IX-1U65FX8P-2AC

1U Dual Input Flex ATX Power Supply

(1U Flex650W 80PLUS)

SPECIFICATION

Revision: 1.0

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1. Purpose

This specification defines the performance characteristics and functions of a 650 watts power supply in Flex ATX form factor With Dual AC input connectors, PMBus and with Active Power factor Correction.

2. Input Requirements

2.1. Input Rating

The power supply must operate within all specified limits under the rated input voltage range.
The power supply must meet the AC inrush current requirements, at cold start, ambient 25℃.

Table 1: Input Rating

Parameter	Minimum Operating	Input Range Rated	Maximum Operating	Current Range Rated
Input Voltage(Vac)	90Vac	100-240Vac	240Vac	8.2-3.5 Amps
Input Frequency	47Hz	50/60Hz	63Hz	-

2.2. Input Inrush Current

The power supply must meet the AC inrush current requirements, at cold start, ambient 25℃.
The maximum inrush current shall not exceed to 50 Amps at Input 240Vac.

2.3. Input Power Factor Correction& Total Current Harmonic

The power factor at 100% of rated load shall be ≥ 0.95 at nominal input voltage and full load. And the power supply shall meet the requirements of IEC 61000-3-2 of harmonic current.

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 sag and surge conditions.

Table 2: AC Line Sag Transient Performance

Duration	Sag	Operating AC Voltage	Line Frequency	Load	Performance Criteria
Continuous	10%	115/230VAC	60/50 Hz	100%	No loss of function or performance
0 - ½ AC cycle	30%	115/230VAC	60/50 Hz	70%	No loss of function or performance
> 1 AC cycle	> 30%	115/230VAC	60/50 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%	115/230VAC	60/50 Hz	No loss of function or performance
0 - ½ AC cycle	30%	115/230VAC	50/60 Hz	

3. DC Output Specification

3.1. Output Power / Currents

Table 4: Load Range

Voltage	Minimum Load	Maximum Load
+3.3V	0A	15A
+5V	0A	18A
+12V	0.5A	48A
-12V	0A	0.3A
+5VSB	0A	2A

Note1: Maximum continuous total DC output power should not exceed 650 W
Note2: Combined load on +3.3 VDC and +5 VDC outputs should not exceed 100 W.

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	50mV	50mV	120mV	120mV	50mV

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 220uF 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. 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 6: 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,	30% of Max. Load	0.5 A/μS	1000μF
+12V	50% of Max. Load	0.5 A/μS	2200μF
5VSB	30% of Max. Load	0.5 A/μS	1μF

Note: For dynamic condition +3.3V, +5V, +12V min loading is 1A.

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
+5VSB	1	350	uF

3.5. Timing Requirements

Table 8: Output Voltage Timing

Item	Description	MIN	MAX	Units
Tvout_rise	Output voltage rise time from each main output (+3.3V/+5V/+12V/+5VSB)	1	20	mS
	Output voltage rise time (-12V)	0.1	20	mS
T vout_on	All main outputs must be within regulation of each other within this time.		50	mS
T vout_off	All main outputs must leave regulation within this time.		400	mS

Figure 1: Output Voltage Timing

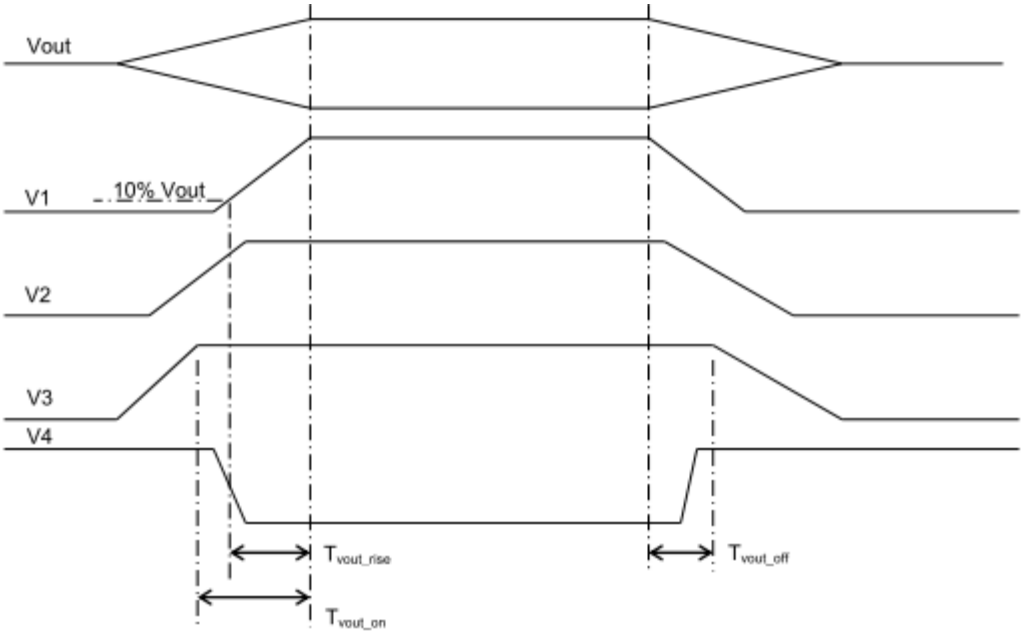


Figure 2: Turn On/Off Timing

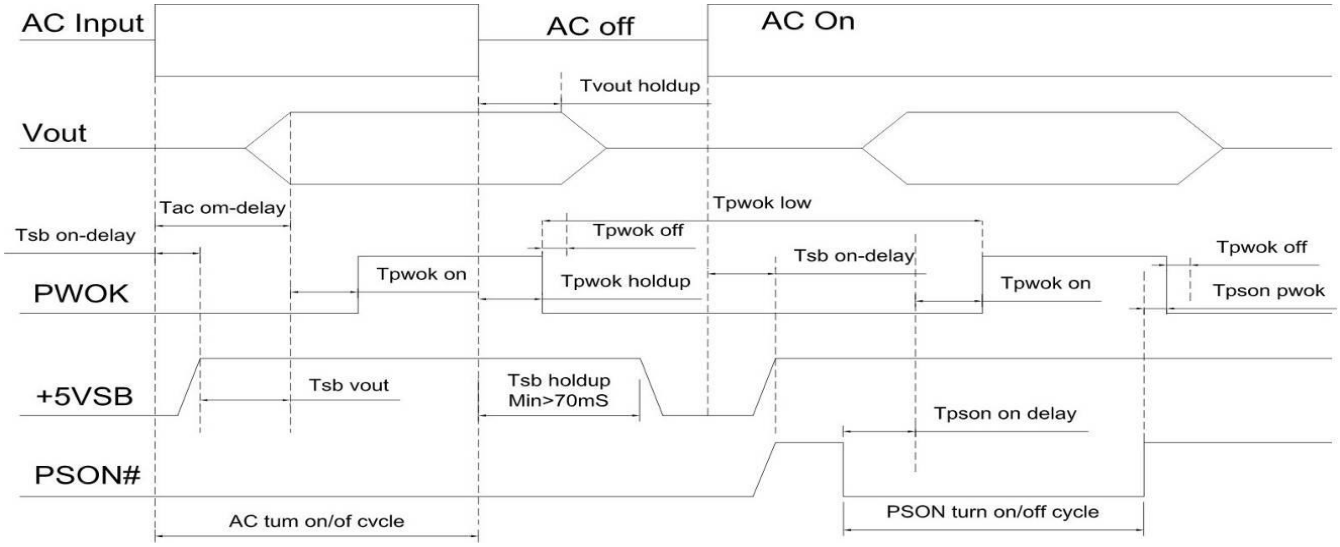


Table 9: Timing Requirements

Item	Description	MIN	MAX	Units
T sb_on_delay	Delay from AC being applied to 5 VSB being within regulation.		1500	mS
T ac_on_delay	Delay from AC being applied to all output voltages being within regulation.		2500	mS
Tvout_holdup	Time all output voltages stay within regulation after loss of AC. Tested at 70% of maximum load and over 100-240VAC input.	12		mS
Tpwok_holdup	Delay from loss of AC to deassertion of PWOK. Tested at 70% of maximum load and over 100-240VAC input.	11		mS
T pson_on_delay	Delay from PSON# active to output voltages within regulation limits.	5	500	mS
T pson_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	500	mS
Tpwok_off	Delay from PWOK deasserted to output voltages (3.3 V,5 V, 12 V, -12 V) dropping out of regulation limits.	1		mS
T pwok_low	Duration of PWOK being in the deasserted state during an off/on cycle using AC or the PSON# signal.	100		mS
T sb_vout	Delay from 5 VSB being in regulation to O/Ps being in regulation at AC turn on.	50	1000	mS

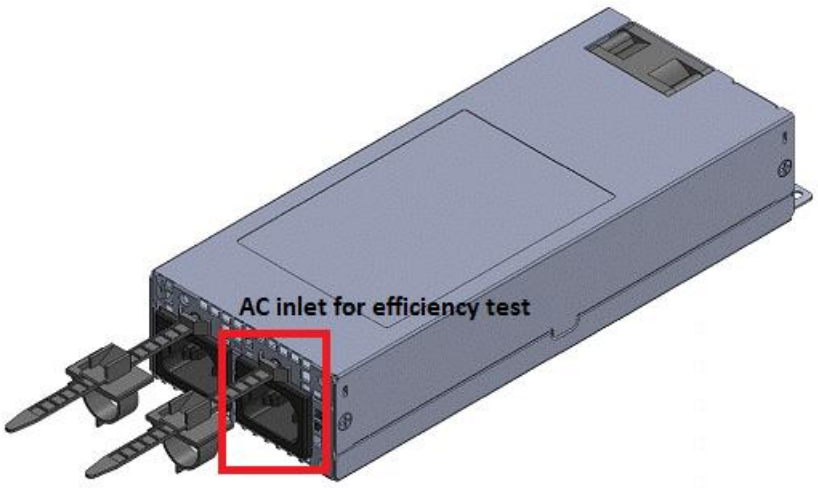
3.6. Efficiency

The power efficiency shall be at least 90% at 20% max. load, 92% at 50% max. load and 89% at 100% maximum load, tested at 115VAC/50Hz Input at 25 deg ambient condition.

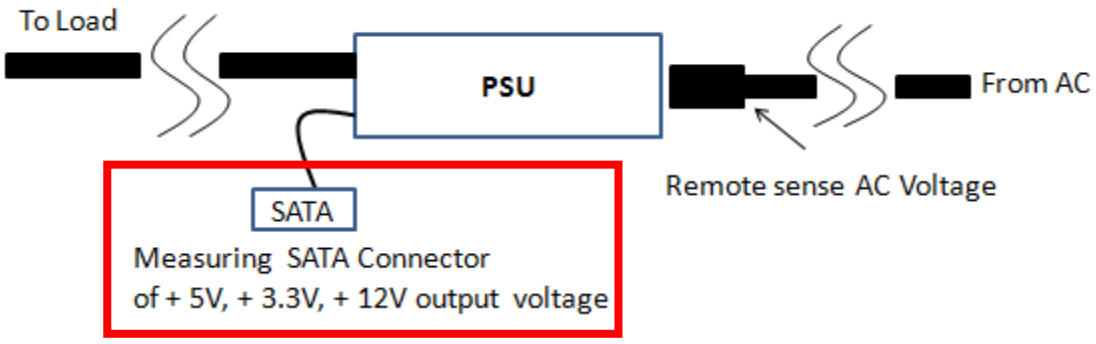
Efficiency Test Load condition:

Parameter	12V	3.3V	5V	-12V	5Vsb
20% rated Loads	6.6A	2.03A	2.43A	0A	0.38A
50% rated Loads	16.51A	5.07A	6.09A	0A	0.94A
100% rated Load	33.02A	10.14A	12.17A	0A	1.89A

Tested with only single AC inlet at right side. See below :



Input and output voltage measurement Mode Description.



3.7. 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.

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, a power on-off cycle must be able to restart the power supply.

4.1. 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 +5VSB). The fault must be removed to restore the DC outputs. Tested shall be with minimum load.

Table 10: Over Voltage Protection

Voltage	Minimum	Maximum	Shutdown Mode
+3.3V	+3.9V	+4.5V	Latch off all main output
+5V	+5.7V	+6.5V	Latch off all main output
+12V	+13.3V	+14.5V	Latch off all main output
+5VSB	+5.7V	+6.5V	Latch off all main output

4.2. Over Current Protection (OCP)

The power supply shall have power limit to prevent outputs from exceeding design limitation. The power supply shall shutdown and latch off. The protection voltage shall be at range shown in Table of rated loads.

Table 11: Over Current Protection

Voltage	Minimum	Maximum	Shutdown Mode
+3.3V	16.5A	22.5A	Latch off all main output
+5V	19.8A	27A	Latch off all main output
+12V	38.5A	52.5A	Latch off all main output
+5VSB	2.2A	3.6A	Auto recovery

4.3. Short Circuit Protection

The power supply shall shut down in latch off mode when the output voltage is short circuit with 100mΩ resistance. +5VSB will recover automatically when fault is removed. The other output will recover if system meets the minimum load requirements in Table 2 - Load Range.

4.4. Over Temperature Protection (OTP)

The power supply shall shut down in latch off mode when the ambient temperature >=70°C and Hot-spot >=110°C

5. Environmental Requirements

5.1. Temperature

Operating Ambient, normal mode (inlet air): 0°C ~ +50°C
Non-operating Ambient:: -40°C ~ 85°C (-40°F~ 158°F)

5.2. Humidity

Operating: 20% ~ 80%RH non-condensing
Non-Operating: 5% ~ 95%RH non-condensing

5.3. Altitude

Operating: Sea level to 16,400 ft (5000m)
Non Operating: Sea level to 40,000 ft (12192m)

5.4. Mechanical Shock (Non-Operating)

Table 12: Mechanical Shock Requirements

Shock	
Shock Response Spectrum	Half Sine
Peak Acceleration	30 m/s^2
Duration	11 ms
Axis	3 per axis
Reference Standard	IEC 60068-2-27 Ea: Shock

5.5. Vibration (Operating)

Table 13: Vibration Test Requirements

Sinusoidal Vibration		
Lower Frequency Band	Range	5 to 62 Hz
	Velocity	5 mm/s
Upper Frequency Band	Range	62 to 200 Hz
	Acceleration	2.0 m/s^2
Axis		5 sweep cycles per axis
Reference Standard		IEC 60068-2-6 Fc: Vibration (Sinusoidal)
Random Vibration		
ASD		0.02 m^2/s
Lower Frequency Band	Range	5 to 10 Hz
	Slope	+12 dB/octave
Middle Frequency Band	Range	10 to 50 Hz
	Slope	0 dB/octave
Upper Frequency Band	Range	50 to 100 Hz
	Slope	-12 dB/octave
Axis		30 minutes per axis
Reference Standard		IEC 60068-2-64 Fh: Vibration, Broad-Band Random (Digital Control)

6. Electromagnetic Compatibility

Table 14: EMC Requirements

Electromagnetic Interference	FCC CFR Title 47 Part 15 Sub Part B EN55022/EN55024	Conducted A Class Radiated A Class		
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/1A(ms)/m Performance Criteria A		
Voltage Dips and Interruptions	EN61000-4-11	>95% (Voltage Dips) 30% (Voltage Dips) >95% (Voltage Dips)	10 ms 100ms 500ms	Criteria A Criteria C Criteria C

6.1. Safety Agency Requirements

This power supply is designed to meet the following safety:

Table 15: Product Safety

Product Safety:	• IEC 60950-1:2005 (2nd Edition) + A2:2013 with all country variations • TUV: EN60950-1/A2:2013 • UL: UL60950-1, 2nd Edition, 2014-10-14 • CCC:GB4943.1-2011, GB9254-2008, GB17625.1 – 2012

6.2. RoHS Requirements

Table 16: RoHS Requirements

RoHS Requirements	• EN 50581:2012 • RoHS Directive 2011/65/EU and carry the marking accordingly with the address of representative in Europe. • Comply with RoHS European requirements and a declaration of compliance and test data for CE mark. • Comply with RoHS China requirements including marking and declaration. • Complete verification of RoHS Compliance Declaration.

7. Reliability

7.1. 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°C

8. Mechanical Overview

Dimension: 81.5mm (W) x 40.5mm (H) x 200mm (D)
Weight: <1.2kg

8.1. Input AC Connector

The AC inlet is a IEC320 C14 type 3pin connector

8.2. Output Connector

Please refer to appendix: Mechanical Drawing of output Cabling.

9. PMBus Command Codes Summary

Table 17: Support Command Code Table

Command Code	Command Name	SMBus Transaction Type	Number of Data Bytes	Data Format
19h	CAPABILITY	Read Byte	1	U8
20h	VOUT_MODE	Read Byte	1	U8
78h	STATUS_BYTE	Read Byte	1	Byte
79h	STATUS_WORD	Read Word	2	U16
7Ah	STATUS_VOUT	Read Byte	1	U8
7Bh	STATUS_IOUT	Read Byte	1	U8
7Ch	STATUS_INPUT	Read Byte	1	U8
7Dh	STATUS_TEMPERATURE	Read Byte	1	U8
80h	STATUS_MFR_SPECIFIC	Read Byte	1	U8
81h	STATUS_FANS_1_2	Read Byte	1	U8
86h	READ_EIN	Block Read	5	Block (U8 / U16)
88h	READ_VIN	Read Word	2	Linear
89h	READ_IIN	Read Word	2	Linear
8Bh	READ_VOUT (1)	Read Word	2	Linear VOUT Mode
8Ch	READ_IOUT (2)	Read Word	2	Linear
8Dh	READ_TEMPERATURE_1 (3)	Read Word	2	Linear
8Eh	READ_TEMPERATURE_2 (4)	Read Word	2	Linear
90h	READ_FAN_SPEED_1	Read Word	2	Linear
96h	READ_POUT	Read Word	2	Linear
97h	READ_PIN	Read Word	2	Linear
98h	PMBUS_REVISION	Read Byte	1	U8
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
A2h	MFR_IIN_MAX	Read Word	2	Linear
A3h	MFR_PIN_MAX	Read Word	2	Linear
A4h	MFR_VOUT_MIN	Read Word	2	Linear
A5h	MFR_VOUT_MAX	Read Word	2	Linear
A6h	MFR_IOUT_MAX	Read Word	2	Linear
A7h	MFR_POUT_MAX	Read Word	2	Linear
A8h	MFR_TAMBIENT_MAX	Read Word	2	Linear
AAh	MFR_EFFICIENCY_LL	Block Read	14	Linear of Block
ABh	MFR_EFFICIENCY_HL	Block Read	14	Linear of Block
D2h	READ_+3.3V_VOUT	Read Word	2	Linear VOUT Mode
D3h	READ_+3.3_IOUT	Read Word	2	Linear
D5h	READ_+5V_VOUT	Read Word	2	Linear VOUT Mode
D6h	READ_+5V_IOUT	Read Word	2	Linear

Note 1: The Command code is Read 12V output voltage only

Note 2: The Command code is Read 12V output current only.

Note 3: READ_TEMPERATURE_1, should provide the PSU inlet temperature (Ambient)

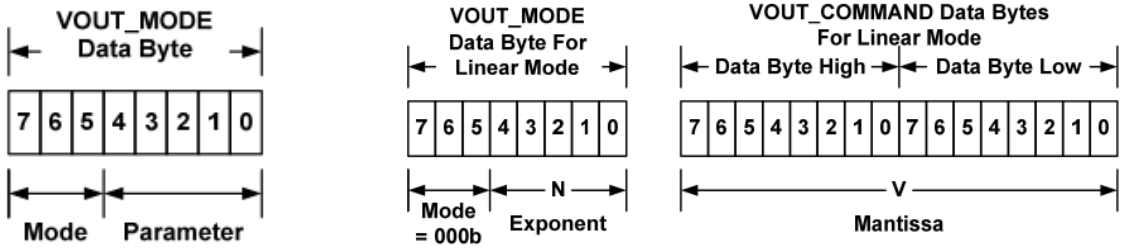
Note 4: READ_TEMPERATURE_2, should provide the temperature of the assumed Hot-spot in the PSU.

Table 18: Contents in 19h (CAPABILITY) Command Code

Bit Number	Value	Meaning
7	1	Packet Error Checking is supported
[6:5]	00b	Maximum supported bus speed is 100 kHz
4	1	The device does have a SMBALERT# pin and does support the SMBus Alert Response protocol
[3:0]	X	Reserved

Table 19: 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_OUT , 12VSB_OUT), in volts, is calculated from the equation:
Voltage = V x 2n
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 20: Contents in 79h (STATUS_WORD) Command Code

Byte	Bit Number	Status Bit Name	Meaning
Low	7	Reserved	Return=0
	6	OFF	Power Unit Power OFF = 1 ; Power ON = 0
	5	Reserved	Return=0
	4	+12V_IOUT_OC_FAULT	An output overcurrent fault has occurred = 1; Normal = 0
	3	VIN_UV_FAULT	An input undervoltage fault has occurred = 1; Normal = 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	INPUT	An input voltage fault or warning has occurred =1; Normal = 0
	4	MFR_SPECIFIC	An +3.3V and +5V output current fault or warning has occurred = 1; Normal = 0
	3	POWER_GOOD#	The POWER_GOOD signal is OK = 0; FAIL = 1
	2	FANS	A fan or airflow fault or warning has occurred=1; Normal = 0
	[1:0]	Reserved	Return=0

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

Table 21: Contents in 7Ah (STATUS_VOUT) Command Code

Bit Number	Status Bit Name	Meaning
7	Reserved	Return=0
6	+12V_VOUT_OV_WARNING	VOUT > 13.2V = 1 ; Normal = 0
5	+12V_VOUT_UV_WARNING	VOUT < 11.0V = 1 ; Normal = 0
4	+12V_VOUT_UV_FAULT	VOUT < 10.0 V = 1 ; Normal = 0
[3:0]	Reserved	Return=0

Table 22: Contents in 7Bh (STATUS_IOUT) Command Code

Bit Number	Status Bit Name	Meaning
7	+12V_IOUT_OC_FAULT	+12V_IOUT > Max Current of 110~ 150% = 1 ; Normal = 0
6	Reserved	Return=0
5	+12V_IOUT_OC_WARNING	+12V_IOUT > Max Current of 110%@10ms = 1; Normal = 0
[4:0]	Reserved	Return=0

Table 23: Contents in 7Ch (STATUS_INPUT) Command Code

Bit Number	Status Bit Name	Meaning
[7:5]	Reserved	Return=0
4	VIN_UV_FAULT	AC Input Voltage < 80~75V@20ms = 1; Input Voltage > 80~85V@20ms = 0
3	Unit Off For Insufficient Input Voltage	Follow Bits[4] Status
[2:0]	Reserved	Return=0

Table 24: Contents in 7Dh (STATUS_TEMPERATURE) Command Code

Bit Number	Status Bit Name	Meaning
7	HOT-SPOT_OT_FAULT	Hot-spot temperature >110°C = 1 ; Normal = 0
6	HOT-SPOT_OT_WARNING	Hot-spot temperature >100°C = 1 ; Normal = 0
[5:4]	Reserved	Return=0
3	Ambient_OT_FAULT	Ambient temperature >70°C = 1 ; Normal = 0
2	Ambient _OT_WARNING	Ambient temperature >60°C = 1 ; Normal = 0
[1:0]	Reserved	Return=0

Table 25: Contents in 80h (STATUS_MFR_SPECIFIC) Command Code

Bit Number	Status Bit Name	Meaning
[4:7]	Reserved	Return=0
3	+3.3_IOUT_OC_FAULT	+3.3V_IOUT > Max Current of 110%~150% = 1; Normal = 0
2	+3.3_IOUT_OC_WARNING	+3.3V_IOUT > Max Current of 110% = 1; Normal = 0
1	+5V_IOUT_OC_FAULT	+5V_IOUT > Max Current of 110%~150% = 1; Normal = 0
0	+5V_IOUT_OC_WARNING	+5V_IOUT > Max Current of 110% = 1; Normal = 0

Table 26: Contents in 81h (STATUS_FANS_1_2) Command Code

Bit Number	Status Bit Name	Meaning
7	Fan 1 Fault	Fan Fault = 1 ; Normal = 0
[6:0]	Reserved	Return=0

Note: If FAN Fault for more than 5 seconds later, PSU will automatically shut down. (Latch)

Table 27: MFR Meaning

Command Code	Command Name	Meaning (ASCII Code)	Data Format
99h	MFR_ID	ISTARUSA	ASCII
9Ah	MFR_MODEL	IX-1U65FX8P-2AC	ASCII
9Bh	MFR_REVSION	A0 ~ Z9	ASCII
9Eh	MFR_SERIAL	Code = 12 (eg. T501xxG00001) ;xx = Product code	ASCII
A0h	MFR_VIN_MIN	100 (Vac)	Linear
A1h	MFR_VIN_MAX	240 (Vac)	Linear
A2h	MFR_IIN_MAX	6(A)	Linear
A3h	MFR_PIN_MAX	600 (W)	Linear
A4h	MFR_VOUT_MIN	11.4 (V)	Linear
A5h	MFR_VOUT_MAX	12.6 (V)	Linear
A6h	MFR_IOUT_MAX	35.0(A)	Linear
A7h	MFR_POUT_MAX	500 (W)	Linear
A8h	MFR_TAMBIENT_MAX	50 (°C)	Linear
AAh	MFR_EFFICIENCY_LL	115V | 100W: 90% | 250W: 92% | 500W: 89%	Linear of Block
ABh	MFR_EFFICIENCY_HL	230V | 100W: 90% | 250W: 94% | 500W: 91%	Linear of Block

Appendix I. Data Format Description

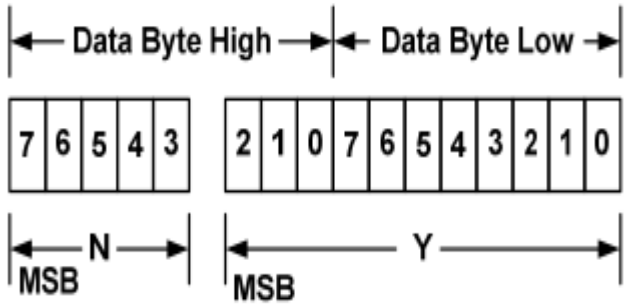
The Linear Data Format is typically used for commanding and reporting the parameters such as (but not only) the following:

- Input Voltage (V)
- Input Current (A)
- Input Power (W)
- Output Current (A)
- Output Power(W)
- FAN Speed Command (Duty)
- FAN Speed (RPM)
- 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.

Appendix Ⅱ. Trade Mark

A trademark identifies the brand owner of a particular product or service.

Trade-Mark (if any):