REV.	Description	Raise by	Date
S00	RELEASE S/M	劉龍/賈曉東	03/03/'23

DDCC-ChungLi
Document is
Released
2023.03.06
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台達電子工業股份有限公司 DELTA ELECTRONICS, INC.				DESCRIPTION : 電氣規格(Electrical Specification)	
THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF DELTA ELECTRONICS, INC. AND SHALL NOT BE REPRODUCED OR USED AS THE BASIS FOR THE MANUFACTURE OR SELL OF APPARATUSES OR DEVICES WITHOUT PERMISSION.				MODEL NO. : AC-195 A	
Date	Drawn	Design (EE)	Design (ME)	DOCUMENT NAME. : ES-195 A	REV. S00
03/03/'23	金雨霞	劉龍	賈曉東		

CONTENTS

1. SCOPE

This requirement defines the key characteristics for the power supply PDB specification. The specification that PS supplier provides shall include but not limited the characteristics in this requirement.

1.1 General

This is a multiple function power supply backplane assembly providing the following features:

- +12V to +3.3V DC to DC converter
- +12V to +5V DC to DC converter
- +12VSB to +5VSB DC to DC converter

1.2 Label:

The label shall be located at the location that it's easier to see when the system chassis is opened. The marking is legible and preserved permanently. The marking contents shall not be deteriorated due to heating or chemical influence. Model name and PS revision: REV:00, start from the first mass production

2. INPUT

2.1 Input Voltage/Current

DC input from 300W (DPS-300AB-102 X)、550W (DPS-550AB-36 X)、650W (DPS-650AB-16 X)、800W (DPS-800AB-30 X)、1200W(DPS-1200AB-16 X)、2400W(DPS-2400AB-12 A) output.
Each one module input as below table.

Module / Loading	+12V/A	+12VSB/A
300W	24	1.5
550W	45	2.1
650W	52.5	2.1
800W	65	2
1200W	98	2.1
2400W	210	2.1

2.2 Efficiency

20%~100% rated load for cage's efficiency.

DC input from 300W (DPS-300AB-102 X):

Loading	Efficiency	+5V	+3.3V	+12V	+5VSB	+12VSB
Light load (20%)	91%	4	3	2.23	0.34	0.14
Half load (50%)	93%	10	7.5	5.58	0.84	0.35
Max load (100%)	93%	20	15	11.15	1.68	0.7

DC input from 550W (DPS-550AB-36 X):

Loading	Efficiency	+5V	+3.3V	+12V	+5VSB	+12VSB
Light load (20%)	91%	4	3	6.28	0.48	0.2
Half load (50%)	93%	10	7.5	15.69	1.2	0.5
Max load (100%)	93%	20	15	31.38	2.4	1

DC input from 650W (DPS-650AB-16 X):

Loading	Efficiency	+5V	+3.3V	+12V	+5VSB	+12VSB
Light load (20%)	91%	4	3	7.45	0.48	0.2
Half load (50%)	93%	10	7.5	18.625	1.2	0.5
Max load (100%)	93%	20	15	37.25	2.4	1

DC input from 800W (DPS-800AB-30 X):

Loading	Efficiency	+5V	+3.3V	+12V	+5VSB	+12VSB
Light load (20%)	91%	4	3	9.94	0.48	0.2
Half load (50%)	93%	10	7.5	24.86	1.2	0.5
Max load (100%)	93%	20	15	49.72	2.4	1

DC input from 1200W (DPS-1200AB-16 X in low voltage input):

Loading	Efficiency	+5V	+3.3V	+12V	+5VSB	+12VSB
Light load (20%)	91%	4	3	12.24	0.48	0.2
Half load (50%)	93%	10	7.5	30.61	1.2	0.5
Max load (100%)	93%	20	15	61.21	2.4	1

DC input from 1200W (DPS-1200AB-16 X in high voltage input):

Loading	Efficiency	+5V	+3.3V	+12V	+5VSB	+12VSB
Light load (20%)	91%	4	3	15.44	0.48	0.2
Half load (50%)	93%	10	7.5	38.61	1.2	0.5
Max load (100%)	93%	20	15	77.21	2.4	1

DC input from 2400W (DPS-2400AB-12 A in low voltage input):

Loading	Efficiency	+5V	+3.3V	+12V	+5VSB	+12VSB

Light load (20%)	91%	4	3	13.91	0.48	0.2
Half load (50%)	93%	10	7.5	34.77	1.2	0.5
Max load (100%)	93%	20	15	69.54	2.4	1

DC input from 2400W (DPS-2400AB-12 A in high voltage input):

Loading	Efficiency	+5V	+3.3V	+12V	+5VSB	+12VSB
Light load (20%)	91%	4	3	37.12	0.48	0.2
Half load (50%)	93%	10	7.5	92.8	1.2	0.5
Max load (100%)	93%	20	15	185.6	2.4	1

3. OUTPUT

3.1 Power/Currents Rating

The following tables define the power and current ratings. The combined output power of all outputs shall not exceed the rated output power. Load ranges are provided for each output level. The power supply shall meet both static, dynamic voltage regulation and timing requirements for the minimum/maximum/cross loading conditions.

Table 3.1 output power and current rating

Output	Min load(A)	Max load(A)	Power limit
+5V	0.5	22 peak 29	≤150W
+3.3V	0.5	16 peak 20	
+12V (With 300W Module)	0	23 peak 26	
+12V (With 550W Module)	0	42 peak 45	
+12V (With 650W Module)	0	48 peak 54	
+12V (With 800W Module)	0	58 peak 63	
+12V (With 1200W Module in low voltage input)	0	72 peak 77	
+12V (With 1200W Module in high voltage input)	0	88 peak 93	
+12V (With 2400W Module in low voltage input)	3	80 peak N/A	
+12V (With 2400W Module in high voltage input)	3	200 peak N/A	
+5VSB	0.1	4	≤24W
+12VSB	0.1	1	
Total continuous power	≤300W (With 300W Module) ≤550W (With 550W Module) ≤620W (With 650W Module) ≤770W (With 800W Module) ≤908W (With 1200W Module in low voltage input) ≤1100W (With 1200W Module in high voltage input) ≤1008W (With 2400W Module in low voltage input) ≤2410W (With 2400W Module in high voltage input)		

Footnotes:

1) The keep time of peak load shall be 12S for all outputs every .10 minutes, make sure the power supply will not be shut down and no component damage with peak load.
2) When with 300W, the +5VSB max load is 3A, the total SB power limit 16.2W.

3.2 Voltage Regulation

The power supply output voltages must stay within the following voltage limits shown in *Table 3.2* when operating at steady state, dynamic loading conditions. And the overshoot at turn on conditions shall only meet the outputs voltage ±10% tolerance. All outputs are measured with reference to the return remote sense (ReturnS) signal. The +5V, +12V, +5VSB &+12VSB outputs are measured at the power supply connectors referenced to ReturnS. The +3.3V is measured at its remote sense signal (3.3VS) located at the signal connector if this connector is available. AC line Harmonic distortion of up to 10% THD shall not cause the power supply to go out of specified limits.

Table 3.2 voltage regulation limits

outputs	min	max	units	tolerance
+3.3V	+3.135	+3.465	Vdc	+ 5%-5%
+5V	+4.75	+5.25	Vdc	+ 5%-5%
+12V	+11.4	+12.6	Vdc	+ 5%-5%
+5VSB	+4.75	+5.25	Vdc	+ 5%-5%
+12VSB	+11.4	+12.6	Vdc	+ 5%-5%

3.2.1 Cross regulation load table

Table 3.2.1 cross regulation load

DC input from 300W (DPS-300AB-102 X):

Load	+5V/A	+3.3V/A	+12V/A	+5VSB/A	+12VSB/A	P t/ W	Remark
1	0.5	0.5	0	0.1	0.1	5.85	Min Load
2	0.5	0.5	0	0.1	1.0	16.65	12VSB Max
3	0.5	0.5	0	3	0.1	20.35	5VSB Max
4	0.5	0.5	23	0.1	0.1	281.85	12V Max
5	0.5	16	0	0.1	0.1	57	3.3V Max
6	22	0.5	0	0.1	0.1	113.35	5V Max
7	19.4	16	0	0.1	0.1	151.50	5 & 3.3V=150W, 3.3V Max
8	22	12.2	0	0.1	0.1	151.96	5 & 3.3V=150W, 5V Max
9	4	3	2.23	0.34	0.14	60	20% of Eff max load
10	10	7.5	5.58	0.84	0.35	150	50% of Eff max load
11	20	15	11.15	1.68	0.7	300	100% of Eff max load

12	20	20	11.15	1.68	0.7	316.6	3.3V Peak load
13	29	15	10.15	1.68	0.7	333.1	5V Peak load
14	0.5	0.5	26	1.68	0.7	332.95	12V Peak load
15	Remote off			0.1	0.1	1.7	Remote off, 5VSB min
16	Remote off			3	0.1	16.2	Remote off, 5VSB max
The keep time of peak load shall be less than 12s for all outputs							

DC input from 550W (DPS-550AB-36 X):

Load	+5V/A	+3.3V/A	+12V/A	+5VSB/A	+12VSB/A	P t/ W	Remark
1	0.5	0.5	0	0.1	0.1	5.85	Min Load
2	0.5	0.5	0	0.1	1.0	16.65	12VSB Max
3	0.5	0.5	0	4	0.1	25.35	5VSB Max
4	0.5	0.5	42	0.1	0.1	509.85	12V Max
5	0.5	16	0	0.1	0.1	57	3.3V Max
6	22	0.5	0	0.1	0.1	113.35	5V Max
7	19.4	16	0	0.1	0.1	151.50	5 & 3.3V=150W, 3.3V Max
8	22	12.2	0	0.1	0.1	151.96	5 & 3.3V=150W, 5V Max
9	4	3	6.28	0.48	0.2	110.06	20% of Eff max load
10	10	7.5	15.69	1.2	0.5	275.03	50% of Eff max load
11	20	15	31.38	2.4	1	550.06	100% of Eff max load
12	20	20	31.38	2.4	1	566.56	3.3V Peak load
13	29	15	29.18	2.4	1	568.66	5V Peak load
14	0.5	0.5	45	2.4	1	568.15	12V Peak load
15	Remote off			0.1	0.1	1.7	Remote off, 5VSB min
16	Remote off			4	0.1	21.2	Remote off, 5VSB max
The keep time of peak load shall be less than 12s for all outputs							

DC input from 650W (DPS-650AB-16 X):

Load	+5V/A	+3.3V/A	+12V/A	+5VSB/A	+12VSB/A	P t/ W	Remark
1	0.5	0.5	0	0.1	0.1	5.85	Min Load
2	0.5	0.5	0	0.1	1.0	16.65	12VSB Max
3	0.5	0.5	0	4	0.1	25.35	5VSB Max

4	0.5	0.5	48	0.1	0.1	581.85	12V Max
5	0.5	16	0	0.1	0.1	57	3.3V Max
6	22	0.5	0	0.1	0.1	113.35	5V Max
7	19.4	16	0	0.1	0.1	151.50	5 & 3.3V=150W, 3.3V Max
8	22	12.2	0	0.1	0.1	151.96	5 & 3.3V=150W, 5V Max
9	4	3	7.45	0.48	0.2	124.1	20% of Eff max load
10	10	7.5	18.625	1.2	0.5	310.25	50% of Eff max load
11	20	15	37.25	2.4	1	620.5	100% of Eff max load
12	20	20	37.25	2.4	1	637	3.3V Peak load
13	29	15	37.25	2.4	1	665.5	5V Peak load
14	0.5	0.5	54	2.4	1	676.15	12V Peak load
15	Remote off			0.1	0.1	1.7	Remote off, 5VSB min
16	Remote off			4	0.1	21.2	Remote off, 5VSB max
The keep time of peak load shall be less than 12s for all outputs							

DC input from 800W (DPS-800AB-30 X):

Load	+5V/A	+3.3V/A	+12V/A	+5VSB/A	+12VSB/A	P t/ W	Remark
1	0.5	0.5	0	0.1	0.1	5.85	Min Load
2	0.5	0.5	0	0.1	1.0	16.65	12VSB Max
3	0.5	0.5	0	4	0.1	25.35	5VSB Max
4	0.5	0.5	58	0.1	0.1	701.85	12V Max
5	0.5	16	0	0.1	0.1	57	3.3V Max
6	22	0.5	0	0.1	0.1	113.35	5V Max
7	19.4	16	0	0.1	0.1	151.50	5 & 3.3V=150W, 3.3V Max
8	22	12.2	0	0.1	0.1	151.96	5 & 3.3V=150W, 5V Max
9	4	3	9.94	0.48	0.2	154.03	20% of Eff max load
10	10	7.5	24.86	1.2	0.5	385.07	50% of Eff max load
11	20	15	49.72	2.4	1	770.14	100% of Eff max load
12	20	20	49.35	2.4	1	782.2	3.3V Peak load
13	29	15	47	2.4	1	782.5	5V Peak load
14	0.5	0.5	63	2.4	1	784.15	12V Peak load

15	Remote off	0.1	0.1	1.7	Remote off, 5VSB min
16	Remote off	4	0.1	21.2	Remote off, 5VSB max
The keep time of peak load shall be less than 12s for all outputs					

DC input from 1200W (DPS-1200AB-16 X in low AC voltage input):

Load	+5V/A	+3.3V/A	+12V/A	+5VSB/A	+12VSB/A	P t/ W	Remark
1	0.5	0.5	0	0.1	0.1	5.85	Min Load
2	0.5	0.5	0	0.1	1.0	16.65	12VSB Max
3	0.5	0.5	0	4	0.1	25.35	5VSB Max
4	0.5	0.5	72	0.1	0.1	869.85	12V Max
5	0.5	16	0	0.1	0.1	57	3.3V Max
6	22	0.5	0	0.1	0.1	113.35	5V Max
7	19.4	16	0	0.1	0.1	151.50	5 & 3.3V=150W, 3.3V Max
8	22	12.2	0	0.1	0.1	151.96	5 & 3.3V=150W, 5V Max
9	4	3	12.24	0.48	0.2	181.58	20% of Eff max load
10	10	7.5	30.61	1.2	0.5	454.07	50% of Eff max load
11	20	15	61.21	2.4	1	908.02	100% of Eff max load
12	20	20	61.21	2.4	1	924.52	3.3V Peak load
13	29	15	61.11	2.4	1	951.82	5V Peak load
14	0.5	0.5	77	2.4	1	952.15	12V Peak load
15	Remote off			0.1	0.1	1.7	Remote off, 5VSB min
16	Remote off			4	0.1	21.2	Remote off, 5VSB max
The keep time of peak load shall be less than 12s for all outputs							

DC input from 1200W (DPS-1200AB-16 X in High AC voltage input):

Load	+5V/A	+3.3V/A	+12V/A	+5VSB/A	+12VSB/A	P t/ W	Remark
1	0.5	0.5	0	0.1	0.1	5.85	Min Load
2	0.5	0.5	0	0.1	1.0	28.65	12VSB Max
3	0.5	0.5	0	4	0.1	25.35	5VSB Max
4	0.5	0.5	88	0.1	0.1	1061.9	12V Max
5	0.5	16	0	0.1	0.1	57	3.3V Max
6	22	0.5	0	0.1	0.1	113.35	5V Max

7	19.4	16	0	0.1	0.1	151.50	5 & 3.3V=150W, 3.3V Max
8	22	12.2	0	0.1	0.1	151.96	5 & 3.3V=150W, 5V Max
9	4	3	15.44	0.48	0.2	219.98	20% of Eff max load
10	10	7.5	38.61	1.2	0.5	550.07	50% of Eff max load
11	20	15	77.21	2.4	1	1100	100% of Eff max load
12	20	20	77.21	2.4	1	1116.5	3.3V Peak load
13	29	15	77.11	2.4	1	1143.8	5V Peak load
14	0.5	0.5	93	2.4	1	1144.2	12V Peak load
15	Remote off			0.1	0.1	1.7	Remote off, 5VSB min
16	Remote off			4	0.1	21.2	Remote off, 5VSB max
The keep time of peak load shall be less than 12s for all outputs							

DC input from 2400W (DPS-2400AB-12 A in Low AC voltage input):

Load	+5V/A	+3.3V/A	+12V/A	+5VSB/A	+12VSB/A	P t/ W	Remark
1	0.5	0.5	3	0.1	0.1	41.85	Min Load
2	0.5	0.5	3	0.1	1.0	52.65	12VSB Max
3	0.5	0.5	3	4	0.1	61.35	5VSB Max
4	0.5	0.5	80	0.1	0.1	965.85	12V Max
5	0.5	16	3	0.1	0.1	93	3.3V Max
6	22	0.5	3	0.1	0.1	149.35	5V Max
7	19.4	16	3	0.1	0.1	187.50	5 & 3.3V=150W, 3.3V Max
8	22	12.2	3	0.1	0.1	187.96	5 & 3.3V=150W, 5V Max
9	4	3	13.91	0.48	0.2	201.7	20% of Eff max load
10	10	7.5	34.77	1.2	0.5	504	50% of Eff max load
11	20	15	69.54	2.4	1	1008.0	100% of Eff max load
12	20	20	68.14	2.4	1	1007.7	3.3V Peak load
13	29	15	65.74	2.4	1	1007.4	5V Peak load
14	Remote off			0.1	0.1	1.7	Remote off, 5VSB min
15	Remote off			4	0.1	21.2	Remote off, 5VSB max
The keep time of peak load shall be less than 12s for all outputs							

DC input from 2400W (DPS-2400AB-12 A in High AC voltage input):

Load	+5V/A	+3.3V/A	+12V/A	+5VSB/A	+12VSB/A	P t/ W	Remark
1	0.5	0.5	3	0.1	0.1	41.85	Min Load
2	0.5	0.5	3	0.1	1.0	52.65	12VSB Max
3	0.5	0.5	3	4	0.1	61.35	5VSB Max
4	0.5	0.5	200	0.1	0.1	2405.8	12V Max
5	0.5	16	3	0.1	0.1	93	3.3V Max
6	22	0.5	3	0.1	0.1	149.35	5V Max
7	19.4	16	3	0.1	0.1	187.50	5 & 3.3V=150W, 3.3V Max
8	22	12.2	3	0.1	0.1	187.96	5 & 3.3V=150W, 5V Max
9	4	3	37.12	0.48	0.2	480.14	20% of Eff max load
10	10	7.5	92.8	1.2	0.5	1200	50% of Eff max load
11	20	15	185.6	2.4	1	2400	100% of Eff max load
12	20	20	185	2.4	1	2410	3.3V Peak load
13	29	15	182.6	2.4	1	2409	5V Peak load
14	Remote off			0.1	0.1	1.7	Remote off, 5VSB min
15	Remote off			4	0.1	21.2	Remote off, 5VSB max
The keep time of peak load shall be less than 12s for all outputs							

3.3 Ripple Noise

Table3.3 ripple and noise

Voltage	Ripple/Noise pk-pk
+3.3V	50 mV
+5V	50 mV
+12V	120 mV
+5VSB	50 mV
+12VSB	120 mV

Footnotes:

1) This is measured over a bandwidth of 20Hz to 20MHz at the output connector. A 10μF tantalum Capacitor in parallel with a 0.1μF ceramic capacitor are placed at the point of measurement.
2) Ripple noise test must be at least in 5us/1ms/10ms sweep and peak detect mode.
3) When test +5VSB、+3.3V、+5V ripple noise, each output needs add a piece of 100uF/16V low ESR electrolytic capacitor.

4) Adding a piece of low ESR electrolytic capacitance of 2200uF/16V in +12V & +12VSB output (when with 2400W, should adding a piece of 2200uF Solid Capacitor for +12V main and a piece of 1000uF Solid Capacitor for +12VSB).

3.4 Dynamic Loading

The load transient repetition rate shall be tested between 50Hz to 5KHz at duty cycles range from 10%-90%.The test shall be at least in 50 Hz/1KHz/5KHz condition. The load transient repetition rate is only a test specification. The output voltages shall remain within limits specified in table 3.2 for the step loading, Slew rate, and capacitive loading in the table 3.4.

Table3.4 transient load requirements

Output	Transient Step (A) XX % of rated current		A/us	Frequency (Hz)	Cap(uF)
	module	PDB or None redundant			
+5V		30%	1	50HZ - 5KHZ	1000
+3.3V		30%	1		1000
+5VSB		0.5A	0.1		100
+12V		50%	0.5		2200
+12VSB		0.5A	0.5		2200

Footnotes:
1）For dynamic condition +12V Min loading is 1A (with 2400W, the min load is 5A).
2）While +12V dynamic Min load less than 2A (With 2400W, less than 5A), +12V shall follow +/-10% regulation.

3.5 Capacitive Loading

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

Table3.5 output capacitive loading

Outputs	+5V	+3.3V	+12V	+5VSB	+12VSB
Cap load/uF	100-12000	100-12000	2200-18000	1--3100	

3.6 No Load

The power supply turn on in no load condition shall not cause damage to the power supply. The power supply shall be able to turn up in no load condition.

3.7 Residual Voltage in Standby mode

Residual voltage at the power supply outputs for no load condition shall not exceed 100mV when AC voltage is applied and the PSON# signal is de-asserted

3.8 Redundant 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 +/-10% regulation limit.
2. DC signal, such as PG, PS-ON, present and other signals shall not oscillate or change.
3. Current Sharing bus shall not oscillate.
4. LED color shall not change.
5. Power supply shall not be overload and other protection.
6. The newly inserted power supply may get turned on by plugging AC into the external and meet the turn on requirements, including the voltage shown in table 3.2 and timing shown in table 4.1.
7. The two modules shall be synchronous while the power supply turn on, turn off, dropout and brownout. Any oscillation of voltage waveform due to the non-synchronous is not acceptable.

3.9 Remote Sense

Remote sense is necessary at +5V/+3.3Voutputs and return sense. The remote sense should be able to regulate out voltage drop of 300mV minimum on voltage outputs as well as return. There are the values of resistor connecting between the remote sense and the out voltages internal to PDB.

3.10 Output Cable/Connector Requirement

REFER PD SPEC

4. TIMING & SEQUENCE

4.1 General Timing

These are the timing requirements for power supply operation including alone module outputs and multi module outputs. All outputs shall rise monotonically. The +3.3V output shall not exceed the 5V output by more than 0.5V at power on. In general, +5V/+3.3V rise waveform shall soft-start from the time when +12V goes to regulation limit if +5V/+3.3V is converted from +12V, and +5VSB rise waveform shall soft-start from the time when +12VSB goes to regulation limit if the +5VSB is converted by +12VSB.However, power supply timing must meet the requirement of mother board.

The criteria in below table is recommended.

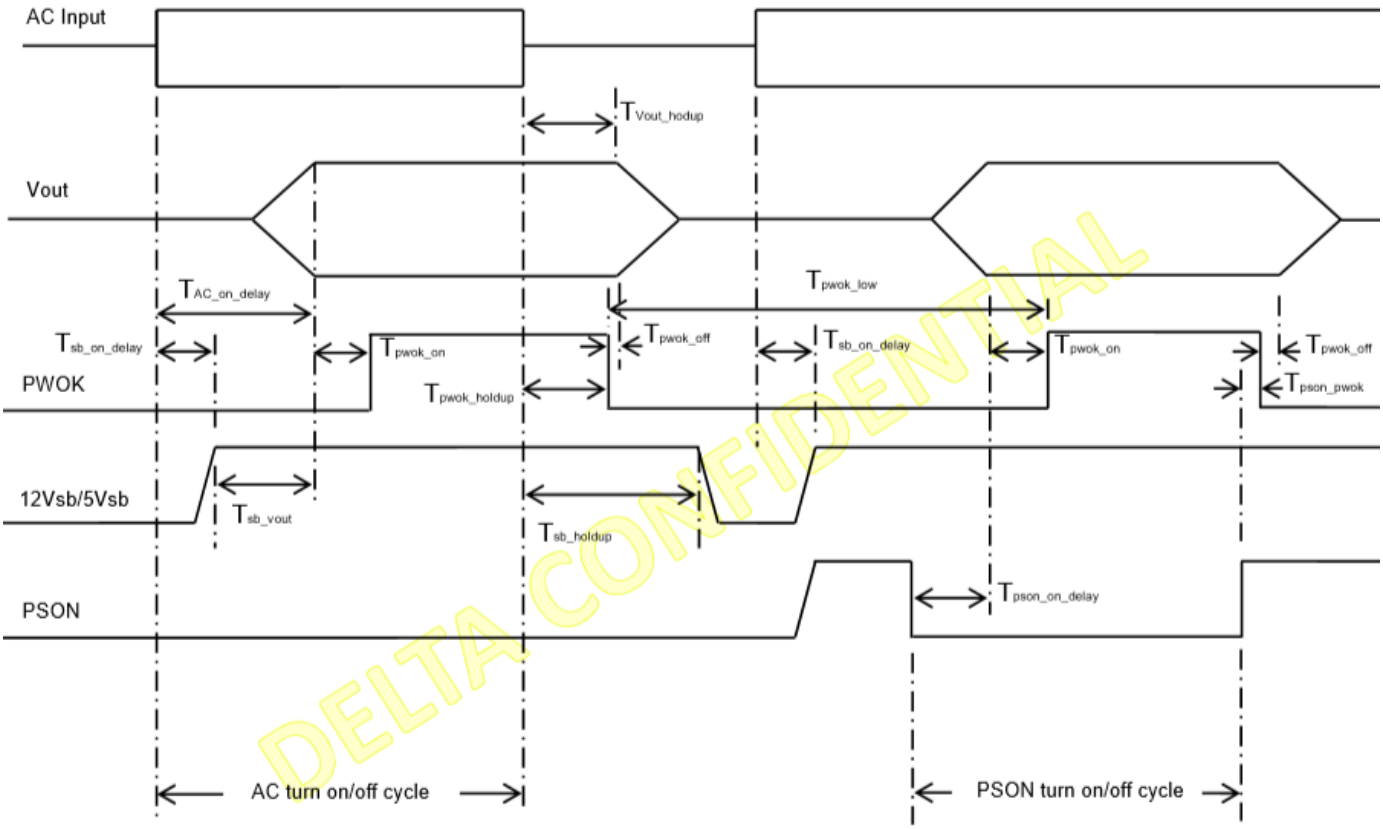
Table 4.1 turn on/turn off timing

ITEM	DESCRIPTION	MIN	MAX	UNIS
*$T_{sb\_on\_delay}$	Delay from AC being applied to +5VSB/+12VSB being within regulation.	0	2000	msec
*$T_{ac\_on\_delay}$	Delay from AC being applied to all output voltages being within regulation.		3000	msec
T_{vout_rise}	Output voltage rise time for main outputs from 10% to within regulation limits. For +5VSB,+12VSB	1 1	70 70	msec
T_{vout_on}	All main outputs must be within regulation of each other within this time.		50	msec
**T_{vout_holdup}	Time of all main output voltages stay within regulation after loss of AC. (At 70% Full load). T5vsb/12vsb hold up time.	11 70		msec
T_{pwok_holdup}	Delay from loss of AC to de-assertion of PWOK (At 70% Full load)	10		msec
$T_{pson\_on\_delay}$	Delay from PSON# active to output voltages within regulation limits.	5	400	msec
T_{pson_pwok}	Delay from PSON# de-active to PWOK being de-asserted.		50	msec
T_{pwok_on}	Delay from main output voltages within regulation limits to PWOK asserted at turn on.	100	500	msec
***T_{pwok_off}	Delay from PWOK de-asserted to output voltages (+3.3V, +5V) dropping out of regulation limits.	1		msec
T_{pwok_low}	Duration of PWOK being in the de-asserted state during an off/on cycle using AC or PSON signal.	100		msec
T_{sb_vout}	Delay from +5VSB/+12VSB being in regulation to O/Ps being in regulation at AC turn on.	5	1500	msec

Footnotes:

1. *: Since the AC-195 A has the function that Automatic configuration Current of 12VHPWR Connector, in order to ensure the integrity of its functions, the AC on-time must be maintained for more than 2 seconds to ensure that the AC-195 A initialization is complete.
2. **: When test the Tvout_holdup, the +12V regulation should follow +/-8%.
3. ***: When test the Tpwok_off with 2400W Module, should at 70% of max load.

Figure 1 timing diagram



4.2 Control Signal and Other DC Signals

4.2.1 PG Signal (PWOK)

The power supply shall provide a TTL compatible PWOK signal to the system. The combined PWOK signal from two power supply modules shall use logic “OR”; And the ultimate PWOK signal to the motherboard from the combined PWOK and DC-DC converter shall use logic “AND”.

Table 4.2.1 PWOK Characteristics

Signal type	TTL compatible
Logical low voltage	∠0.4V, 4mAsink current
Logical high voltage	4.4VDC - 5.25VDC
Sink current, PWOK= low	≤4mA
PWOK rise and fall time	≤ 100mS
High-state output impedance	A pull up resistor is between PWOK output and +5VSB voltage located in PDB

4.2.2 PS-ON Signal

PSON# signal is required to remotely turn on/off the power supply. PSON# is the active low signal that turns on the +12V power rail and other DC to DC converters. When this signal is not pulled low by the system, or left open, all the outputs (except for +5VSB/+12VSB) shall be turned off. This signal is pulled to +3.3VSB voltage by a pull-up resistor internal to the power supply. Refer to Figure 1 On/Off Timing for timing diagram.

Table 4.2.2 PS_ON Characteristics

Logical low voltage (Vil)	0.0—1.0V
Logical high voltage(Vih；Iin=-200Ua)	≥2V
Source current(Iil ,Vin=0.4V)	≤4mA
Open status(Iin=0)	≤ 5.25V
Power-on status	PS_ON= 0
Power-off status	PS_ON= 1 or open state

4.2.3 PSU PMBus Setting Time

PSU PMBus needs 500ms to do internal initial setting, in this setting period we don't allowed any access actions through PMBus. System communicates with PSU after PSON 500ms.

4.2.4 SMBAlert Signal

This signal indicates that the power supply is experiencing a problem that the user should investigate. This shall be asserted due to critical events or Warning events. The signal shall activate in the case of critical component temperature reached a warning threshold, general failure, over-current, over-voltage, under-voltage, failed fan. This signal may also indicate the power supply is reaching its end of life or is operating in an environment exceeding the specified limits. This signal is to be asserted in parallel with LED turning solid Amber or blink Amber.

Table 4.2.4-1 SMBAlert# Signal Characteristics

Signal Type (Active Low)	Open collector / drain output from power supply. Pull-up to VSB located in system.(System provide the pull-up voltage (3.3V or 5V))	
Alert# = High	OK	
Alert# = Low	Power Alert to system	
	MIN	MAX
Logic level low	0V	0.4V
Logic level high	2.4V	5.25V

Type	PSU1 Module	PSU2 Module	Cage work	SMBAlert	Buzzer

1	Installed	Not Installed	OK	High	N/A
2	Not Installed	Installed	OK	High	N/A
3	Installed	Installed	OK	High	N/A
4	Installed	Failure	OK	Low	Alarm
5	Failure	Installed	OK	Low	Alarm
6	Not Installed	Failure	OK	Low	Alarm
7	Failure	Not Installed	OK	Low	Alarm
8	Installed	Not Installed	Fail	Low	Alarm
9	Not Installed	Installed	Fail	Low	Alarm
10	Installed	Installed	Fail	Low	Alarm
11	Installed	Failure	Fail	Low	Alarm
12	Failure	Installed	Fail	Low	Alarm
13	Not Installed	Failure	Fail	Low	Alarm
14	Failure	Not Installed	Fail	Low	Alarm

Footnotes:

1) Installed=Module is installed in the drawer and working well.
2) Not Installed=No module, drawer is empty.
3) Failure=Defective module installed in the drawer（except +5VSB/+12VSB）(OCP, AC Loss, OTP, OVP, Fan Fail）.
4) The buzzer alarm can be reset/muted in any of the following ways.
   a) System sends PMbus command B0H;
   b) Mute Switching can reset buzzer (If have a switch is connected to the terminal of Mute signal of PDB by customer;

Table 4.2.4-2 Alert Warning Trip Levels (Alert# = Low)

ITEM	Min.	Typ.	Max.
3.3V Over Current Warning	20A	21.5 A	23A
5V Over Current Warning	29A	30.5A	32A
Over temperature warning(OTW)	--	63℃	--
Module Alert Warning	Any Module Alert is Low		

4.2.5 TTL Signal

There shall be an open-collect TTL to indicate power supply status. The TTL shall pull high to

+3.3VSB indicate that all the power outputs are available. The TTL shall pull low indicate that one module has failed or shutdown due to protection. Refer to Table 4.2.6 for detail status.

Table 4.2.5 TTL Signal Characteristics

Signal Type (Active Low)	Open collector / drain output from power supply. Pull-up to VSB located in PDB.	
TTL= High	OK	
TTL= Low	Power Alert to system	
	MIN	MAX
Logic level low	0V	0.4V
Logic level high	2.4V	5.25V

4.2.6 PDB LED and Buzzer

The PDB is equipped with a wire terminal with one LED, and the other end of the wire can be connected with an LED, the LED shows the states of the PDB. The signal is pulled to +3.3VSB voltage by a 330ohm pull-up resistor internal to the PDB.
If the customer wants this function, he can install an LED lamp through the LED signal terminal on the PDB, The customer can calculate the LED current according to the pull-up voltage and current limiting resistance as required to select the appropriate LED, or directly select the following recommended source (EVERLIGHT---333GD---LED GRN 5mm GD ROUND 10)

Table 4.2.6 Led & PDB Buzzer

Status			Module LED	PDB LED	TTL	buzzer
1 module +1PDB	Input voltage turn off, power supply internal energy complete release		off	off	--	--
	Input voltage normal, normal working		Green continuously	Green continuously	Low	--
	Input voltage normal, standby mode(PS_OFF)		Green blinking(1Hz)	Green blinking(1Hz)	Low	--
	Input voltage normal , module fault(PS_ON)		Amber continuously	Green blinking(4Hz)	Low	alarm
	Input voltage normal , PDB fault(PS_ON)		Green blinking(1Hz)	Green blinking(4Hz)	Low	alarm
2 module +1 PDB	Input voltage normal, normal working		Green continuously	Green continuously	High	--
	Input voltage normal , module fault(PS_ON)		Amber continuously	Green blinking(4Hz)	Low	alarm
	Input voltage normal ,two modules shall be synchronous work(PS_ON),	module of AC LOSS	Amber continuously	Green blinking(4Hz)	Low	alarm
		module of AC OK	Green continuously			

	one module AC LOSS					
	Two modules shall be synchronous, only one module input voltage turn on(PS_ON)(first input voltage)	module of no input voltage	Amber continuously	Green blinking(4Hz)	Low	alarm
		module of input voltage	Green continuously			
	Input voltage normal ,two modules shall be synchronous work(PS_ON), Remove one Module	module in PDB	Green continuously	Green blinking(Green for 1.5s and off for 1s, circulating)	Low	--
		--	--			

4.2.7 SCL and SDA

Both signal line will be used as communication interface for PMBus. Open pin is the serial clock (SCL) and the other is used for serial data (SDA). The SCL and SDA signals are pulled up by PDB, both pins are bi-directional, open drain signals and are used to form a serial bus.

4.2.8 PCIe* Gen 5.0 12VHPWR Connectors Sideband Signals

The PCIe Gen 5.0 12VHPWR connector has 4 sideband signals defined that communicate between the PDB and the Add-in Card (GBU) in system.

- SENSE0
- SENSE1
- CARD_PWR_STABLE
- CARD_CBL_PRES#

● SENSE0/SENSE1

These signals allow the PDB to tell the Add-in Cards how much power the Add-in Card can use. PDB can tell the system the power limit that can be used by Add-in Cards through different combinations of S0/S1 TTL signals. The signals must not change state while the Add-in Cards is operational. The signal is Open collector / drain output from power supply.

Table 4.2.8-1 PCI e Gen5.0 12VHPWR Connector power limits

SENSE0	SENSE1	Max Sustain Power after Software Configuration
LOW	LOW	600W

HIGH	LOW	450W
LOW	HIGH	300W
HIGH	HIGH	150W

Footnotes:
If the Add-in Card does not monitor these signals, it must default to the lowest value in this table.

- CARD_PWR_STABLE

This signal is from Add-in Cards in system to the PDB. It is the active low signal that provide a fault detection from Add-in Cards to the PDB, allow the PDB a protection opportunity. When this signal is not pulled low by the system, or left open, it indicates that the Add-in Cards in system are working normally. When implemented, the signal is tied to a 4.7Kohm pull-up resistor to +3.3VSB internal at the PDB.

Table 4.2.8-2 CARD_PWR_STABLE Characteristics

Signal Type (Active Low)	Pull-up to +3.3VSB located in PDB	
CARD_PWR_STABLE = High(OPEN)	AIC(system) work normal	
CARD_PWR_STABLE = Low(GND)	AIC(system) Alert to PDB	
	MIN	MAX
Logic level low	-0.2V	+0.8V
Logic level high	2.0V	3.5V

- CARD_CBL_PRES#

This signal is from Add-in Card in system to the PDB. It is the active low signal that can be used to determine how many Add-in Cards are plugged into the system, so as to configure the current for the PDB. When implemented, the signal is tied to a 100Kohm pull-up resistor to +3.3VSB internal at the PDB.

Table 4.2.8-3 CARD_CBL_PRES# Characteristics

Signal Type (Active Low)	Pull-up to +3.3VSB located in PDB	
CARD_CBL_PRES# = High(OPEN)	AIC is not inserted system for this 12HPWR Connectors	
CARD_CBL_PRES# = Low(GND)	AIC is inserted system for this 12HPWR Connectors	
	MIN	MAX
Logic level low	-0.2V	+0.8V
Logic level high	2.0V	3.5V

4.2.9 Current configuration of 12VHPWR Connector

PDB has three current configuration modes: Average mode, Priority mode and User-defined mode

- Average mode: PDB default mode.
- Priority mode: Can be modified to this mode by system PMBus command.
- User-defined mode: In developer mode, Can be modified to this mode by system PMBus command.

The modification of the above mode, refer to 10.9.2 for details. For detailed current configuration of average and priority modes, please refer to the following table.

Table 4.2.9 Current configuration of Total 12VHPWR Connector

Delta Module	Total PCIe 12VHPWR Power	Configuration	N=Numbers of Add-in Cards inserted system			
			1	2	3	4
DPS-300AB-102 X	150W	#00_Average	150	150+△	150+△+△	150+△+△+△
		#01_ Priority	150	150+△	150+△+△	150+△+△+△
DPS-550AB-36 X	300W	#00_Average	300	150+150	150+150+△	150+150+△+△
		#01_ Priority	300	150+150	150+150+△	150+150+△+△
DPS-650AB-16 X	450W	#00_Average	450	300+150	150+150+150	150+150+150+△
		#01_ Priority	450	300+150	150+150+150	150+150+150+△
DPS-800AB-30 X	600W	#00_Average	600	300+300	300+150+150	150+150+150+150
		#01_ Priority	600	450+150	300+150+150	150+150+150+150
DPS-1200AB-16 X	900W	#00_Average	600	450+450	300+300+300	300+300+150+150
		#01_ Priority	600	600+300	600+150+150	450+150+150+150
DPS-2400AB-12 A	1800W	#00_Average	600	600+600	600+600+600	450+450+450+450
		#01_ Priority	600	600+600	600+600+600	600+600+450+150

Footnotes:

1. The total PCIe power calculation, N= Module Power*0.8/150W, and rounded down. Then Total PCIe power=N*150W (e.g. Module 800W*0.8/150W=4,then the PCIe power is 4*150W=600W)
2. When the module is inserted into the PDB, but PDB can't establish communication with module. The PDB will skip the current configuration logic, and turn on directly. At this time, SENSE0 and SENSE1 of the all 12VHPWR connectors all display high level, and all LEDs of 12VHPWR connector are off.
3. "△": Over Configured: The 12VHPWR connector with Add-in Card plugged in must obtain at least 150W power, otherwise it is over configured.
4. In the over configuration state, the PDB can be turned on.
   1) The SENSE0 and SENSE1 of the four 12VHPWRs connectors all display high level.
   2) The 12VHPWR connectors without over configuration, LED lights up according to normal configuration logic.
   3) The over configured 12VHPWR connectors, the LEDs corresponding to the 12VHPWR are yellow (flashing in standby and are always on during operation)

4.2.10 LED Indicator of 12VHPWR Connector

Each 12VHPWR Connector is equipped with 4pcs Bi-color LEDs to express the link status. Also when the system pull down the CARD_PWR_STABLE signal, the LED can make corresponding response according to the time of the signal being pulled down.
The following table shows the status of LEDs and sideband signals of one 12VHPWR Connector.

Table 4.2.10 LED Indicator of one 12VHPWR Connector

CONDITION				STATE					
One PCIe 12VHPWR POWER	STATUS	CARD_CBL_PRES#	CARD_PWR_STABLE	SENSE0	SENSE1	LED_#1	LED_#2	LED_#3	LED_#4
600W	Normal work	LOW	HIGH	LOW	LOW	GREEN	GREEN	GREEN	GREEN
	Standby	LOW	HIGH	LOW	LOW	1HZ Blink GREEN	1HZ Blink GREEN	1HZ Blink GREEN	1HZ Blink GREEN
	Output Abnormal (Dynamic jump)	LOW	LOW (<= 3000mS)	LOW	LOW	YELLOW	YELLOW	YELLOW	YELLOW
	Output Abnormal (Poor connection)	LOW	LOW (> 3000mS)	LOW	LOW	YELLOW	YELLOW	YELLOW	YELLOW
450W	Normal work	LOW	HIGH	HIGH	LOW	GREEN	GREEN	GREEN	--
	Standby	LOW	HIGH	HIGH	LOW	1HZ Blink GREEN	1HZ Blink GREEN	1HZ Blink GREEN	--
	Output Abnormal (Dynamic jump)	LOW	LOW (<= 3000mS)	HIGH	LOW	YELLOW	YELLOW	YELLOW	--
	Output Abnormal (Poor connection)	LOW	LOW (> 3000mS)	HIGH	LOW	YELLOW	YELLOW	YELLOW	YELLOW
300W	Normal work	LOW	HIGH	LOW	HIGH	GREEN	GREEN	--	--
	Standby	LOW	HIGH	LOW	HIGH	1HZ Blink GREEN	1HZ Blink GREEN	--	--
	Output Abnormal (Dynamic jump)	LOW	LOW (<= 3000mS)	LOW	HIGH	YELLOW	YELLOW	--	--
	Output Abnormal (Poor connection)	LOW	LOW (> 3000mS)	LOW	HIGH	YELLOW	YELLOW	YELLOW	YELLOW
150W	Normal work	LOW	HIGH	HIGH	HIGH	GREEN	--	--	--
	Standby	LOW	HIGH	HIGH	HIGH	1HZ Blink GREEN	--	--	--
	Output Abnormal (Dynamic jump)	LOW	LOW (<= 3000mS)	HIGH	HIGH	YELLOW	--	--	--
	Output Abnormal (Poor connection)	LOW	LOW (> 3000mS)	HIGH	HIGH	YELLOW	YELLOW	YELLOW	YELLOW

Footnotes:

1. Dynamic jump: is that the output voltages over specification due to the Load dynamic changes. When it happens, the system will pull down the CARD_PWR_STABLE signal and keep it <=3s, this is only used for indicator LED and does not trigger protection.

   Which 12VHPWR connector signal is triggered, and its LED turns yellow and SMBalert will be pull down, other 12VHPWR's LED remain unchanged. After the signal jump state is removed, the LED returns to the normal state.

2. Poor connection: is that abnormal connector connection leads to excessive contact resistance and output voltage over specification.
   When it happens, the system will pull down the CARD_PWR_STABLE signal and >=3s, this is used for indicator LED and trigger protection (PDB shutdown).

   Which 12VHPWR signal is triggered, and its 4 LEDs turn yellow and are always on, other 12VHPWR's LED are off. LED states are latched, when the fault is removed, it requires PS_ OFF/ON or AC_ OFF/ON can be reset.

3. In normal work mode, when PDB is protected (OCP, OVP, SHORT, OTP), (except +5VSB/+12VSB/+12V), the all 16 LEDs in 4 groups turn yellow and are always on and latched. When the fault is removed, it requires PS_OFF/ON or AC_OFF/ON can be reset.

5. PROTECTION

5.1 Power Supply Turn On After Protection

Power supply shall shut down and latch-off by fault or protection. Protection circuits inside the power supply shall only cause the power supply's main outputs to shut down. When this fault or protection is removed, Power supply must be able to turn up through toggling PS ON/OFF or AC ON/OFF re-cycle. The toggling time is <=1S by PSON turn on mode, and after the AC is turned off, it is not until the Steadby voltage discharge is complete by AC on mode. The +5VSB /+12VSB protection mode is auto restart once the fault or protection is removed.

5.2 OVP

Table 5.2 over voltage protection

Voltage	Min	Max	Unit
+3.3V	+3.7	+4.3	VDC
+5V	+5.7	+6.5	VDC
+12V	+13	+15	VDC
+5VSB	+5.7	+6.5	VDC

Footnotes:
1. OVP state on main outputs shall shutdown and latch off;
2. When +5VSB OVP condition is remove, +5VSB and main outputs shall be Auto Restart itself;

5.3 OCP

Table5.3-1 over current protection

Voltage	Module	PDB		
		Min	Max	Unit

+3.3V		20	26	A
+5V		29	35	A
5VSB		4.5	10	A

Footnotes:

1. OCP state on main outputs shall shut down and latch off, and shall be cleared by toggling the PSON# signal or by an AC input re-cycle;
2. +5VSB OCP shall be Auto Restart when OCP condition is removed;
3. +12V OCP depend on Modules, as table5.3.1

Table5.3-2 over current protection

Voltage	Module	Module		
		Min	Max	Unit
+12V	DPS-300AB-102 X	29	40	A
	DPS-550AB-36 X	52	60	A
	DPS-650AB-16 X	63	73	A
	DPS-800AB-30 X	77	84	A
	DPS-1200AB-16 X with low line	90.2	123	A
	DPS-1200AB-16 X with high line	107.8	147	A
	DPS-2400AB-12 A with low line	94	104	A
	DPS-2400AB-12 A with High line	230	250	A

5.4 Short Circuit Protection

The power supply shall shut down and latch off when any output is short circuit (impedance less than 0.1ohm) with any other outputs, whatever the outputs is shorten when power supply is running as well as before turn on.

1) The power supply shall be no physical damage when +12V,+5V,+3.3V,+5VSB output is shorted to its DC return;
2) +5VSB shall be Auto Restart when short condition is removed.

5.5 No load Condition

No protection occurs when power supply operates in no load condition.

5.6 Over Temperature Protection

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 failures. In over temperature condition the PS shall shutdown. The Standby output shall not shutdown during an OP condition on the main outputs. When the temperature drops to within safe operating limit for internal parts, the power supply shall restore 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 are recovering condition. The OTP trip level shall have a minimum of 5℃ of ambient temperature margin.

Table 5.6 Inlet Ambient Sensor Trip Level for Reference

Type	MIN	MAX
Over temp warning; inlet air (OTW)	61℃	63℃
Over temp shutdown; inlet air (OTP)	65℃	67℃

5.7 Immunity voltage from system at outputs rail

The Power supply shall be immune to any residual voltage placed on its outputs (Typically a leakage voltage through the system from standby output) up to 500mV. There shall be no additional heat generated, stress of any internal components, nor protection circuit trip during turn on with this voltage applied to any individual output, and all outputs simultaneously.

5.8 Burn-In Condition

The power supply should follow 10000-032500 to perform Burn-In test in below condition:
1. Environment Temperature: 40+/-5 ℃
2. Output Load: 95+/-5% of Rated Power

6. ENVIRONMENT REQUIREMENT

6.1 Temperature

6.1.1 Operating Temperature

+0°C Min，+55°C Max
Note:
1. Full load and all input voltage range, temperature change rate 5°C/min~10°C/h is accepted). This temperature is the input temperature at the wind inlet of the cage.
2. Under without system airflow (Windless System), in order to facilitate the heat dissipation of the product, the output cable is required to be combed straight in the space range shown in the Picture 6-1, try not to bend, stack, and there are no other objects to obstruct. The Picture 6-1 refer to the last page of ES, please have a note.

6.1.2 None operating temperature (storage)

-40°C Min~+80°C Max

6.2 ROHS

Power supply must be ROHS compliant including the component, PCB, soldering material, case, wire, process.

6.3 Humidity

Operating (non-condensing): 5% to 90%
Make sure to thoroughly test the higher values (50 degrees and 95% humidity)
Non-operating (non-condensing): 5% to 95%

6.4 Altitude: 5000m

7. POWER SUPPLY MONITOR AND CONTROL

PM bus specification 1.2 shall be used for the communication with system.
The power supply shall comply with Intel Node manager2.0 specification.

8. LOAD SHARING AND COMPATIBILITY

8.1 Load sharing

The PDB combined power, the current sharing accuracy should be within (+10%, -10%) at 100% load. The accuracy shall be calculated by:（M1-M2）/M1， or（M1-M2）/M2. For example M1=10W(input power)，M2=9.1-11W(input power).

8.2 Compatibility

This PDB could compatible with different PSU， defined as 300W(DPS-300AB-102 X) 、550W(DPS-550AB-36 X) 、650W(DPS-650AB-16 X) 、800W(DPS-800AB-30 X) or 1200W(DPS-1200AB-16 X)、2400W(DPS-2400AB-12 A) could not mixture match with different PSU (such as 650W mixture match with 800W， or 300W mixture match with 1200W and so on).

9. RELIABILITY

9.1 E-cap life

100% of full load、 50℃ not less than 3years;

9.2 MTBF

The power supply should have a minimum MTBF at continuous operation of 100,000 hours at 100% load and 55 ℃.

9.3 Shock

Non-operating, half sine, 50G, 11ms, 3 times on each of 6 faces

9.4 Vibration

Non-operating
0.015g2/Hz 3 to 100 Hz
-6dB/octave 100-137Hz
0.008g2/Hz 137 to 350 Hz
-6dB/octave 350-500Hz
0.0039g2/Hz 500 Hz
2.09Grms
20 minutes / axis, all three axes

10. PMBUS

The PS+PDB combo shall provide a monitoring interface to the system over a system management bus to the system. Device should be compatible with both PMBus 1.2 spec and I2C Vdd based power and drive. This bus shall operate at 3.3V. The SMBus pull-ups are located on the PDB.
This shall provide power monitoring, failure conditions, warning conditions. Two pins have been reserved on the connector to provide this information. One pin is the Serial Clock (SCL). The second pin is used for Serial Data (SDA). Both pins are bi-directional and are used to form a serial bus.

10.1 Addressing

For redundant power systems there may be a power distribution board (PDB). In this case there may need to be a PMBusTM device on the PDB. If the PDB is passive then the PMBusTM device on the PDB may not be needed. Below are the PDB device address locations: PDB PMBusTM address: 4Ah

10.2 Data Formats

The data format for current, voltage, power, temperature, and fan speed shall use the PMBus Literal format.
Literal data format: X = Y · 2N
X = the sensor value in volts, amps, watts, degrees C, or RPM
Y = mantissa
The mantissa is the variable components that changes as the sensor value changes. Y is a 16 bit unsigned value for the READ_VOUT command. For all other READ commands Y is a 11 bit signed 2's compliment value.
N = exponent. The exponents are fixed for each power supply and define the resolution for each sensor.

10.3 Accuracy

The sensor commands shall meet the following accuracy requirements.

	Required Accuracy (+/-x% of equipment reading) (Vin range=(100v~127v) or (200v~240v))		
Output Loading	<10%	10% - 20%	>20%
READ_POUT	No spec	+/-10%	+/-5%
READ_IOUT	No spec	+/-10%	
READ_VOUT	+/- 5% over full range		

10.4 Vout_mode

For reading output voltages the power supply shall support the VOUT_MODE command to report the output voltage formatting for the READ_VOUT command. The VOUT_MODE shall be set to Linear and the exponent (N) shall be set to -9.

Table 11: VOUT_MODE settings for reading output voltage(s).

Mode	Bit[7:5]	Bit[4:0]
Linear	000b	10111b(-9)

10.5 Sensor Formatting Tables

These tables define the values for N and associate resolutions that are supported for each range of power supply parameters. The value of N shall be fixed for a given power supply and sensor based on the power supplies capabilities.

READ_IOUT	N	Peak(Amps)	Resolution(Amps)
	-7	0 to < 8	0.007813
	-6	8 to <16	0.015625
	-5	16 to < 32	0.03125
	-4	32 to < 64	0.0625
	-3	64 to <128	0.125
	-2	128 to <256	0.25

READ_POUT	N	Peak(Watts)	Resolution(Watts)
	-3	0 < 128	0.125
	-2	128 to < 256	0.25
	-1	256 to < 512	0.5
	0	512 to <1024	1
	1	1024 to < 2048	2
	2	2048 to < 4096	4

10.6 Monitoring Power/current/voltage

The following PMBus commands shall be supported for the purpose of monitoring currents, voltages, and power.

PMBus command	Description
READ_IOUT	Output current of the selected output in amps
READ_VOUT	Output voltage of the selected output in volts
READ_POUT	Total output power of the monitored outputs in watts

For power supplies or power distribution boards with multiple outputs the PAGE command shall be supported. The following PAGEs shall be assigned to support standard voltages.

Item	Output	Page location
1	12V	00h
2	5V	01h
3	3.3V	02h

10.7 Status Commands

The following PMBus status commands shall be supported.

CLEAR_FAULTS
STATUS_WORD
Low Byte

Bit	Bit Name Meaning
7	not used
6	OFF power supply is off for any reason
5	VOUT_OV_FAULT any output overvoltage fault has occurred
4	IOUT_OC_FAULT any output shuts down due to over current
3	not used
2	TEMPERATURE temperature shut down or warning condition
1	CML A communication, memory or logic fault has occured
0	NONE OF ABOVE the fault or warning not listed in bits [7:1]

High Byte

7	VOUT An output voltage fault or warning has occurred
6	IOUT Output current fault or warning event
5	INPUT Input current or voltage fault or warning event
4	not used
3	POWER_GOOD# Power good is de-asserted
2	not used
1	not used
0	UNKNOWN Other FAILURE Power supply is shut down for other reasons and not listed in bits [15:1]

STATUS_IOUT

Bit	Meaning
7	not used
6	not used
5	IOUT_OC_WARNING over current warning
4	not used

3	not used
2	not used
1	not used
0	POUT_OP_WARNING Out over power warning

STATUS_INPUT

Bit	Meaning
7	not used
6	not used
5	not used
4	not used
3	Unit is OFF due to insufficient input voltage
2	not used
1	not used
0	not used

STATUS_TEMPERATURE

Bit	Meaning
7	OTP_FAULT Over temperature fault
6	not used
5	not used
4	not used
3	not used
2	not used
1	not used
0	not used

STATUS_CML

Bit	Meaning
7	Invalid or unsupported command received
6	Invalid or unsupported data received
5	Packet error check failed
4	not used
3	not used
2	not used
1	not used
0	not used

10.8 Limit commands

The following PMBus commands shall be supported to allow the system to set warning limits. If one of the warning limits are exceeded the appropriate bit in the status register shall be set.

Command	Meaning
IOUT_OC_WARN_LIMIT	Output over current warning limit
POUT_OP_WARN_LIMIT	Output over power warning limit

Default Limits for System Controllable Limits

The default values for system controllable limits shall be set to the power supplies maximum capabilities.

10.9 Fault limit commands and 12VHPWR current configuration in development mode

The following PMBus commands allow the system to set fault limits and customize 12VHPWR current configuration.

Command	Meaning
PRODUCT_MODE_PERMITS (D5h)	Enable the permission to modify the product mode
PRODUCT_MODE_MODIFY (D6h)	Modify the product mode
FAULT_LIMITS_PERMITS (D7h)	Enable the permission to modify the fault limits
IOUT_OC_FAULT_LIMIT	Modify product output over current fault limit
_12VHPWR_CUR_CONFIG (D8h)	Enable the manual setting option for the 12VHPWR current configuration
_12VHPWR_CUR_COMMAND (D9h)	Customize 12VHPWR current configuration

10.9.1 Set fault limits

See the following for set fault limits steps:

1) Enable the permission to modify the product mode (Write Byte with PEC).

Slave Address	Command Code	Data Byte	PEC
4A	D5	01	FD

Default value 0x00 indicates the permission is disable, modify the value to 0x01 indicates the permission change to enable. This data will be reset to default value 0x00 each time the product cold start.

2) Modify the product mode (Write Byte with PEC).

Slave Address	Command Code	Data Byte	PEC
0x4A	0xD6	0x01	0xC2

Default value 0x00 indicates the product mode is mass production phase, modify the value to 0x01 indicates the product mode change to development mode. The value can only be changed from 0x00 to 0x01.

3) Enable the permission to modify the fault limits (Write Byte with PEC).

Slave Address	Command Code	Data Byte	PEC
0x4A	0xD7	0x01	0xD7

Default value 0x00 indicates the permission is disable, modify the value to 0x01 indicates the permission change to enable. This data will be reset to default value 0x00 each time the product cold start.

4) Modify product fault limit (Write Word with PEC, Take 12V OCP for example).

Slave Address	Command Code	Data Byte L	Data Byte H	PEC
0x4A	0x46	0xXX	0xXX	0xXX

The written fault limit will be saved until the next time it is modified by this command.

10.9.2 Product redundancy mode configuration

The following PMBus command allows the system use to change the product redundancy mode when the product is in development mode.

Slave Address	Command Code	Data Byte	PEC
0x4A	0xDA	0x01	0x3E

Default value 0x00 indicates the product redundancy mode is 1+1. Modify the value to 0x01 can change the product redundancy mode to 2+0. The value will be saved until the next time the system modify it with this command.
In 2+0 mode, mixed inserts will cause the product to fail to turn on, now all 16 leds yellow blink.

10.9.3 Customize the 12VHPWR current configuration

1) The following PMBus command allow the system use to change the 12VHPWR current configuration or enable the manual setting option for the 12VHPWR current configuration (Write Byte with PEC).

Slave Address	Command Code	Data Byte	PEC

0x4A	0xD8	0x01	0x14
0x4A	0xD8	0x02	0x1D
0x4A	0xD8	0x00	0x13

Default value 0x00 indicates the product average configure the 12VHPWR current. Modify the value to 0x01 indicates the product prioritize in sequence configure 12VHPWR current. When the product is in development mode, the value can be modify to 0x02, then the command D9h allow system to set the customized 12VHPWR current configuration strategy.

Current configuration of 12VHPWR connector in average mode or priority mode can refer to 4.2.9.

The written 12VHPWR current configuration will be saved until the next time it is modified by this command.

2) Customize the 12VHPWR current configuration (Block Write with PEC).

Slave Address	Command Code	Byte Count	Data Byte 1	Data Byte 2	Data Byte 3	Data Byte 4	PEC
0x4A	0xD9	0x04	0x0X	0x0X	0x0X	0x0X	0xXX

Byte1, byte2, byte3, byte4 default value is 0x00. Refer to the following table for the corresponding power:

Data Byte	0x00	0x01	0x02	0x03	0x04
Power (W)	0	150	300	450	600

10.10 Capability and inventory reporting

The follow commands shall be supported for discovery of the power supplies capabilities.

Command Meaning
CAPABILITY Defines the power supplies PEC support, bus speed, and support of SMBAlert
QUERY Used to determine if the power supply supports a specific command
PAGE Used to QUERY a specific output of a multi output power supply
Revision and inventory information
SHUTDOWN_BUZZER
CUSTOMER_CMD Used to turn on one or two modules
FW_VER_DATE
PMBUS_REVISION
MFR_ID
MFR_MODEL
MFR_REVISION
MFR_VOUT_MIN
MFR_VOUT_MAX
MFR_IOUT_MAX

MFR_POUT_MAX
MFR_TAMBIENT_MAX
MFR_EEPROM_W
MFR_EEPROM_R

10.11 Write Protection

The WRITE_PROTECT command shall be supported. There is one added call to the WRITE_PROTECT command.

Data Byte	Value Meaning
0001 0000	Disables all commands but the WRITE_PROTECT, PAGE, and all MFR_xxxx

10.12 PMBus Commands Set

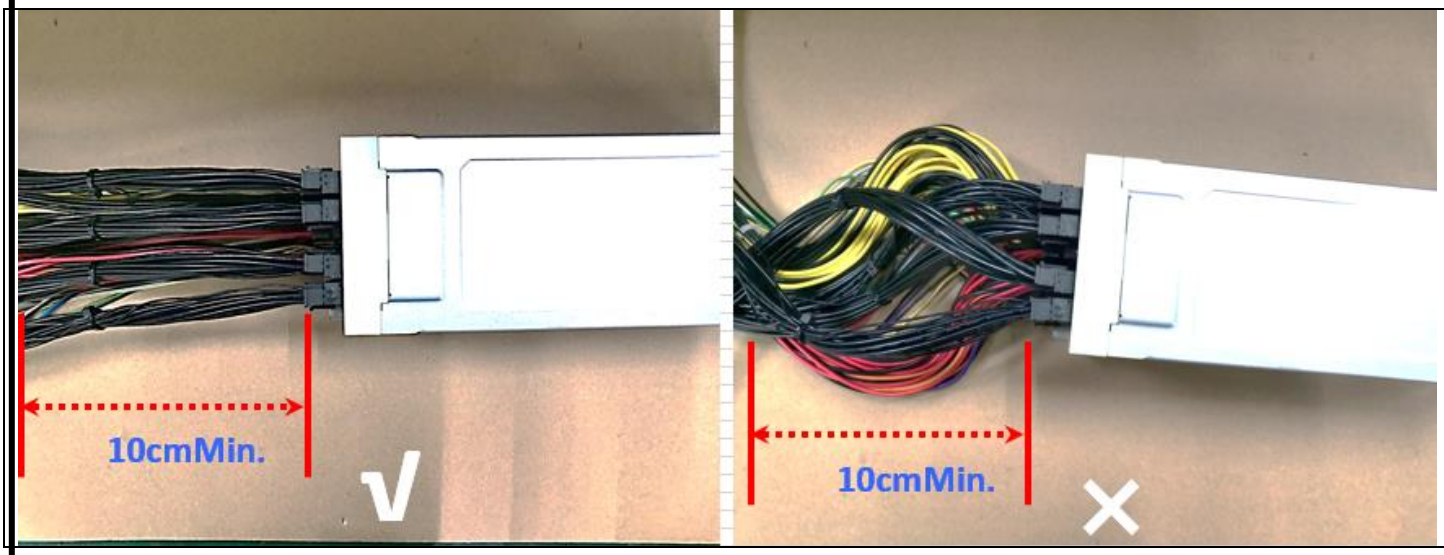
Following below table shows mandatory PMBus commands to be supported by the PSU.

Command Code	Command Name	Number Of Data Bytes	PSU Transaction Type
00h	PAGE	1	R/W Byte
03h	CLEAR_FAULTS	0	Send Byte
10h	WRITE_PROTECT	1	R/W Byte
19h	CAPABILITY	1	Read Byte
1Ah	QUERY	1	Block Write/Read Process Call
20h	VOUT_MODE	1	Read Byte
40h	VOUT_OV_FAULT_LIMIT	2	Read Word
44h	VOUT_UV_FAULT_LIMIT	2	Read Word
46h	IOUT_OC_FAULT_LIMIT	2	Read Word
4Ah	IOUT_OC_WARN_LIMIT	2	R/W Word
6Ah	POUT_OP_WARN_LIMIT	2	R/W Word
70h	FW_VER_DATE		Read Block
79h	STATUS_WORD	2	Read Word
bit6	OFF		
bit5	VOUT_OV_FAULT		
bit4	IOUT_OC		
bit2	TEMPERATURE		
bit1	CML		
bit0	NON OF THE ABOVE		
(High)bit7	VOUT		
bit6	IOUT/POUT		
bit5	INPUT		
bit3	POWER_GOOD#		
bit0	UNKNOWN		

7Bh	STATUS_IOUT	1	Read Byte
bit5	IOUT_OC_WARNING		
bit0	POUT_OP_WARNING		
7Ch	STATUS_INPUT	1	Read Byte
bit3	INSUFFICIENT_INPUT		
7Dh	STATUS_TEMPERATURE	1	R/W Byte
bit7	TEMPERATURE_FAULT		
7Eh	STATUS_CML	1	Read Byte
bit7	COMMAND_FAULT		
bit6	DATA_FAULT		
bit5	PEC_FAULT		
8Bh	READ_VOUT	2	Read Word
8Ch	READ_IOUT	2	Read Word
96h	READ_POUT	2	Read Word
98h	PMBUS_REVISION	1	Read Byte
99h	MFR_ID	Variable	Block Write/Read
9Ah	MFR_MODE	Variable	Block Write/Read
9Bh	MFR_REVISION	Variable	Block Write/Read
A4h	MFR_VOUT_MIN	2	Read Word
A5h	MFR_VOUT_MAX	2	Read Word
A6h	MFR_IOUT_MAX	2	Read Word
A7h	MFR_POUT_MAX	2	Read Word
A8h	MFR_TAMBIENT_MAX	2	Read Word
F0h	LENOVO_CMD	2	Write Word
FCh	MFR_EEPROM_W	Variable	Block Write/Read
FDh	MFR_EEPROM_R	Variable	Block Write/Read

Picture6-1, Under Windless System Application Note

Recommend	Not-Recommend



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03/03/'23	金雨霞	劉龍	賈曉東		