

SPECIFICATION



Specification
SP500-AD
9PA450AF00

Content

| | |
|--|----|
| 1 \ General | 4 |
| 2. \ Input Specification | 4 |
| 2.1 \ AC Input | 4 |
| 2.2 \ Input over Current Protection | 4 |
| 2.3 \ Inrush Current Limiting | 4 |
| 2.4 \ Input Under Voltage | 4 |
| 3. \ DC Output | 5 |
| 3.1 \ Voltage Regulation | 5 |
| 3.2 \ +5V DC / +3.3V DC Power Sequencing | 5 |
| 3.3 \ Power Distribution | 5 |
| 3.4 \ Cross Load Regulation | 6 |
| 3.5 \ Efficiency | 6 |
| 3.6 \ Energy Star & ErP | 6 |
| 3.7 \ Ripple Noise | 7 |
| 3.8 \ Transient Response | 7 |
| 3.9 \ Capacitive Load | 8 |
| 3.10 \ Hold Up Time | 8 |
| 3.11 \ Over Voltage Protection | 8 |
| 3.12 \ Short Circuit Protection | 9 |
| 3.13 \ No Load Operation | 9 |
| 3.14 \ Over Current Protection | 9 |
| 3.15 \ Over Power Protection | 9 |
| 3.16 \ Over Temperature Protection | 10 |
| 4.0 \ System specification | 10 |
| 4.1 \ Power Good Signal PWR_OK | 10 |
| 4.2 \ PS_ON # | 11 |
| 4.3 \ +5Vsb | 12 |
| 4.4 \ Power-on Time | 12 |
| 4.5 \ Rise Time | 12 |
| 4.6 \ Over Shoot at Turn-on / Turn-off | 12 |
| 4.7 \ Reset after Shutdown | 13 |
| 4.8 \ +5V _{SB} at AC Power-down | 13 |
| 5.0 \ Mechanical | 13 |
| 5.1 \ Dimension | 13 |
| 5.2 \ Airflow / Fan / Fan Speed Control | 13 |
| 5.3 \ DC Cables | 13 |
| 6.0 \ Environmental | 14 |
| 6.1 \ MTBF | 14 |
| 6.2 \ Operation Temperature | 14 |



6.3 \ Altitude 14
 6.4 \ Mechanical Shock 14
 6.5 \ Random Vibration 14

7.0 \ Regulatory 14

7.1 \ GROUND LEAKAGE CURRENT 14
 7.2 \ DIELECTRIC STRENGTH 15
 7.3 \ INSULATION RESISTANCE 15
 7.4 \ Lightning surge..... 15

8.0 \ Safety Requirement..... 15

Reversion History

| Ver. | Description | Date | Author |
|------|-------------|------------|--------|
| 1.00 | Original | 2021/10/08 | Maksim |
| 1.01 | Full update | 2022/01/19 | Maksim |
| | | | |

1 ․ General

This document is defined for SP500-AD series specification that complies with newest ATX 12V V2.52 and EPS 12V V2.92 standards. Regarding to energy saving purpose, the PSU shall pass energy star 8.0 and ErP 2013 requirement. All models have to be certificated by 80 PLUS Bronze Level.

2. ․ Input Specification

2.1 ․ AC Input

Table 1 lists AC input voltage and frequency requirements for continuous operation. The power supply shall be capable of supplying full-rated output power from voltage ranges rated 200 to 240 VAC RMS nominal. The power supply shall automatically recover from AC power loss.

Table 1: AC Input Requirements

| Parameter | Minimum | Nominal | Maximum | Unit |
|---------------|-------------------------|----------|---------|------|
| Vin | 180 | 200~240 | 265 | Vrms |
| Vin Frequency | 47 | 50 or 60 | 63 | Hz |
| Iin | 3A @ 230V _{AC} | | | Arms |
| PFC | PF ≥ 0.95 @ Full Load | | | |

2.2 ․ Input over Current Protection

The power supply shall incorporate primary fusing 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

2.3 ․ Inrush Current Limiting

Maximum inrush current from power-on (with power-on at any point on the AC sine) and including, but not limited to, three line cycles, shall be limited to a level below the surge rating of the AC switch if present, bridge rectifier, and fuse components. Repetitive ON/OFF cycling of the AC input voltage should not damage the power supply or cause the input fuse to blow.

2.4 ․ Input Under Voltage

The power supply shall contain protection circuitry such that the application of an input voltage below the minimum specification and shall not cause damage to the power supply.

3. DC Output

3.1 Voltage Regulation

The DC output voltages shall remain within the regulation ranges shown in Table 2 when measured at the load end of the output connectors under all line, load, and environmental conditions.

Table 2: DC Output Voltage Regulation

| Output | Range | Minimum | Nominal | Maximum | Units |
|--------------------|-------|---------|---------|---------|-------|
| + 3.3V | ± 5% | + 3.135 | + 3.30 | + 3.465 | Volts |
| + 5V | ± 5% | + 4.75 | + 5.00 | + 5.25 | Volts |
| + 12V | ± 5% | + 11.4 | + 12.00 | + 12.6 | Volts |
| - 12V | ± 10% | - 13.20 | - 12.00 | - 10.80 | Volts |
| + 5V _{SB} | ± 5% | + 4.75 | + 5.00 | + 5.25 | Volts |

3.2 +5V DC / +3.3V DC Power Sequencing

The +12 VDC and +5 VDC output levels must be equal to or greater than the +3.3 VDC output at all times during power-up and normal operation.

The time between any output of +12 VDC and +5 VDC reaching its minimum in regulation level and +3.3 VDC reaching its minimum in-regulation level must be ≤ 20ms.

3.3 Power Distribution

It should not be inferred that those three models must conform to these tables.

The power supply designed to meet the information in the tables will work for all system configurations under total power consumption.

| AC INPUT | 200-240V~ 3A 50-60Hz | | | | |
|--------------|----------------------|-----|-------|------|-------|
| DC OUTPUT | +3.3V | +5V | +12V | -12V | +5Vsb |
| MAX CURRENT | 15A | 15A | 37.5A | 0.3A | 2.5A |
| MAX COMBINED | 80W | | 450W | 3.6W | 12.5W |
| TOTAL | 450W | | | | |

Note: The PSU shall deliver total power output wattages continuously when ambient temperature is under 40°C without damage and the maximum fan speed shall be controlled by fan curve chart.



3.4 · Cross Load Regulation

The DC load voltages shall remain within the regulation ranges shown in the following tables when measured at the load end of the output connector.

| LOAD | +3.3V | +5V | +12V | -12V | +5Vsb | PS-ON |
|-------------|-------|------|--------|------|-------|-------|
| Condition_1 | X | X | X | X | 2.5A | Off |
| Condition_2 | 0A | 0A | 0A | 0A | 0A | On |
| Condition_3 | 0A | 0A | 2A | 0.3A | 0A | On |
| Condition_4 | 15A | 6.1A | 29.49A | 0.3A | 2.5A | On |
| Condition_5 | 1.51A | 15A | 29.49A | 0.3A | 2.5A | On |
| Condition_6 | 0A | 0A | 37.5A | 0A | 0A | On |

3.5 · Efficiency

The power supply required minimum is 82% efficient under “Full” load, 85% under “typical” load, and 82% in a “light” load or idle condition. The efficiency of the power supply should be tested at nominal input voltage of 230VAC input. The loading condition for testing efficiency shown in table below represents a fully loaded system, a ~50% (typical) loaded system, and a ~20% (light) loaded system.

| Specification | 20% Loading | 50% Loading | 100% Loading |
|----------------|-------------|-------------|--------------|
| 80 PLUS Bronze | 82% | 85% | 82% |

| 450W (loading shown in Amps) | | | | | |
|------------------------------|-------|-------|--------|-------|-------|
| Load | +3.3V | +5V | +12V | -12V | +5Vsb |
| Light | 1.588 | 1.588 | 6.18 | 0.049 | 0.412 |
| Typical | 3.971 | 3.971 | 15.45 | 0.124 | 1.03 |
| Full | 7.942 | 7.942 | 30.901 | 0.247 | 2.06 |

3.6 · Energy Star & ErP

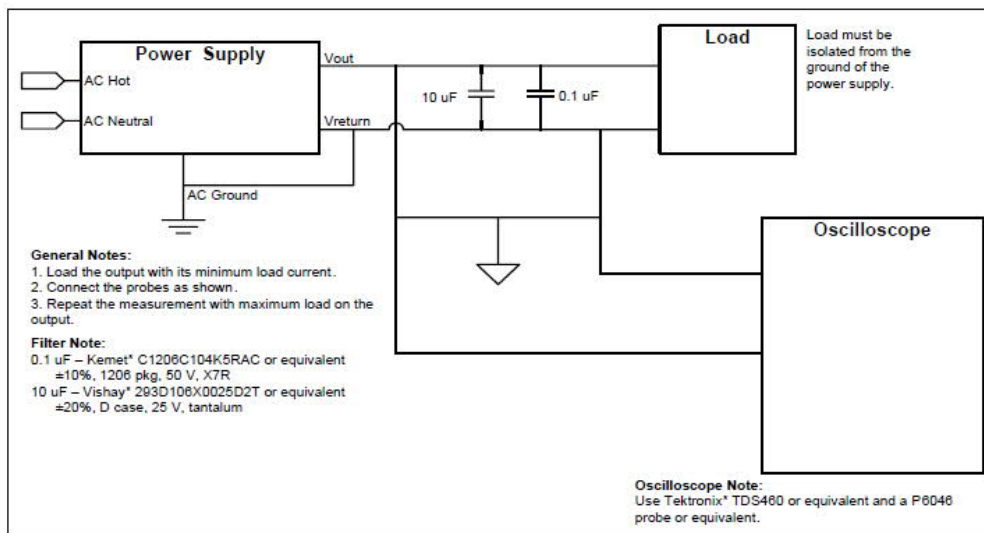
The PSU shall meet ENERGY STAR 6.0 and ErP 2013 requirements, and other low Power system demands, It is recommended that the +5 VSB standby supply efficiency should be as high as possible. Standby efficiency is measured with the main outputs off (PS_ON# high state). Standby efficiency should be as shown in Table below.

| Vac | 230Vac input | | | | | |
|------------|--------------|-------|-------|------|-------|------|
| Load | 45mA | 90mA | 550mA | 1A | 1.5A | 2.5A |
| Efficiency | >45% | >55% | >75% | >75% | >75% | >75% |
| Version | Lot 6 | Lot 6 | Lot 3 | | Lot 3 | |

3.7 · Ripple Noise

The output ripple noise requirements listed in Table below should be met throughout the load ranges specified for the appropriate form factor and under all input voltage conditions as specified in Table 1. Ripple and noise are defined as periodic or random signals over a frequency band of 10 Hz to 20MHz. Measurements shall be made with an oscilloscope with 20 MHz of bandwidth. Outputs should be bypassed at the connector with a 0.1µF ceramic disk capacitor and a 10µF electrolytic capacitor to simulate system loading. See Figure 1 for the differential noise measurement setup.

| Parameter | +3.3V | +5V | +12V | -12V | +5Vsb |
|-----------|----------------------|----------------------|-----------------------|-----------------------|----------------------|
| Maximum | 50 mV _{p-p} | 50 mV _{p-p} | 120 mV _{p-p} | 120 mV _{p-p} | 50 mV _{p-p} |



3.8 · Transient Response

The table summarizes the expected output transient step sizes for each output. The transient load slew rate is = 5.0 A/us.

| Output | Max. Step size (% of rate output amps) | Max. Step Size (amps) |
|--------------------|---|--------------------------|
| + 12V | 60% | |
| + 5V | 30% | |
| + 3.3V | 30% | |
| - 12V | | 0.1 A |
| + 5V _{sb} | | 0.5 A |

Output voltage should remain the regulation limits of DC voltage regulation, and the power supply should be stable when subjected to load transients. from any steady states load, including any or all of the following conditions.



| | | | | | |
|-------|-----------|-----------|-------------|------|-------|
| LOAD | +3.3V | +5V | +12V | -12V | +5Vsb |
| +3.3V | 10.5A~15A | 6.1A | 29.49A | 0.3A | 2.5A |
| +5V | 1.51A | 10.5A~15A | 29.49A | 0.3A | 2.5A |
| +12V | 0A | 0A | 22.5A~37.5A | 0A | 0A |

3.9 · Capacitive Load

The power supply should be able to power up and operate normally with the following capacitances simultaneously present on the DC outputs.

This capacitive loading should be used to check stability and should not be included for noise testing.

| | | | | | |
|-----------------|--------|--------|--------------------|-------|--------------------|
| Output Voltage | + 3.3V | + 5V | + 12V ₁ | - 12V | + 5V _{SB} |
| Capacitive Load | 3300μF | 3300μF | 3300μF | 330μF | 3300μF |

3.10 · Hold Up Time

The power supply should maintain output regulation per Section 3.1 despite a loss of input power at the low-end nominal range — 230 VAC / 50 Hz — at 70% continuous output load as applicable for a minimum of 16ms.

3.11 · Over Voltage Protection

The over voltage sense circuitry and reference shall reside in packages that are separate and distinct from the regulator control circuitry and reference. No single point fault shall be able to cause a sustained over voltage condition on any or all outputs.

The PSU shall provide latch-mode Over Voltage Protection for the main outputs only. A remote power OFF/ON cycle is permitted to restore normal operation but is not required. For the 5Vsb a Main AC power OFF/ON cycle is permitted to restore normal operation but is not required.

| Output Voltage | Min. | Nom. | Max. | Unit |
|----------------|-------|-------|-------|-------|
| + 3.3V | 3.76 | 4.10 | 4.80 | Volts |
| + 5V | 5.75 | 6.30 | 7.00 | Volts |
| + 12V | 13.50 | 14.50 | 16.50 | Volts |



3.12 · Short Circuit Protection

An output short circuit is defined as any output impedance of less than 0.1 ohms. The PSU shall shut down and latch off for shorting the +3.3V, +5V, or +12V rails to return or any other rails. Short between main output rails and +5Vsb shall not cause any damage to the PSU. The PSU shall either shut down and latch off or fold back for shorting the negative rails. +5Vsb must be capable of being shorted indefinitely, but when the short is removed, the PSU shall recover automatically or by cycling PS_ON#.

The PSU shall be capable of withstanding a continuous short-circuit to the output without damage or overstress to the unit (for example, to components, PCB traces, connectors) under the input conditions specified in Section 2.1.

3.13 · No Load Operation

No damage or hazardous condition should occur with all the DC output connectors disconnected from the load. The power supply may latch into the shut down state.

3.14 · Over Current Protection

Basically, the OCP is defined by vendor but the trigger point shall be 120% of maximum current at least each rail. And the PSU can't be damaged when OCP occur. Current protection should be designed to limit the current to operate within safe operating conditions.

Over current protection schemes where only the voltage output that experiences the over current event is shut off may be adequate to maintain safe operation of the power supply and the system; however, damage to the motherboard or other system components may occur. The recommended over current protection scheme is for the power supply to latch into the shutdown state.

| Output voltage | Over current limit |
|----------------|--------------------|
| +3.3V | 16A~30A |
| +5V | 16A~30A |
| +12V | 41A~49A |

3.15 · Over Power Protection

The power supply shall be shut down and latch off

Test: Full load

When the output wattage of the power supply is higher from 540W to 675W

3.16 · Over Temperature Protection

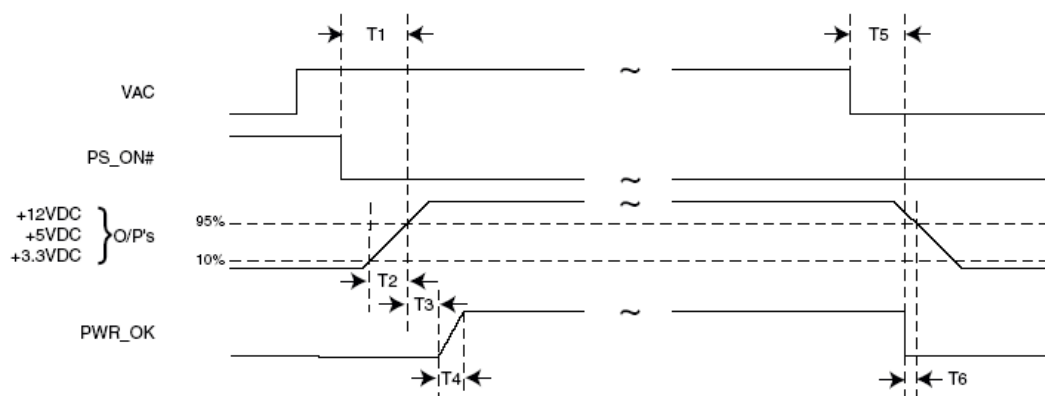
The power supply shall include an over-temperature protection sensor, which can trip and shut down the power supply at a preset temperature point. Such an overheated condition is typically the result of internal current overloading or a cooling fan failure. If the protection circuit is non-latching, then it should have hysteresis built in to avoid intermittent tripping.

4.0 · System specification

4.1 · Power Good Signal PWR_OK

PWR_OK is a “power good” signal. It should be asserted high by the power supply to indicate that the +12 VDC, +5VDC, and +3.3VDC outputs are above the under-voltage thresholds listed and that sufficient mains energy is stored by the converter to guarantee continuous power operation. Conversely, PWR_OK should be deasserted to a low state when any of the +12 VDC, +5 VDC, or +3.3 VDC output voltages falls below its under-voltage threshold, or when mains power has been removed for a time sufficiently long such that power supply operation cannot be guaranteed beyond the power down warning time. The electrical and timing characteristics of the PWR_OK signal are given in table.

| | |
|--------------------------------|---|
| Signal Type | +5 V 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 μ A |
| High-state output impedance | 1 k Ω from output to common |
| PWR_OK delay | 100 ms < T_3 < 150 ms |
| PWR_OK rise-time | $T_4 \leq 10$ ms |
| AC loss to PWR_OK hold-up time | $T_5 \geq 16$ ms |
| Power-down warning | $T_6 \geq 1$ ms |



4.2 、 PS_ON

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 +5 VSB output, which is always enabled whenever the AC power is present. Below table lists PS_ON# signal characteristics.

The power supply shall provide an internal pull-up to TTL high. The power supply shall also provide de-bounce circuitry on PS_ON# to prevent it from oscillating on/off at startup when activated by a mechanical switch. The DC output enable circuitry must be SELV-compliant.

The power supply shall not latch into a shutdown state when PS_ON# is driven active by pulses between 10ms to 100ms during the decay of the power rails.

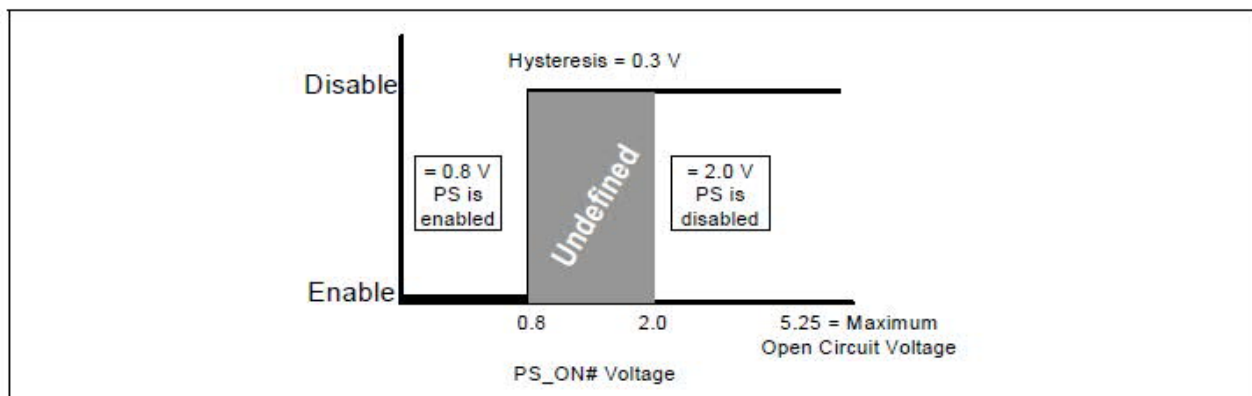
PS_ON# Signal Characteristics

| Parameter | Minimum | Maximum |
|-------------------------------------|---------|----------------------|
| V_{IL} | 0 | 0.8 V |
| IIL ($V_{IN} = 0.4$ V) | - | -1.6 mA ¹ |
| V_{IH} ($I_{IN} = -200$ μ A) | 2.0 V | - |
| V_{IH} open circuit | - | 5.25 V |

NOTES:

1. Negative current indicates that the current is flowing from the power supply to the motherboard.

PS_ON# Signal Characteristics





4.3 · +5Vsb

+5Vsb is a standby supply output that is active whenever the AC power is present. This output provides a power source for circuits that must remain operational when the five 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.

The power supply must be able to provide the required power during a “wake up” event. If an external USB device generates the event, there may be peak currents as high as 3.0A, lasting no more than 500ms.

Over current protection is required on the +5Vsb output regardless of the output current rating. This ensures the power supply will not be damaged if external circuits draw more current than the supply can provide.

4.4 · Power-on Time

The power-on time is defined as the time from when PS_ON# is pulled low to when the +12 VDC, +5 VDC, and +3.3 VDC outputs are within the regulation ranges specified in Section 3.1. The power-on time shall be less than 500ms ($T1 < 150\text{ms}$). +5V_{SB} shall have a power-on time of two seconds maximum after application of valid AC voltages.

4.5 · Rise Time

The output voltages shall rise from $\leq 10\%$ of nominal to within the regulation ranges specified in Section 3.1 within 0.1 ms to 20 ms ($0.1 \text{ ms} \leq T2 \leq 20 \text{ ms}$).

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 in the Section 3.4. 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 $[V_{\text{out, nominal}} / 0.1] \text{ V/ms}$. Also, for any 5 ms segment of the 10% to 90% risetime waveform, a straight line drawn between the end points of the waveform segment must have a slope $\geq [V_{\text{out, nominal}} / 20] \text{ V/ms}$.

4.6 · Over Shoot at Turn-on / Turn-off

The output voltage overshoot upon the application or removal of the input voltage, or the assertion/desertion of PS_ON#, under the conditions specified in Section 2.1, shall be less than 10% above the nominal voltage.

No voltage of opposite polarity shall be present on any output during turn-on or turn-off.



4.7 ‧ Reset after Shutdown

If the power supply latches into a shutdown status because of a fault condition on its outputs, the power supply shall return to normal operation only after the fault has been removed and the PS_ON# (or AC input) has been cycled OFF/ON with a minimum OFF time of 1 second.

4.8 ‧ +5V_{SB} at AC Power-down

After AC power is removed, the +5V_{SB} standby voltage output should remain at its steady state value for the minimum hold-up time specified in Section 3.10 until the output begins to decrease in voltage. The decrease shall be monotonic in nature, dropping to 0.0V. There shall be no other perturbations of this voltage at or following removal of AC power.

5.0 ‧ Mechanical

5.1 ‧ Dimension

Mechanical specifications are to be the standard ATX12V (150mm x 150mm x 86mm). The fan guard and rating label will be defined by FSP. FSP is thinking to have a brand new ID and will need vendor input for ME limitation.

5.2 ‧ Airflow / Fan / Fan Speed Control

Exact CFM requirements vary by application and end-use environment, but 80-90 CFM is typical for the fan itself. The noise-sensitive applications, it is recommended that a thermally sensitive fan speed control circuit be used to balance system-level thermal and acoustic performance. The circuit typically senses the temperature of an internal heatsink and/or incoming ambient air and adjusts the fan speed as necessary to keep power supply and system component temperatures within specification.

The power supply fan should be turned off when PS_ON# is de-asserted (high). In this status, any remaining active power supply circuitry must rely only on passive convection for cooling. In general, more venting in a power supply case yields reduced airflow impedance and improved cooling performance. Intake and exhaust vents should be as large, open, and unobstructed as possible so as not to impede airflow or generate excessive acoustic noise.

| AC INPUT | Full load | Typical load | Light load |
|----------|--------------|--------------|--------------|
| 230V | Noise < 40dB | Noise < 25dB | Noise < 25dB |

5.3 ‧ DC Cables

Base on the OAD drawing define.

6.0 、 Environmental

The following subsections define recommended environmental specifications and test parameters, based on the typical conditions to which an ATX12V power supply may be subjected during operation or shipment.

6.1 、 MTBF

FSP requires the MTBF shall be meet 100,000 hours at full load condition.
The vendor shall provide test report after MP for a while.

6.2 、 Operation Temperature

- Operating ambient: 0 ~ 40°C
At full load, with a maximum temperature rate of change of 5°C/10mins.
but no more than 10°C/hr
- Non-operating ambient: -40 ~ 70°C

6.3 、 Altitude

- Operation Altitude: 2000 meters
- Storage Altitude: 2000 meters

6.4 、 Mechanical Shock

50g, trapezoidal, input; velocity change ≥ 170 in/s.
Three drops on each of six faces are applied to each sample.(non-operating)

6.5 、 Random Vibration

0.01g²/ Hz at 5 Hz, sloping to 0.02g²/ Hz at 20 Hz, and maintaining 0.02g²/ Hz from 20Hz to 500Hz. The area under the PSD curve is 3.13gRMS.
The duration shall be 10 minutes per axis for all three axes on all samples. (non-operating)

7.0 、 Regulatory

7.1 、 GROUND LEAKAGE CURRENT

The power supply ground leakage current shall be less than 3.5 mA.



7.2 、 DIELECTRIC STRENGTH

Primary to Frame Ground : 1800Vac / 3 sec.

Primary to Secondary : 1800Vac / 3 sec.

7.3 、 INSULATION RESISTANCE

Primary to Frame Ground : 20M ohm , Minimum

Primary to Secondary : 20M ohm , Minimum

7.4 、 Lightning surge

Line to line: 1KV

Line to ground: 2KV

8.0 、 Safety Requirement

@EMC

EN 55032: 2015 / AC: 2016

CISPR 32: 2015(Ed 2.0) / C1: 2016

AS/NZS CISPR 32: 2015

EN 61000-3-2: 2014

EN 61000-3-3: 2013

EN 55024: 2010 + A1: 2015

IEC 61000-4-2: 2008; IEC 61000-4-3: 2006 + A1: 2007 + A2:2010; IEC 61000-4-4: 2012;

IEC 61000-4-5: 2014; IEC 61000-4-6: 2013; IEC 61000-4-8: 2009; IEC 61000-4-11:

2004+A1: 2017

@CB

IEC 62368-1: 2014