IX-500R8PD8

Redundant Power Supply

(PS2 MINI - 500W+500W)

SPECIFICATION

Revision: 1.0

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1. Purpose

This specification defines the performance characteristics and functions of a 500-watt **PS2 Mini Redundant** power supply furnished with compulsory APFC (Active Power Factor Correction) and optional PMBus (Power Management Bus).

2. Input Requirements

2.1 Input Rating

The power supply must operate within all specified limits under the rated input voltage ranges, shown in ***Table 1: Input Rating***. During turn-on at any phase of AC input voltage, the inrush current shall not peak over 80 A or impair any components, such as input fuse, inrush-limiting device, bridge rectifier, bulk capacitor, and then some in the input power loop.

Table 1: Input Rating

Parameter	Minimum	Rated	Maximum	Max. Current
Voltage (115V)	90 Vrms	100-127Vrms	140 Vrms	8.0 A
Voltage (230V)	180 Vrms	200-240Vrms	264 Vrms	3.5 A
Frequency	47 Hz	50 / 60 Hz	63 Hz	

2.2 Input Power Factor Correction

The power factor measured under the simultaneous conditions of nominal input voltages (115V/230V) and full load (100% loading) shall be no less than 0.95.

2.3 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%	230/115VAC	50/60 Hz	100%	No loss of function or performance
0-1/2 AC cycle	30%	230/115VAC	50/60 Hz	70%	No loss of function or performance
> 1/2 AC cycle	> 30%	230/115VAC	50/60 Hz	70%	Loss of function Acceptable Self-recoverable

Table 3: AC Line Surge Transient Performance

Duration	Surge	Operating AC Voltage	Line Frequency	Load	Performance Criteria
Continuous	10%	230/115VAC	50/60 Hz	100%	No loss of function or performance
0 - ½ AC cycle	30%	230/115VAC	50/60 Hz	100%	No loss of function or performance
> 1/2 AC cycle	> 30%	230/115VAC	50/60 Hz	100%	Loss of function Acceptable Self-recoverable

3. DC Output Specification

3.1 Output Power / Currents

Table 4: Load Range

Voltage	Minimum Load	Maximum Continuous Load
+3.3V	1A	25A
+5V	1A	30A
+12V	0.05A	41A
-12V	0A	0.5A
5VSB	0A	2.5A

Note 1: Combined load on 3.3V and 5V rails shall not exceed 170W.

Note 2: Total output power shall not exceed 500W.

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%	±10%	±5%
Line Reg.	±1%	±1%	±1%	±1%	±1%
Ripple & Noise	60mV	60mV	120mV	120mV	60mV

Ripple and noise shall be measured with the following test setups:

a) Differential-mode measurements are made to eliminate common-mode noise.

b) Oscilloscope probe ground lead length shall be no longer than 0.25 inch.

c) Measurements are made at locations where the cable connectors hook up to the load.

d) Test points are bypassed with a parallel combination of a 10µF tantalum capacitor and a 0.1µF ceramic capacitor.

e) Oscilloscope bandwidth is limited to 20MHz.

f) Measurements are made at locations where remote sense wires get connected.

g) Regulation tolerance shall include temperature change, warm-up drift, and dynamic load.

3.3 Dynamic Loading

The output voltages shall remain within the limits specified in ***Table 5: Regulation, ripple and noise*** for the step loading and within the limits specified in ***Table 7: Transient Load Requirement*** for the capacitive loading. The load transient repetition rate shall be tested between **50Hz and 5 kHz** at duty cycle ranging from 10%-90%.

Table 6: Transient Load Requirements

Output	**Step Load Size**	Load Slew Rate	Capacitive Load
+3.3V, +5V,	2A to 30% Load; 70% load to 100% Load	0.5 A/µS	3300µF
+12V	1A to 50% Load; 51% load to 100% Load	0.5 A/µS	2200µF
5VSB	0.5A	0.5 A/µS	20µF

3.4 Capacitive Loading

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

Table 7 – Capacitive Loading Conditions

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

3.5 Overshoot/Undershoot at Turn-on/Turn-off

Any output overshoot/undershoot at turn-on/turn-off shall be less than 10% of the nominal output voltage and settle down to within the normal regulation range in less than 10ms.

3.6 Timing Requirements

Figure 1: Output Voltage Timing

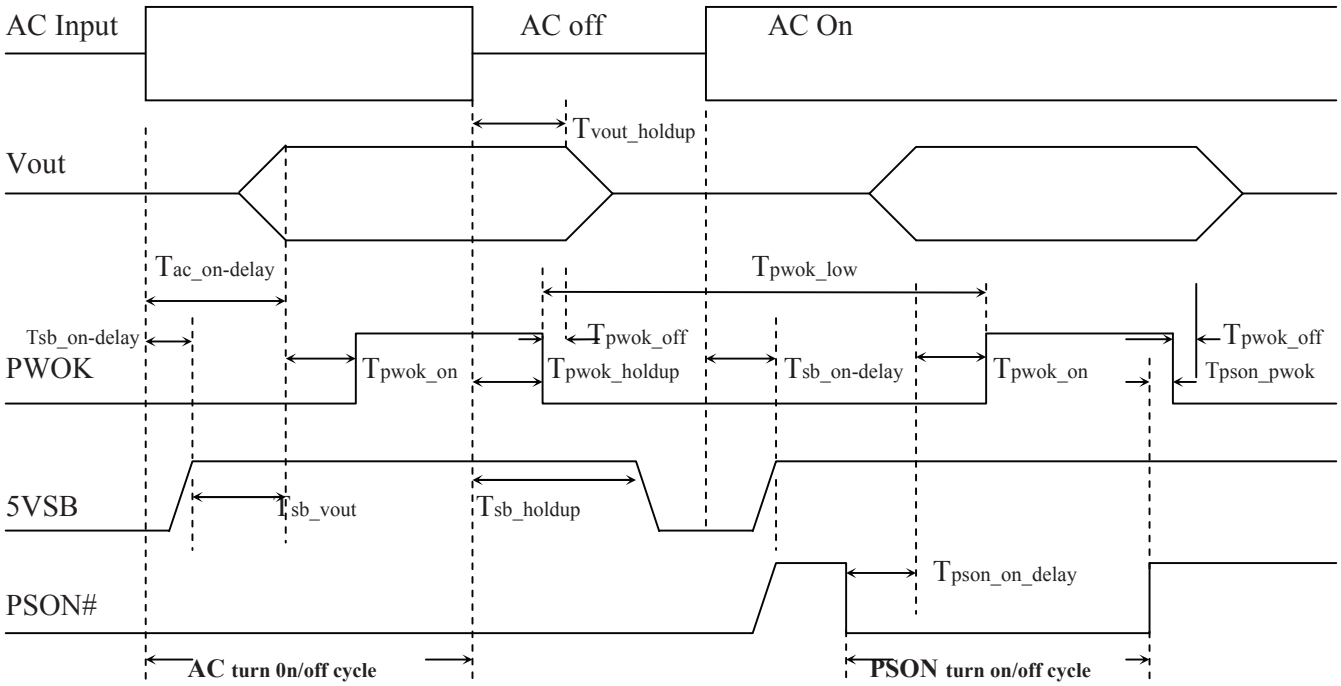


Table 8: Timing Requirements (ms)

Item	Description	MIN	MAX
Tvout_rise	Output voltage rise time from each main output	1	20
	Output voltage rise time for the 5VSB out put	1	25
Tvout_on	All main output must be within regulation of each other within this time.		50
Tvout_off	All main output must leave regulation within this time		400
Tsb_on-delay	Delay from AC being applied to 5VSB being within regulation.		1500
Tac_on-delay	Delay from AC being applied to all output voltages being within regulation.		2500
Tvout_holdup	Time all output voltage stay within regulation after loss of AC tested at 80% load.	20	
Tpwok_holdup	Delay from loss of AC to deassertion of PWOK tested at 80% load.	19	

Tpson_on_delay	Delay from PSON# active to output voltage within regulation limits.	5	400
Tpson_pwok	Delay from PSON# deactive to PWOK being deasserted.		50
Tpwok_on	Delay from output voltage within regulation limits to PWOK asserted at turn on.	100	500
Tpwok_off	Delay from PWOK deasserted to output voltage dropping out of regulation limits measured at 80% load.	1	
Tpwok_low	Duration of PWOK being in the deasserted state during an off/on cycle using AC or the PSON# signal.	100	
Tsb_vout	Delay from 5VSB being in regulation to O/Ps being in regulation at AC turn on.	10	1000

3.7 Hot Swap Requirements

Hot swapping a power supply is a process of inserting/extracting a power supply into/from an operating power system. During this process the output voltages shall remain within the limits with the capacitive load specified. The hot swapping test must be conducted when the system is operating under static, dynamic, and zero loading conditions. The power supply can be hot swapped by taking the following steps:
Extraction: The AC power shall be disconnected from the power supply before the power supply is extracted from the system. This could occur in standby mode or power-on mode.
Insertion: The AC power shall be connected back to the power supply after the power supply is inserted into the system and the power supply will get into standby mode or power-on mode. In general, a failed supply shut off by way of internal latch or external control may be removed, and then replaced with a normal one; however, hot swapping needs to be done on operating as well as failed power supplies. The newly inserted power supply will get into standby mode or power-on mode once starting up.

3.8 Efficiency

1. The power module efficiency shall at least come up to the 80plus bronze standard specified as 81%, 85%, and 81% minimum respectively measured at 20%, 50%, and 100% loads with 230VAC/60Hz input, 25C ambient temperature, and cooling fan power consumption excluded.
2. The overall power efficiency shall be in excess of 80% measured under the simultaneous conditions of 115V input and full load.
3. Only for single +12v output channel.

4. Protection Circuits

Once triggered by fault conditions occurring inside the power supply, protection circuits shall only cause the main outputs to shut off without affecting the normal operation of the system. If latched off due to triggering of protection circuits, the power supply must be able to get back to normal operation after a 15-second AC turn-off and then a 1-sec PSON.

4.1 Over Current Protection (OCP)

The power supply shall get into the latch-off mode in case of over-current conditions specified in *Table 9: Over Current Protection*.

Table 9: Over Current Protection

Voltage	Minimum of rated load	Maximum of rated load	Shutdown Mode
+3.3V, +5V, +12V	110%	150%	Latch Off

4.2 Over Voltage Protection (OVP)

The power supply is protected against an over-voltage fault, specified with the numeric limits shown in *Table 10: Over Voltage Protection*, due to the loss of voltage regulation by an internal shunt regulator. When an over-voltage fault takes place, all DC outputs except the 5VSB rail are shut off. The fault must be removed to restore the DC outputs.

Table 10: Over Voltage Protection

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

4.3 Short Circuit Protection

The power supply shall get into the latch-off mode when the output rail is shorted with less than 0.1Ω impedance.

1) There shall be no permanent damage or catastrophic failure when the output terminals get shorted.
2) 5VSB shall automatically resume normal operation after the short-circuit condition is removed from the power supply.

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)

An over-temperature condition shall shut off the power supply but cause no damages.

Ambient Temperature	Power Status
> 55°C	Warning
> 60°C	Power Shut off , but no damages
<55°C	Power Recovery

5. Environmental Requirements

5.1 Temperature

Operating Ambient, normal mode (inlet air): -5°C ~ 50°C,

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

5.2 Humidity

Operating: 10% ~ 95%RH non-condensing

Non-Operating: 0% ~ 95%RH non-condensing

5.3 Altitude

Operating: Sea level to 16,404 ft (5000m)

Non Operating: Sea level to 40,000 ft (12192m)

5.4 Mechanical Shock

Shock Response Spectrum: Half Sine

Peak Acceleration: 30 m/s²

Duration: 11 ms

Axis: 3 per axis

Reference Standard: IEC 60068-2-27 Ea: Shock

5.5 Vibration

Sinusoidal Vibration

Velocity: 5 mm/s

Frequency Range: 62-200 Hz

Acceleration: 2.0 m/s²

Axis: 5 sweep cycles per axis

Reference Standard: IEC 60068-2-6 Fc: Vibration (Sinusoidal)

Random Vibration

ASD: 0.02 m²/s³

Frequency Range: 5-10 Hz

Slope: +12 dB/oct

Frequency Range: 10-50 Hz

Slope: 0 dB/oct

Frequency Range: 50-100 Hz

Slope: -12 dB/oct

Axis: 30 minutes per axis

Reference Standard: IEC 60068-2-64 Fh: Vibration, Broad-Band Random (Digital Control)

5.6 Electromagnetic Compatibility

Table 11: EMC Requirements

Electromagnetic Interference	FCC CFR Title 47 Part 15	Conducted A Class		
	Sub Part B	Radiated A Class		
	EN55022/EN55024			
Harmonics	IEC61000-3-2 Class A			
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)	10 ms	Criteria B
		60%(Voltage Dips)	100ms	Criteria C
		>95%(Voltage Dips)	500ms	Criteria C
Leakage Current	EN60950-1	3.5mA@240VAC		

5.7 Safety Agency Requirements

This power supply is designed to meet the following safety:

Electromagnetic Interference	FCC CFR Title 47 Part 15	Conducted A Class		
	Sub Part B	Radiated A Class		
	EN55022/EN55024			
Harmonics	IEC61000-3-2 Class A			
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)	10 ms	Criteria B
		60%(Voltage Dips)	100ms	Criteria C
		>95%(Voltage Dips)	500ms	Criteria C
Leakage Current	EN60950-1	3.5mA@240VAC		

Table 12: 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

6. Reliability

6.1 Mean Time Between Failures (MTBF)

The MTBF of the power module in PSU shall be calculated utilizing in 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 COMMAND CODE SUMMARY:

Table 13: Support Command Code Table

Command Code	Command Name	SMBus Transaction Type	Number of Data Bytes	Data Format
03h	CLEAR_FAULTS	Send Byte	0	-
19h	CAPABILITY (1)	Read Byte	1	Byte
20h	VOUT_MODE (1)	Read Byte	1	Byte
1Ah	QUERY (1)	Read Byte	1	Byte
78h	STATUS_BYTE	Read Byte	1	Byte
79h	STATUS_WORD	Read Word	2	Word
7Ah	STATUS_12V_VOUT	Read Byte	1	Byte
7Bh	STATUS_12V_IOUT	Read Byte	1	Byte
7Dh	STATUS_TEMPERATURE	Read Byte	1	Byte
80h	STATUS_MFR_SPECIFIC	Read Byte	1	Byte
8Bh	READ_12V_VOUT	Read Word	2	Linear Vout
8Ch	READ_12V_IOUT	Read Word	2	Linear
8Dh	READ_TEMPERATURE_1 (2)	Read Word	2	Linear
96h	READ_12V_POUT	Read Word	2	Linear
99h	MFR_ID	Block Read	6	ASCII
9Ah	MFR_MODEL	Block Read	9	ASCII
9Bh	MFR_REVSION	Block Read	2	ASCII
9Eh	MFR_SERIAL	Block Read	12	ASCII
A0h	MFR_VIN_MIN	Read Word	2	Linear
A1h	MFR_VIN_MAX	Read Word	2	Linear
A7h	MFR_POUT_MAX	Read Word	2	Linear
A8h	MFR_TAMBIENT_MAX	Read Word	2	Linear
B0h	STATUS_PDB	Read Byte	1	Byte
E0h	READ_3V3_VOUT	Read Word	2	Linear Vout
E1h	READ_3V3_IOUT	Read Word	2	Linear
E2h	READ_3V3_POUT	Read Word	2	Linear
E3h	READ_5V_VOUT	Read Word	2	Linear Vout
E4h	READ_5V_IOUT	Read Word	2	Linear
E5h	READ_5V_POUT	Read Word	2	Linear

Note : **1.** Detailed settings, please refer to the Module Description.

2. READ_TEMPERATURE_1, should provide the PDB inlet temperature.

Table 14: Contents in 79h (STATUS_WORD)Command Code

Byte	Bit Number	Status Bit Name	Meaning
Low	7	Reserved	Return=0
	6	OFF	The Unit Main Power OFF = 1 ;Power ON = 0;
	5	+12V_OV_FAULT	An output overvoltage fault has occurred = 1 ; Normal = 0
	4	+12V_OC_FAULT	An output over current fault has occurred = 1 ; Normal = 0
	3	Reserved	Return=0
	2	Temperature	A Temperature fault or warning has occurred = 1 ; Normal = 0
	[1:0]	Reserved	Return=0
High	7	+12V_VOUT	An output voltage fault or warning has occurred = 1 ; Normal = 0
	6	+12V_IOUT	An output current fault or warning has occurred = 1 ; Normal = 0
	5	Reserved	Return=0
	4	MFR_SPECIFIC	Any Bits of Byte Action (See Contents of *STATUS_MFR_SPECIFIC* (80h)) below
	3	POWER_ GOOD#	The POWER_GOOD signal is OK = 1; ;FAIL = 0
	[2:0]	Reserved	Return=0

Table 15: Contents in 7Ah (STATUS_VOUT)Command Code

Bit Number	Status Bit Name	Meaning
7	Reserved	Return=0
6	+12V_OV_WARNING	VOUT > 13.3V = 1 ; Normal = 0
5	+12V_UV_WARNING	VOUT < 10.8V = 1 ; Normal = 0
[4:0]	Reserved	Return=0

Table 16: Contents in 7Bh (STATUS_IOUT)Command Code

Bit Number	Status Bit Name	Meaning
7	+12V_OC_FAULT	12V_IOUT > Max Current of 130% = 1 ; Normal = 0
6	Reserved	Return=0
5	+12V_OC_WARNING	12V_IOUT > Max Current of 110%@10ms = 1 ; Normal = 0
[4:0]	Reserved	Return=0

Table 17: Contents in 7Dh (STATUS_TEMPERATURE)Command Code

Bit Number	Status Bit Name	Meaning
7	Ambient_OT_FAULT	Ambient temperature >60°C = 1 ; Normal = 0
6	Ambient_OT_WARNING	Ambient temperature >55°C = 1 ; Normal = 0
[5:0]	Reserved	Return=0

Table 18 : Contents in 80h (STATUS_MFR_SPECIFIC)Command Code

Bit Number	Status Bit Name	Meaning
7	3V3_UV_ WARNING	VOUT < 2.9V = 1 ; Normal = 0
6	3V3_OV_ WARNING	VOUT > 3.9V = 1 ; Normal = 0
5	5V_UV_ WARNING	VOUT < 4.5V = 1 ; Normal = 0
4	5V_OV_ WARNING	VOUT > 5.7V = 1 ; Normal = 0
3	3V3_IOUT_OC_WARNING	3V3_IOUT > Max Current of 110% = 1 ; Normal = 0
2	3V3_IOUT_OC_FAULT	3V3_IOUT > Max Current of 130% = 1 ; Normal = 0
1	5V_IOUT_OC_WARNING	5V_IOUT > Max Current of 110% = 1 ; Normal = 0
0	5V_IOUT_OC_FAULT	5V_IOUT > Max Current of 130% = 1 ; Normal = 0

Table 19 : Contents in B0h (STATUS_PDB)Command Code

Bit Number	Status Bit Name	Meaning
7	PSU1_FAULT	PSU1 FAULT = 1 ; Normal = 0
6	PSU2_FAULT	PSU2 FAULT= 1 ; Normal = 0
5	PSU1 PLUG_STATUS	PSU1 PLUG-OUT= 1 ; PLUG-IN = 0
4	PSU2 PLUG_STATUS	PSU2 PLUG-OUT= 1 ; PLUG-IN = 0
3	POWER_GOOD#	POWER_GOOD signal is FAIL= 1; OK = 0
2	PSON#	PSON#_H = 1 ; PSON#_L = 0;
[1:0]	Reserved	Return=0

Table 20: MFR Meaning

Command Code	Command Name	Meaning
99h	MFR_ID	
9Ah	MFR_MODEL	
9Bh	MFR_REVSION	A0 ~ Z9
9Eh	MFR_SERIAL	Code = 12 (ex. T201XXG00001)
A7h	MFR_POUT_MAX	500 (W)
A8h	MFR_TAMBIENT_MAX	50 (°C)

Table 21: Pmbus Address Set

PDB address	
MCU Device	**4A**

8 . LED behaviors:

Table 22 :LED Behaviors

Power Supply Condition	LED State
Normal	GREEN
No AC power to all power supplies	OFF
Power Fail	RED

9. Mechanical Overview (Drawing TBD)

Dimension: 150mm(W) x 86mm(H) x 190mm(D)

Weight: <5kg

10. Output Pin Definition:

Table 23 : Pin Definition

Pin Name	Pin POS	Function	Application
AC-N	1~2 , 37~38	AC INPUT	To AC Neutral
AC-L	4~5 , 40~41	AC INPUT	To AC Line
+12V	13~16 , 49~52	+12V power output	To System +12V BUS
+5V	26~29 , 62~65	+3V power output	To System +5V BUS
+3V3	30~33 , 66~69	+3V3 power output	To System +3V3 BUS
GND	17~25,53~61	Grounding	System GND
5VSB	72	+5VSB Power output	To System +5VSB BUS
PSKILL	9	Activate PSU by hot-plug activity	Grounded at backplane
12VRS+	10	+12V Remote sense	To System +12V BUS
SMB_ALERT	11	If PSU FAIL,FAN FAIL,OCP occurs, signal will be pulled from High to Low ,PSU normal =High(TTL LEVEL)	To system related bus
PSON#	12	Module PSON. Remote control power On/Off (Pulled LOW = POWER ON)	From System On/Off Controller
5VRS+	34	+5V Remote sense	To System +5V BUS
3V3RS+	35	+3V3 Remote sense	To System +3V3 BUS
FAN_SPEED	36	FAN FULL SPEED Control (Activate Low = Fan Full speed)	From System TTL Control Circuit or PDB Control Circuit.
AC_OK	45	AC Loss Detect Signal(Less than Brown out point Active to Low)	To system related bus or PDB Detection Circuit
12VSHR	46	+12V Load Share	Connect pin to pin at backplane for each power module
PG	47	Power Good Output. Signal is pulled HIGH by PSU to indicate all outputs ok.	To System Power Good
PRESENT	48	This pin is grounded with a 47R resistor. To indicate a power has been plugged in.	To System Plug detection circuit or floating via backplane.

Appendix I. Data Format Description

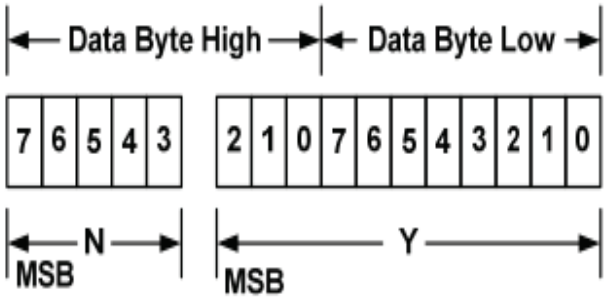
The Linear Data Format is typically used for commanding and reporting the parameters such as (but not only) the following:

- Output Current (A)
- Output Power(W)
- Temperature(℃)
- Any Warning Limit

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 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;

Y is an 11 bit, two's complement integer; and

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.