IX-280RSH1UP8

Redundant Power Supply

(1U- 280W+280W)

SPECIFICATION

Revision: 1.0

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1. Purpose

This specification defines the performance characteristics and functions of a 280 watts 1U form factor of switching mode redundant power supply with Active PFC (Power Factor Correction) and PMBus.

2. AC Input Requirements

2.1 Input Voltage and Frequency

Voltage (sinusoidal) : 100~240 VAC full range, with ±10% tolerance, 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. Repetitive On/Off cycling of the AC input voltage shall not damage the power supply.

Table 1: AC Input Current and Inrush Current

Parameter	Minimum	Rated	Maximum	Max. Current	Inrush Current
Voltage (115V)	90 Vac	100-127Vac	132 Vac	4A	50A@115VAC/ Per module
Voltage (230V)	180 Vac	200-240Vac	264Vac	2A	100A@230VAC/ Per module

Note: The charging current for X capacitors is not considered as inrush 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 tested per module.

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	Load	Line Frequency	Performance Criteria
Continuous	10%	Nominal AC Input ranges	100%	50/60 Hz	No loss of function or performance
0-1 AC cycle	100%	Nominal AC Input ranges	80%	50/60 Hz	No loss of function or performance
> 1 AC cycle	> 10%	Nominal AC Input ranges	100%	50/60 Hz	Loss of function Acceptable,

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 Continuous Load	Maximum Continuous Load
+3.3V	0.5A	20A
+5V	0.5A	20A
+12V	0.8A	22A
-12V	0A	0.5A
+5VSB	0A	2A

Notes: 1: The +3.3 &+5 Volt total outputs shall not exceed 120W.
2: Noise bandwidth is from DC to 20 MHz

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	30% of Max. Load	0.5 A/uS	1000 uF
+3.3V	30% of Max. Load	0.5 A/uS	1000 uF
+12V	50% of Max. Load	0.5 A/uS	2200 uF
+5VSB	30% 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	25	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

Figure 1: Output Voltage Timing

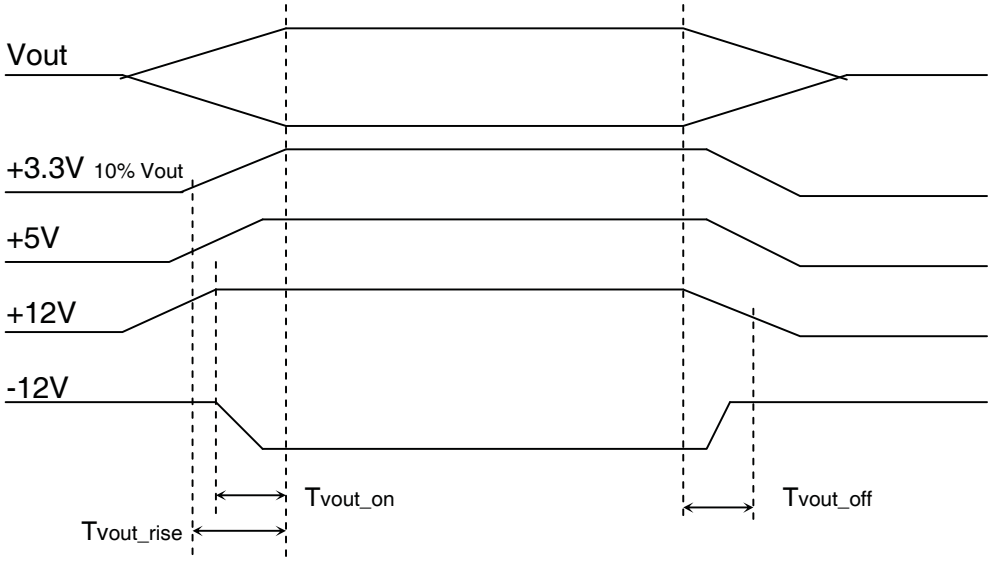
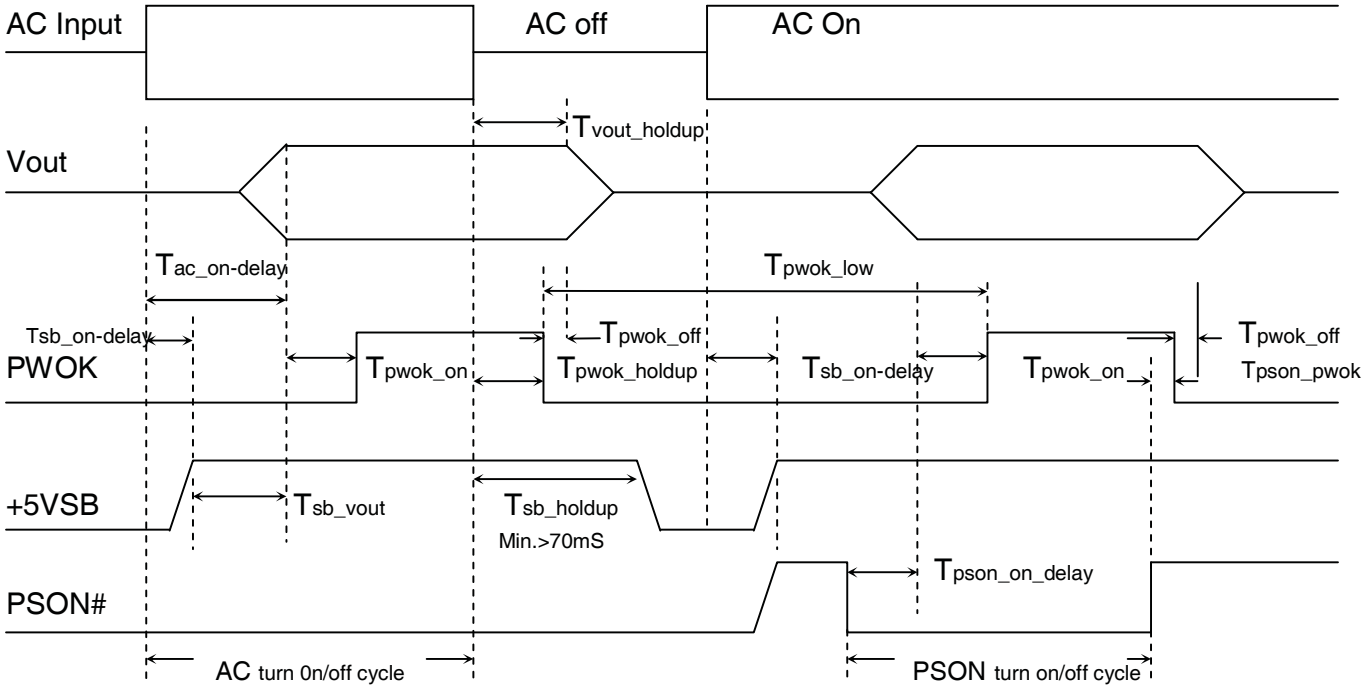


Table 9: Turn On/Off Timing

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 80% of maximum load.	18		mS
Tpwok_holdup	Delay from loss of AC deassertion of PWOK tested at 80% of maximum load.	17		mS
Tpson_on_delay	Delay from PSON# active to output voltage within regulation limits.	5	400	mS
Tpson_pwok	Delay from PSON# deactive to PWOK being deasserted.		50	mS
Tpwok_on	Delay from output voltage within regulation limits to PWOK asserted at turn on.	100	1000	mS
Tpwok_off	Delay from PWOK deasserted to output voltages (+5V, +3.3V, +12V, -12V) dropping out of regulation limits at 80% of maximum load.	1		mS
Tpwok_low	Duration of PWOK being in the deasserted state during an off/on cycle using AC or the PSON# 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 2: Turn On/Off Timing



3.7 Efficiency

a. The minimum efficiency of power module shall be ≧83% measured at nominal input voltage 230 V, while output +12V/16A and +5VSB/0.5A without Fan;
b. The efficiency should be ≧80% measured at input voltage 115V while output +12V/16A and +5VSB/0.5A with Fan.
c. The efficiency should be ≧75%, tested while both modules are installed. Condition as below:

AC 115V/60Hz (With Fan)

+5V	+3.3V	+12V	-12V	+5Vsb
5.0A	5.0A	12.5A	0.3A	1.5A

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 PSON# 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 10: Over Current Protection

Voltage	Minimum	Maximum	Shutdown Mode
+5V	22A	32A	Latch Off
+3.3V	22A	32A	Latch Off
+12V	24A	35A	Latch Off

4.2 Over Voltage Protection (OVP)

The power supply shall shut down and latch off after an over voltage conditions occurs.

Table 11: 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: 0℃ ~ 40℃ (32℉~ 104℉)
Non-operating Ambient:: -40℃ ~ 70℃ (-40℉~ 158℉)

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 12: 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/1A(ms)/m Performance Criteria A		
Voltage Dips and Interruptions	EN61000-4-11	>95%(Voltage Dips) 30%(Voltage Dips) >95%(Voltage Interruptions)	10 ms 100ms 500ms	Criteria B Criteria C Criteria C
Leakage Current	EN60950-1	3.5mA@250VAC		

5.7 Safety Agency Requirements

This power supply is designed to meet the following safety

Table 13: 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 supply 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℃

7. Mechanical Overview

Dimension: 106mm(W) x 41.5mm(H) x 260mm(D)
Weight: 3 Kg

8. LED Indicators

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

Table 14: LED Color and Power Status

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

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

9. Signals from Wire Harness

Table 15: Signals from Wire Harness

Power Supply Status	Signal Type
Works Normally	High
Power Module Not Inserted or Pulled Out	Low
Power Fail	Low
Fan Fail	Low

Alarm reset is used to clear power fail status by shorting circuit activities.
Buzzer shall alarm if signal goes low.

10. Pmbus Command Code Summary

Table 16: Support Command Code Table

Command Code	Command Name	Data Format	Number of Data Bytes
03h	CLEAR_FAULTS(1)	Send Byte	0
20h	VOUT_MODE	Read Byte	1
79h	STATUS_WORD	Read Word	2
7Ah	STATUS_VOUT	Read Byte	1
7Bh	STATUS_IOUT	Read Byte	1
7Dh	STATUS_TEMPERATURE	Read Byte	1
80h	STATUS_OF_3V3 And 5V	Read Byte	1
8Bh	READ_+12V_VOUT	Read VOUT Mode	2
8Ch	READ_+12V_IOUT	Read Linear	2
8Dh	READ_TEMPERATURE_1 (2)	Read Linear	2
96h	READ_+12V_POUT	Read Linear	2
99h	MFR_ID	Read ASCII	6
9Ah	MFR_MODEL	Read ASCII	13
9Bh	MFR_REVSION	Read ASCII	2
9Eh	MFR_SERIAL	Read ASCII	12
A7h	MFR_POUT_MAX	Read Linear	2
A8h	MFR_TAMBIENT_MAX	Read Linear	2
B0h	PSU_STATUS	Read Byte	1
D1h	READ_TOTAL_POUT (3)	Read Linear	2
D2h	READ_3V3_VOUT	Read VOUT Mode	2
D3h	READ_3V3_IOUT	Read Linear	2
D4h	REDA_3V3_POUT	Read Linear	2
D5h	READ_5V_VOUT	Read VOUT Mode	2
D6h	READ_5V_IOUT	Read Linear	2
D7h	READ_5V_POUT	Read Linear	2
FBh	Buzzer_Mute (4)	R/W Byte	1

Note :

(1) Status will retain the last occurrence , Latch defined as the status , Must be cleared through the 03h (CLEAR_FAULTS) command , Please See the following Table.

Command	Status Name	Status action
79h	STATUS_WORD	Latch
7Ah	STATUS_VOUT	Latch
7Bh	STATUS_IOUT	Latch
7Dh	STATUS_TEMPERATURE	Latch
80h	STATUS_OF_3V3 And 5V	Latch
B0h	PSU_STATUS	Automatic recovery

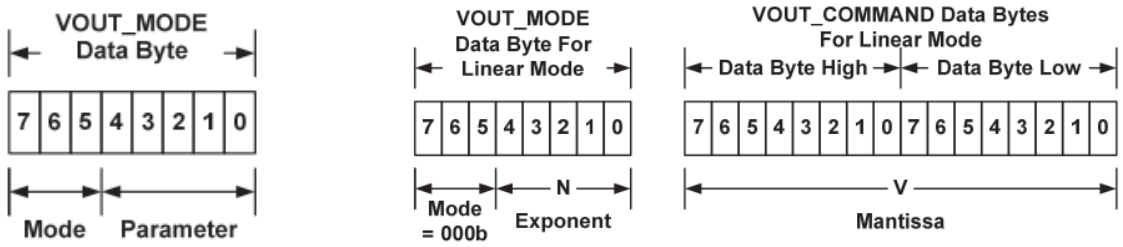
(2)READ_TEMPERATURE_1, should provide the PDB Inlet Ambient temperature

(3) Read Total Power command only at +12 V, 3V3, 5V total power.

(4) Buzzer will alert when any PSU fault occurs. Write 0x20 command in PMBus will be able to mute buzzer alarm. When PSU goes back to normal state, the register will be set at 0x00.

Table 17 : Contents in 20h (VOUT_MODE) Command Code

Mode	Bits [7:5]	Bits [4:0] (Parameter)
Linear	000b	Five bit two's complement exponent for the mantissa delivered as the data bytes for an output voltage related command.



Note:
The Mode bits are set to 000b.
The Voltage(ex.+12V_VOUT , 3V3_VOUT , 5V_VOUT), in volts, is calculated from the equation:

Voltage = V x 2^n

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

Table 18: Contents in 79h (STATUS_WORD)Command Code

Byte	Bit Number	Status Bit Name	Meaning
Low	[7:0	Reserved	Return=0
High	7	VOUT	+12V Output voltage warning has occurred = 1 ; Normal = 0
	6	IOUT	+12V Output current warning has occurred = 1; Normal = 0
	5	Reserved	Return=0
	4	3V3/5V_VOUT&IOUT	3V3/5V Output voltage warning has occurred = 1 ; Normal = 0
	3	POWER_ GOOD#	The POWER_GOOD signal is OK = 1; FAIL = 0
	[2:0]	Reserved	Return=0

Table 19 : Contents in 7Ah (STATUS_VOUT)Command Code

Bit Number	Status Bit Name	Meaning
7	Reserved	Return=0
6	+12V_OV_WARNING	VOUT > 13.0V = 1 ; Normal = 0
5	+12V_UV_WARNING	VOUT < 11.0V = 1 ; Normal = 0
[4:0]	Reserved	Return=0

Table 20: Contents in 7Bh (STATUS_IOUT)Command Code

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

Table 21: Contents in 7Dh (STATUS_TEMPERATURE)Command Code

Bit Number	Status Bit Name	Meaning
[7:3]	Reserved	Return=0
3	AMBIENT_OT_FAULT	Ambient temperature >60℃ = 1 ;Normal =0
2	AMBIENT_OT_WARNING	Ambient temperature >55℃ = 1 ; Normal = 0
[1:0]	Reserved	Return=0

Table 22 : Contents in 80h (*STATUS_OF_3V3 And 5V*)Command Code

Bit Number	Status Bit Name	Meaning
7	5V_OC_ FAULT	5V_IOUT > Max Current of 130%@ 1Sec = 1 ; Normal = 0
6	3V3_OC_FAULT	3V3_IOUT > Max Current of 130%@ 1Sec = 1; Normal = 0
5	5V_UV_WARNING	VOUT < 4.5V = 1 ; Normal = 0
4	3V3_UV_WARNING	VOUT < 3.0V = 1 ; Normal = 0
3	5V_OV_WARNING	VOUT > 5.5V = 1 ; Normal = 0
2	5V_OC_WARNING	5V_IOUT > Max Current of 110%@ 1Sec = 1 ; Normal = 0
1	3V3_OV_WARNING	VOUT > 3.6V = 1 ; Normal = 0
0	3V3_OC_WARNING	3V3_IOUT > Max Current of 110%@ 1Sec = 1 ; Normal = 0

Table 23 : Contents in B0h (*PSU_STATUS*)Command Code

Bit Number	Status Bit Name	Meaning
[7:4]	Reserved	Return=0
3	PSU2 PRESENT	Module Plug OUT = 1 ; Module Plug IN = 0
2	PSU1 PRESENT	Module Plug OUT = 1 ; Module Plug IN = 0
1	PSU2 STATUS	FAIL = 1 ; OK = 0
0	PSU1 STATUS	FAIL = 1 ; OK = 0

Table 24: 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	280 (W)
A8h	MFR_TAMBIENT_MAX	40(℃)

Table 25: I²C Address Set Table

PDB MCU Device	4A
FRU Device **(Option)**	AC

Appendix I. Data Format Description

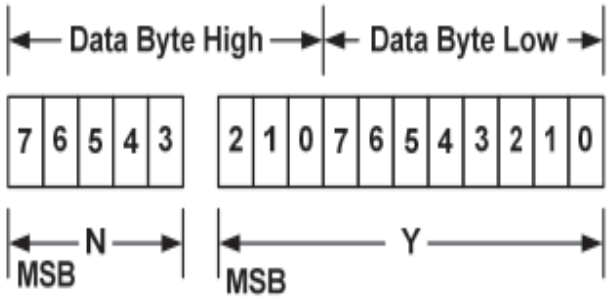
The Linear Data Format is typically used for commanding and reporting the parameters such as (but not only) the following:

- Output Current (A)
- Output Power(W)
- Temperature(℃)

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.