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Electrical Specification

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Rev	Description	Date
S0	Release	2019/10/29
S1	1.Table 6 ： Update 180-210Vac to 180V-200Vac; Update 210-264Vac to 200V-264Vac 2.Peak Load requirement: Update 220Vac-240Vac,240Vdc-310Vdc to 220Vac-240Vac,240Vdc-340Vdc 3.Table 25:Surge:Update Common Mode to ±2KV/12ohm ,Different Mode: ±1KV/2ohm,del GR-1089-CORE 4.Del the Note of Table 25: Performance criterion of the voltage fluctuation immunity test content 5.6.3 Grounding Impedance Test: Update 32A/60S to 40A/120S 6.Update item 7.0 Outline dimension 7.Update item 11.0 Package	2020/08/10

Contents

1.0 SCOPE

This specification defines the key characteristics for the 2000W power supply, which is intended for worldwide use in IT equipment such as server application. This unit contains +12V and +12Vsb output. The input connector is compatible with IEC C20 standard. The physical size of the power supply enclosure is 39/40(H)mm x 73.5(W)mm x 185(L)mm. and contains a single rotor fan (40x40x28mm).All the specifications are applicable under all operating conditions when installed in the end used system unless other noted.

2.0 INPUT PARAMETER

2.1 Input Voltage/Input Current/Frequency

The power supply shall operate within input limited voltage range as defined as Table 1, which includes the limited value of input current, input voltage, working frequency. The power supply shall be capable of start up from min load to max load at line input as low as 90VAC.

Table1.

	Min	Rated	Max	Units
AC input voltage	90	100~240	264	VAC
Frequency	47	50/60	63	Hz
DC input voltage	200	240	340V	VDC
Input current (RMS)	<15A@100~240VAC <15A@240VDC			

2.2 Inrush Current

When input AC/HVDC is applied to the power supply, The AC line inrush current shall not exceed 50A(230Vac) Peak for up to one-quarter of the AC cycle per module with the condition of cold start at 25℃ ambient. Any additional inrush current surges or spikes in the form of AC cycles or multiple AC cycles dropout should be less than the ratings of the critical components(including input fuse, bulk rectifier, and surge limiting device).

And 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. But the peak current during time should < 0.2ms.

2.3 AC Line Fuse

The power supply has a fuse in the live line wire of the input. The line fusing shall be acceptable for safety agency requirements. The input fuse shall be a fast blow type. The input 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.

2.4 Efficiency

The power supply achieves the 80 plus platinum level by testing at the 230Vac/50Hz, 25degC ambient temperature and the loading condition show in Table 2.

Table2.

Load	+12V	+12Vsb	EFF
10%	16.4A	0.3A	>85%
20%	32.8A	0.6A	>90%
50%	82A	1.5A	>94%
100%	164A	3A	>91%

Note: The fan power consumption is not included in efficiency calculation.

2.5 AC Line Dropout

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

Table3.

AC Power Holdup Requirement	Loading	PWOK Hold up Time (ms)
	80% Load	8.0

2.6 Power Factor and iTHD

The power supply must meet the power factor requirements stated in the Energy Star Program Requirement for Computer Servers V2.0.

Input condition	Output condition	PF value
230Vac/50Hz	10%	≥0.9
	20%	≥0.96
	50%	≥0.98
	100%	≥0.99

Input voltage	load	Max iTHD
200Vac~240Vac50-60Hz	≤5%	/
	＞5%-10%	20%
	＞10%	15%
	＞20%	10%
	＞40%	8%
	＞50%-100%	5%

2.7 Surge and Sag

AC line transient conditions are defined as “sag” and “surge”. “Sag” is defined as the AC line voltage drops below nominal voltage. “Surge” is defined as the AC line voltage rises above nominal voltage. The power supply should meet below AC line sag and surge conditions.

Table4. AC Line Sag Transient Performance

Duration	Sag	Input Voltage	Frequency	Performance Criteria
=1/2 AC cycle (80% Load)	95%	100~127VAC 200~240VAC	50/60Hz	No loss of function or performance
>1.0 AC cycle	>30%	100~127VAC 200~240VAC	50/60Hz	Loss of function acceptable

Table5. AC Line Surge Transient Performance

Duration	Surge	Input Voltage	Frequency	Performance Criteria
Continuous (80% Load)	10%	100~127VAC 200~240VAC	50/60Hz	No loss of function or performance
0 to 1/2 AC cycle (80% Load)	30%	115VAC/230VAC	50/60Hz	No loss of function or performance

3.0 OUTPUT PARAMETER

3.1 Output Current

The following table defines the output 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 all loading conditions defined in specification.

Table6.

Output Voltage	Output Voltage（A）		
	Min	Max	Unit
+12V（90～100VAC）	1	83	A
+12V（100～127VAC）	1	100	A
+12V（180-200VAC）	1	150	A
+12V（200-264VAC）	1	166	A
+12V（200-340VDC）	1	166	A
+12VSB	0.05	3.0	A

Peak Load requirement

Input Voltage	Output	Continuous power	CLST 20s	Pmax.app 10ms	Pmax.peak 100us	System Cap
220Vac-240Vac 240Vdc-340Vdc	12V	PSU rating	Rated + 6A	Rated + 30A	Rated + 45A	6*1500uF
Rated Voltage	12VSB	3A	4A	NA	NA	NA

3.2 Voltage Regulation

The power supply output voltages must stay within the following voltage limits shown in below table when operating at steady state, dynamic loading conditions. All outputs are measured with reference to the return remote sense (Return_S) signal.

Table7.

Output Voltage	Min	Rated	Max	Tolerance
+12V	11.4V	12.0V	12.6V	+/-5%
+12Vsb	11.4V	12.0V	12.6V	+/-5%

3.3 Ripple & Noise

Table8.

Output voltage	Ripple & noise
+12V	<120mV
+12Vsb	<120mV

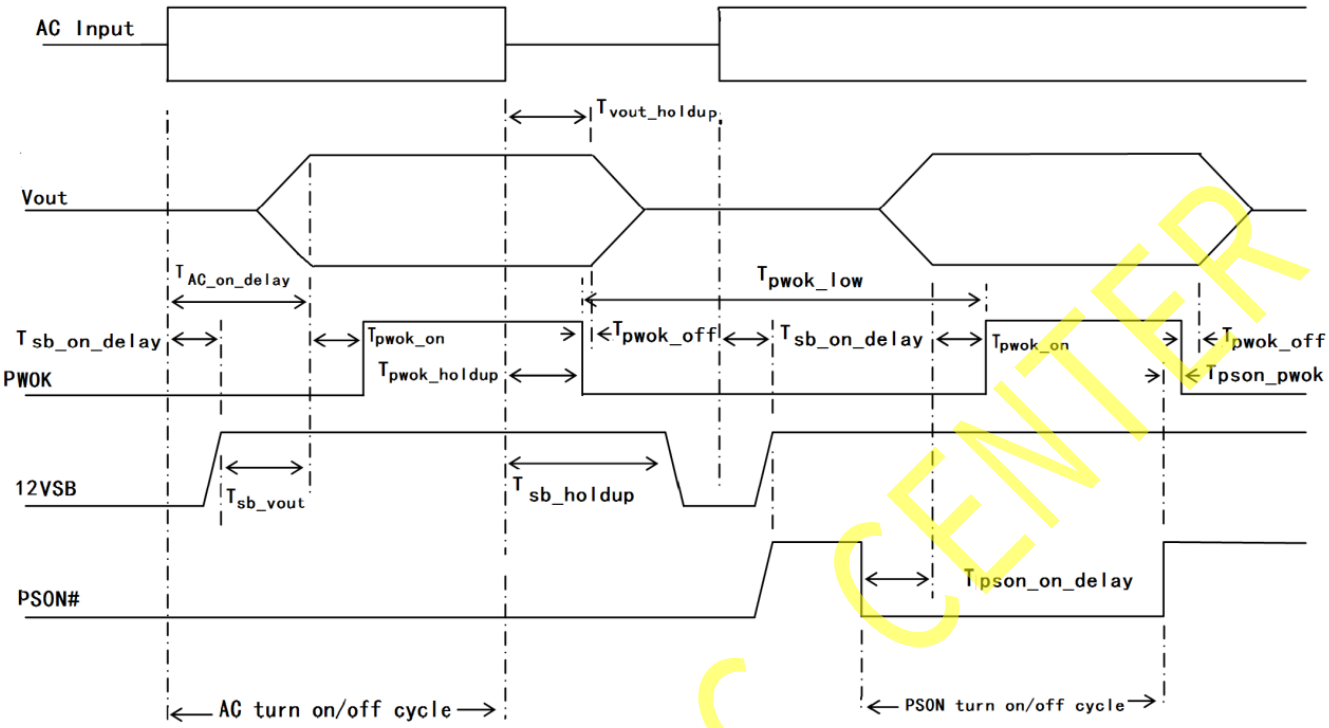
Note: The ripple & noise is measured over a bandwidth of 20MHz at the power supply output connectors. A 10μF Electrolytic capacitor in parallel with a 0.1μF ceramic capacitor is placed at the point of measurement. A additional 2200uF Low ESR Capacitor for 12V when measure Ripple Noise.

3.4 Timing

These timing requirements for power supply operation include alone module's output and multi modules' outputs. All outputs shall rise and fall monotonically. In additional, PSU timing must meet the requirement of mother board. The timing characteristics must be evaluated and verified when in design stage and system test stage.

Table9. Turn On/Off Timing

Item	Description	Min	Max	Units
Tsb_on_delay	Delay from AC being applied to +12Vsb being within regulation.		1500	ms
Tac_on_delay	Delay from AC being applied to +12V being within regulation.		3000	ms
Tvout _rise	Output voltage rise from 10% to 90% time for +12V.	5	70	ms
Tvout _rise	Output voltage rise from 10% to 90% time for +12Vsb.	1	25	ms
Tsb_vout	Delay from +12Vsb being in regulation to +12V being in regulation at AC turn on.	50	1500	ms
Tpson_on_delay	Delay from PSON active to output voltages being within regulation limits.	5	400	ms
Tpwok_on	Delay from output voltages within regulation limits to PWOK asserted at turn on.	100	500	ms
Tvout_holdup	Time 12V output voltage drop to 10.8V after loss of AC. (80%Load)	11		ms
Tpwok_holdup	Delay from loss of AC to de-assertion of PWOK. (80%Load)	10		ms
T12Vsb_hold up	Time the +12Vsb output voltage stays within regulation after loss of AC.	70		ms
Tpwok_off	Delay from PWOK de-asserted to output voltages dropping out of regulation limits.	1		ms
Tpwok_low	Duration of PWOK being in the de-asserted state during an OFF/ON cycle using AC or the PSON signal.	100		ms
Tpson_pwok	PWOK being de-asserted delay from PSON deactivate.		5	ms



3.5 Overshoot

The turn-on overshoot due to application of AC input or remote enable shall be < 10% of the nominal output voltage for any application of input voltage within the specified range.

Overshoot/undershoot on turn on or restart must meet under all loading conditions, including minimum output capacitance on all output voltages.

3.6 Dynamic

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

The load transient repetition rate shall be tested between 50Hz to 5KHz at 50% duty cycles. And +12V's, +12Vsb's min load is 3.0A, 0.1A when do dynamic loading test. The test shall be at least in 50 Hz/1KHz/5KHz condition. The output current transient repetition rate is only a test specification.

Table10.

Output Voltage	Transient Step (A) Percent of Rated Current	Slew rate (A/us)	Frequency (Hz)	Cap (uF)
+12V	60% of max load	0.5	50-5K	2200uF
+12Vsb	1.0	0.5	50-5K	100uF

3.7 Capacitive Loading

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

Table11.

Output Voltage	+12V	+12Vsb
Capacitive loading (uF)	2000~50000	10~3100

3.8 Current Sharing

PSU shall have output Or-ing devices for 12V, and active load sharing for 12v, No requirement for 12vsb current share, 12V load sharing shall be a single wire type. Connecting the load share bus pins of each power supply together shall enable the current share feature. Load sharing accuracy is displayed in the following table. The startup loading should not exceed the rate output power at any redundant mode

Table12.

12V Load Sharing Specification (1+1)	
Load current	Specification
20%< Output Load<50% of full load	<=10%
>= 50% of full load	<=5%

Table13. 12V load sharing signal (12VLS) specification

Item	Meaning	Specification	Units
V-share; I out=Max for 12V	12V maximum load sharing bus voltage	8+/-0.4	V
ΔVo/ΔIo for 12V	12V load sharing bus voltage change rate	8/Imax	V/A

Note: 1+1 redundant mode the current sharing precision calculating formula is ｜Iout1-Iout2｜/(Iout1+Iout2).

3.9 Hot Swap Requirement

Hot swapping is the process of inserting and extracting a power supply from an operating power system. During this process the output voltage shall remain within the limits. The hot swap test must be conducted when the system is operating under static, dynamic and no loading conditions. The power supply shall use a latching mechanism to prevent insertion and extraction of the power supply when the AC power cord is inserted into the power supply. The power supplies must be able to operate in a hot-swap/redundant configuration.

3.10 No Load Condition

The power supply shall not be damaged nor cause abnormal operation at any load conditions including no load. The power supply shall be able to turn on and off under no load condition. The on and off waveforms shall be monotonic.

3.11 Output Regulation

All outputs shall remain within the tolerances in section 3.2's table 8 under all allowable load and temperature conditions during load variations on the other output voltage, any combination of the following conditions. The outputs will be measured at the output terminals.

1. Input operating rated range.
2. Specified load range.
3. Cross regulation on dual or multiple outputs.
4. Specified environmental conditions.

3.12 Grounding

The output ground of the pins of the power supply provides the output power return path. The output connector ground pins shall be connected to the safety ground (power supply enclosure). This grounding should be well designed to ensure passing the max allowed common mode noise levels. The power supply shall be provided with a reliable protective earth ground. All secondary return circuits shall be connected to protective earth ground.

3.13 Control Signal

3.13.1 Control and Status Signals

All control signals shall be TTL compatible with respect to the output return and shall be isolated from the primary circuit and be SELV (safety extra-low voltage circuit) rated.

3.13.2 PSON Input Signal

The PSON signal is required to remotely turn on/off the power supply. PSON is an active low signal that turn on the +12V power rail. When this signal is not pulled low by the system, or left open, the outputs (except the +12Vsb) turn off. This signal is pulled to a standby voltage by a pull-up resistor internal to the power supply. Refer to section 3.4 for the timing diagram. This signal accepts an open collector/drain input from the system and a 5.1K ohm resistor pull up to +3.3Vs located in power supply.

Table14. PSON Signal Characteristic

Signal Type	Power State	Logic Level (Min)	Logic Level (Max)
PSON=Low	ON	0V	1.0V
PSON=High or Open	OFF	2.0V	3.46V
Source Current (Low)	ON		2mA

3.13.3 PWOK (Power OK) Output Signal

PWOK is a power OK signal and will be pulled high when the power supply to indicate that all the outputs are within the regulation limits of the power supply. When any output voltage falls out of 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 de-asserted to a low state. The start of the PWOK delay time shall inhibited as long as any power supply output is in current limit. This signal is open collector/drain output and a resistor pull-up to +3.3Vs in power supply.

Table15. PWOK Signal Characteristic

Signal Type	Power State	Logic Level (Min)	Logic Level (Max)
PWOK=Low	Power Not OK	0V	0.4V
PWOK=High	Power OK	2.4V	3.46V
Sink Current (Low)			0.4mA
Source Current (High)			2mA
PWOK Rise and Fall Time			0.5ms

3.13.4 Alert Signal

This is low active, sideband and open collector signal indicates that the power supply is experiencing a problem, warning or fault that the user should investigate. The signal shall activate in

the case of critical component temperature reached a warning threshold, output over current warning, input under voltage fault. It's also to be asserted in parallel with LED turning solid Amber or blink Amber. This signal is open collector output and a 2K ohm resistor pull-up to +3.3Vs in power supply.

Table16. Alert Signal Characteristic

Signal Type	Power State	Logic Level (Min)	Logic Level (Max)
Alert=Low	Alert to system	0V	0.4V
Alert=High	Power OK	2.4V	3.46V
Sink Current, Alert=Low			4mA
Alert Rise and Fall Time			0.5ms

3.13.5 Input OK Signal

Input OK signal is an input voltage OK signal and will be asserted low to indicate the power supply's input voltage are within range. This signal accepts an open collector/drain input from the system and a 5.1K Ω resistor pull up to +3.3Vs located in power supply.

Table17. Input OK Signal Characteristic

Signal Type	Power State	Logic Level (Min)	Logic Level (Max)
Input OK Signal=Low	Input OK	0V	0.4V
Input OK Signal=High	Input Fail of Range	2.4V	3.46V

3.13.6 SDA and SCL Signal

SDA and SCL pins (for I2C bus) is designed to operate at +3.3V volts. The pull-up resistors are 10K ohm to +3.3Vs in power supply. We suggest the pull-up resistors on the system side of the SDA and SCL are 10K ohm.

3.13.7 A0, A1 Signal

PSU module address line 0 and line 1. This signal line is provided for determining the address for the specific PSU FRU and SMBus address. A resistor pull-up to +3.3Vs located in the PSU for each. The address line should be either float or pull low with equal to or less than 100ohm in the motherboard design.

3.13.8 SM_Bus Signal

Power supplies that support cold redundancy can be enabled to go into a low power state (that is cold redundant / standby redundant mode state) in order to provide increased power usage efficiency when system loads are such that both power supplies are not needed. When the power subsystem is in cold redundant mode, only the needed power supply to support the best power delivery efficiency is ON. Any additional power supplies; including the redundant power supply, is in cold standby state. Each power supply has an additional signal (SM_Bus—Standby Mode Bus) that is dedicated to supporting cold redundancy. This signal is a common bus between all power supplies in the system. SM_BUS is asserted when there is a fault in any power supply or the power supplies output voltage falls below the Vfault threshold etc. Asserting the SM_Bus signal causes all power supplies in cold standby state to power ON. Enabling power supplies to maintain best efficiency is achieved by looking at the load share bus voltage and comparing it to a programmed voltage level through a PMBus command. Whenever there is no active power supply on the cold redundancy bus driving a high level on the bus all power supplies are ON no matter their defined cold redundant roll (active or cold standby). This guarantees that incorrect programming of the cold redundancy states of the power supply will never cause the power subsystem to shut down or become over loaded. The default state of the power subsystem is all power supplies ON. There needs to be at least one power supply in cold redundant active state or standard redundant state to allow the cold standby state power supplies to go into cold standby mode.

Table18. SM_Bus Signal Characteristic

Signal Type	Power State	Logic Level (Min)	Logic Level (Max)
SM_Bus=Low	Active Redundant Mode	0V	0.4V
SM_Bus=High	Standby Redundant Mode	2.4V	3.46V

3.13.9 Power Cold Redundancy Requirement

3.13.9.1 Power MCU Address Settings

Power should support N+1 cold redundant (N≤3). Power address settings is refers to the below table.

Power MCU address settings

A1(B20 PIN)	A0(B19 PIN)	Power Internal MCU Address	Power slot position
0	0	B0	1
0	1	B2	2
1	0	B4	3
1	1	B6	4

3.13.9.2 Cold Redundancy Configuration

There is a Cold_Redundancy_CONFIG(D0h)command in power supply, the system can read or write access. The format of the command for example: the command S B0 w D0 01 PEC P is to set the register of power supply B0 to 01h. According to the requirements, the value of the register can be set to 00h / 01h / 02h /03h / 04h according to the requirements. The different value represents the diffident meaning that can refer to the descriptions from the below table.

Cold Redundant Configuration Description

Cold Redundant Configuration(D0h)		
Value	State	Description
00h	Standard Redundancy	Power loading in average cold redundant
01h	Cold Redundant Active	Normal operating output power from cold redundant.
02h	Cold Standby 1	Standby power1 without output power from cold redundant.
03h	Cold Standby 2	Standby power2 without output power from cold redundant.
04h	Cold Standby 3	Standby power3 without output power from cold redundant.
Remarks: The power supply which is in cold standby mode will not involve the output loading by slightly decrease its output voltage		

The default factory setting state is standard redundancy; its value is 00h.

When power supply occurs any abnormal conditions (including AC cord plugging in/out, power off reset, over-temperature warning, ambient temperature out of range; 12V short protection, UVP, OVP, OCP, Fan alert and abnormal internal circuit) will make the register value reset to default 00h, and also set the Cold Redundant BUS short for CRB (B22 PIN) to low level, force the other paralleled operating power supplies into standard redundancy state.

3.13.9.3 Cold Standby Signal Require

The essential condition for power supply access into cold standby state: PSON is low level, the register value should be 02h/03h/04h. At the same time the requirements for the power supply which is access into cold standby state as below:

When CRB is low level, the power of cold redundant active and cold standby should be awaked immediately and the D0h value recover to 00h, moving into standard redundancy state.

Keep PWOK (A25 PIN) as high level.

Every power status should keep normal, could not report any fault or abnormal condition, unless it is indeed existed.

Indicator light should flicker as the specification requirements.

3.13.9.4 Access Cold Redundancy Status

For example (at most 4 units power), the cold redundancy operating mode of power supply should follow the below descriptions.

Cold Redundancy BUS (B22 PIN) abbreviate CRB, Power Supply Unite abbreviate PSU.

Power Access Cold Redundancy example sheet

PSU	D0h Register Value(hex)				
	Step1	Step2	Step3	Step4	Step5
1#	00	01	01	01	01
2#	00	00	02	02	02
3#	00	00	00	03	03
4#	00	00	00	00	04
CRB	Low Level	Low Level	Low Level	Low Level	High Level

Remarks:

1. The PSU 1#~4# don't have correspondence with I2C Address B0~B6 ,that the PSU#1 does not necessarily refers to PSU from physical slot 1 (B0) of system.

2. Step1~Step5 indicate the configuration procedure to PSU's internal register by the system.

3. Step3~Step5 There are PSUs in the system move into cold redundancy mode

4. Before move in cold redundancy, all operating power D0h value must set as 01, then may set any power optionally D0h register value as 02h/03h/04h, to make the power move in cold redundancy, but it must ensure at least 1unit power will be 01h.

5. Take the example of 1+1 redundant of 2PSUs, when working in the cold redundant mode, one of the PSUs should be 01h, and another one can be any of 02h/03h/04h, the difference between 02h/03h/04/ refer to chapter.

3.13.9.5 Exit Cold Redundancy State

Power supply support exiting the cold redundant mode both by command via system and the real time load reach the exit threshold.

1. Exit Cold Redundancy command via system

When PSU is working in cold redundancy mode, system can send command to order the PSU in cold standby mode. By setting the D0h to 00h or 01h to exit cold standby and move into cold redundant active or standard redundancy mode.

When setting the cold standby PSU to 01h, to let it move into cold redundant active state, but it could not affect the state of other paroled PSU which is in cold standby state.

When setting the cold standby PSU to 00h, to let it move into standard redundancy state, at the same time change the high level for CRB to low level. And drive all paralleled power to move in standard redundancy state.

2. Exit Cold Redundancy Automatically by Output Loading Reach the Setting Threshold

When output loading is bigger than 40% of Max load, the PSU's value of D0h is 02h will exit Cold Standby1, and move into cold redundant active mode, but the value of D0h will remains unchanged, is still 02h. The CRB should keep high level.

When output loading is bigger than 62% of Max load, the PSU's value of D0h is 03h will exit Cold Standby2, and move into cold redundant active mode, but the value of D0h will remains unchanged, is still 03h. The CRB should keep high level.

When output loading is bigger than 84% of Max load, the PSU's value of D0h is 04h will exit Cold Standby3, and move into cold redundant active mode, but the value of D0h will remains unchanged, is still 04h. The CRB should keep high level.

The PSU is in Cold Standby mode should polling its output power and check if its output power is bigger than the value of D0h's setting point, if its output power is bigger than the setting point (should have multiple polling confirmation), it must exit cold redundant mode and move into Cold Redundant Active mode within 500ms. When the output load is smaller than 18% of full load, PSU can automatically enter the cold redundant mode.

PSU pull low the CRB when PSU has abnormal condition at any time, all PSU will move into Standard Redundancy mode .The range of low level CRB is 0V-0.6V, the range of high level of CRB is 2.0V-3.46V.And the timing sequence of pulling low the CRB should be the high so that to ensure awaking other cold redundant PSU in time.

Take the example of 1+1 cold redundant of 2 units PSU ,when PSUs are operating in Cold Redundancy mode ,one of the PSUs is 01h,another one is 02h,when output power is bigger than 40% of Max load, it must exit cold redundant mode and move into Cold Redundant Active

mode ,02h remains unchanged. When output power is smaller than 18% of full load, it must automatically enter the cold redundant mode.

Loading ratio is refer to I-Share bus compare with Max loading 8V, is not refer to the presented PSU's rated total power.

3.13.10 EEPROM

The power supply shall have a 24LC02 256 bytes serial EEPROM, which contains power supply specific information, this device will be programmed by the unit vendor with detailed information on the unit. This device shall have its highest order address bit (A2 internally wired to ground). The A0 & A1 address bit are wired to the output connector.

Table19. Address Signals

A1	A0	EEPROM Address	MCU Address	PSU
0	0	A0	B0	1
0	1	A2	B2	2
1	0	A4	B4	3
1	1	A6	B6	4

3.13.11 LED Indicators

There will be a dual color LED lamp on the case's front panel; the color is green and orange to indicate the power supply status. There will be a (slow) blinking green to indicate that AC is applied to the PSU and the standby voltage is available. It shall go steady to indicate that all the power outputs are available. This same LED will (slowly) blink or be solid ON orange to indicate that the power supply reached a warning status or has failed and therefore a replacement of the unit is/maybe necessary. The LED operation is defined as below table.

The LED shall be visible on the power supply's exterior face. The LED locations shall meet ESD requirements. The LED shall be securely mounted in such a way that incidental pressure on the LED won't cause it to become displaced.

Table20. LED State Requirement

Power Supply Status	LED Status
Output ON and OK.	Green
No AC power to all power supplies.	OFF

AC present/Only 12Vsb on (PS off).	1Hz Blink Green (0.5s Off and 0.5s Green)
AC cord unplugged or DC power lost; with a second power supply in parallels still with AC input power.	Orange
Power supply warning events where the PSU continues to operate: high temperature warning, Fan warning, Over current warning.	1Hz Blink Orange （0.5s Off and 0.5s Orange）
Power supply critical event causing a shutdown: UVP, OVP, OCP, OTP	Orange
When the power in cold redundant state.	1Hz Blink Green (0.5s Off and 0.5s Green)
Power supply FW update mode	2Hz Blink Green

4.0 PROTECTION

When the input UVP/OVP, +12Vsb output's UVP/OCP/OVP, OTP protection is triggered, the power supply will shut down and self-recovery when the fault condition removed. If +12V output's OVP/UVP/SCP/OCP is triggered, the power supply will shut down and latched off. The latch state can be cleared by toggling the PSON signal or by an AC power interruption of 5 seconds nominal.

4.1 Input Under and Over Voltage Protection (Input UVP/OVP)

The input UVP should be 78Vac ±5Vac or 180Vdc±10Vdc and recover point should be 84Vac ±5Vac or 190Vdc ±10Vdc.

The input OVP should be 290Vac±10Vac or 415Vdc ±10Vdc and recover point should be 280Vac±10Vac or 405Vdc ±10Vdc.

Note: when doing the Brown out test, the load setting should be 70% according to the input line

4.2 Output Under and Over Voltage Protection (Output UVP/OVP)

The power supply should have over and under voltage protection to prevent the outputs from exceeding limits or abnormal operation. If +12Vsb's OVP occurred, the power supply should shut down and self-recovery after the fault condition removed. If the +12V's OVP/UVP occurred, the power supply will shut down and latched off. The latch state can be cleared by toggling the PSON signal or by an AC power interruption of 5 seconds nominal.

+12V UVP range: 9.0~10.5Vdc;

+12Vsb & +12V OVP range: 13.3~15.6Vdc.

The over and under voltage protection should tested at +12V/10.0A, +12Vsb/0.2A load condition.

4.3 Over Temperature Protection (OTP)

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 shut down. When the power supply temperature drops to within specified limits, the power supply shall restore power automatically, while the +12Vsb remains always on. The OTP circuit must be built in margin 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 5 ℃ of ambient temperature margin.

Before, OTP triggered, there is warning first, and the trigger points are as below table.

Table21.

The temp sensors	Over temperature warning	Over temperature protection	Self-recovery
ambient	58±4℃	60±4℃	55±4℃

4.4 Short Circuit Protection (SCP)

The power supply shall be protected from damage due to faults between output (+12V or +12Vsb) and GND. Short circuit of the power supply outputs shall not result in fire hazard, shock hazard, or damage to the power supply. Components shall not be damaged during the short circuit conditions. If the +12V shorted to GND, the power supply will shut down and latch off ,the latch state can be cleared by toggling the PSON signal or by an AC power interruption of 5 seconds nominal. All outputs shut down upon a short circuit of the +12Vsb and when the short is removed, the power supply shall self-recovery.

4.5 Over Current Protection (OCP)

The power supply should have over current protection to prevent the outputs from exceeding limits. If +12Vsb's OCP occurred, the power supply should shut down and self-recovery after the fault condition removed. If the +12V's OCP occurred, the power supply will shut down and latched off. The latch state can be cleared by toggling the PSON signal or by an AC power interruption of 5 seconds nominal.

+12Vsb OCP range: 4~6A;

+12V OCP range: refer the below table

12V OCP Limited Table

+12V Main Output	Total Range Input	Alert	LED
Over current warning	Max Load[Note2] + (6A~18A)	Low	1Hz Blink Orange
Over current protection	Max Load[Note2] + (10A~24A)	Low	Orange
Over current warning recovery	Max Load[Note2] + (2A~12A)	Low	Green

Note: 1.When +12Vsb's OCP occurred, the power supply in hiccup mode.

2.Max Load should be according to the input line voltage

5.0 OPERATE ENVIRONMENT

Table22. Environment Limits

Item	Unit	Min	Nominal	Max	Notes
Operating Temperature	℃	-5	25	50	
Storage Temperature	℃	-40	25	70	Non-operating, maximum rate of change of 20℃ /hour.
Relative Humidity	%	10		85	Operating, non-condensing.
		5		95	Non-operating, non-condensing.
Operating Altitude	m	0		5000	The power supply max operating ambient temperature is defined at sea level. The max operating ambient temperature should drops at a slew of 0.33℃/100m altitude raised.
Storage Altitude	m	0		15250	

6.0 SAFETY

6.1 Safety Certification: TBD

1、UL-CUL 2、FCC 3、CE 4、CCC 5、CB 6、BSMI

6.2 Hi-pot

Primary to secondary, HI-POT Withstand voltage: 10mA max 1800Vac, 50/60Hz or 0.5mA max 2545Vdc for 60 seconds for power supply unit.

Primary to GND, HI-POT Withstand voltage: 10mA max 1800Vac, 50/60Hz or 0.5mA max 2545Vdc for 60 seconds.

6.3 Grounding Impedance Test

Grounding impedance test using grounding current 40A for 120s and the impedance should less than 100mohm.

6.4 Leakage Current

In order to ensure that the leakage current of the power supply case not cause leakage damage to the human body, after inserting the AC power, the leakage current of the power supply should meet the requirements of safety. Under 264Vac/63Hz conditions to be less than 1.75mA without surge screw.

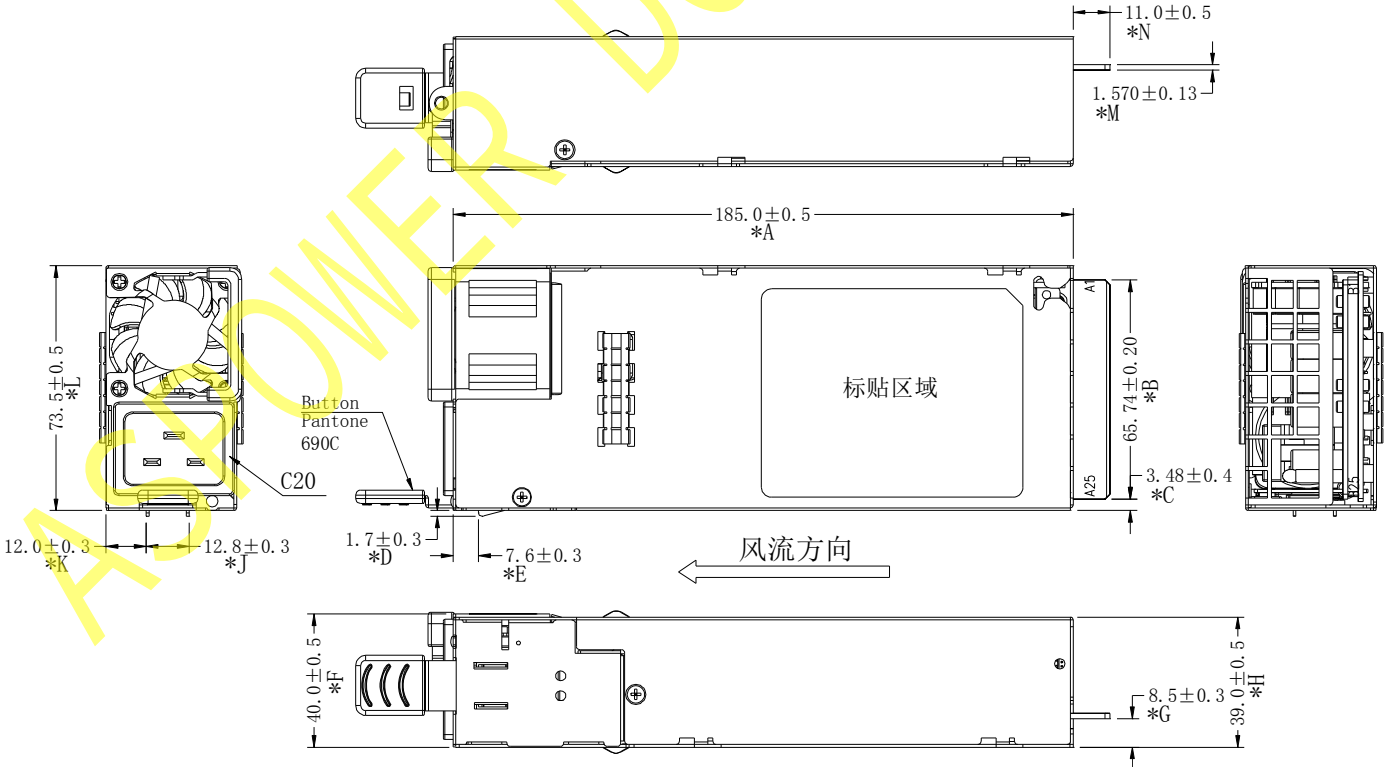
6.5 Insulation Resistance

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

7.0 OUTLINE STRUCTURE

7.1 Outline Dimension

Outline dimension: 185mm (L)*73.5mm (W)* 39mm (T)



7.2 Output Connector

The power supply with golden finger design for output connection of the power and signal as below table for pin assignment, and mating connector is FCI-10121510 系列(50PIN) or equivalent .

Table23. Output Terminals

PIN	Name	Description
A1~A9, B1~B9	GND	Outputs return and it's also connected with the case.
A10~A18,B10~B18	+12V	The main output voltage.
A19	PMBus*SDA	I2C DATA bus, 100kHz max.
A20	PMBus*SCL	I2C Clock bus, 100kHz max.
A21	PSON	Remote ON/OFF control signal: When the PSON signal is low, the power supply will turn on the +12V main output, and turn off when it's high.
A22	Alert	Power supply warning signal: When this pin get low signal will notice system the power supply has some fault occurred.
A23	+12V RS-	+12V output GND return sense for feedback.
A24	+12V RS+	+12V output voltage sense for feedback.
A25	PWOK	Power supply work OK signal.
B19	A0(SMBus*address)	Address set Pin.
B20	A1(SMBus*address)	Address set Pin.
B21	+12Vsb	The auxiliary output voltage.
B22	SM-Bus	Power supply cold redundancy control signal.
B23	12V_LS	+12V output load sharing bus.
B24	Present	The power online signal, connected to GND in PSU
B25	Input OK	Input voltage OK signal, low level means input voltage is in range.

7.3 Airflow Requirements

The power supply shall incorporate a single rotor 40*28mm fan for cooling the Power supply when installed in the system. The airflow direction shall be from the card edge connector side to the AC inlet side of the power supply.

8.0 EMI AND EMS REQUIREMENT

Table24. EMI (Electromagnetic Interference) Requirements Table

Item	Description and Requirement	Criterion	Notes
Radiated Emissions	Frequency: 30MHz~1GHz Class A	EN 55032	230V/50Hz input
		FCC Part 15	120V/60Hz input
Conducted Emissions (Voltage)	Frequency: 150KHz~30MHz Class A	EN 55032	230V/50Hz input
		FCC Part 15	120V/60Hz input
Harmonic	EN 61000-3-2 Class A	EN 61000-3-2	230V/50Hz input
Voltage Flicker	Pst≦1.0 and Plt≦0.65 Voltage change≦3.3% Relative Voltage change≦4% The voltage changed over 3.3% duration time should≦500ms	EN 61000-3-3	230V/50Hz input

Table25. EMS (Electromagnetic Susceptibility) Requirements Table

Item	Description and Requirement	Level	Criterion
Surge	Different Mode: ±1KV/2ohm Common Mode: ±2KV/12ohm	B	EN61000-4-5 EN 55035
Electrical Fast Transient Group (EFT)	±2KV	B	EN61000-4-4 EN 55035
Electrical Static Discharge (ESD)	Touch: ±6KV Air: ±8KV	B	EN61000-4-2 EN 55035
Radiated Susceptibility (RS)	80M~2.7GHz 3V/m 80% AM	A	EN 61000-4-3 EN 55035
Conducted Susceptibility (CS)	150KHz~80MHz 3V 80% AM	A	EN 61000-4-6 EN 55035
Voltage Dips and Interruptions	0% Ut: 10ms 70% Ut: 500ms 0% Ut: 5000ms	C C C	EN 61000-4-11 EN 61000-4-29 EN 55024 / 60601 GB 19286

9.0 MECHANICAL PERFORMANCE

Non-operating:

Sine sweep: 5~500Hz @0.5gRMS at 0.5 octave/min; dwell 15 min at each of 3 resonant points;

Random profile: 5Hz @0.01g^2/Hz (slope up); 20~500Hz @0.02g^2/Hz (flat);

Input acceleration = 3.13gRMS; 10min.per axis for 3 axis on all samples.

10.0 Reliability

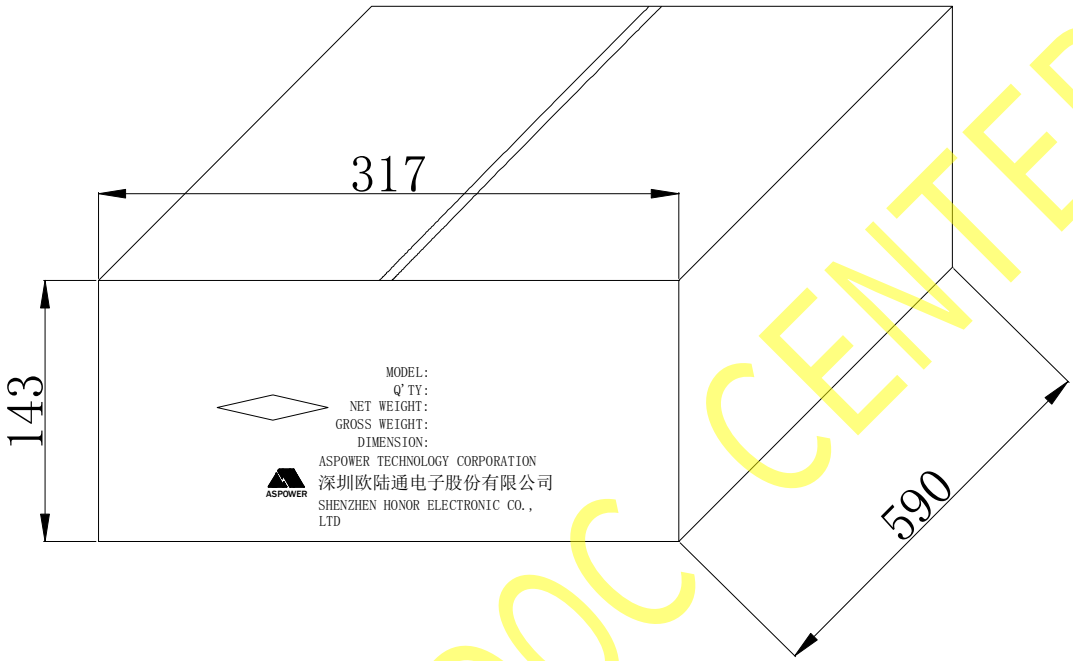
The power supply shall have a reliability requirement as below table

Table26.

Item	Requirement	Notes
Life Time	≧7 years at 35℃ ambient with 80% Load	Input Voltage： 115Vac /230Vac HVDC:240Vdc Should ≧7 years at 25℃ ambient when mating with customer system.
CMTBF (Calculated MTBF)	250,000 hours calculated at 100%, according to BELL CORE TR-322 at 35℃ excluding the Fan MTBF, and at least 100,000 hours including the fan MTBF.	
Annual Return Rate	≦0.1%	
Warranty	≧3 years	

11.0 PACKAGE

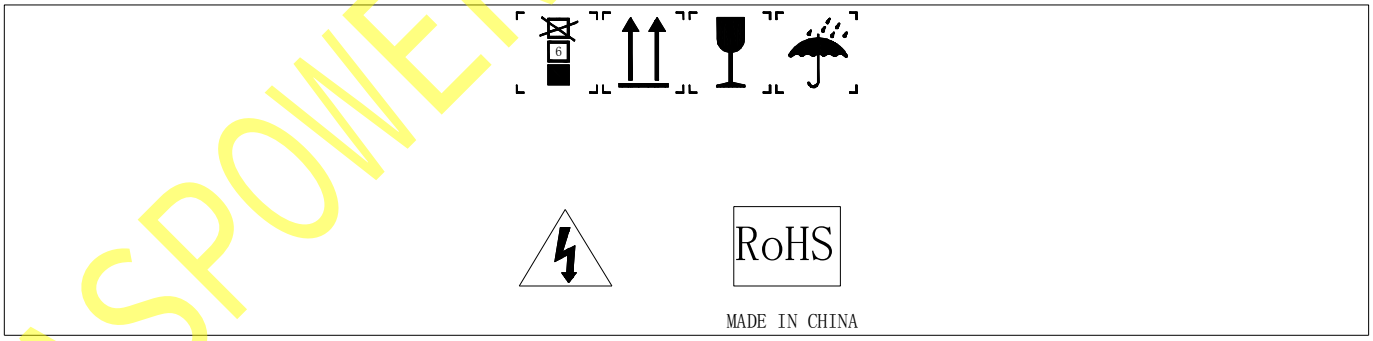
11.1 Outline Diagram of Carton



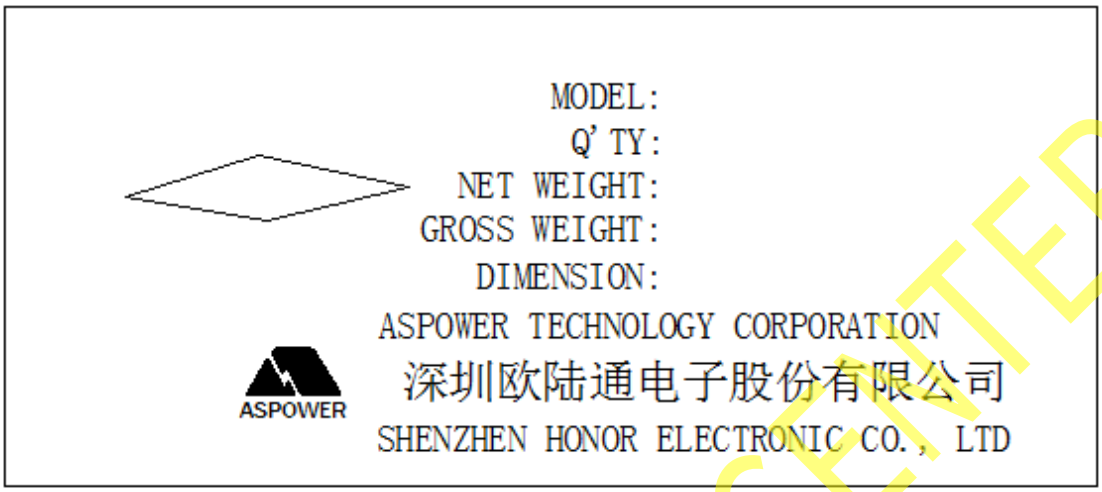
Note:

1. Material: outside the box: five layers of corrugated paper

11.2 Side Label



11.3 Front Label



11.4 Label Drawing: TBD

12.0 SOFTWARE

12.1 Data Precision Requirement

Some data read from power supply should have a precision requirement as below table:

Table27. Required Accuracy (220Vac or 240Vdc)

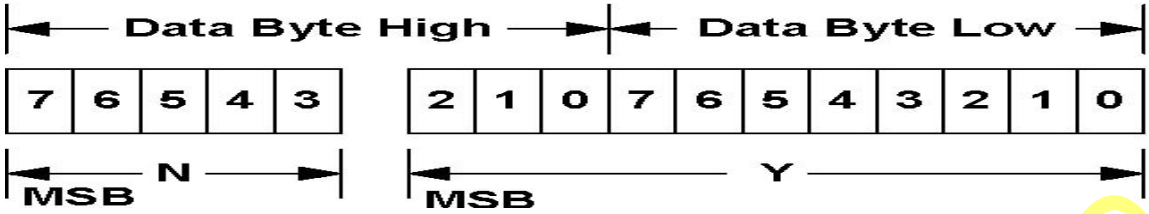
Output Load Condition	≤10%	10%＜load≤20%	load＞20%
Read_VIN(88h)	±3%		
Read_Iin(89h)	No Spec	±0.1A or ±5%	±5%
Read_PIN(97h)	No Spec	±10W or ±5%	±5%
Read_Vout(8Bh)	±3%		
Read_Iout(8Ch)	No Spec	±1A or ±5%	±5%
Read_Pout(96h)	No Spec	±10W or ±5%	±5%
Read_Temperature(8Dh)	±3℃		

Note: READ_POUT(96h) does not contain standby power .There's no requirement when power supply is in standby mode.

12.2 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: $X = Y \cdot 2^{N}$

Where, as described above:

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.

12.3 PMBUS Command Supported

Table28. Supported Command Summary

Command Code	Command Name	SMBus Transaction Type: Writing Data	SMBus Transaction Type: Reading Data	Number Of Data Bytes	Value	Conditions(description)
00h	PAGE	Write Byte	Read Byte	1	0x00(default)	Setting a PAGE value of FFh is used to clear all status bits in all PAGEs with the CLEAR_FAULT command.
01h	OPERATION	Write Byte	Read Byte	1	0x00(default)	0x80: means turn on. 0x00: means turn off.
02h	ON_OFF_CONFIG	Write Byte	Read Byte	1	0x00(default)	0x15: means PSU on/off only by PSON# control. 0x19: means PSU on/off only by PMBus control. 0x1D: means PSU on/off by PSON# and PMBus control. Other value: means PSU on/off only by PSON# control.
03h	CLEAR_FAULTS	Send Byte	N/A	0		
05h	PAGE_PLUS_WRITE	Block Write	N/A	Variable		
06h	PAGE_PLUS_READ	N/A	Block Write – Block Read Process Call	Variable		
19h	CAPABILITY	N/A	Read Byte	1	0x90	100KHz, PEC support, SMBAlert support
1Ah	QUERY	N/A	Block Write- Block Read Process Call	1		
1Bh	SMBALERT_MASK	Write Word	Block Write- Block Read Process Call	2		
20h	VOUT_MODE	Write Byte	Read Byte	1	0x17	Vout reading scale is 512.
30h	COEFFICIENTS	N/A	Block Write- Block Read Process Call	5		m=1;b=0;R=0 for READ_EIN and READ_EOUT
3Ah	FAN_CONFIG_1_2	Write Byte	Read Byte	1	0x90(default)	1 Fan; duty control; 2 pulse per revolution.
3Bh	FAN_COMMAND_1	Write Word	Read Word	2		Duty control, if setting value is 0x0032, means adjust fan duty to 50%.
4Ah	IOUT_OC_WARN_LIMIT	Write Word	Read Word	2		

51h	OT_WARN_LIMIT	Write Word	Read Word	2	105'C(default)	Primary side heat sink temperature OT warning.
5Dh	IIN_OC_WARN_LIMIT	Write Word	Read Word	2		
6Ah	POUT_OP_WARN_LIMIT	Write Word	Read Word	2		
6Bh	PIN_OP_WARN_LIMIT	Write Word	Read Word	2		
78h	STATUS_BYTE	Write Byte	Read Byte	1		
6	OFF					
5	VOUT_OV_FAULT					
4	IOUT_OC_FAULT					
3	VIN_UV_FAULT					
2	TEMPERATURE					
1	CML					
0	NONE OF THE ABOVE					
79h	STATUS_WORD	Write Word	Read Word	2		
6	OFF					
5	VOUT_OV_FAULT					
4	IOUT_OC_FAULT					
3	VIN_UV_FAULT					
2	TEMPERATURE					
1	CML					
0	NONE OF THE ABOVE					
(high) 7	VOUT					
6	IOUT/POUT					
5	INPUT					
3	POWER_GOOD#					
2	FANS					
7Ah	STATUS_VOUT	Write Byte	Read Byte	1		
7	VOUT_OV_FAULT					
4	VOUT_UV_FAULT					
7Bh	STATUS_IOUT	Write Byte	Read Byte	1		
7	IOUT_OC_FAULT					
5	IOUT_OC_WARNING					
1	POUT_OP_FAULT					
0	POUT_OP_WARNING					
7Ch	STATUS_INPUT	Write Byte	Read Byte	1		
7	VIN_OV_FAULT					
6	VIN_OV_WARNING					
5	VIN_UV_WARNING					
4	VIN_UV_FAULT					

3	Unit Off For Insufficient Input Voltage					
1	IIN_OC_WARNING					
0	PIN_OP_WARNING					
7Dh	STATUS_TEMPERATURE	Write Byte	Read Byte	1		
7	OT_FAULT					
6	OT_WARNING					
7Eh	STATUS_CML	Write Byte	Read Byte	1		
7	Invalid Or Unsupported Command Received					
6	Invalid Or Unsupported Data Received					
5	Packet Error Check Failed					
80h	STATUS_MFR_SPECIFIC	Write Byte	Read Byte	1		00: No Input 01: AC Input 02: HVDC Input
1	Manufacturer Defined					
0	Manufacturer Defined					
81h	STATUS_FANS_1_2	Write Byte	Read Byte	1		
7	Fan 1 Fault					600rpm/10Seconds when normal run.
5	Fan 1 Warning					
3	Fan 1 Speed Overridden					
86h	READ_EIN	N/A	Block Read	5		
87h	READ_EOUT	N/A	Block Read	5		
88h	READ_VIN	N/A	Read Word	2		
89h	READ_IIN	N/A	Read Word	2		
8Ah	READ_VCAP	N/A	Read Word	2		
8Bh	READ_VOUT	N/A	Read Word	2		
8Ch	READ_IOUT	N/A	Read Word	2		
8Dh	READ_TEMPERATURE_1	N/A	Read Word	2		Inlet ambient temperature by degree C
8Eh	READ_TEMPERATURE_2	N/A	Read Word	2		Secondary side heat sink temperature by degree C
8Fh	READ_TEMPERATURE_3	N/A	Read Word	2		Primary side heat sink temperature by degree C
90h	READ_FAN_SPEED_1	N/A	Read Word	2		In FAN RPM
96h	READ_POUT	N/A	Read Word	2		
97h	READ_PIN	N/A	Read Word	2		
98h	PMBUS_REVISION	N/A	Read Byte	1		
99h	MFR_ID	Block Write	Block Read	Variable		ASPOWER

9Ah	MFR_MODEL	Block Write	Block Read	Variable		
9Bh	MFR_REVISION	Block Write	Block Read	Variable		
9Ch	MFR_LOCATION	Block Write	Block Read	Variable		CHINA
9Fh	APP_PROFILE_SUPPORT	N/A	Block Read	Variable		
A0h	MFR_VIN_MIN	N/A	Read Word	2		
A1h	MFR_VIN_MAX	N/A	Read Word	2		
A2h	MFR_IIN_MAX	N/A	Read Word	2		
A3h	MFR_PIN_MAX	N/A	Read Word	2		
A4h	MFR_VOUT_MIN	N/A	Read Word	2		
A5h	MFR_VOUT_MAX	N/A	Read Word	2		
A6h	MFR_IOUT_MAX	N/A	Read Word	2		
A7h	MFR_POUT_MAX	N/A	Read Word	2		
A8h	MFR_TAMBIENT_MAX	N/A	Read Word	2		
A9h	MFR_TAMBIENT_MIN	N/A	Read Word	2		
AAh	MFR_EFFICIENCY_LL	N/A	Block Read	14		
ABh	MFR_EFFICIENCY_HL	N/A	Block Read	14		
C0h	MFR_MAX_TEMP_1	Write Word	Read Word	2		
C1h	MFR_MAX_TEMP_2	Write Word	Read Word	2		
D0h	MFR_SPECIFIC_00	Mfr. Defined	Mfr. Defined	Mfr. Defined		Cold redundant
D1h	MFR_SPECIFIC_01	Mfr. Defined	Mfr. Defined	Mfr. Defined		Cold redundant
E4h	MFR_SPECIFIC_20	Mfr. Defined	Mfr. Defined	Mfr. Defined		MFR_HISTORY_PAGE R/W 1byte
E5h	MFR_SPECIFIC_21	Mfr. Defined	Mfr. Defined	Mfr. Defined		MFR_POS_TATAL R 4bytes
E6h	MFR_SPECIFIC_22	Mfr. Defined	Mfr. Defined	Mfr. Defined		MFR_POS_LAST R 4bytes
EAh	MFR_SPECIFIC_26	Mfr. Defined	Mfr. Defined	Mfr. Defined		FW_DOWNLOAD_PARAMETERS R 6 bytes
EBh	MFR_SPECIFIC_27	Mfr. Defined	Mfr. Defined	Mfr. Defined		FW_UPDATE_COMMAND R/W 1 byte
ECh	MFR_SPECIFIC_28	Mfr. Defined	Mfr. Defined	Mfr. Defined		FW_DOWNLOAD_REGISTER W 37 bytes
EDh	MFR_SPECIFIC_29	Mfr. Defined	Mfr. Defined	Mfr. Defined		FW_UPDATE_STATUS R 1 byte

12.4 Bootloader spec

Please refer attachment (FW bootloader SPEC.pdf) which is from Inspur PSU team.

FW bootloader SPEC.pdf

12.5 Blackbox spec

Please refer attachment (Black box SPEC.pdf) which is from Inspur PSU team.

Black box SPEC.pdf