IX-500RSH1UP8G

Redundant Power Supply

(1U- 500W+500W)

SPECIFICATION

Revision: 1.0

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1. Purpose

This specification defines the performance characteristics and functions of a 500 watts 1U form factor of switch mode redundant power supply with Active PFC (Power Factor Correction) and PMBus (Power Management Bus). Support 1+1 or 1+0 parallel operation.

2. AC Input Requirements

2.1 Input Voltage and Frequency

Voltage (sinusoidal): 100~240 VAC full range, with ±10% tolerance. Input frequency ranges from 47hz~63hz

2.2 AC Input Current and Inrush Current

AC line inrush current shall not damage any component nor cause the AC line fuse to blow under any DC conditions and with any specified AC line input voltage and frequency. Inrush current is tested at 25 ℃ ambient and cold start within 1/4 AC cycle. Repetitive On/Off cycling of the AC input voltage shall not damage the power supply.

Table 1: AC Input Current and Inrush Current

Input Voltage	Input Current	Inrush Current
100~240VAC	7~3.5A	35Apeak@115VAC 70Apeak@240VAC

Note: The charging current for X capacitors is not considered as in-rush current.

2.3 Input Power Factor Correction (Active PFC)

The power factor at 100% of rated load shall be ≥ 0.95 at nominal input voltage and full load.

2.4 AC Line Transient Specification

AC line transient conditions are characterized as "sag" and "surge" conditions. Sag conditions (also referred to as "brownout" conditions) will be defined as the AC line voltage dropping below nominal voltage. Surge conditions will be defined as the AC line voltage rising above nominal voltage. The power supply shall meet the regulation requirements under the following AC line sage and surge conditions.

Table 2: AC Line Sag Transient Performance

Duration	Sag	Operating AC Voltage	Line Frequency	Load	Performance Criteria
Continuous	10%	Nominal AC Input ranges	50/60 Hz	100%	No loss of function or performance
0-1 AC cycle	100%	Nominal AC Input ranges	50/60 Hz	70%	No loss of function or performance
> 1 AC cycle	> 10%	Nominal AC Input ranges	50/60 Hz	100%	Loss of function Acceptable, Self- recoverable

Table 3: AC Line Surge Transient Performance

Duration	Surge	Operating AC Voltage	Line Frequency	Performance Criteria
Continuous	10%	Nominal AC Voltage	50/60 Hz	No loss of function or performance
0 - ½ AC cycle	30%	Mid-point of Nominal AC Voltage	50/60 Hz	No loss of function or performance

3. DC Output Specification

3.1 Output Power / Currents

Table 4: Load Range

Voltage	Minimum Load	Maximum Continuous Load
+3.3V	0.5A	20A
+5V	0.5A	20A
+12V	1A	40A
-12V	0A	0.5A
+5VSB	0.1A	3A

Notes: The +3.3, +5 Volt total outputs shall not exceed 140W.

3.2 Voltage Regulation, Ripple and Noise

Table 5: Regulation, ripple and noise

Output Voltage	+3.3V	+5V	+12V	-12V	+5VSB
Load Reg.	±5%	±5%	±5%	±5%	±5%
Line Reg.	±1%	±1%	±1%	±1%	±1%
Ripple & Noise	60mV	60mV	120mV	120mV	60mV

Ripple and noise shall be measured using the following methods:

a) Measurements made differentially to eliminate common-mode noise
b) Ground lead length of oscilloscope probe shall be ≤ 0.25 inch.
c) Measurements made where the cable connectors attach to the load.
d) Outputs bypassed at the point of measurement with a parallel combination of 10uF tantalum capacitor in parallel with 0.1uF ceramic capacitors.
e) Oscilloscope bandwidth of 0 Hz to 20MHz.
f) Measurements measured at locations where remote sense wires are connected.
g) Regulation tolerance shall include temperature change, warm up drift and dynamic load

3.3 Capacitive Loading

The power supply shall be stable and meet all requirements in the following table, except dynamic loading requirements.

Table 6: Capacitive Loading Conditions

Output	MIN	MAX	Units
+3.3V	10	12,000	uF
+5V	10	12,000	uF
+12V	10	11,000	uF
-12V	1	350	uF
+5VSB	1	350	uF

3.4 Dynamic Loading

The output voltages shall remain within the limits specified in ***Table-Regulation, ripple and noise*** for the step loading and within the limits specified in ***Table-Transient Load Requirement*** for the capacitive loading. The load transient repetition rate shall be tested between **50Hz and 5kHz** at duty cycle ranging from 10%-90%. The load transient repetition rate is only a test specification. The Δ step load may occur anywhere within the MIN load to the MAX load shown in ***Table-Load Range.***

Table 7: Transient Load Requirements

Output	ΔStep Load Size	Load Slew Rate	Capacitive Load
+5V	50% of Max. Load	0.5 A/uS	1000 uF
+3.3V	50% of Max. Load	0.5 A/uS	1000 uF
+12V	50% of Max. Load	0.5 A/uS	2200 uF
+5VSB	50% of Max. Load	0.5 A/uS	1 uF

3.5 Overshoot at Turn-on/Turn-off

Any output overshoot at turn on shall be less than 10% of the nominal output value. Any overshoot shall recover to be within regulation requirements in less than 10ms.

3.6 Timing Requirements

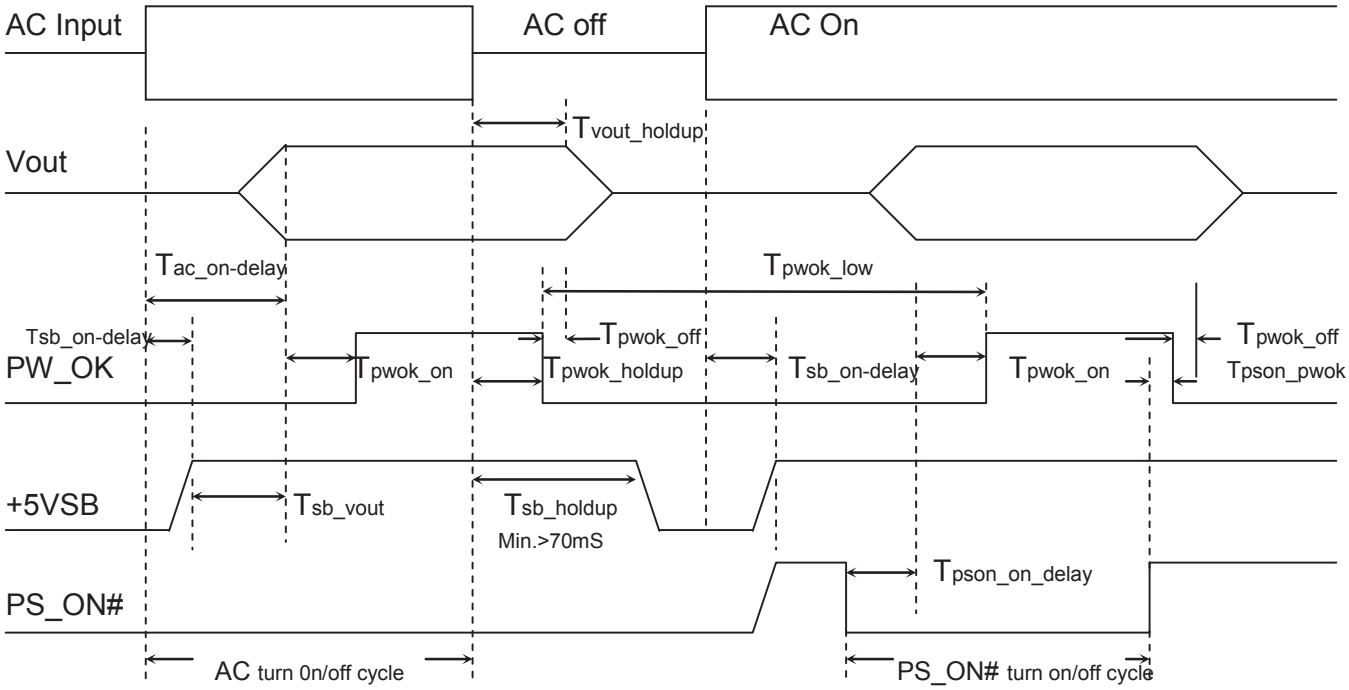
Table 8: Output Voltage Timing

Item	Description	MIN	MAX	Units
Tvout_rise	Output voltage rise time from each main output	1	20	mS
	Output voltage rise time for the 5Vsb out put	1	25	mS
Tvout_on	All main output must be within regulation of each other within this time.		50	mS
Tvout_off	All main output must leave regulation within this time		400	mS

Table 9: Turn On/Off Timing

Item	Description	MIN	MAX	Units
Tsb_on-delay	Delay from AC being applied to +5VSB being within regulation.		1500	mS
Tac_on-delay	Delay from AC being applied to all output voltages being within regulation.		2500	mS
Tvout_holdup	Time all output voltage stay within regulation after loss of AC tested at 60% of maximum load.	17		mS
Tpwok_holdup	Delay from loss of AC deassertion of PW_OK tested at 60% of maximum load.	16		mS
Tpson_on_delay	Delay from PS_ON# active to output voltage within regulation limits.	5	400	mS
Tpson_pwok	Delay from PS_ON# deactive to PW_OK being deasserted.		50	mS
Tpwok_on	Delay from output voltage within regulation limits to PW_OK asserted at turn on.	100	500	mS
Tpwok_off	Delay from PW_OK deasserted to output voltages (+5V, +3.3V, +12V, -12V) dropping out of regulation limits. Tested at 60% of maximum load.	1		mS
Tpwok_low	Duration of PW_OK being in the deasserted state during an off/on cycle using AC or the PS_ON# signal. .	100		mS
Tsb_vout	Delay from +5VSB being in regulation to O/Ps being in regulation at AC turn on.	50	1000	mS

Figure 1: Turn On/Off Timing



3.7 Control Signal and Other DC Signals

3.7.1 PG Signal (PW_OK)

The power supply shall provide TTL compatible PW_OK signal to the system. Low pass filter (104 capacitor is recommended) shall be added into the PW_OK signal to suppress the high frequency noise to keep the high level absolutely. However, this low pass filter shall be used in PSU or motherboard PW_OK circuit. Therefore, supplier must be subject to add this low pass filter in the PW_OK input circuit of motherboard if it cannot be added in PSU circuit due to the re-layout difficulty.

Table10: PW_OK TTL Characteristics

Signal type	+5VDC TTL Compatible output signal	
PW_OK = High	Power OK	
PW_OK = Low	Power Not OK	
	MIN	MAX
Logical low voltage , Isink = 4mA	0V	0.4V
Logical high voltage , Isource = 200uA	2.4V	5.25V
PW_OK rise and fall time	-	100uS
High-state output impedance	Internal PSU to provide a pull-up resistor between 5VSB and PW_OK	

3.7.2 PS_ON# Signal

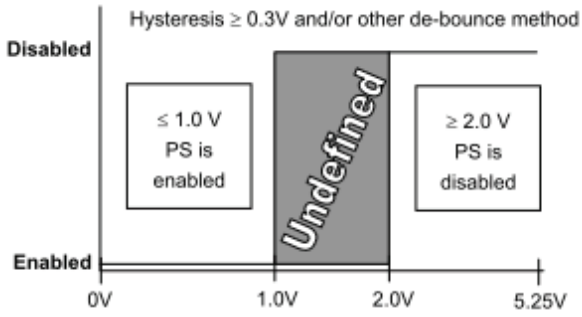
PS_ON# signal is required to remotely turn on/off the power supply module / PDB Combo. PS_ON# is an active low signal that turns on the +12V power rail and other DC to DC converters on the PDB. When this signal is not pulled low by the system, or left open, all the outputs (except for 5VSB) shall be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

Table11: PS_ON# TTL Signal Characteristics

Signal type	Accepts an open collector/drain input from the system. Pull-up to VSB located in power supply.	
PS_ON# = Low	Power ON	
PS_ON# = Open or High	Power OFF	
	MIN	MAX
Logic level low (power supply ON)	0V	1.0V
Logic level high (power supply OFF)	2.0V	5.25V
Source current, Vpson = low	-	4mA

Note: When the ON / OFF switching of the PS_ON# signal, Interval cycle time must be > 1Sec.

Figure 2: PS_ON# Signal Characteristics



3.7.3 SMB_Alert# 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 and that power supply is operating in an environment exceeding the specified limits. This signal is to be asserted in parallel with LED turning solid red.

Table12: SMB_ALERT# Signal Characteristics

Signal Type (Active Low)	+5VDC TTL Compatible output signal	
SMB_Alert# = High	OK	
SMB_Alert# = Low	Alert to System	
	MIN	**MAX**
Logic level low voltage, Isink=4 mA	0V	0.4V
Logic level high voltage, Isource=50uA	2.0V	5.25V
Sink current, SMB_Alert# = low	-	4mA
Source current, SMB_Alert# = high	-	50uA
SMB_Alert# rise and fall time	-	100uS

3.7.4 SCL and SDA Signal

PMBus device uses System Management Bus (SMBus) Version 2.0, for transport layer, which is a two-wire communication protocol based on I2C. Both SCL and SDL lines are bi-directional, connected to a positive supply voltage through a pull-up resistor or a current source.

Table13: SCL and SDA Signal Characteristics

Signal Type	TTL Compatible	
Operating Frequency	100KHz	
	MIN	**MAX**
Data Clock Input Low Voltage, (Vil)	0V	0.8V
Data Clock Input High Voltage (Vih)	2.1V	VDD
Data Clock Output Low Voltage (Vol)	-	0.4V
Input Leakage (Ileak)	-	±5uA
Current Through Pull-Up Resistor Or Current Source (Ipullup)	100uA	350uA
Nominal Bus Voltage (VDD)	2.7V	5V

Note: For proper I2C communication, system designer must take account of all I2C devices connected to I2C bus and calculate appropriate pull-up resistors value that satisfy with above rating.

3.8 Efficiency

Efficiency shall be at least 80%, tested at full load and 115VAC input

4. Protection Circuits

Protection circuits inside the power supply shall cause only the power supply's main outputs to shutdown. If the power supply latches off due to a protection circuit tripping, an AC cycle OFF for 15 sec and a PS_ON# cycle HIGH for 1 sec must be able to restart the power supply.

4.1 Over Current Protection (OCP)

The power supply shall have current limit to prevent the +5V, +3.3V, and +12V outputs from exceeding the values shown in ***Table-Over Current Protection.*** The power supply shall latch off if the current exceeds the limit.

Table 14: Over Current Protection

Voltage	Minimum	Maximum	Shutdown Mode
+5V	22A	30A	Latch Off
+3.3V	22A	30A	Latch Off
+12V	44A	60A	Latch Off

4.2 Over Voltage Protection (OVP)

The power supply is protected against over voltage due to an internal regulator failure. When an over voltage condition is detected, all DC outputs are disabled (except the +5 VSB). The fault must be removed to restore the DC outputs. The limits are given in Table 11.

Table 15: Over Voltage Protection

Voltage	Minimum	Maximum	Shutdown Mode
+5V	+5.7V	+6.5V	Latch Off
+3.3V	+3.9V	+4.5V	Latch Off
+12V	+13.3V	+14.5V	Latch Off

4.3 Short Circuit Protection

The power supply shall shut down in a latch off mode when the +12V output voltage is short circuit. The power supply shall shut down in auto recovery mode when the +5VSB output voltage is short circuit.

4.4 No Load Operation

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

4.5 Over Temperature Protection (OTP)

The power supply will shut down when an over temperature condition occurs; no damage shall be caused.

5. Environmental Requirements

5.1 Temperature

Operating Ambient, normal mode (inlet air): 0°C ~ 50°C (32°F~ 122°F), FAN air flow can be reversed by customer's request w/o de-rating.

Non-operating Ambient: -40°C ~ 70°C (-40°F~ 158°F)

5.2 Humidity

Operating: 20% ~ 90%RH non-condensing
Non-Operating: 5% ~ 95%RH non-condensing

5.3 Altitude

Operating: Sea level to 10,000 ft
Non Operating: Sea level to 40,000 ft

5.4 Mechanical Shock

Non-Operating: 50 G Trapezoidal Wave, 11mS half sin wave. The shock is to be applied in each of the orthogonal axes.

5.5 Vibration (Non-Operating)

The power supply shall be subjected to a vibration test consisting of a 10 to 300 Hz sweep at a constant acceleration of 2.0g for duration of one (1) hour for each of the perpendicular axes X, Y and Z (0.1 octave/minute). The output voltages shall remain within specification.

5.6 Electromagnetic Compatibility

Table 16: EMC Requirements

Electromagnetic Interference	FCC CFR Title 47 Part 15 Sub Part B EN55022/EN55024	Conducted B Class Radiated B Class		
Harmonics	IEC61000-3-2 Class D			
Flicker	IEC61000-3-3			
ESD Susceptibility	EN-61000-4-2	±8KV by Air, ±4KV by Contact Performance Criteria B		
Radiated Susceptibility	EN61000-4-3	80MHz~1000MHz (3V/m(mns) Amplitude 80% AM 1KHz Criteria A		
EFT/Burst	EN61000-4-4	5KHz, AC: 1KV, DC: 0,5 KV, Performance Criteria B		
Surge Voltage	EN61000-4-5	Line-to-Line: 1KV Line-to-Ground: 2KV Performance Criteria B		
Conducted Susceptibility	EN61000-4-6	0.15MHz~80MHz 3V/m Amplitude 80% AM 1KHz Performance Criteria A		
RF Conducted	EN61000-4-8	50 Hz/3A(ms)/m Performance Criteria A		
Voltage Dips and Interruptions	EN61000-4-11	30%(Voltage Dips) 60%(Voltage Dips) >95%(Voltage Dips)	10 ms 100ms 500ms	Criteria B Criteria C Criteria C
Leakage Current	EN60950-1	3.5mA@240VAC		

5.7 Safety Agency Requirements

This power supply is designed to meet the following safety:

Table 17: Product Safety

Product Safety:	• CB: IEC 60950-1:2005 (2nd Edition); Am 1:2009 • TUV: EN60950-1/A12:2011 • UL: UL60950-1, 2nd Edition, 2011-12-19 • CCC: GB4943.1-2011 GB9254-2008 GB17625.1-2003 • BSMI: CNS14336-1 (99). CNS13438(95)

6. Reliability

6.1 Mean Time Between Failures (MTBF)

The MTBF of the power module shall be calculated utilizing the Part-Stress Analysis method of MIL217F. The calculated MTBF of the power supply shall be greater than 100,000 hours under the following conditions:

Full rated load; 120V AC input; Ground Benign; 25°C

7. PMBus

7.1 Command Summary

Table 18 – PMBus Command Codes

Command Code	Command Name	SMBus Transaction Type	Number of Data Bytes	Decode Format
19h	CAPABILITY	Read Byte	1	Byte
20h	VOUT_MODE	Read Byte	1	Byte
78h	STATUS_BYTE	Read Byte	1	Byte
79h	STATUS_WORD	Read Word	2	Word
7Dh	STATUS_TEMPERATURE	Read Byte	1	Byte
81h	STATUS_FAN_1_2	Read Byte	1	Byte
88h	READ_VIN(Note1)	Read Word	2	Linear Format
89h	READ_IIN	Read Word	2	Linear Format
8Bh	READ_VOUT	Read Word	2	Vout Format
8Ch	READ_IOUT	Read Word	2	Linear Format
8Dh	READ_TEMP1 (Hotspot)	Read Word	2	Linear Format
8Eh	READ_TEMP2 (Ambient)	Read Word	2	Linear Format
90h	READ_FAN_SPEED_1	Read Word	2	Linear Format
91h	RESERVED	Read Word	2	Linear Format
96h	READ_POUT	Read Word	2	Linear Format
97h	READ_PIN	Read Word	2	Linear Format
98h	PMBUS_REVISION	Read Byte	1	Byte
99h	MFR_ID	R/W Block	6	Ascii
9Ah	MFR_MODEL	R/W Block	9	Ascii
9Bh	MFR_REVSION	R/W Block	2	Ascii
9Eh	MFR_SERIAL	R/W Block	12	Ascii
A0h	MFR_VIN_MIN	Read Word	2	Linear Format
A1h	MFR_VIN_MAX	Read Word	2	Linear Format
A7h	MFR_POUT_MAX	Read Word	2	Linear Format

Note:

1. If AC Input= 90V ~ 130V PMBus sent the value of 115V
2. If AC Input= 200V ~ 264V PMBus sent the value of 230V

Table 19 - Device address locations

PDB address A1/A0	0/0	0/1
PSU IPMI FRU Device	A0h	A2h
PSU PMBUS Device	B0h	B2h

Note:

1. Only power modules have PMBus capability, PDB serve as by-pass bus only. System host can access each power module with corresponding device address.
2. IPMI FRU is optional and is turned off by default.

Table 20 - Contents of STATUS_WORD (Command 0x79)

Byte	Bit Number	Status Bit Name	Meaning	Latch
Low	7	Reserved	Return=0	N/A
	6	OFF	Power Unit Power OFF = 1 ; Power ON = 0	No
	5	Reserved	Return=0	N/A
	4	Reserved	Return=0	N/A
	3	Reserved	Return=0	N/A
	2	TEMPERATURE	A Temperature fault or warning has occurred = 1 ; Normal = 0	Yes
	1	Reserved	Return=0	N/A
	0	Reserved	Return=0	N/A
High	7	Reserved	Return=0	N/A
	6	Reserved	Return=0	N/A
	5	Reserved	Return=0	N/A
	4	Reserved	Return=0	N/A
	3	POWER_GOOD#	The POWER_GOOD signal is OK = 0 ; FAIL = 1	No
	2	FANS	A fan or airflow fault or warning has occurred=1 ; Normal = 0	Yes
	1	Reserved	Return=0	N/A
	0	Reserved	Return=0	N/A

Note: STATUS_BYTE (Command 0x78) is same as lower byte of STATUS_WORD

Table 21 - Contents in STATUS_TEMPERATURE (Command 0x7D)

Bit Number	Status Bit Name	Meaning
7	OT_FAULT	Over temperature has occurred = 1 ; Normal = 0
6	OT_WARNING	Not Implemented; Return=0
5	UT_WARNING	Not Implemented; Return=0
4	UT_FAULT	Not Implemented; Return=0
[3:0]	Reserved	Return=0

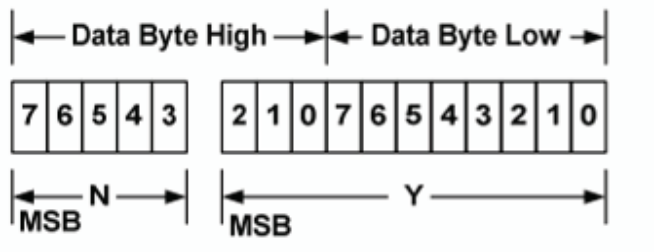
Table 22 - Contents in STATUS_FANS_1_2 (Command 0x81)

Bit Number	Status Bit Name	Meaning
7	Fan 1 Fault	Fan RPM < 300 RPM = 1 ; Normal = 0
6	Fan 2 Fault	Not Implemented; Return=0
5	Fan 1 Warning	Not Implemented; Return=0
4	Fan 2 Warning	Not Implemented; Return=0
3	Fan 1 Speed Override	Not Implemented; Return=0
2	Fan 2 Speed Override	Not Implemented; Return=0
1	Air Flow Fault	Not Implemented; Return=0
0	Air Flow Warning	Not Implemented; Return=0

Note: If FAN RPM < 300 RPM for more than 10 seconds later, PSU will automatically shut down. (Latch)

7.2 Linear Format

Most of data exchanges with power supply are done with Linear Format. Linear Format is a two byte value with 5bit's two's complement exponent and 11bit two's complement mantissa.



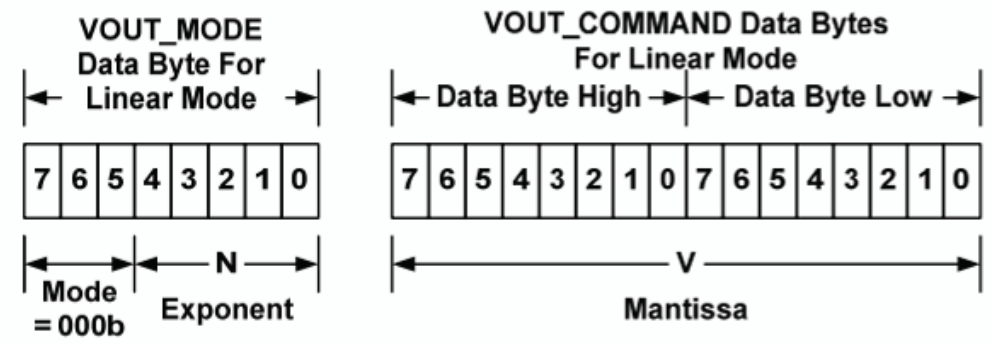
The relation between Y, N and the "real world" value is:

$$X = Y \bullet 2^N$$

Where, as described above:
X is a "real world" value
Y is a 11 bit, two's complement integer; and
N is a 5 bit, two's complement integer.

7.3 Vout Format

Vout Format is a two steps reading process which involve with reading a VOUT_MODE (Command 0x20) byte and a Vout_Command word as shown below:



The Voltage, in volts, is calculated from the equation:

$$Voltage = V \bullet 2^N$$

Where:
Voltage is the parameter of interest in volts;
V is a 16bit signed binary integer; and
N is a 5bit two's complement binary integer.

7.4 MFR Information

Table 23 – MFR Meanings

Command Code	Command Name	Meaning
99h	MFR_ID	
9Ah	MFR_MODEL	
9Bh	MFR_REVSION	A0 ~ Z9
9Eh	MFR_SERIAL	Code = 12
A0h	MFR_VIN_MIN	100VAC
A1h	MFR_VIN_MAX	240VAC
A7h	MFR_POUT_MAX	500W

8. LED Indicators

There will be a LED on each power module to indicate power status

Table 24 – LED Color and Power Status

Power Supply Status	Color
Power Switch On	Blinking Green -> Red -> Green
Normal State	Green
Power Switch Off	Green -> Red -> Blinking Green
Standby (AC In, Only +5VSB output)	Blinking Green
Power Fail	Red
Fan Fail	Blinking Red

Note: Power will send a gentle alarm to indicate its readiness when switched on.

9. Mechanical Overview

Dimension: 106mm(W) x 41.5mm(H) x 335mm(D)
Weight: 3.2 Kg
Fan: Single Fan per Module