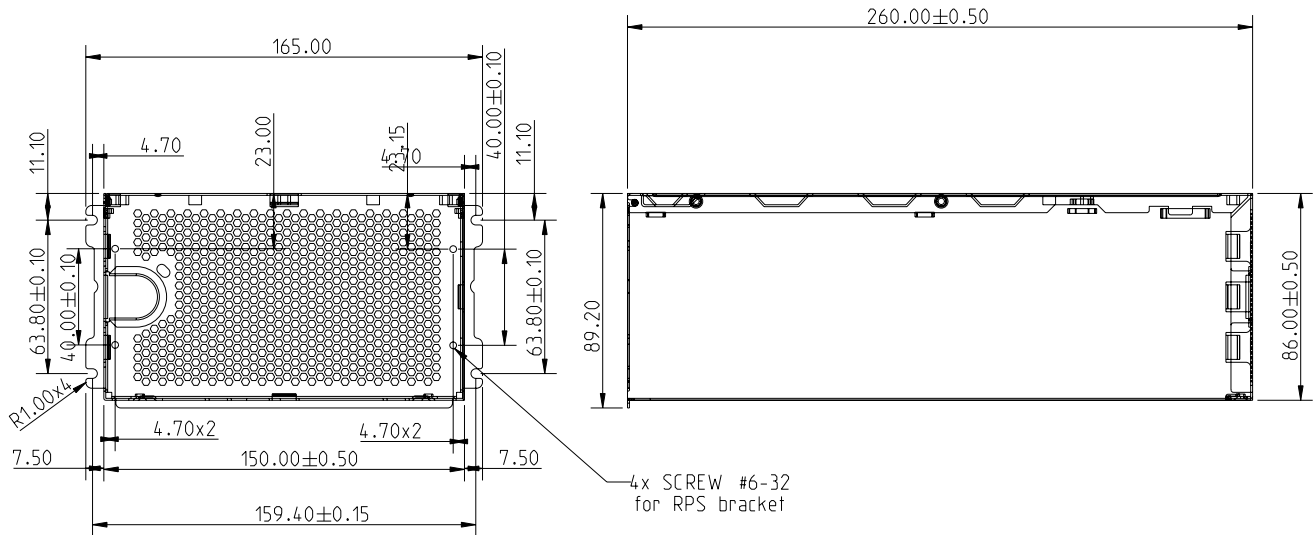


Figure 4: Enclosure Drawing

11.2 ERP12V Form Factor for Pedestal Redundant Servers

The ERP12V is a power sub-system made up of a cage and redundant, hot swappable power supply modules. A mechanical drawing of the cage is shown below. The cage is intended to be mounted in the system and not redundant or hot swappable. The exterior face of the cage accepts hot swappable power supply modules. The distribution board within the cage distributes output power from the modules to a wire harness. Cooling fans, EMI filtering, and IEC inlet connector(s) may be located in the modules or cage.



11.3 Acoustic Requirements

STATUS
Recommended

It is recommended the power supply have a variable speed fan based on temperature and loading conditions. There are three different acoustic sound power levels defined at different ambient temperatures and loading conditions.

Table 33 Recommended Acoustic Sound Power Levels

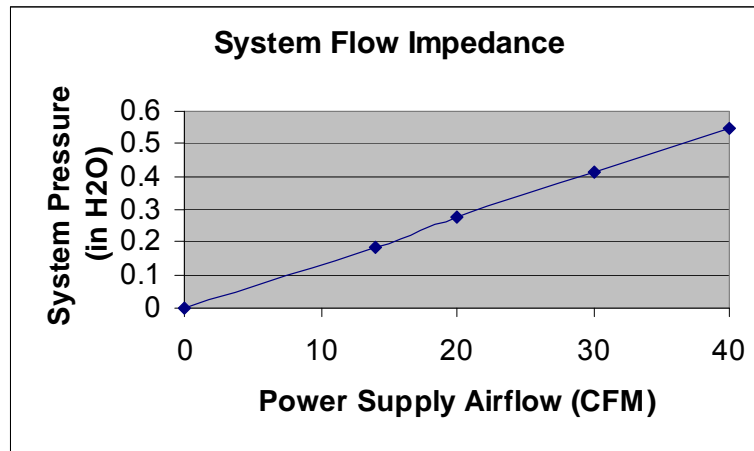
	Idle	Typical	Max
Ambient Temperature	35°C	40°C	45°C
% Loading	40%	60%	100%
Sound Power (BA)	4.0	4.7	6.0

11.4 Airflow Requirements

STATUS
Recommended

It is recommended the power supply have no less than 14 CFM of airflow to provide proper airflow to system components. The air shall exit the power supply on the AC inlet face. The power supply shall meet all requirements with the below system airflow impedance presented to the power supplies airflow path.

Figure 5 System Airflow Impedance



11.5 Output Power/Currents

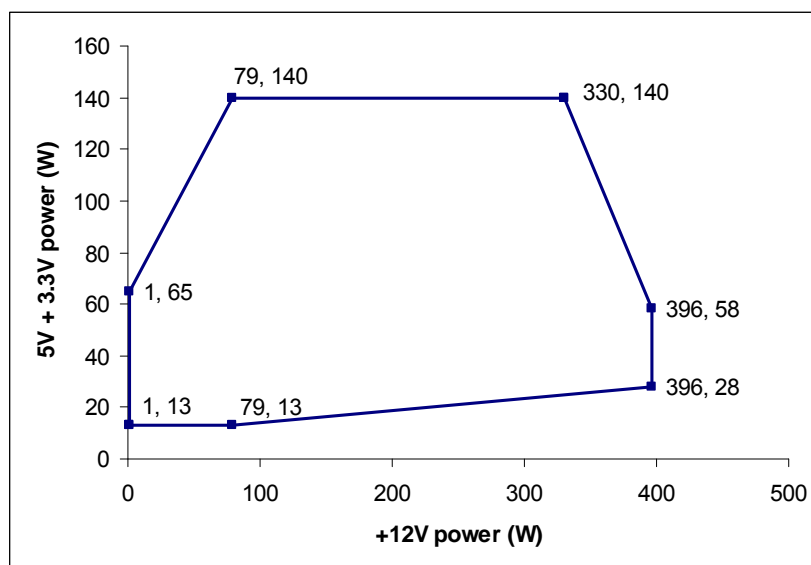
The following tables define power and current ratings for the EPS12V power supply. These cover server and workstation configurations.

The combined output power of all outputs shall not exceed the rated output power. Load ranges are provided for each output level. The power supply must meet both static and dynamic voltage regulation requirements for the minimum loading conditions.

Table 34: 450 W Server Load Ratings

Voltage	Minimum Continuous	Maximum Continuous	Peak
+3.3 V	1.5 A	24 A	
+5 V	1.0 A	24 A	
+12V1	0 A	16 A	18 A
+12V2	0 A	16 A	18 A
+12V3	0 A	18 A	
+12V4	0.1 A	18 A	
-12 V	0 A	0.5 A	
+5 VSB	0.1 A	3.0 A	3.5 A

1. Maximum continuous total DC output power should not exceed 450 W.
2. Maximum continuous combined load on +3.3 VDC and +5 VDC outputs shall not exceed 140 W.
3. Maximum peak total DC output power should not exceed 560 W.
4. Peak power and current loading shall be supported for a minimum of 12 second.
5. Maximum combined current for the 12 V outputs shall be 33 A.
6. Peak current for the combined 12 V outputs shall be 42 A.

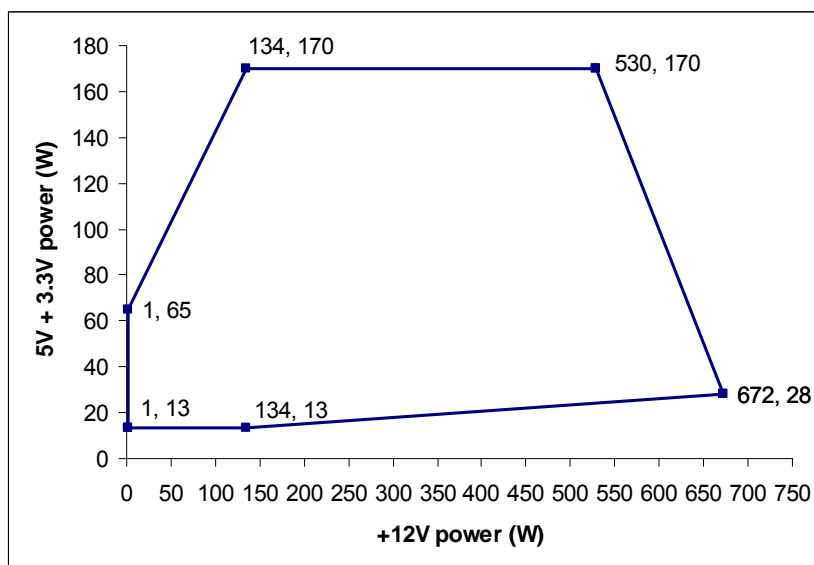


Power Supply Design Guideline for 2008 Dual-Socket Servers and Workstations, V1.2.1
Table 35: 700 W Server and Workstation Load Ratings

Voltage	Minimum Continuous	Maximum Continuous	Peak
+3.3 V	1.5 A	24 A	
+5 V	1.0 A	30 A	
+12V1	0.8 A	16 A	18 A
+12V2	0.8 A	16 A	18 A
+12V3	0.5 A	16 A	18 A
+12V4	1.0 A	16 A	18 A
-12 V	0 A	0.5 A	
+5 VSB	0.1 A	3.0 A / 4.0 A ⁷	3.5 A / 4.5 A ⁷

1. Maximum continuous total DC output power should not exceed 700 W.
2. Maximum continuous combined load on +3.3 VDC and +5 VDC outputs shall not exceed 170 W.
3. Maximum peak total DC output power should not exceed 780 W.
4. Peak power and current loading shall be supported for a minimum of 12 second.
5. Maximum combined current for the 12 V outputs shall be 56 A.
6. Peak current for the combined 12 V outputs shall be 62 A.
7. 4.0 A / 4.5 A peak of +5 VSB is required only for power supplies in systems supporting ACPI S3 power state; suspend to memory. ACPI S3 is used to support workstation's suspend to memory power state.

Figure 6 Cross Loading Graph for 700W Configuration

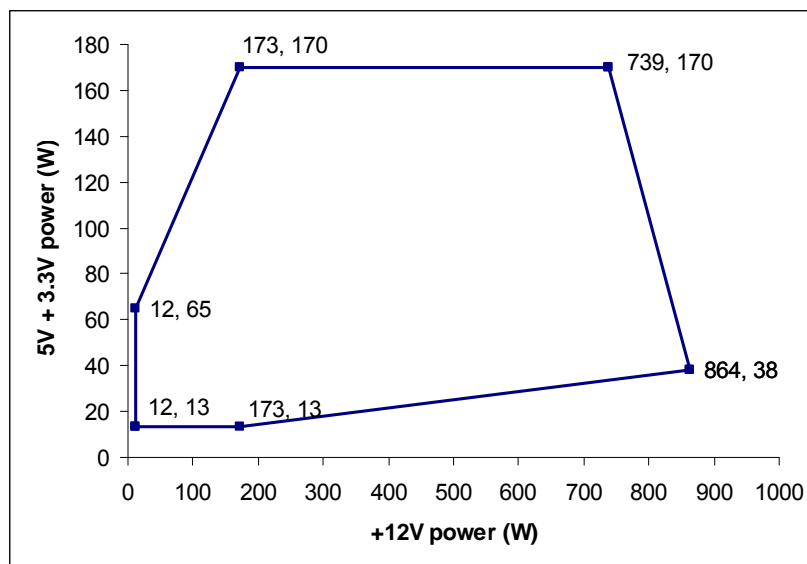


Power Supply Design Guideline for 2008 Dual-Socket Servers and Workstations, V1.2.1
Table 36: 900 W Performance Server and Workstation Load Ratings

Voltage	Minimum Continuous	Maximum Continuous	Peak
+3.3 V	0.8 A	24 A	
+5 V	0.5 A	30 A	
+12V1	0 A	16 A	18 A
+12V2	0 A	16 A	18 A
+12V3	0.9 A	16 A	18 A
+12V4	0.1 A	18 A	22 A ⁷
+12V5	0 A	18 A	
-12 V	0 A	0.5 A	
+5 VSB	0.1 A	3.0 A / 5.0 A ⁸	3.5 A / 5.5 A ⁸

1. Maximum continuous total DC output power should not exceed 900 W.
2. Maximum continuous combined load on +3.3 VDC and +5 VDC outputs shall not exceed 170 W.
3. Maximum peak total DC output power should not exceed 980 W.
4. Peak power and current loading shall be supported for a minimum of 12 second.
5. Maximum combined current for the 12 V outputs shall be 72 A.
6. Peak current for the combined 12 V outputs shall be 78 A.
7. Peak power on the +12V4 rail shall be sustained for a minimum of 500msec.
8. 5.0 A / 5.5 A peak of +5 VSB is required only for power supplies in systems supporting ACPI S3 power state; suspend to memory. ACPI S3 is used to support workstation's suspend to memory power state. Servers do not typically support suspend to memory power state.

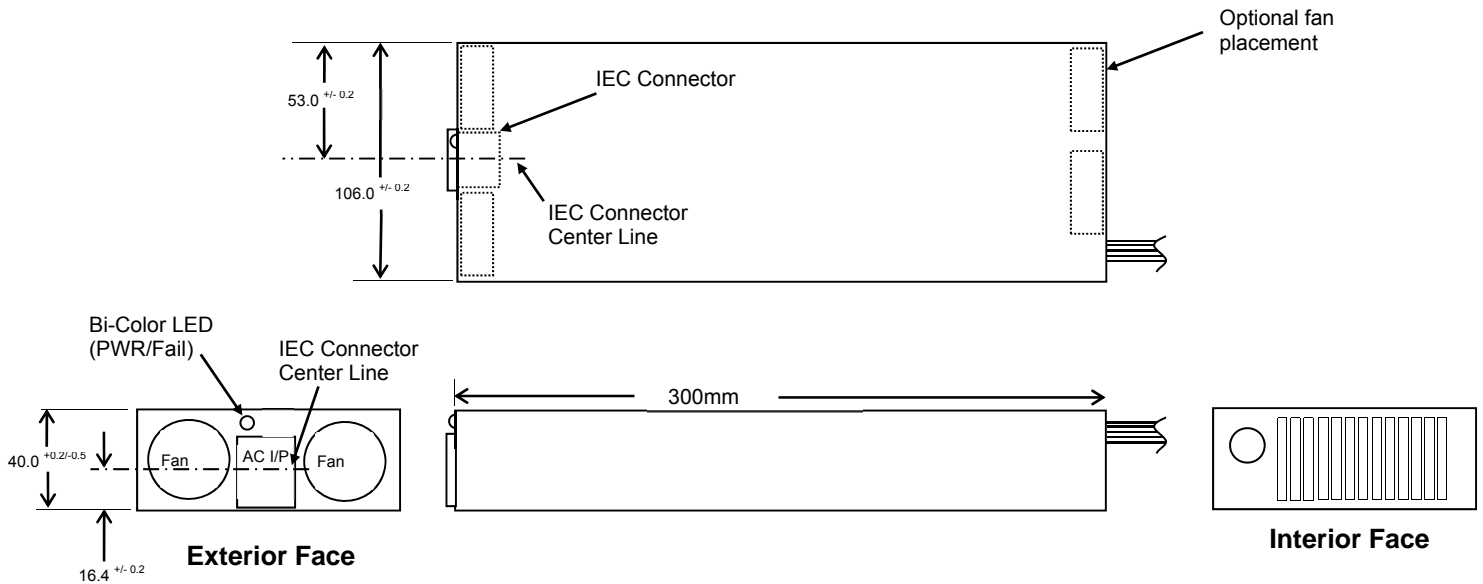
Figure 7 Cross Loading Graph for 900W Configuration



12 EPS1U & ERP1U Specific Guidelines

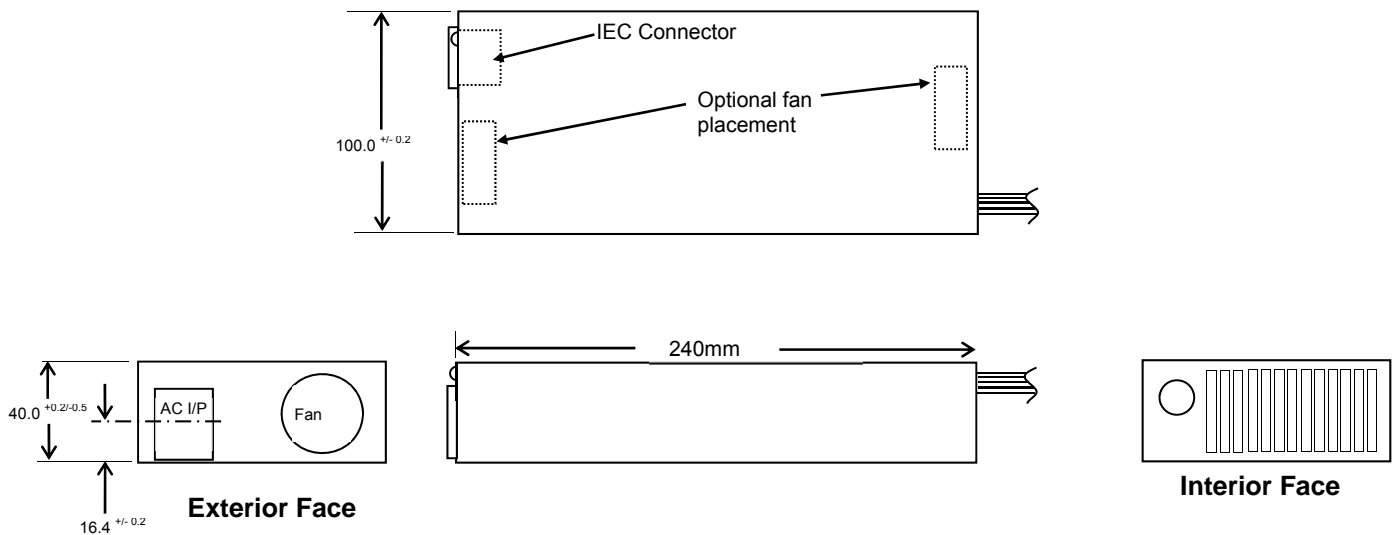
STATUS
Required

The enclosure of the entry 1U power supply is designed for use in 1U rack mounted systems.



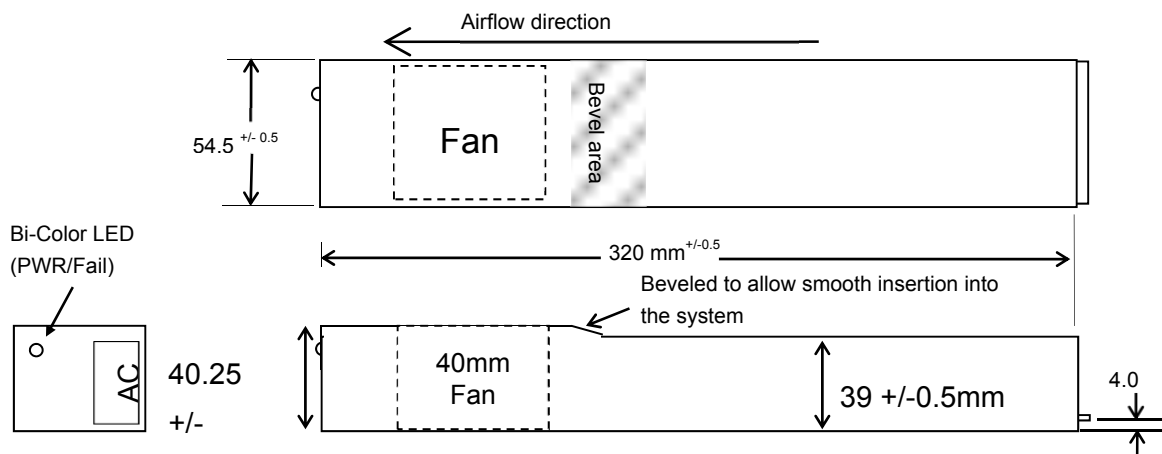
12.1 High Density EPS1U power supply (EPS1U-HD)

The EPS1U High Density form factor is defines for system requiring a smaller form factor in a non-redundant power supply.



12.2 Redundant 1U power supply (ERP1U)

The ERP1U power supply form factor is intended to be used in 1U rack mount system that require hot swap redundant 1+1 power supplies. Only the model is defined here. The cage needs to be incorporated into the system chassis due to space limitations.



12.3 Acoustic Requirements

STATUS
Recommended

It is recommended the power supply have a variable speed fan based on temperature and loading conditions. There are three different acoustic sound power levels defined at different ambient temperatures and loading conditions.

Table 37 Recommended Acoustic Sound Power Levels

	Idle	Typical	Max
Ambient Temperature	28°C	28°C	45°C
% Loading	40%	60%	100%
Sound Power (BA)	5.4	5.6	6.5

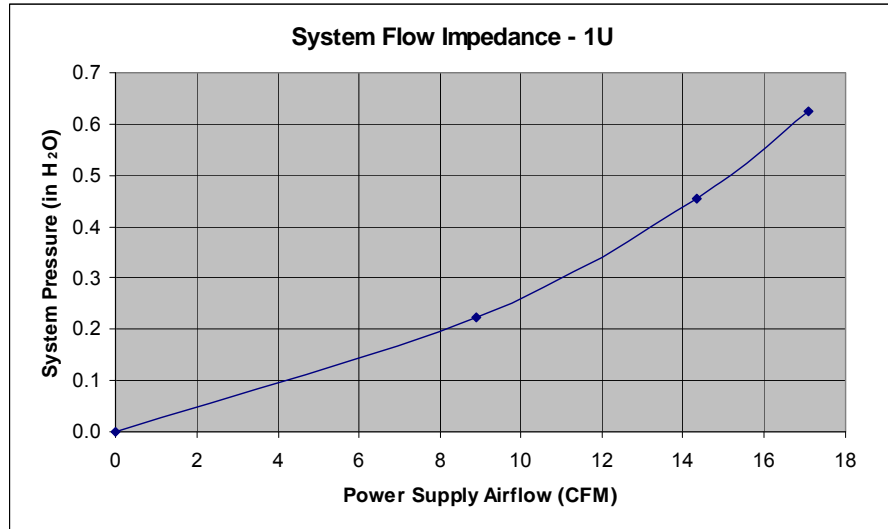
12.4 Airflow Requirements

STATUS
Recommended

Power Supply Design Guideline for 2008 Dual-Socket Servers and Workstations, V1.2.1

The air shall exit the power supply on the AC inlet face. The power supply shall meet all requirements with the below system airflow impedance presented to the power supplies airflow path.

Figure 8 System Airflow Impedance



12.5 Output Power/Currents

STATUS
Recommendations

The following tables define power and current ratings for 1U rack mount power supplies. These output levels were selected to cover different types of systems and configurations. The combined output power of all outputs shall not exceed the rated output power. The tables show the load ranges for each of the power supply power levels. The power supply must meet both static and dynamic voltage regulation requirements for the minimum loading conditions.

Table 38: 450 W 1U Server Load Ratings

Voltage	Minimum Continuous	Maximum Continuous	Peak
+3.3 V	1.5 A	16 A	
+5 V	1.0 A	12 A	
+12 V1	0.5 A	16 A	18 A
+12 V2	0.5 A	16 A	18 A
+12 V3	1.0 A	15 A	18 A
+12 V4	1.0 A	15 A	18 A
-12 V	0 A	0.5 A	
+5 VSB	0.1 A	2.0 A	

1. Maximum continuous total DC output power should not exceed 450 W.
2. Peak load on the combined 12 V output shall not exceed 40 A.
3. Maximum continuous load on the combined 12 V output shall not exceed 35 A.
4. Peak total DC output power should not exceed 500 W.
5. Peak power and current loading shall be supported for a minimum of 12 seconds.
6. Combined 3.3V and 5V power shall not exceed 100W.

Figure 9 Cross loading graph for 450W configuration

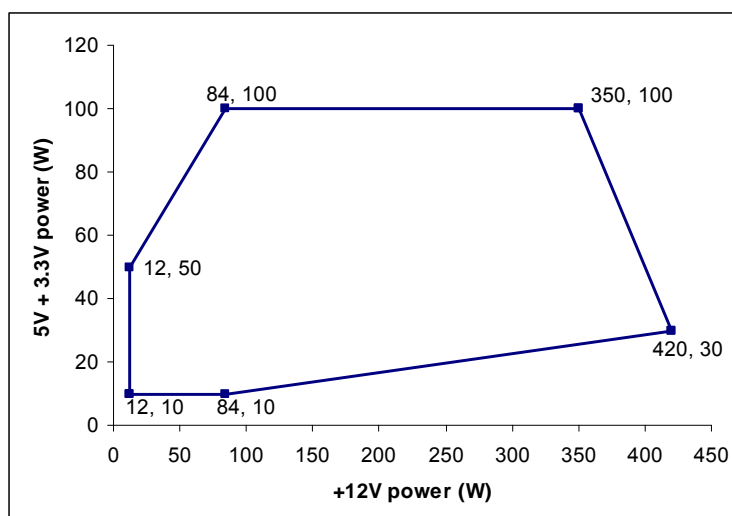
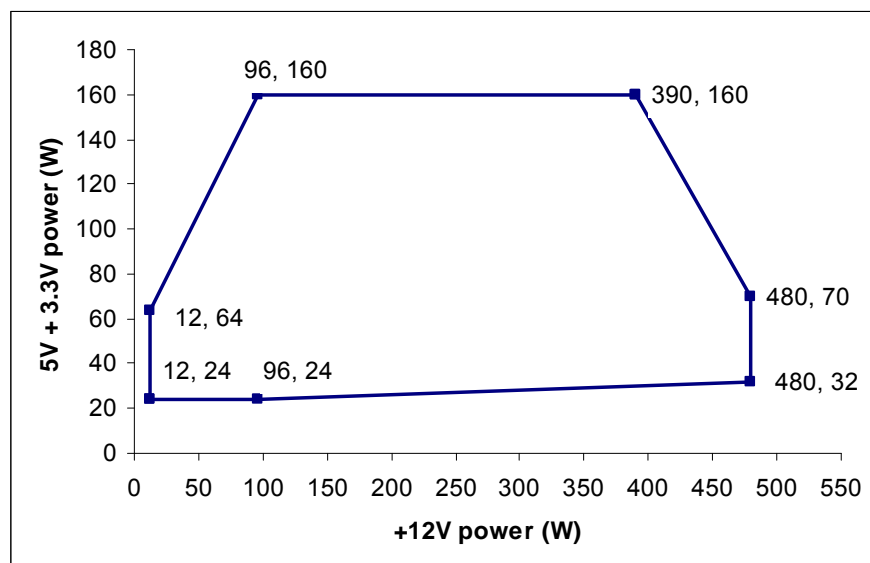


Table 39: 550 W 1U Server Load Ratings

Voltage	Minimum Continuous	Maximum Continuous	Peak
+3.3 V	1.5 A	16 A	
+5 V	1.0 A	15 A	
+12 V1	0.8 A	16 A	18 A
+12 V2	0.8 A	16 A	18 A
+12 V3	1.0 A	15 A	18 A
+12 V4	1.0 A	15 A	18 A
-12 V	0 A	0.5 A	
+5 VSB	0.1 A	3.0 A	3.5 A

1. Maximum continuous total DC output power should not exceed 550 W.
2. Peak load on the combined 12 V output shall not exceed 50 A.
3. Maximum continuous load on the combined 12 V output shall not exceed 44 A.
4. Peak total DC output power should not exceed 620 W.
5. Peak power and current loading shall be supported for a minimum of 12 seconds.
6. Combined 3.3V and 5V power shall not exceed 100W.

Figure 10 Cross loading graph for 550W configuration



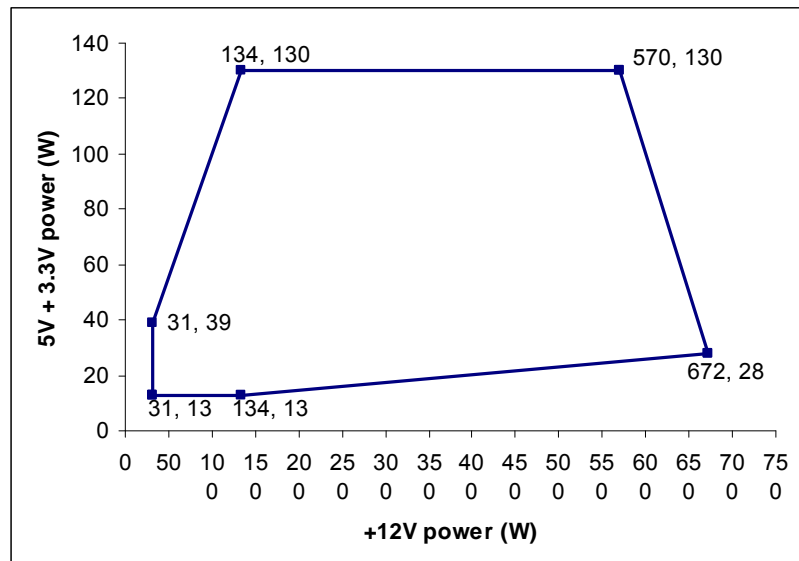
Power Supply Design Guideline for 2008 Dual-Socket Servers and Workstations, V1.2.1

Table 40: 700 W 1U Server Load Ratings

Voltage	Minimum Continuous	Maximum Continuous	Peak
+3.3 V	1.5 A	10 A	
+5 V	1.0 A	21 A	
+12 V1	0.8 A	16 A	18 A
+12 V2	0.8 A	16 A	18 A
+12 V3	0.5 A	16 A	18 A
+12 V4	0.5 A	16 A	18 A
-12 V	0 A	0.5 A	
+5 VSB	0.1 A	3.0 A	3.5 A

1. Maximum continuous total DC output power should not exceed 700 W.
2. Peak load on the combined 12 V output shall not exceed 62 A.
3. Maximum continuous load on the combined 12 V output shall not exceed 56 A.
4. Peak total DC output power should not exceed 770 W.
5. Peak power and current loading shall be supported for a minimum of 12 seconds.
6. Combined 3.3V and 5V power shall not exceed 130W.

Figure 11 700W Cross loading graph



13 EPS2U & ERP2U Specific Guidelines

13.1 EPS2U Non-redundant Form Factor for 2U Rack Mount Servers

STATUS
Required (Optional)

The EPS2U is a power supply enclosure intended to power 2U rack mount system with non-redundant power supplies.

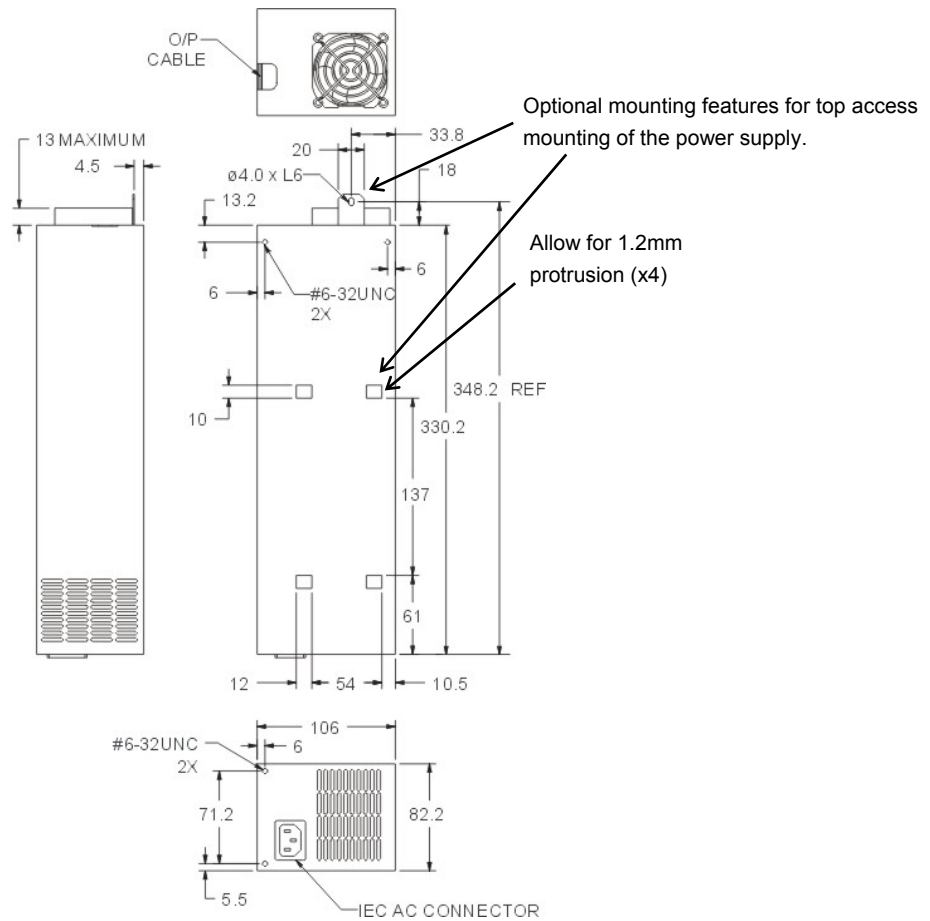


Figure 12: Enclosure Drawing

13.2 ERP2U Redundant Form Factor for 2U Rack Mount Servers

STATUS
Required (Optional)

The ERP2U is a power sub-system made up of a cage and redundant, hot swappable power supply modules. A mechanical drawing of the cage is shown below in Figure 4. Two depths are defined to the cage; 400mm and 350mm. This cage is intended to be mounted in the system and not redundant or hot swappable. The exterior face of the cage accepts hot swappable power supply modules. The cage distributes output power from the modules to a wire harness. Cooling fans, EMI filtering, and IEC inlet connector(s) may be located in the modules or cage.

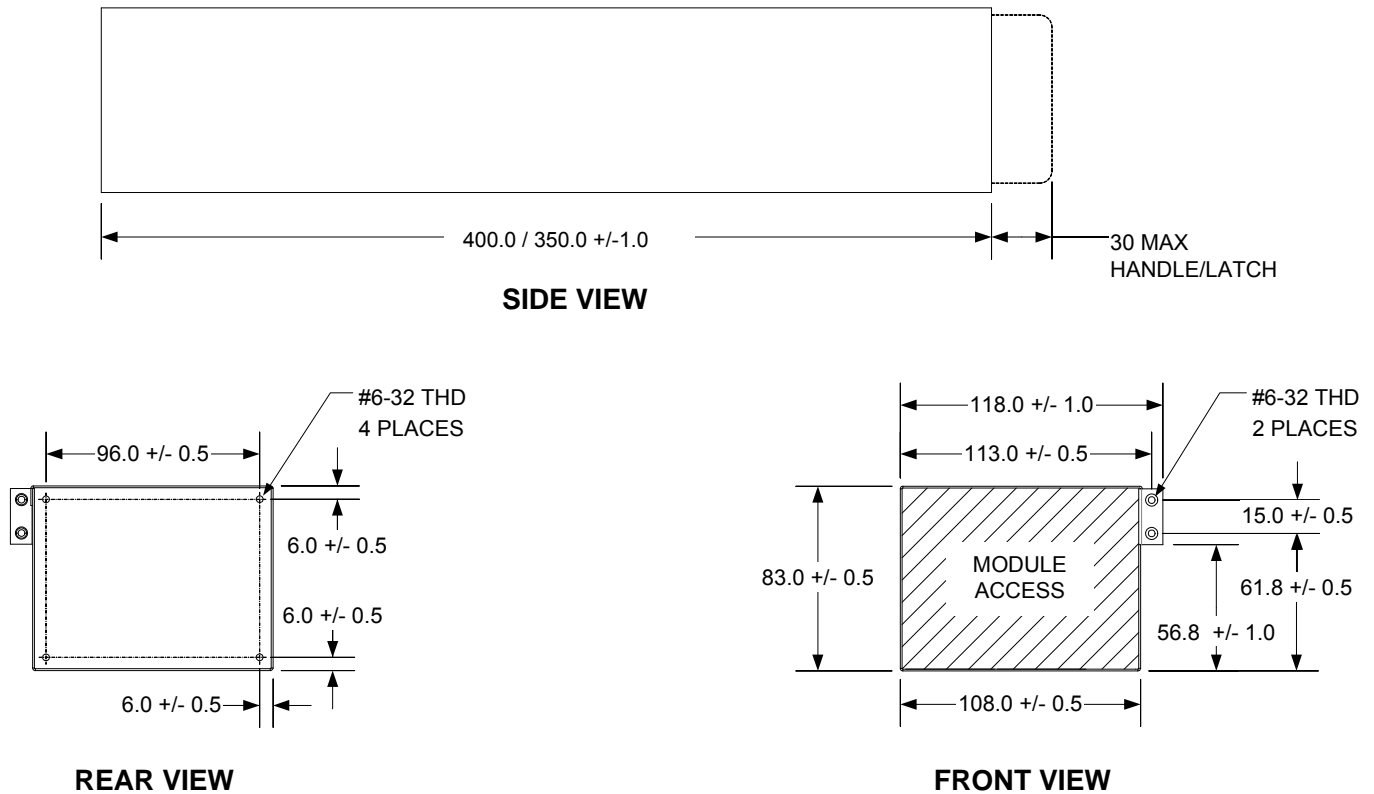


Figure 13: Enclosure Drawing

13.3 Acoustic Requirements

STATUS
Recommended

It is recommended the power supplies have a variable speed fan based on temperature and loading conditions. There are three different acoustic sound power levels defined at different ambient temperatures and loading conditions.

Table 41 Recommended Acoustic Sound Power Levels

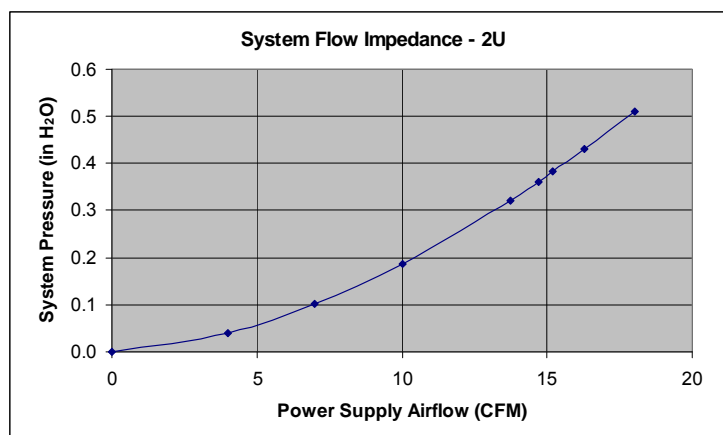
	Idle	Typical	Max
Ambient Temperature	28°C	28°C	45°C
% Loading	30%	60%	100%
Sound Power (BA)	5.2	5.6	6.1

13.4 Airflow Requirements

STATUS
Recommended

The air shall exit the power supply on the AC inlet face. The power supply shall meet all requirements with the below system airflow impedance presented to the power supplies airflow path.

Figure 14 System Airflow Impedance



13.5 Output Power/Currents

STATUS
Recommended

Power Supply Design Guideline for 2008 Dual-Socket Servers and Workstations, V1.2.1

The following tables define the power and current ratings for different recommended power levels. Depending upon the system design, the redundant power supply modules may have less outputs than required by the system (example: +12V and 5VSB). If there are less outputs than required by the system on the module, the cage shall have additional DC/DC converters to generate the voltages not produced by the modules (example: +12V/+5V, +12V/+3.3V, +12V/-12V). The combined output power of all outputs shall not exceed the rated output power. The power assembly shall meet both static and dynamic voltage regulation requirements over the full load ranges.

Table 42: 550 W 2U Load Ratings

Voltage	Minimum Continuous	Maximum Continuous	Peak
+3.3 V ⁷	0.8 A	24 A	
+5 V ⁷	0.5 A	24 A	
+12V1	0 A	16 A	18 A
+12V2	0 A	16 A	18 A
+12V3	0.9 A	14 A	
+12V4	0.1 A	8 A	13 A
-12 V	0 A	0.5 A	
+5 VSB	0.1 A	2.0 A	

1. Maximum continuous total DC output power should not exceed 550 W.
2. Maximum continuous combined load on +3.3 VDC and +5 VDC outputs shall not exceed 140 W.
3. Maximum Peak total DC output power should not exceed 630 W.
4. Peak power and current loading shall be supported for a minimum of 10 second.
5. Maximum combined current for the 12 V outputs shall be 38 A.
6. Maximum 12V combined peak current shall be 45 A.
7. The 3.3V and 5V may be supply by the module or DC/DC converters powered from +12V in the cage.

Figure 15 550W Cross Loading Graph

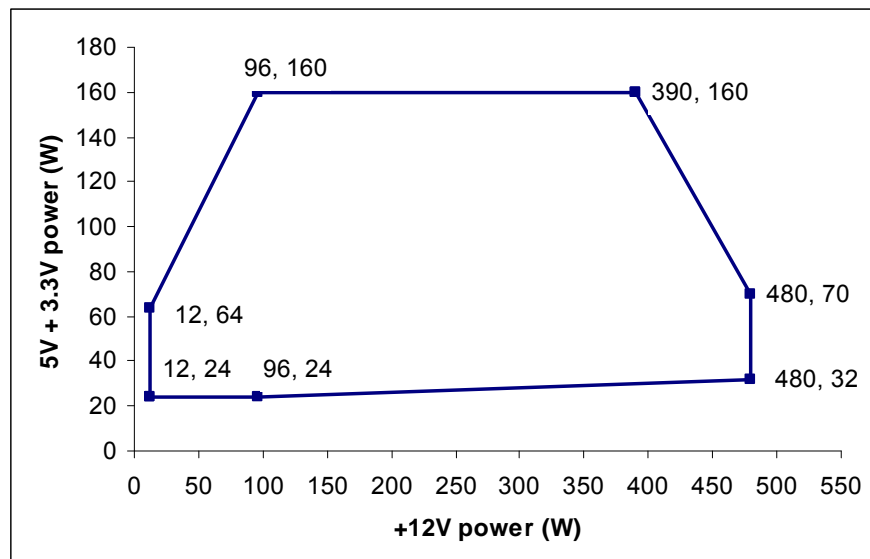


Table 43: 650 W 2U Load Ratings

Voltage	Minimum Continuous	Maximum Continuous	Peak
+3.3 V ⁷	0.8 A	24 A	
+5 V ⁷	0.5 A	24 A	
+12V1	0 A	16 A	18 A
+12V2	0 A	16 A	18 A
+12V3	0.9 A	14 A	
+12V4	0.1 A	8 A	13 A
-12 V	0 A	0.5 A	
+5 VSB	0.1 A	2.0 A	

1. Maximum continuous total DC output power should not exceed 650 W.
2. Maximum continuous combined load on +3.3 VDC and +5 VDC outputs shall not exceed 140 W.
3. Maximum Peak total DC output power should not exceed 770 W.
4. Peak power and current loading shall be supported for a minimum of 10 second.
5. Maximum combined current for the 12 V outputs shall be 45 A.
6. Maximum 12V combined peak current shall be 54 A.
7. The 3.3V and 5V may be supply by the module or DC/DC converters powered from +12V in the cage.

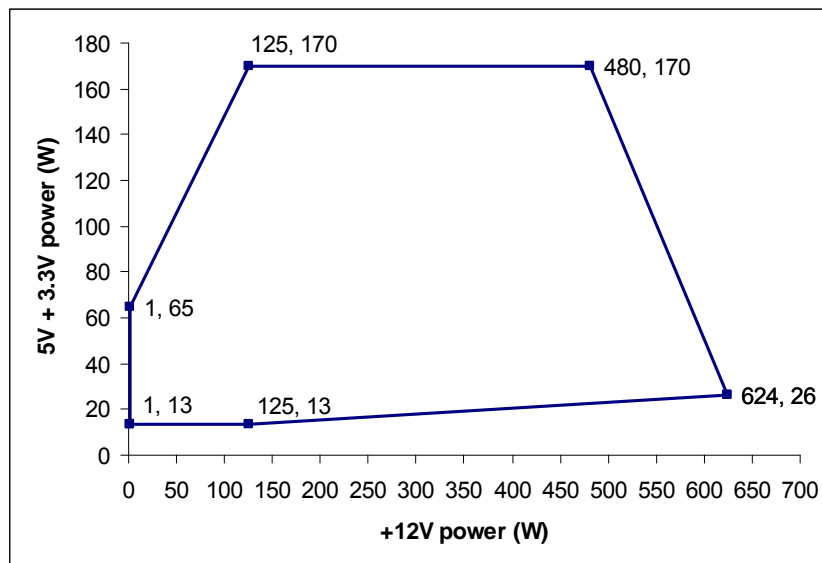


Table 44: 750 W Load Ratings

Voltage	Minimum Continuous	Maximum Continuous	Peak
+3.3 V ⁷	0.8 A	24 A	
+5 V ⁷	0.5 A	30 A	
+12V1	0 A	16 A	18 A
+12V2	0 A	16 A	18 A
+12V3	0.9 A	16 A	18 A
+12V4	0.1 A	16 A	18 A
-12 V	0 A	0.5 A	
+5 VSB	0.1 A	3.0 A	3.5 A

1. Maximum continuous total DC output power should not exceed 750 W.
2. Maximum continuous combined load on +3.3 VDC and +5 VDC outputs shall not exceed 170 W.
3. Maximum Peak total DC output power should not exceed 830 W.
4. Peak power and current loading shall be supported for a minimum of 10 second.
5. Maximum combined current for the 12 V outputs shall be 60 A.
6. Maximum 12V combined peak current shall be 66 A.
7. The 3.3V and 5V may be supply by the module or DC/DC converters powered from +12V in the cage.

Figure 16 750W ross Loading Graph

