Electrical Specification	Model Name	NR2-HVR400-N
	Version	S2
	Release Date	2018/07/21

Electrical Specification

(With ATX output (SGCC) 1+1 Redundant)

Drawn: 王宝玫

Design (EE): 孙海阳

Design (ME): 孙飞宇

Design (FE): 鄂来恩

Approve: 李秀娟

REV	Description	Date
S0	Release	2018/01/26
S1	1. 2.4 Tvout_holdup is changed from 14ms/80%Load to 13ms/80%Load	2018/05/24
	2. Update 2.5 Power Factor.	
	3. 3.2 5Vsb Voltage range is changed from 4.75-5.25V ±5% to 4.5-5.5V ±10%.	
	4. 3.4 Tvout_rise is changed from 1-20ms to 1-70ms.	
	5. 3.4 Tvout_holdup is changed from 14ms to 13ms.	
	6. 3.7 12V Capacitive Loading is changed from 10000uF to 31000uF.	
	7. 3.10.1 PS_ON modify high level(Max) from 5.25V to 4.7V.	
	8. 3.10.2 PG modify high level(Max) from 5.25V to 4.7V, and low level (Max) from 0.6V to 0.7V.	
	9. NC 3.10.3	
	10. NC 4.2 OPP	
	11. 4.3 OTP add recovery point is 47-57degC.	
	12. 4.4 add the +5V and +3.3V can't be unlocked until 5Vsb is fully discharged.	
	13. 4.5 add the +5V and +3.3V can't be unlocked until 5Vsb is fully discharged.	
	14. 4.6 LED light's color is changed from Yellow to Orange.	
	15. Update 5.0 Current share.	
	16. 10.3 EMI is changed from Class A to Class B.	
	17. Modify 13.0 MTBF 12V Load from 27A to 33A.	
	18. 17.3 Table 39 is changed from U1A-K10300-DRB and 1.0 to R1A-KH0300 and 1.1.	
	19. Update the 17.3 PMBus Command Supported.	
	20. MFR Date Table.	
S2	1. Update the 3.2, Delete All outputs are measured with reference to the return remote sense (ReturnS) signal and Update the Table7	2018/07/21
	2. Update the 3.4Tpwok_off description of Table9, add at 80% Load condition	

	3. Modify 4.4 OCP Note description and 3.3V and 5V OCP	
	4. Modify 10.3,add CE satisfy 3dB margin	
	5. Modify 17.3 ,from Conditions of Table37and Table38 to comment	
	6. Add 7.5 Insulation Resistance	

Contents

1.0 SCOPE

The specification defines the key characteristics for the power supply. The power supply can be used for Server storage filed, and normal AC or HVDC input voltage can apply in the power supply. Output connector is output cable, and output port include +3.3V/+5V/+12V/-12V and +5VSB. The max output power is 400W.

2.0 INPUT PARAMETER

2.1 Input Voltage/Input Current/Frequency

The power supply should operate in input limited voltage range, and follow the specification defined as below table, includes the limited value of input current, input voltage, working frequency. The power supply should be turned on when 90VAC or 135VDC at min load and max load.

Table1.

	Min	Rated	Max	Units
AC input voltage	90	100~127	264	Vrms
		200~240		Vrms
Frequency	47	50/60	63	Hz
HVDC input voltage	135	145~350	380	Vdc
Input current	<6.3A@100-240VAC <5A@145-350VDC			

Note:

1. For 350V-380V only meet turn on at full load.

2.2 Inrush Current

Cold start at 230Vac/350Vdc input voltage at 25℃, when input power is applied to the power supply and any initial inrush current surge or spike of 1ms or less shall not exceed 40A peak per module. Any additional inrush current surges or spikes in the form of AC cycles or multiple AC cycles greater than 5ms shall not exceed 60A peak per module. The inrush shall be less than the ratings of the critical components. Any inrush current of the AC line shall not cause damage to the power supply. Surge current does not contain the current spike due to X-CAP.

2.3 Efficiency

Efficiency testing should be in ambient temperature:18degC-27degC, input voltage at 230Vac/50Hz. Efficiency testing delay time should be 15min after running the PSU, and so that the PSU in under steady state. Negligible fan loss and the power of the fan should be supplied by an external DC source. Test with one module (1+0).

Table2.

Load	+3.3V	+5V	+12V	-12V	+5Vsb	EFF
20%	2.4A	2.4A	4.77A	0.07A	0.4A	>84%
50%	6A	6A	11.91A	0.15A	1.0A	>89%
100%	12A	12A	23.82A	0.3A	2.0A	>88%

2.4 Hold up Time

Hold up time is defined length of time from AC input drops to 0V to +12V dropping out of voltage regulation range at any phase of the AC, the power supply should meet dynamic voltage range.

1. Hold up time +12Vout>=13ms with 80%load (90-264VAC)
2. Hold up time PG>=12ms with 80%load (90-264VAC)

2.5 Power Factor

Power factor is used to measure the power efficiency of the data used in electrical equipment. It is necessary for meeting the energy star's computer server 2 standard requirements. Input voltage condition: 230Vac/50Hz, power factor meets the requirement as below table and tested with one module (1+0).

Table3.

Vin	Load	PF
115Vac	100% Load	> 0.95
230Vac	100% Load	> 0.95

2.6 Surge and Sag

The dynamic conditions of mains input are defined as sag and surge. Sag is mains drop to below normal voltage, surge refers to the input voltage rises above the normal range, the PSU should meet sag and surge requirement.

Table4. Surge and Sag

Duration	Surge/Sag	Input Voltage	Frequency	Performance Criteria
500ms	10%	220/110VAC 240VDC	50/60Hz	No loss of function or performance
0 to 1/2 AC cycle	30%	220/110VAC 240VDC	50/60Hz	No loss of function or performance
=1/2 AC cycle	30%	220/110VAC 240VDC	50/60Hz	No loss of function or performance
>1/2 AC cycle	>30%	220/110VAC 240VDC	50/60Hz	Loss of function acceptable, Power supply can turn on automatically

3.0 OUTPUT PARAMETER

3.1 Output Current

The following table defines the current ratings. The combined output power of all outputs shall not exceed the rated output power. The power supply shall meet both static, dynamic voltage regulation and timing requirements for the min/ max loading conditions.

Table5. Output Current

Output Voltage	Min Current	Max current
+3.3V	0A	18A
+5V	0A	18A
+12V	0.5A	33A
-12V	0A	0.5A
+5VSB	0A	3A

Note:

1. The continuous total output power is 400W max.
2. The combined power of +5V and +3.3V is 110W max.

3.2 Voltage Regulation

The power supply output voltage must stay within the following voltage limits shown in below table when operating at steady state, dynamic loading conditions.

Table6. Output Voltage

Output Voltage	Min	Rated	Max	Tolerance
+3.3V	3.135V	3.3V	3.465V	+/-5%
+5V	4.75V	5.0V	5.25V	+/-5%
+12V	11.4V	12.0V	12.6V	+/-5%
-12V	10.8V	12.0V	13.2V	+/-10%
+5VSB	4.5V	5.0V	5.5V	+/-10%

Table7. Load Regulation Test Table

	+3.3V	+5V	+12V	-12V	+5VSB
Load1	0.0A	0.0A	0.5A	0.0A	0.0A
Load2	12A	12A	23.8A	0.3A	2A
Load3	6A	6A	11.9A	0.15A	1A
Load4	2.4A	2.4A	4.7A	0.06A	0.4A
Load5	18A	10A	22.5A	0.5A	3A
Load6	6.06A	18A	22.5A	0.5A	3A
Load7	0A	0A	33A	0A	0A

3.3 Ripple & Noise

Table8. Ripple and Noise

Output voltage	Ripple & noise
+3.3V	<50mV
+5V	<50mV
+12V	<120mV
-12V	<120mV
+5VSB	<50mV

Note:

1. This is measured over a bandwidth of 20MHz at the output connector. A 10μF Electrolytic capacitor in parallel with a 0.1μF ceramic capacitor are placed at the point of measurement.

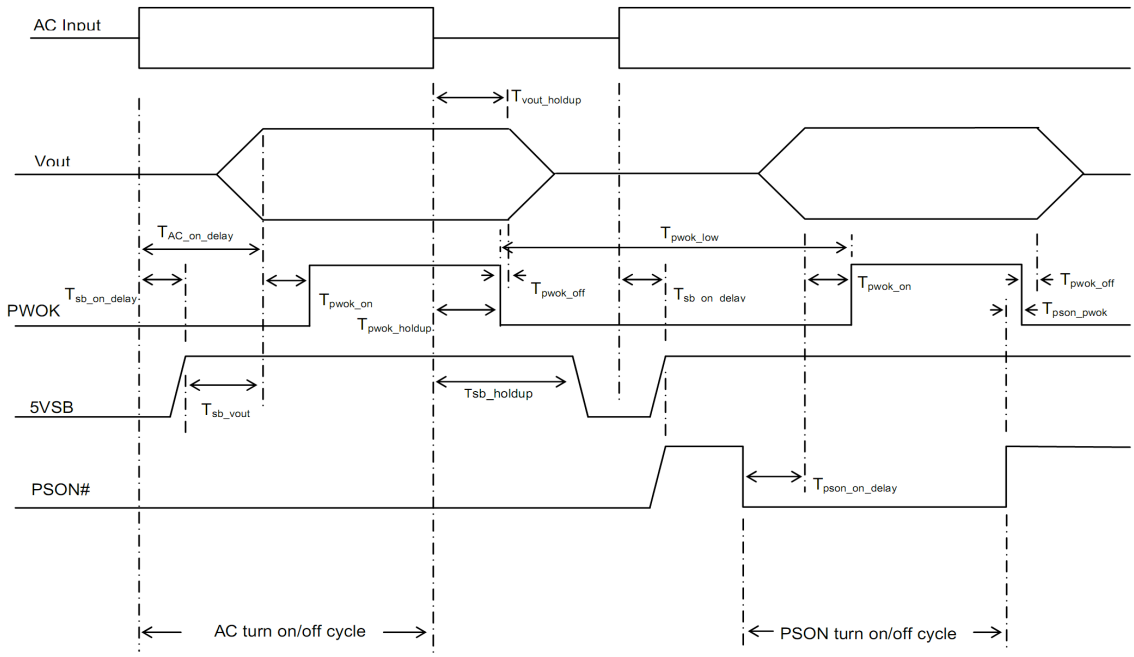
3.4 Timing

These are the timing requirements for power supply operation including alone module outputs and multi model outputs. All outputs shall rise and fall monotonically. However, PS timing must

meet the requirement of mother board. PS supplier must evaluate and verify the timing characteristics when in design stage and system test stage.

Table9. Turn On/Off Timing

Item	Description	Min	Max	Units
Tvout_rise	Output voltage rise from 10% to 90% time.	1	70	ms
Tsb_on_delay	Delay from AC being applied to 5Vsb being within regulation.		2000	ms
Tac_on_delay	Delay from AC being applied to 12V being within regulation.		2000	ms
Tsb_vout	Delay from 5Vsb being in regulation to 12V being in regulation at AC turn on.	50	1000	ms
Tpson_on_delay	Delay from PSON active to output voltages being within regulation limits.	5	500	ms
Tpwok_on	Delay from output voltages within regulation limits to PWOK asserted at turn on.	100	500	ms
Tvout_holdup	All output stay within regulation after loss of AC.	13		ms
Tpwok_holdup	Delay from loss of AC to de-assertion of PWOK.	12		ms
Tpwok_off	Delay from PWOK de-asserted to output voltages dropping out of regulation limits at 80% Load.	1		ms



3.5 Overshoot

Output voltage overshoot is less than 10% of nominal voltage at any load and any input voltage, the output rising up waveform should be kept flat and smooth.

Table10. Overshoot Table

Output Voltage	Overshoot (Max)
+12V	13.2V
+5VSB	5.5V

3.6 Dynamic

The overshoot is less than 10% with 30% load change. The load transient repetition rate shall be tested between 50Hz to 10 KHz at duty cycles rang from10%-90%. The test shall be at least in 50 Hz/1KHz/10KHz condition. The load transient repetition rate is only a test specification.

The output voltage shall remain within limits specified for the step loading, slew rate, and capacitive loading in below table.

Table11. Dynamic Table

Output Voltage	Transient Step (A) Percent of Rated current	A/us	Frequency (Hz)	Cap (uF)
+3.3V	30%	1.0	50-10K	10000
+5V	30%	1.0	50-10K	10000
+12V	30%	1.0	50-10K	10000

3.7 Capacitive Loading

The power supply shall be stable and meet all requirements with the following capacitive loading range. The PSU is not damaged include normal turn on timing, running under light load and full load.

Table12. Capacitive Loading Table

Output Voltage	+3.3V	+5V	+12V	-12V	+5VSB
Capacitive loading (uF)	10000	10000	31000	330	5000

3.8 Redundancy and Hot Swap

Hot swapping a power supply is the process of inserting and extracting a power supply module from an operating power system both stead and dynamic conditions with power cord as well as

without power cord. In general, a failed (off by internal latch or external control) supply module may be removed, and replaced with a good power supply module. However, hot swap needs to work with operational as well as failed power supply module.

The power supply shall meet following requirements while hot remove or insert the module to the cage:

1. The output voltage shall stay within the limits.
2. Output signal, such as PG, PS-ON shall not oscillate or change.
3. Current Sharing bus shall not oscillate.
4. Power supply shall not be overload and other protection.
5. The newly inserted power supply may get turned on by plugging AC into the external and meet the turn on requirements.

3.9 Return

All DC Returns (GND) are internally connected to frame ground.

3.10 Control Signal

3.10.1 PSON Signal

PSON signal is required to remotely turn on/off the power supply PDB. PSON is an active low signal that turns on +12V output. When this signal is not pulled low by the system, or left open, all the outputs (except for 5VSB) shall be turned off. This signal is pulled to a 5V voltage by a pull-up resistor internal to the system.

Table13. PSON Signal

Signal Level	Status	Logical Level (Min)	Logical Level (Max)
PSON high level	Turn off power	2V	4.7V
PSON low level	Turn on power	0V	1V
PSON rise and fall time		≦1ms	
High-state output impedance		Pull up a resistor between PSON and 5V	

3.10.2 PG Signal

PG signal is the logical signal for PSU under normal status: high level is power normal, low level is power abnormal.

Table14. PG Signal Characteristic

Signal Status	Status	Logical Level (Min)	Logical Level (Max)
PG high level	Power normal	2.4V	4.7V
PG low level	Power abnormal	0V	0.7V
Source current (PG high level)		≦2mA	
PG rise and fall time		≦1ms	
High-state output impedance		Pull up a resistor between PG and 5V	

4.0 PROTECTION

To operation safely and reliably, inside circuit in the power supply should have necessary protection function for various abnormal situations, include OCP, OVP, OPP, OTP, and SHORT. The main outputs will be latched off. The main outputs can be reset by cycle the AC &DC remote on/off. +5VSB output is auto recovery when fault condition removed. Power supply shall shut down and latch-off by fault or protection. When this fault or protection is removed, power supply must be able to turn on through toggling PS ON/OFF or AC ON/OFF re-cycles. The toggling time is <=1s by PSON turn on, and <=15s by AC turn on. The 5VSB protection mode is auto restart once the fault or protection is removed.

Output Voltage	Min Current	Max current
+3.3V	0A	18A
+5V	0A	18A
+12V	0.5A	33A
-12V	0A	0.5A
+5VSB	0A	3A

4.1 Over Voltage Protection (OVP)

When one module +12V occurs OVP, +12V should latch off, power supply must be able to turn on through toggling PS ON/OFF or AC ON/OFF re-cycle after remove the protection.

For redundant PS, once one power supply module (not PDB) is in OVP state due to the internal OVP trip point detected, another one will continue to work unless another one also occur internal OVP. Power supply must be able to turn on through toggling PS ON/OFF or AC ON/OFF re-cycle after remove the protection.

Table15. OVP Table

Voltage	Min(V)	Max(V)
+3.3V	3.7	4.5
+5V	5.9	7
+12V	13.2	15.6

4.2 Over Temperature Protection (OTP)

The power supply shall be protected against over temperature conditions caused by loss of fan cooling or excessive ambient temperature, which could cause internal parts failure. When the PSU shutdown in an oven temperature condition. The +5VSB shall not shut down during an OTP condition. When the temperature drops to within safe operating range for internal parts, the power supply shall restart power automatically.

The OTP circuit shall incorporate built in hysteretic (>5°C) such that the power supply does not oscillate on and off due to temperature recovery.

The ambient over temperature protection is set at55-65degC. and recovery point is 47-57degC.

4.3 Short Circuit Protection (SCP)

All output to GND. The power supply shall shut down and latch off when +12V output is short circuit (impedance less than 0.1ohm), and +5VSB shall be auto restart. The power should be under protection to keep component safe, whatever the outputs is shorten before turn on or shorten after turn on. The +12V can be recovery after removing short by AC on/off or PSON/OFF, but +5VSB can be auto restart after short is removed. The +5V and +3.3V can't be unlocked until 5Vsb is fully discharged.

4.4 Over Current Protection (OCP)

Table16. OCP Limited Table

Output	Min(A)	Max(A)
+3.3V	20	26
+5V	20	26
+12V	37	43

Note:

1. After OCP, the +12V output is turned off and locked, The +12V can be recovery after removing OCP by AC on/off or PSON/OFF, but +5VSB can be auto restart after OCP is removed. The +5V and +3.3V can't be unlocked until 5Vsb is fully discharged.

4.5 No Load Operating

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

4.6 Warning Method

Table17. Warning Method Table

Status		Module LED	Backplane LED	Buzzle	TTL Level
Normal		green	green	quiet	high
Fault	Only +5Vsb	orange	flash	alarm	low
	No +5Vsb	off	flash	alarm	low
Reset		orange/off	flash	quiet	low

Note:

1. Audio alarm: buzzer sounds, Can be eliminated by the reset button.

After unplug the abnormal modules, all signals will be back to normal.

5.0 CURRENT SHARE

As this power supply has redundant function, the output current sharing should within ±10% when half, full load and within ±15% at light load as below. The supplies must be able to load share in parallel and operate in a hot-swap/redundant configuration.

Table18. Load Regulation Test Table

	+3.3V	+5V	+12V	-12V	+5VSB	SPEC
Load1	2.4A	2.4A	4.77A	0.06A	0.4A	±15%
Load2	6A	6A	11.91A	0.15A	1A	±10%
Load3	12A	12A	23.82A	0.3A	2A	±10%

Two PSU working in parallel, when the load is under 20% to 100%, the current of redundancy PSU are not exceed the scope of below table accuracy, sharing degree is calculated as follows sharing degree =(I1-I2)/(I1+12). I1, I2 is PSU1, PSU2 output current.

Table19. Load Current Sharing

<20%	20%≦I<50%	50%≦I≦100%
≤15	≤10%	≤10%

6.0 OPERATE ENVIRONMENT

6.1 Operate Temperature

Operate temperature: 0℃ to +50℃.

6.2 Storage Temperature

Storage temperature: -40℃ to +70℃.

6.3 Operate Humidity

Operating Humidity(non-condensing at 40℃): 10% to 90%.

6.4 Storage Humidity

Storage Humidity(non-condensing at 50℃): 5% to 95%.

6.5 Operate Altitude

Operate Altitude: 0 to 5000m.

6.6 Storage Altitude

Storage Altitude: 0 to 10000m.

6.7 Cold Start

The power supply shall be able to turn on at 0degC.

7.0 SAFETY

7.1 Safety Certification

Meet CCC

7.2 Hi-pot

Primary to secondary Hi-pot withstand voltage: 3000Vac or 4242Vdc, 60s, leakage current <10mA (PCBA).

Primary to grounding Hi-pot withstand voltage: 1500Vac or 2121Vdc, 60s, leakage current <10mA.

7.3 Grounding Impedance Test

Grounding impedance test using grounding current 32A and the impedance is less than 100mohm.

7.4 Leakage Current

Leakage current refers to the voltage applied to the no fault, between the metal parts with electrical insulated from each other, or between charged parts and grounding parts, the current formed through the medium around the insulated surface called leakage current. Leakage current is the current flowing through the insulation part under the action of the electrical line or equipment in the absence of failure and voltage. Therefore, it is one of the important symbols to measure the insulation quality of electrical appliances, and is the main quota of product safety performance. The leakage current is limited to a very small value, which plays an important role in improving product safety performance.

7.5 Insulation Resistance

Primary to Secondary: 500Vdc for 60S, the isolation resistance shall not be less than 100Mohm.

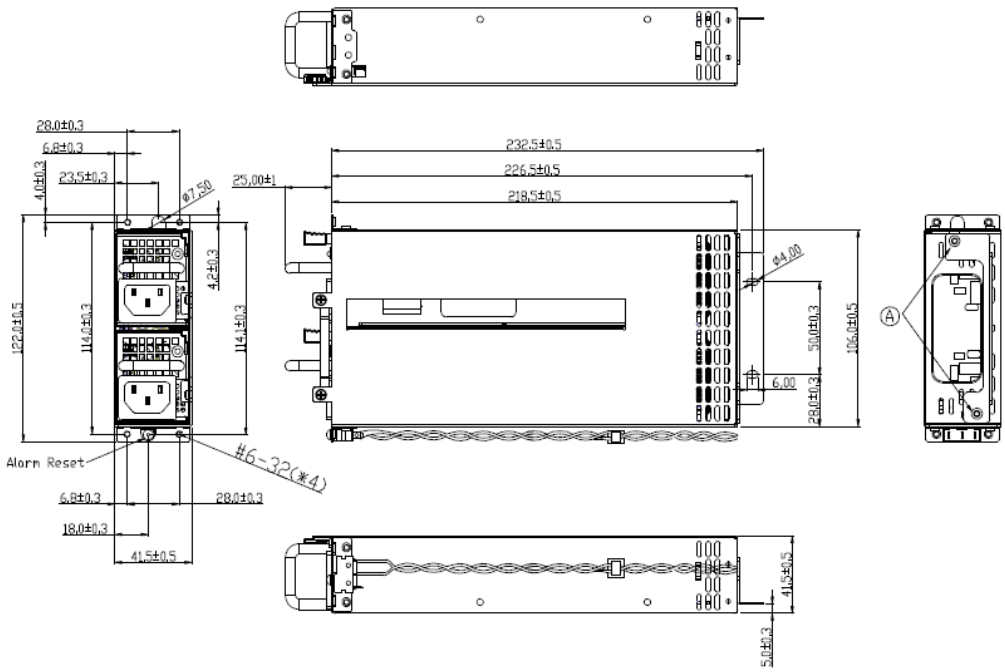
8.0 OUTLINE STRUCTURE

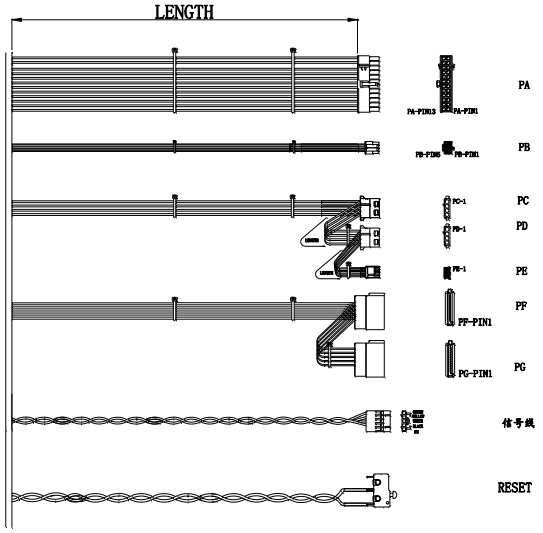
Outline dimension:

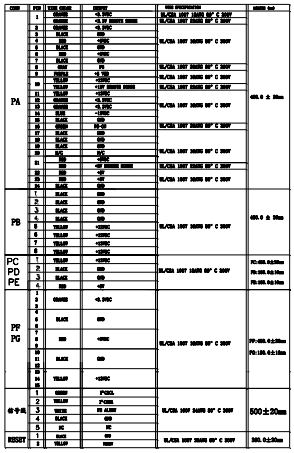
Length: 218.5mm

Width: 106.0mm

Thickness:41.5mm







NOTE:

PA	HOUSING:	WST P20+4-I4200ZH2	OR EQU
	TERMINAL:	WST I4200ZBS(PS)-A	
PB	HOUSING:	WST P4-I4200ZK3	OR EQU
	TERMINAL:	WST I4200ZBS(PS)-A	
PC PD	HOUSING:	WST P4-A10200	OR EQU
	TERMINAL:	WST A10200BS(PS)	
PE	HOUSING:	WST P4-I25001T	OR EQU
	TERMINAL:	WST I25001BS(PS)	
PF PG	HOUSING:	WST P6-I12702 WST I12702PL	OR EQU
	TERMINAL:		

9.0 RESTRICTED SUBSTANCE

9.1 ROHS

Power supply must meet be Rohs6 compliant including the component, PCB, soldering material, case, wire, and so on.

9.2 Restricted Substance

Recycled Plastics: Post-consumer recycled content plastics to constitute have a minimum of 4% of total supplier plastic purchases.

Packaging: Minimum 50% total recycled content, including 30% post-consumer recycled content for corrugated materials. Corrugated - min. 50% total recycled content, min. 30% post-consumer content.

Minimum 50% of total recycled content by weight is across all new systems for cushions.

10.0 EMC

10.1 Lighting

Lightning: for example, when lightning strikes outdoor lines, there are a large of current flowing into the external circuit or grounding resistor, and generating disturbance voltage, also, the indirect lightning (such as clouds or lightning in the clouds) induces voltage or current on the line, moreover, the lightning hit the adjacent objects and establish electromagnetic field in their surround. When outdoor line passes through the electromagnetic field, it will induce voltage or current on the line, also as lightning struck near ground, introduced the disturbance when the current pass through public grounding system.

1. Lightning test meet the IEC61000-4-4 electric fast transient standard, withstand voltage: +/-2KV. Performance criterion: A.

Table20. EFT Voltage Table

Lighting	Withstand Requirement
EFT	±2KV

2. Surge defined in 61000-4-5 standard, including the upper limit of the standard: 2 KV, including phase angle: 0 degree, 90 degree, 180 degree, 270 degree. It is suitable for input AC/DC power supply of six combinations (L1, L1-L2, L1-PE, L1-L2-PE, L2, and L2-PE). Performance criterion: A.

The requirement for surge is listed in the table as below.

Table21. Surge Voltage Table

Lighting	Common	Different
surge	±2KV	±1KV
resistance	12ohm	2ohm

Performance criterion:

A. Equipment can work in the specified conditions.

B. Test equipment temporary performance decline, loss of function or reset phenomenon, but it can be recovery itself.

C. Equipment has temporary performance decline or loss of function and it is restored by operator intervention or system.

D. Equipment has non recoverable performance degradation or loss of function due to component damage, software affected or data loss.

10.2 ESD

Power supply should be able to meet the IEC61000-4-2 ESD standard, the need to meet the level 4 requirements of contact 8KV, isolation 15KV standard. It should not have power product shutdown, signal drop, product burning and other undesirable phenomena. Performance criterion: A.

A. Equipment can work in the specified conditions.

B. Test equipment temporary performance decline, loss of function or reset phenomenon, but it can be recovery itself.

C. Equipment has temporary performance decline or loss of function and it is restored by operator intervention or system.

D. Equipment has non recoverable performance degradation or loss of function due to component damage, software affected or data loss.

Table22. ESD Degree of Severity

ESD Grade	Contact	Air
3	6KV	8KV

10.3 EMI

Electromagnetic interference (EMI) project basic requirements: radiation interference (RE) and conduction interference (CE), and it shall meet the standard requirements of CLASS B. CE satisfy 3dB margin ,Electromagnetic interference EMI (Electromagnetic Interference), there are two kinds: conduction interference and radiation interference.

Table23. Conduction Performance Requirement

Item	Frequency Segment	Reference Standard	Note
Conduction interference	150KHz~30MHz	EN 55022	115V/60Hz, 230Vac/50Hz

Table24. Conduction CLASS B Standard Limitation

Frequency (MHz)	Limitation (dBuV/m)	
	QP	AVG
0.15-0.50	66~56	56~46
0.5-5	56	46
5-30	60	50

Table25. Radiation Index Requirements

Item	Frequency Segment	Reference Standard	Note
Radiation interference	30MHz~1GHz	EN 55022	115V/60Hz,230Vac/50Hz

Table26. Radiation Class B Standard Limitation

FREQ	Limitation (dBuV/m)
30-230MHz	40
230-1000MHz	47

11.0 PART CONTROL REQUIREMENTS

1. All current limiting devices shall have UL, TUV or VDE certification and shall be identified as applications in which the device complies with IEC60950.

2. All printed circuit board ratings shall meet UL94V - 0 and those from UL certified PCB manufacturers.

3. All joints shall pass UL certification and UL flame retardant rating UL94V-0.

4. All wiring harness shall be from UL certified wiring harness manufacturer. SELV cable is rated at minimum 80V, 130degC.

5. Product safety labels must be printed with UL certified labels and ribbons. In addition labels can be purchased from UL label manufacturers for approval.

6. The product must have the correct regulatory marks to support the certification specified in this document.

12.0 MECHANICAL PERFORMANCE

Mechanical vibration experiment is mainly to simulate the product vibration experiment in the work and transport process, the purpose is to test whether the product can meet certain specifications of vibration intensity, the main test items include:

1. Work random vibration.
2. Work shock.
3. Packaging random vibration.

Table27. Mechanical Requirement

NO	Experiment Item	Sample	Standard	Parameter	Criterion

1	work random vibration	≥3	IPC9592A-2010 IEC60068-2-64	ASD: 20~1000Hz: 0.04g2/Hz; 1000~2000Hz: 6db/oct; 2000Hz: 0.01g2/Hz. About 8Grms. 3 axial, each axial at least 10min. Test process sample power on, normal input voltage, no load. During the test, each power output and signal output should be monitored continuously. The monitoring period should be less than 1ms.	Power supply voltage is Within the specification limits during the test.
2	work shock	≥3	IPC9592A-2010 IEC60068-2-27	Half sine wave, 16ms, at least 30g. 3 axial, each axial 3 times. During the test, each power output and signal output should be monitored continuously. The monitoring period should be less than 1ms.	Power supply voltage is Within the specification limits during the test.

3	packaging random vibration	≥3	IPC9592A-2010 IEC60068-2-64	ASD: 5~1000Hz: 0.05g2/Hz; 1000~2000Hz: 6db/oct; 2000Hz: 0.0125g2/Hz. About 9Grms. About 9Grms, 3 axial, each axial at least 10min. Each PSU should have independent packaging follow normal delivery.	After the test, product should be inspected. Allows minor damage without affecting appearance, installation, or function. Connector pins are not allowed to bend, switch damage, handle damage. Label readability is poor, metal deformation or bending. All equipment through functional testing. Test shipment packaging damage degree does not make judgment requirements.

13.0 MTBF

100K hours minimum. Quantitative reliability (Quantitative) performance requirements: MTBF (MTBF Mean Time Between Critical Failure), according to the Bellcore standard SR-332 Issue3, the PSU operates continuously under 25degC condition, 230V/50Hz input voltage under max load, and MTBF is more than 100000 hours, the testing process should not be interrupted.

Table28.

Input Voltage	Load	MTBF
230VAC/50Hz	12V/33A	100000hours

14.0 HALT

Highly accelerated life test, HALT is a kind of process of defect detection, by setting the incremental stricter environmental stress, to expose accelerated test sample defects and weak points, and then have analysis and improvement to defects and faults at design, process and material aspects, so as to improve the purpose of reliability, the biggest feature is setting higher environmental stress of the designed sample running limitation, so that the exposure fault time is much shorter than the normal fault reliability time under the condition of force. Test procedure and test report must meet the "IPC9592B-2012" requirements.

High acceleration life test specific testing includes points as below:

1. Gradually apply stress until the product failure or fault.

2. Take temporary action to correct product failure or fault.

3. Continue to apply stress gradually until the product fails again and correct again.

4. Repeat the above test steps from failure to improve.

5. Find out the basic operating limitation and basic damage limits.

Experimental process:

1. Temperature uniformity test:

After the test at room temperature for the test sample, before low temperature step stress test and turn off test sample power, adjust wind tube position, Device surface temperature is at ambient temperature, adjust the temperature to 50degC, the Duration time for 5min, record temperature of the key chip, and the layout of the site after temperature stability, until the temperature difference of all points is less than Plus or minus 3degC, then start experiment.

2. Temperature step stress test:

Temperature step stress test, have two stages: low temperature and high temperature. The first implementation of low temperature stress test stage, then high temperature stress test, the specific steps are as follows: the test should start from room temperature (20 DEG to 30 DEG); the maximum temperature step level: -10degC (low step) and +10degC (high temperature step); each temperature dwell times should be enough long (at least 10 minutes), until the thermocouple measurements value on the sample reached stable. The function of the test sample can be carried out under temperature stable, may also have been carried out in the whole process of the test sample; until find the operating limits or test has reached limit capacity of HALT test box, the test can be stopped; After determining the operating limits of the product, temperature step test should to be continued. The stress range is between the sample operation and destroying limits and the limit of HALT test box.

3. Rapid temperature change cyclic stress test:

Rapid temperature cyclic stress tests shall be performed at least 5 cycles, unless the test sample exhibits a non-recoverable failure in the test. Temperature change test rate according to the provisions of

test program (not to exceed the maximum temperature change rate of HALT equipment); the lowest temperature test than the lowest temperature limit of 10degC higher (or 80%), the highest temperature is 10 degrees lower than the maximum working temperature limit (or 80%). At least 5 minutes in the temperature extremes, dwell time should be long enough, until the thermocouple measurements on the sample to achieve stability. In the whole process of rapid temperature change cyclic stress test, the samples should be functional monitored to judge whether the test samples will cause failure due to rapid temperature changes.

4. Vibration step stress test:

The vibration order of the experiment was 5~10Grms (recommended 10Grms), the frequency was between 2 and 5000Hz, or higher frequency range. At the end of each vibration magnitude and sample dwell function tests, and then test the vibration magnitude increasing with 5~10Grms (recommended 10Grms), the dwell time at each order of magnitude should not be less than 10 minutes about vibration stress, then test the product function, Until find the sample's operation and destroying limits, due to the stress range, the sample may fail, so it is necessary in all vibration stress level test, reduce stress, determine whether the samples can return to normal.

5. Comprehensive stress test:

The comprehensive stress test performed at least 5 cycles, unless the sample failure does not be recovered in the experiment; the temperature cycling curve of extreme settings is same as rapid temperature change of cyclic stress, the resident time at the extreme temperature is at least 10 minutes; Vibration level in the comprehensive vibration is the first four cycle, vibration =90%* vibration limit cycle number /4* operation, the fifth cycles of vibration stress reduced to 5Grms. After a certain period of time at vibration level, the test product should be functional detection. Test residence time will be appropriately extended according to the time required for product functional testing.

15.0 THERMAL SHOCK TEST

Thermal shock test is a testing technique to test the resistance of material to extreme high temperature or extremely low temperature. This situation is similar to the case of discontinuous in high temperature or low temperature. It can make various objects complete the test in the shortest time. The changing of chemical or physical damage producing in the TST is caused by Thermal changing or changing of other physical value. The effects of TST include electrochemical changes caused by product crack or fracture and displacement.

TEST method:

1. In the temperature controlling room, it change from normal temperature 25degC to low temperature -40degC usually, and bake for 30 minutes under low temperature.

2. Temperature of controlling room changes from low temperature -40degC to high Temperature 70degC usually, changing time is 2min., and high temperature baking for 30 minutes.

3. After 10 cycle changing between the high temperature of 70degC and low temperature -40degC, the temperature returned to normal temperature, and removed the power (at least restore for 4 hours).

4. Confirm the label, case withstand voltage and electrical performance of the tested product before and after test.

Note:

1. After TST test product, performance and appearance of PSU should not appear degradation and degradation phenomenon.

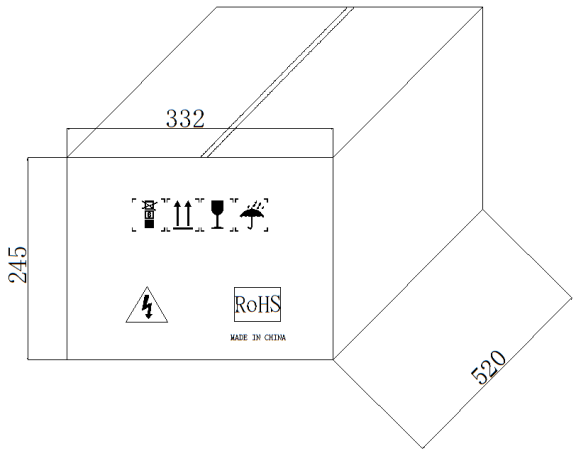
2. The dielectric strength and insulation resistance after thermal shock test products shall meet the requirements of specifications.

3. Products are non-operating condition.

16.0 PACKAGE

Power supply module package shall be the Anti-ESD bag to avoid power supply damage in shipment.

16.1 Outline Diagram of Carton



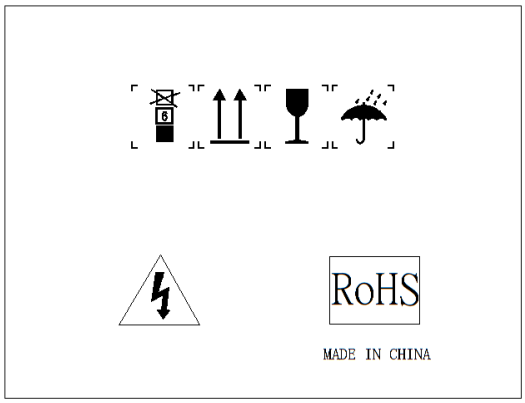
Note:

1. Material: outside the box: K=K, five layers of corrugated paper, the thickness: 6.0mm min, Naipoli: 11KG min.

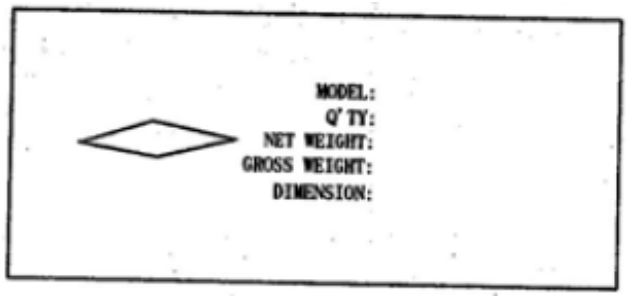
2. Outline: bright and clean, no stain, yellow white and no color difference, no gap junction.

3. Dimension: above dimensions for carton size, tolerance +/-3mm.

16.2 Side Label



16.3 Front Label



17.0 SOFTWARE

17.1 PMBus Communication

There is 4.5V voltage to supply the MCU's Vcc in power supply. The MCU in power supply can communication with system via PMBus1.2 protocol. The power supply output terminal has two signals, one is SCL (clock bus), the other is SDA (data bus), and they are bidirectional communication and can get a continuous signal bus. The supply voltage of bus is 3.3 ~ 4.5V, so SDA (data bus) and SCL (clock bus) needs to be pulled up a 3.6K resistor from system board's 3.3V or 4.5Vvoltage.

We can set address of MCU via power module's A0 signal. SCL- Serial Data Clock Input, 100KHz max, SDA- Serial Data I/O.

Table29. IIC Address

Equipment	Address	Address Bit							
MCU	0xBx	1	0	1	1	0	0	A0	R/W

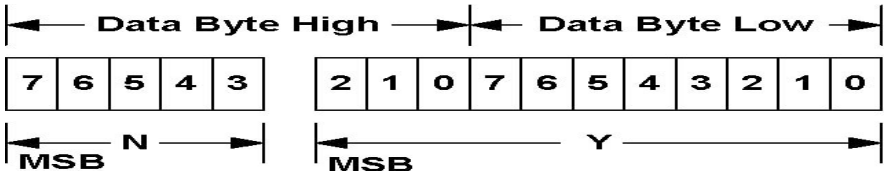
Table30. MCU Address Diagram

Address bit A0	I2C Address for Read Operation
Low (<0.5V)	B0H
High (<3.6V)	B2H

17.2 PMBus Specification

Linear Data Formats:

The Linear Data Format is a two byte value with: An 11 bit, two's complement mantissa and A 5 bit, two's complement exponent (scaling factor). The format of the two data bytes is illustrated in below Figure.



The relation between Y, N and the "real world" value is: $X = Y \cdot 2N$.

Where, as described below:

X is the "real world" value being communicated.

Y is an 11 bit, two's complement integer.

N is a 5 bit, two's complement integer.

Devices that use the linear format must accept and be able to process any value of N.

17.3 PMBus Command Supported

Table31. STATUS_WORD Command

Byte	Bit	Status Bit Name	Meaning	Support
Low	7	BUSY	A fault was declared because the device was busy and unable to respond.	No
	6	OFF	This bit is asserted if the unit is not providing power to the output, regardless of the reason, including simply not being enabled.	Yes
	5	VOUT_OV	An output over voltage fault has occurred.	Yes

	4	IOUT_OC	An output over current fault has occurred.	Yes
	3	VIN_UV	An input under voltage fault has occurred.	Yes
	2	TEMPERATURE	A temperature fault or warning has occurred.	Yes
	1	CML	A communications, memory or logic fault has occurred.	No
	0	NONE OF THE ABOVE	A fault or warning not listed in bits [7:1] of this byte has occurred.	No
High	7	VOUT	An output voltage fault or warning has occurred.	Yes
	6	IOUT/POUT	An output current or output power fault or warning has occurred.	Yes
	5	INPUT	An input voltage, input current, or input power fault or warning has occurred.	Yes
	4	MFR	A manufacturer specific fault or warning has occurred.	No
	3	POWER_ GOOD#	The POWER_GOOD signal, if present, is negated.	Yes
	2	FANS	A fan or airflow fault or warning has occurred.	Yes
	1	OTHER	A bit in STATUS_OTHER is set.	No
	0	UNKNOWN	A fault type not given in bits [15:1] of the SATUS_WORD has been detected.	No

Table32. STATUS_VOUT Command

Bit	Meaning	Support
7	VOUT Over voltage Fault	Yes
6	VOUT Over voltage Warning	No
5	VOUT Under voltage Warning	No
4	VOUT Under voltage Fault	Yes
3	VOUT_MAX Warning (An attempt has been made to set the output voltage to value higher than allowed by the VOUT_MAX command)	No
2	TON_MAX_FAULT	No
1	TOFF_MAX Warning	No
0	VOUT Tracking Error	No

Table33. STATUS_IOUT Command

Bit	Meaning	Support
7	IOUT Over current Fault	Yes
6	IOUT Over current And Low Voltage Shutdown Fault	No

5	IOUT Over current Warning	Yes
4	IOUT Undercurrent Fault	No
3	Current Share Fault	No
2	Power Limiting	No
1	POUT Overpower Fault	No
0	POUT Overpower Warning	No

Table34. STATUS_INPUT Command

Bit	Meaning	Support
7	VIN Over voltage Fault	No
6	VIN Over voltage Warning	No
5	VIN Under voltage Warning	No
4	VIN Under voltage Fault	Yes
3	Unit Off For Insufficient Input Voltage	No
2	IIN Over current Fault	No
1	IIN Over current Warning	No
0	PIN Overpower Warning	No

Table35. STATUS_TEMPERATURE Command

Bit	Meaning	Support
7	Over temperature Fault	Yes
6	Over temperature Warning	Yes
5	Under temperature Warning	No
4	Under temperature Fault	No
3	Reserved	No
2	Reserved	No
1	Reserved	No
0	Reserved	No

Table36. STATUS_FAN_1_2 Command

Bit	Meaning	Support
7	Fan 1 Fault	Yes
6	Fan 2 Fault	No
5	Fan 1 Warning	Yes
4	Fan 2 Warning	No

3	Fan 1 Speed Overridden	No
2	Fan 2 Speed Overridden	No
1	Airflow Fault	No
0	Airflow Warning	No

Table37.

CMD Code	Name	Type	Bytes	Comment
03h	CLEAR_FAULTS	Send Byte	0	
79h	STATUS_WORD	Read Word	2	
7Ah	STATUS_VOUT	Read Byte	1	
7Bh	STATUS_IOUT	Read Byte	1	
81h	STATUS_FANS_1_2	Read Byte	1	
8Bh	READ_VOUT	Read Word	2	
8Ch	READ_IOUT	Read Word	2	
90h	READ_FAN_SPEED_1	Read Word	2	Rpm value
96h	READ_POUT	Read Word	2	
98h	PMBUS_REVISION	Read Byte	1	V1.2(0x22)
99h	MFR_ID	Read Block	14	See MFR Data table
9Ah	MFR_MODEL	Read Block	14	See MFR Data table
9Bh	MFR_REVISION	Read Block	6	See MFR Data table
A0h	MFR_VIN_MIN	Read Word	2	See MFR Data table
A1h	MFR_VIN_MAX	Read Word	2	See MFR Data table
A4h	MFR_VOUT_MIN	Read Word	2	See MFR Data table
A5h	MFR_VOUT_MAX	Read Word	2	See MFR Data table
A6h	MFR_IOUT_MAX	Read Word	2	See MFR Data table
A8h	MFR_TAMBIENT_MAX	Read Word	2	See MFR Data table
A9h	MFR_TAMBIENT_MIN	Read Word	2	See MFR Data table