SILVERSTONE ZEUS Series Designed for the Power Hungry Instructions

Contents

SILVERSTONE

SILVERSTONE ZEUS Series Designed for the Power Hungry

Scope

This document defines the Desktop Power Supply quality, 5 output, power supplies for the application of Desktop systems.
This power supplies meet the buss structures of Intel platform, and the following key features:

1. **Input**: Full Range (90-264Vrms) with Active Power Factor Correction.
2. **Output**: Product is provided with a total of 8 output to meet the requirement of ATX12V/EPS12V platform.
3. **Cooling**: A 135mm high reliable DC fan is used for cooling the power supply.

Electrical

The electrical specifications that follow is going to meet over the environmental ranges specified in Section 3 unless otherwise noted.

AC Input
Table 1 lists AC input voltage and frequency range for continuous operation. The power supply is capable of supplying full-rated output power over the input voltage ranges as specified.

Parameter	Min	Nominal Input	Max	Unit
V_{in} Voltage	90	100-240	264	Vrms
V_{in} Frequency	47	50/60	63	Hz
V_{in} Current 1350W/1650W		18.0		A
Power Factor(PF)		> 0.95	at 230Vac input and full	

Table 1. AC input

- When AC Input voltage is lower than 115Vac, 1650W / 1350W total output power must be reduced to 1250W
- The inrush current is less than 100A under the conditions of 230Vrms input and 25°C ambient cold start. The

inrush current is limited to the extent that no damage will be done to the power supply under any specified line, load, and temperature conditions. The inrush current will not cause external protection devices (fuses) to trip.

- The leakage current of the power supply module is less than 3.5mA measured at 230Vac input.
- The repetitive ON/OFF cycling of AC input voltage will not damage the power supply.
- The primary fuse is installed for input over-current protection, and meet product safety requirement.

DC Output

DC Output Voltage Regulations

The DC output voltages remain within the regulation ranges shown in Table 2. when measured the at load end of the output connectors under all AC line, O/P loads, and environmental conditions. The voltage regulation will be maintained under continuous operation for a period of time equal to the MTBF specified in section 5.2 at any steady state temperature and operating conditions specified in section

Outpu t	Output Voltage	Minimu m	1350W Max. (A)	1650W Max. (A)
V1	+12V	0.0	112.5	137.5
V2	+5V	0.0	22.0	22.0
V3	+3.3V	0.0	22.0	22.0
V4	-12V	0.0	0.3	0.3
V5	+5Vsb	0.0	3.0	3.0
Total Continuous Power			1350W	1650W
Max. combined O/P of V1			1350W	1650W
Max. combined O/P of V2 & V3			120W	120W
Max. combined O/P of V4			6.0W	6.0W
Max. combined O/P of V5			15W	15W

DC Output Efficiency & Eup* requirements

The power supply efficiency is 90% minimum measured at 10%, efficiency is 92% minimum & PFC 0.95 measured at 20%, efficiency is 94% (-0.2% Regulation) minimum measured at 50%, , efficiency is 90% minimum measured at 100% which is 115Vrms conditions.

The efficiency is measured in accordance with the definition released by the 80 Plus Organization (Plug Load Solutions).

The Table 3.1 defines the power supply output load

	LOAD	+12V	+5V	+3.3V	-12V	+5VSB	EFF
1350W	10%	10.191A	1.31A	1.31A	0.03A	0.296A	90%
	20%	20.382A	2.619A	2.619A	0.059A	0.592A	92%
	50%	50.956A	6.549A	6.549A	0.148A	1.48A	94%
	100%	101.912A	12.973A	12.973A	0.492A	2.950A	90%
1650W	10%	12.657A	1.331A	1.331A	0.049A	0.296A	90%
	20%	25.313A	2.662A	2.662A	0.099A	0.592A	92%
	50%	63.283A	6.654A	6.654A	0.247A	1.481A	94%
	100%	126.527A	13.308A	13.308A	0.494A	2.962A	90%

Table 3.1 Power supply output load

Low Load Efficiency	**10W / 2%**
Required	60%

In order to meet the 2010 and 2013 ErP Lot 6 requirements, AMS & 2014 ErP Lot 3 requirements, and if any Computers use an Alternative Sleep Mode (ASM) then the 5V standby efficiency should be met as shown in Table 4 which is measured with the main outputs off (PS_ON# high state).

5VSB Load Target	5VSB Actual Load	Efficiency Target (both 115V and 230V input)	Remark
45mA		≥45%	ErP* Lot 6 2013
90mA		≥55%	ErP* Lot 6 2010
0.55A		≥75%	ASM and ErP* Lot 3 2014
1.00A		≥75%	Recommend
1.50A		≥75%	ASM and ErP* Lot 3 2014
Max / Label	3.0A /Label	≥75%	Recommend

Table 4. The power supply typical output load distribution

DC Output Ripple & Noise

The output ripple & noise specifications listed in Table 5. will meet throughout the load ranges as specified in section 2.2.2 and the nominal line input voltage conditions as specified in section 2.1. Ripple & noise is defined as periodic of random signals over a frequency band of 10Hz to 20MHz. Measurements should be made with an oscilloscope with 20MHz bandwidth. adding a 10uF electrolytic capacitor and a 0.1uF ceramic capacitor across output terminal during ripple & noise measurement.

	+12V	+5V	+3.3V	-12V	+5Vsb	Unit
Max Ripple & Noise	50	50	50	80	50	mV P-P

Table 5. DC Output Ripple & Noise

DC Output Transient Response

The output voltages will remain within the regulation limits specified in Table 2. The load-changing repetition rate is 50Hz to 10KHz, and the transient load slew rate 1.0A/us. The maximum step load size, and output capacitive loading are specified as followings in Table 6.

	+12V	+5V	+3.3V	-12V	+5Vsb
Voltage limits.	±3%	±3%	±3%	±8%	±3%
Load Change Low Load	Min~70%Max	Min~30%Max	Min~30%Max	0A ~ 0.1A	0A ~ 0.5A
Load Change High Load	(Max-70%)~Max	(Max-30%)~Max	(Max-30%)~Max	0.2A ~ 0.3A	2.0A ~ 2.5A
Capacitive Load	6600uF	3300uF	3300uF	330uF	3300uF

Table 6. DC Output Transient Response

DC Output Voltage Hold-up Time

Criteria	REQUIRED	RECOMMENDED
Output Loading	100% of Full Load	80% of Full Load
Time (T5 + T6)	12 ms	17 ms

PCI-E 5_Power Excursion

PCI Express* CEM Add-in Card Power Excursion Limits Chart , shown in Figure.1

Power Excursion % of PSU Rated Size PSU ≤ 450 Watts & PSUs without 12VHPWR Connector	Power Excursion % of PSU Rated Size PSU > 450 Watts & 12VHPWR Connector present	Time for Power Excursion (T_E)	Testing Duty Cycle
150%	200%	100 µs	5%
145%	180%	1 ms	8%
135%	160%	10 ms	12.5%
110%	120%	100 ms	25%
100%	100%	Infinite	--

Figure 1. PCIE* AIC and PSU Power Budget used for Peak Power Excursion

The DC output voltages are required to remain within the regulation ranges shown in Figure.2

Outputs Voltage	Voltage Range (V)		
	Min	Typical	Max
+5V	4.75	5.0	5.25
+3.3V	3.13	3.3	3.47
-12V	-13.2	-12.0	-10.8
+5VSB	4.75	5.0	5.25
+12V1	11.2	12.0	12.6
+12V2	11.2	12.0	12.6

- 5V and 3.3V voltage rails (ATX Multi-Rail power supplies only) start at 80% of full load criteria
- DC output voltage will stay within regulation of +5/- 7% during the step load changes(+12V Capacitive Load 6600uF)
- The 12VHPWR power connector delivers up to 55 A of continuous current to provide a maximum of 600 W of power to the Add-in Card on a 12 V Aux rail, are given in figure 3.

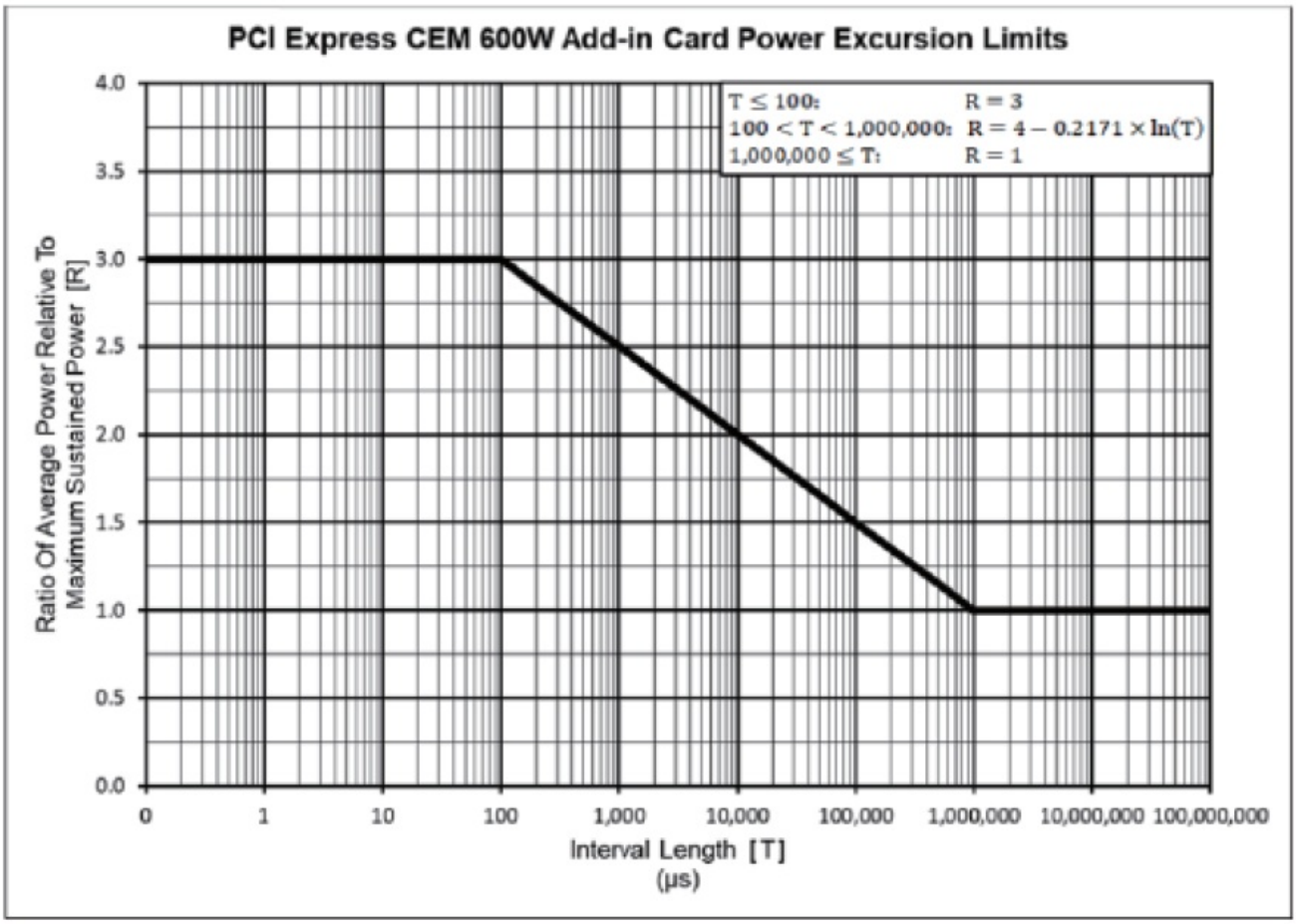
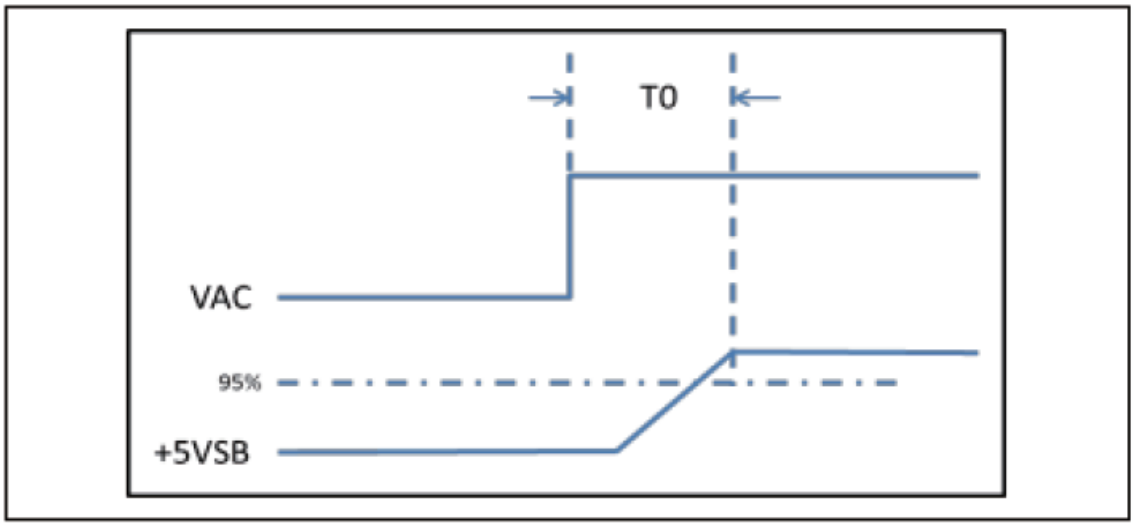
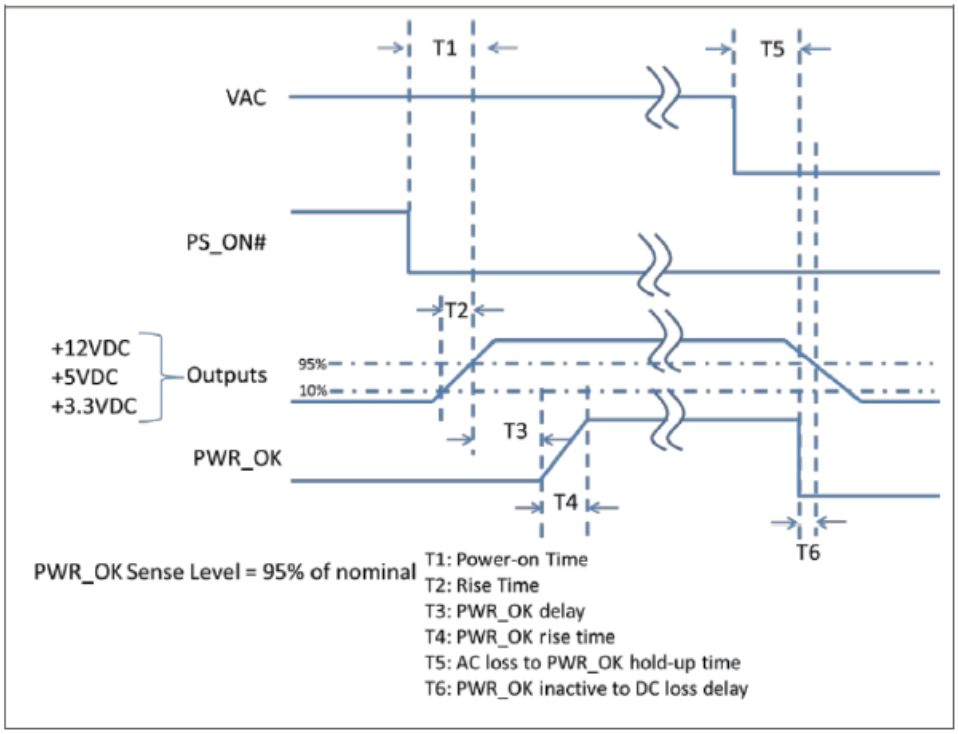


Figure 3. PCI Express* CEM Add-in Card Power Excursion Limits Chart

Timing / Housekeeping / control



+5Vsb shall have a power on time of 2 Seconds maximum after application of a valid AC line voltage.



Parameter	Description	Value		
		Required	Recommended for Non-Alternative Sleep Mode1	Recommended for Alternative Sleep Mode
T0	AC power on time	<2s		
T1	Power-on time			< 150ms
T2	Rise time	0.2 – 20 ms		
T3	PWR_OK delay			100 – 150 ms
T4	PWR_OK rise time	< 10 ms		
T5	AC loss to PWR_OK hold-up time	> 16 ms		
T6	PWR_OK inactive to DC loss delay	> 1 ms		

PWR_OK (Power Good Signal)
PWR_OK is a “power good” signal. It will be asserted high by the power supply to indicate that the +5V output is above the under voltage threshold listed in Table 2. of Section 2.2. PWR_OK will be de-asserted to a low state when +5V output voltage falls below under voltage threshold, or when AC power has been removed for a time sufficiently such that power supply operation cannot work normally.
The electrical and timing characteristics of the PWR_OK signal are given in Table 7. and in figure 1.

Signal type	+5V TTL compatible
Logic level low	< 0.4 V while sinking 4 mA
Logic level high	Between 2.4 V and 5 V output while sourcing 200 µA
High-state output impedance	1 kΩ from output to common
Max Ripple/Noise	400 mV p-p

Table 7. PWR_OK Signal Characteristics

PS_ON (DC Soft Start)
PS_ON# is an active-low, TTL-compatible signal that allows a motherboard to remotely control the power supply in conjunction with features such as soft on/off, Wake on LAN*, or wake-on-modem. When PS_ON# is pulled to TTL low, the power supply should turn on the four main DC output rails: +12 VDC, +5 VDC, +3.3 VDC, and -12 VDC. When PS_ON# is pulled to TTL high or open-circuited, the DC output rails should not deliver current and should be held at zero potential with respect to ground. PS_ON# has no effect on the +5VSB output, which is always enabled whenever the AC power is present. Table 8 lists PS_ON signal characteristics.

	Min	Max
V_{IL}, Input Low Voltage	0.0V	0.8V
I_{IL}, Input Low Current (Vin = 0.4V)		-1.6mA
V_{IH}, Input high Voltage (lin = -200uA)	2.0V	
V_{IH}, open circuit, lin =0		-5.25V
Ripple/Noise		400 mV p-p

Table 8. PS_ON Signal Characteristics

+5Vsb (Standby Voltage Output)
+5Vsb is a standby voltage output that is active whenever the AC power is present. It provides a power source for circuits that must remain operational when the four main DC output rails are in a disabled state. Example uses include soft power control, Wake on LAN, wake on modem, intrusion detection, or suspend state activities. There is over current protection on the +5Vsb output to ensure the power supply will not be damaged if external circuits draw more current than the supply can provide.

Power-on Time
The power-on time is defined as the time from when PS_ON is pulled low to when the12V1, +5V, and +3.3V output are within the regulation ranges specified in Section 2.2.1. The power-on time will be less than 150ms (T1 <150 ms). +5Vsb has a power on time of two second max. after the valid AC Voltages applied.

Rise Time
The output voltage rise from ≤ 10% of nominal to within the regulation ranges specified in section 2.2.1 within 0.2 ms to 20 ms (0.2 ms ≤ T2 ≤ 20 ms)

Power Sequencing
The +12V1 and +5V output levels are equal to or greater than the +3.3V output at all times during power-up and normal operation. The time between the +12V1 or +5V output reaching its minimum in-regulation level and +3.3V reaching its minimum in-regulation level is ≤ 20 msec.

Overshoot at Turn-on / Turn-off
The output voltage overshoot upon the application or removal of the input voltage, or the assertion / de-assertion of PS_ON will be less than 10% above the nominal voltage.

Reset after Shutdown
If the power supply latches into a shutdown state because of a fault condition on its outputs, the power supply can return to normal operation only after the fault condition has been removed and the PS_ON has been cycled OFF/ON with a minimum OFF time of 1 second.

+5Vsb at AC Power-down
After AC power is removed, the +5Vsb standby voltage output will remain at its steady state value for the minimum hold-up time specified in Section 2.2.6 until the output begins to decrease in voltage. The decrease can be monotonic in nature, dropping to 0.0V. There are no other perturbations of this voltage at or following removal of AC power.

Output Protection

Over Voltage Protection
The power supply can provide latch-mode over voltage protection as defined in Table 9.

Output	Min.	Nom.	Max.	Unit
+12VDC	13.6	14.6	15.6	Volts
+5VDC	5.5	6.25	7.0	Volts
+3.3VDC	3.7	4.1	4.5	Volts

Table 9. Over Voltage Protection

Under Voltage Protection
The power supply can provide latch-mode Under voltage protection as defined in Table 10.

Output	Min.	Nom.	Max.	Unit
+12VDC	8.80	9.30	9.80	Volts
+5VDC	4.10	4.30	4.47	Volts
+3.3VDC	2.55	2.69	2.83	Volts

Table 10. Under Voltage Protection

Over Current Protection
The power supply can provide Over Current Protection as defined in Table 11.

Output	Min.	Max.
+12VDC	120%	145%
+5VDC	120%	150%
+3.3VDC	120%	150%

Table 11. Over Current Protection

Short-circuit Protection
The power supply will shut down and latch off for shorting the +12V, +5V, +3.3V, and -12V rails to return or any other rails. Shorts between main output rails and +5Vsb will not cause any damage to power supply. +5Vsb can be capable of being shorted indefinitely, but when the short is removed, the power supply will recover automatically or by cycling PS_ON. The power supply can be capable of withstanding a continuous short circuit to the output without damage or overstress to the unit under the input conditions specified in section 2.1.

Over Power Protection
Fold back at 120%~145% over peak load

OVER TEMPERATURE PROTECTION
Protection temperature is 60℃ to 80℃ at 115V and full load

No-load Operation
No damage or hazardous condition will occur with all the DC output connectors disconnected from the load. The power supply may latch into the shutdown state.

Isolation (High Voltage Withstand)
1800Vac for 1 minute

Environmental

The following subsections define recommended environmental specifications and test parameters. Based on the typical conditions to which an ATX 12V power supply may be subjected during operation or shipment.

Temperature

- Operating 0℃ to +50℃
- Non-operating -20℃ to +70℃

Humidity

- Operating 20% to 90% relative humidity (non-condensing)
- Non-operating 5% to 95% relative humidity (non-condensing)

Altitude

- Operating 0 to 0 to 16,404 ft (5000 meter)
- Storage 0 to 50,000 feet

Electromagnetic Compatibility

The following subsections outline applicable product regulatory specifications for this power supply.

Emissions (Meet)
The power supply can comply with FCC Part 15 and EN55032: 2015 meeting Class B for both conducted and radiated emissions with a 3 dB margin.

Immunity (Meet)
The power supply can comply with EN 55035: 2017.

CE Testing (Meet)
The following standards are applied during the CE testing

- EN 55032: 2015 Class B with 3dB margin minimum
- EN 61000-3-2: 2014 Harmonic Current Measurement
- EN 61000-3-3: 2013 Voltage Fluctuation and Flick Measurement
- EN 55035: 2017, including
- IEC 61000-4-2: 2009 ESD – air discharge 8kV / ESD contact discharge 4kV
- IEC 61000-4-3: 2010 Radiated, Radio Frequency Electromagnetic Field Immunity Test
- IEC 61000-4-4: 2012 Electrical Fast Transient/Burst Immunity Test
- IEC 61000-4-5: 2014 Surge Immunity Test – 2kV L/N to PE and 1kV L to N
- IEC 61000-4-6: 2014 Immunity to Conducted Disturbances Induced by RF Fields
- IEC 61000-4-8: 2010 Power Frequency Magnetic Field Immunity Test
- IEC 61000-4-11: 2004 Voltage Dips and Short Interruptions Immunity Test

Reliability

Component De-rating
The derating process promotes quality and high reliability. All electronic components are designed with conservative derating for use in commercial and industrial environments.

Mean Time between Failures (MTBF)
100K hours minimum at full load 25°C

Safety (Meet)

- cTUVus UL62368-1
- TUV EN 62368-1
- CB IEC 62368-1

RoHS & REACH Compliance
The power supply meets the requirements of RoHS & REACH Compliance specified as followings:

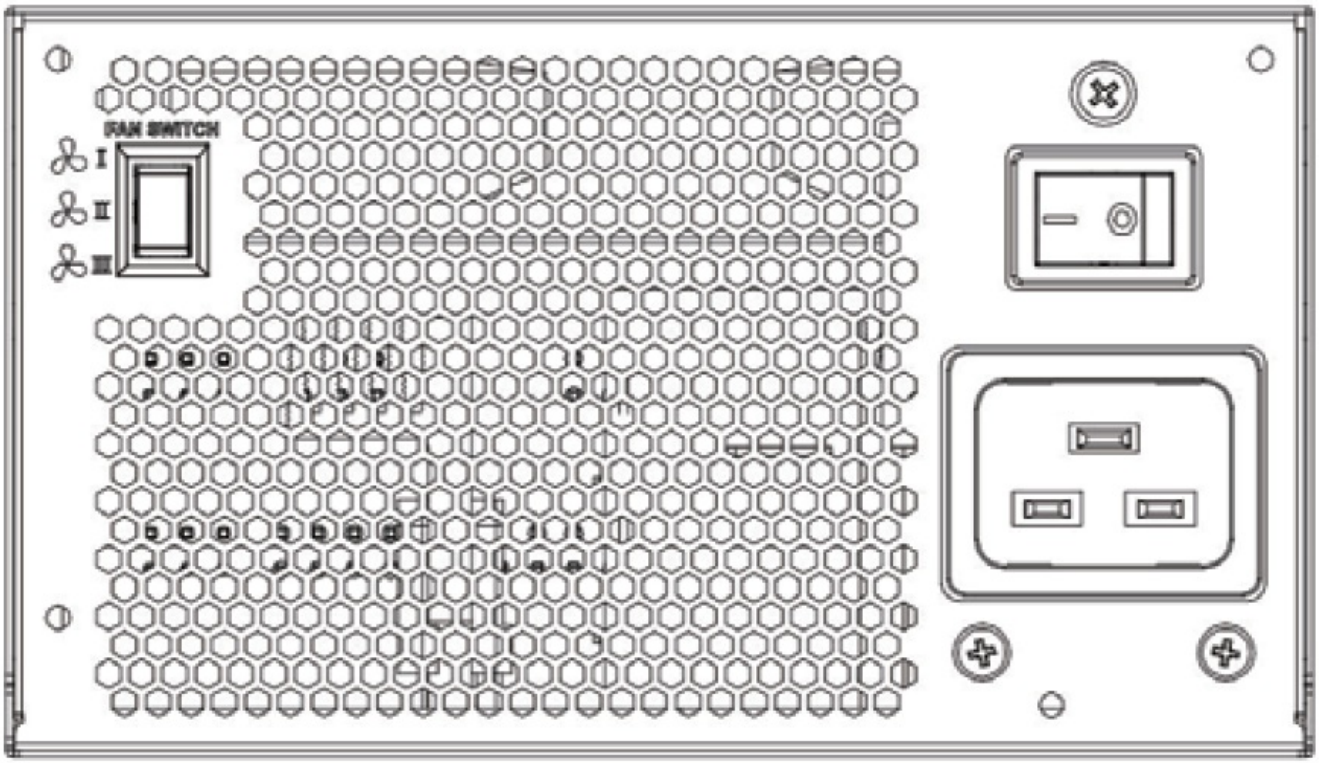
- European Directive for Waste of electrical and electronic equipment (WEEE) 2012/19/EU
- European Directive for Restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) 2011/65/EU
- ACPEIP, Administration on the Control of Pollution caused by Electronic Information Products (China RoHS), e.g. SJ/T 11363-2006 Requirements for Concentration Limits for Certain Hazardous Substances in EIP, SJ/T 11364-2006 Marking for Control of Pollution Caused by EIP
- Plastic and rubber parts are within the limits for 16 PAH and Benzopyrene polycyclic aromatic hydrocarbons
    - PAH (Polycyclic Aromatic Hydrocarbons):
    - 200mg/kg for components touched less than 30 seconds
    - 10mg/kg for components touched longer than 30 seconds
    - Benzopyrene are within the limits of:
    - 20mg/kg for components touched less than 30 seconds
    - 1mg/kg for components touched longer than 30 seconds

- Phthalate concentration is below 1000mg/kg for:
  - Diisononyl phthalate – Diisodecyl phthalate
  - Bis(2-ethylhexyl)phthalate – Butyl benzyl phthalate
  - Di-n-octyl phthalate – Bis(n-butyl)phthalate
- Polychlorinated biphenyl (PCB) concentration limits are less than two (2) parts per million (ppm).
  Regulation (EC) No 1907/2006 … concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH): No substance of Very High Concern of the “Candidate List” exceeds more than 0,1 % of the global weight of the delivered item (without packaging of the item)

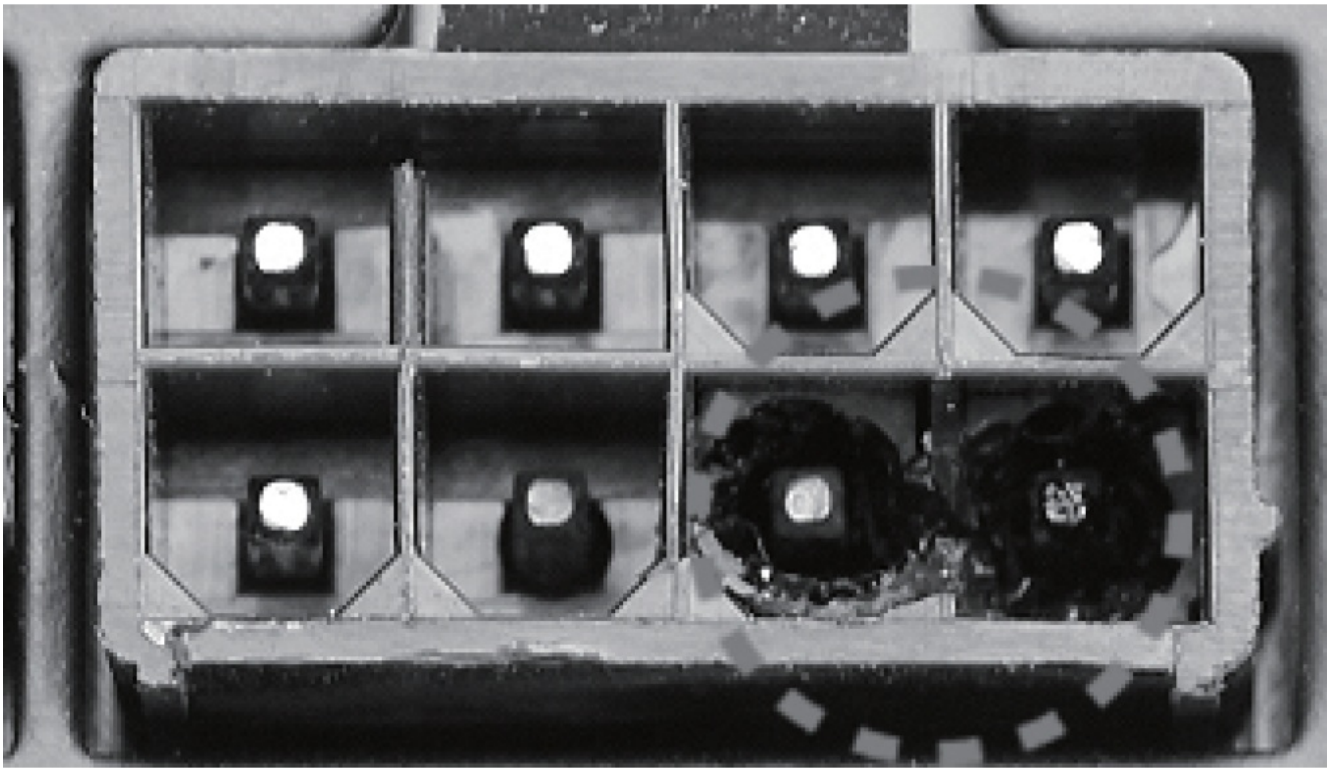
Mechanical
Dimension W x L x H = 150 x 180 x 86mm.

Fan Mode

I: Low Speed mode
II: Semi fanless mode
III: Full Speed High Speed



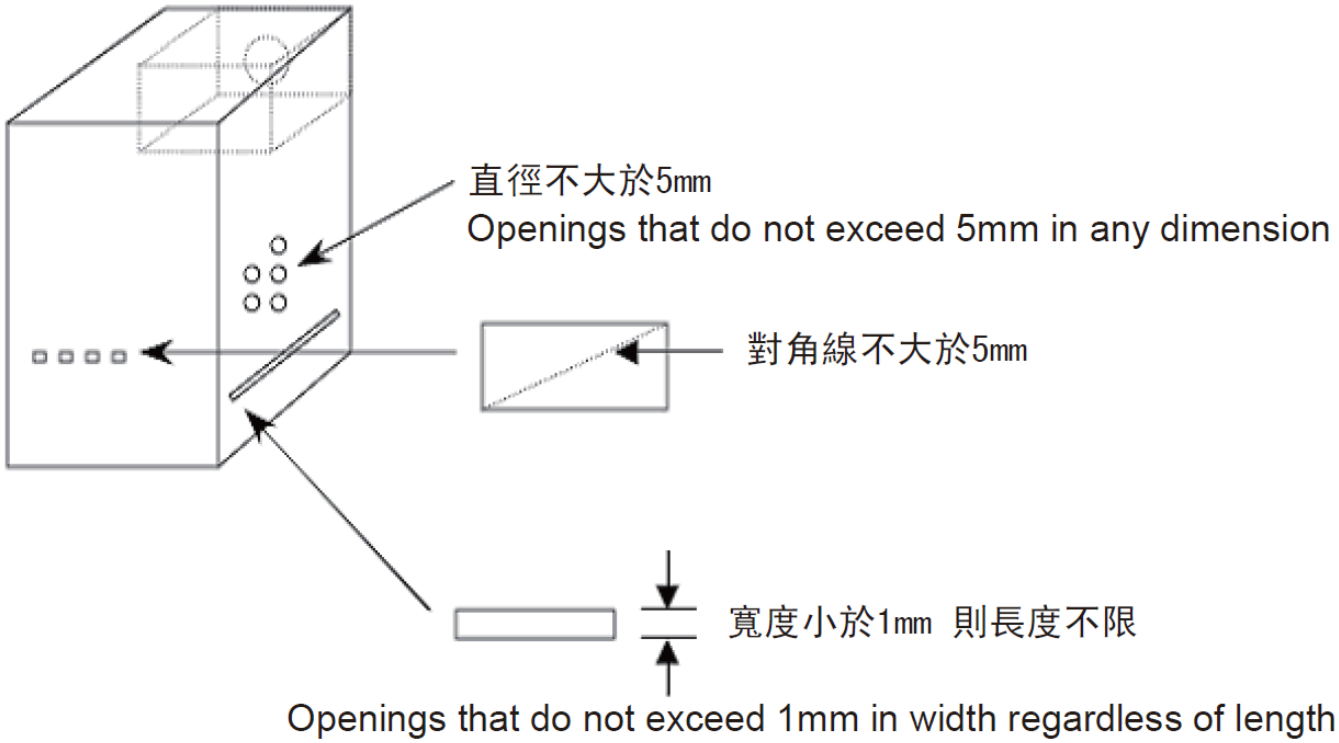
POWER SUPPLY CONNECTOR OVERUSE DEFINITION



A single PCIe 8pin cable and connector's maximum current rating is 12.5A, which is 150W (+12V x 12.5A). So SilverStone's warranty will not cover damages or malfunction resulting from the use of a graphics card or expansion card with a single PCIe 8pin connector that exceeds standard 225W total power draw (150W from PCIe 8pin connector + 75W from PCIe motherboard slot). Similarly, a graphics card or expansion card with dual PCIe 8pin connectors that exceed 375W total power draw (300W from two PCIe 8pin connectors + 75W from PCIe motherboard slot) will also not be covered under warranty.

Peripheral (molex) or SATA connector's maximum current rating is 5A, which is 60W (+12V x 5A) or 25W (+5V x 5A). Please ensure connected devices are operating under these limits. SilverStone's warranty will not cover damages or malfunction resulting from usages exceeding these connectors and their associated cables.

24pin motherboard connector's maximum current rating for its dual +12V metal pins are 5A each, which totals 120W (+12V x 5A x 2). Please ensure +12V drawing devices connected to the motherboard are operating under these limits. SilverStone's warranty will not cover damages or malfunction resulting from usages exceeding these connectors and their associated cables.

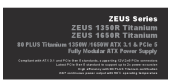


This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.

Model (on safety):SST-AX1350MCTI-A
Model (on safety):SST-AX1650MCTI-B

Documents / Resources

	SILVERSTONE ZEUS Series Designed for the Power Hungry [pdf] Instructions SST-ZU1350R-TM, SST-ZU1650R-TM, ZEUS Series Designed for the Power Hungry, ZEUS Series, Designed for the Power Hungry, for the Power Hungry, Power Hungry, Hungry

References

- User Manual