UNIPOWER
Powering Technology

SPQ3000 MODULE
1500 WATT 12V FRONT END
11.0 x 3.2 x 1.6” | 279.4 x 81.3 x 40.6mm

DESCRIPTION

UNIPOWER’s **SPQ3000** is a new generation of high density hot-swap Front-Ends for Networking and DataCom applications that utilize 12V Bus Architecture. With a power density of 26.6W/in^3 and efficiency of up to 94%, these “GREEN” power solutions help system designers satisfy increasing demands for reduced energy consumption, smaller size and reduced costs.

These 1500 Watt Power Modules feature both Analog and PMBus communication for status and control of each power module. Front panel LED indicator and Audible alarm communicates status or fault conditions for easy identification in any environment. N+N Redundant operation is achieved with active load sharing and ORing protection circuits.

FEATURES

- Up to 94% Efficiency
- 1U High: 1.6”
- 0°C to +50°C Operation
- Universal AC Input
- >0.95 Power Factor (minimum)
- Output Voltages: 12 VDC & 5VSB
- Power Density to 17.5W/Cu. Inch
- Hot Swappable
- Integral Active Output ORing Circuit
- Class B EMI Filter
- LED Indicators
- PMBus Serial Communications
- Variable Speed Cooling Fans

TWO-YEAR WARRANTY

INTERNATIONAL STANDARDS

UL/cUL 60950-1, TUV EN 60950-1
CB IEC 60950-1, WEEE, CE Mark (LVD)

12V FRONT END MODULE

POWER	12VOUT	5VSB	MODEL NO.
1500W [1]	125A [2]	3.5A	SPQ3000

1. Total output power may not exceed 1500 watts
2. Derates to 79A at 110VAC input

1. Purpose

This specification defines the performance characteristics and functions of a standard 1500 watts 1U form factor of power module with Active PFC (Power Factor Correction) and PMBus.

2. AC Input Requirements

2.1 Input Voltage and Frequency

Voltage (sinusoidal): 110~240 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. Repetitive On/Off cycling of the AC input voltage shall not damage the power supply. The charging current for X capacitors is not considered as in-rush current.

Table 1: AC Input Current and Inrush Current (For Safety Application)

Input Voltage	Input Current	Maximum Inrush Current	Output
110VAC	10A	25A peak at cold start for 1/4 of AC cycle	950W
220VAC	7.8A	55A peak at cold start for 1/4 of AC cycle	1500W

2.3 Input Power Factor Correction (Active PFC)

The power factor at 100% of rated load shall be ≥ 0.95 at AC 230V input voltage.

2.4 AC Line Fuse

The power supply shall have one line fused in the **single line fuse** on the line (Hot) wire of the AC input. The input fuse shall be a slow blow type; the line fusing shall be acceptable for all safety agency requirements.

2.5 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 condition

Table 2: AC Line Sag Transient Performance

Duration	Sag	Operating AC Voltage	Line Frequency	Performance Criteria
Continuous	10%	Nominal AC Input ranges	50/60 Hz	No loss of function or performance
0~8ms	100%	Nominal AC Input ranges	50/60 Hz	No loss of function or performance
> 1 AC cycle	> 10%	Nominal AC Input ranges	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 / Current

Table 4: Load Range

Voltage	Minimum Continuous Load	Maximum Continuous Load
+12V	0.5A	79A (110VAC Input) 125A (220VAC Input)
+5VSB	0.1A	3.5A

Notes:

1: Total combined output power shall not exceed 950W at 110Vac input

2: Total combined output power shall not exceed 1500W at 220Vac input

3.2 Voltage Regulation, Ripple and Noise

Table 5: Regulation, ripple and noise

Output Voltage	+12V	+5VSB
Load Reg.	±5%	±5%
Line Reg.	±1%	±1%
Ripple & Noise	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
+12V	10	11,000	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
+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

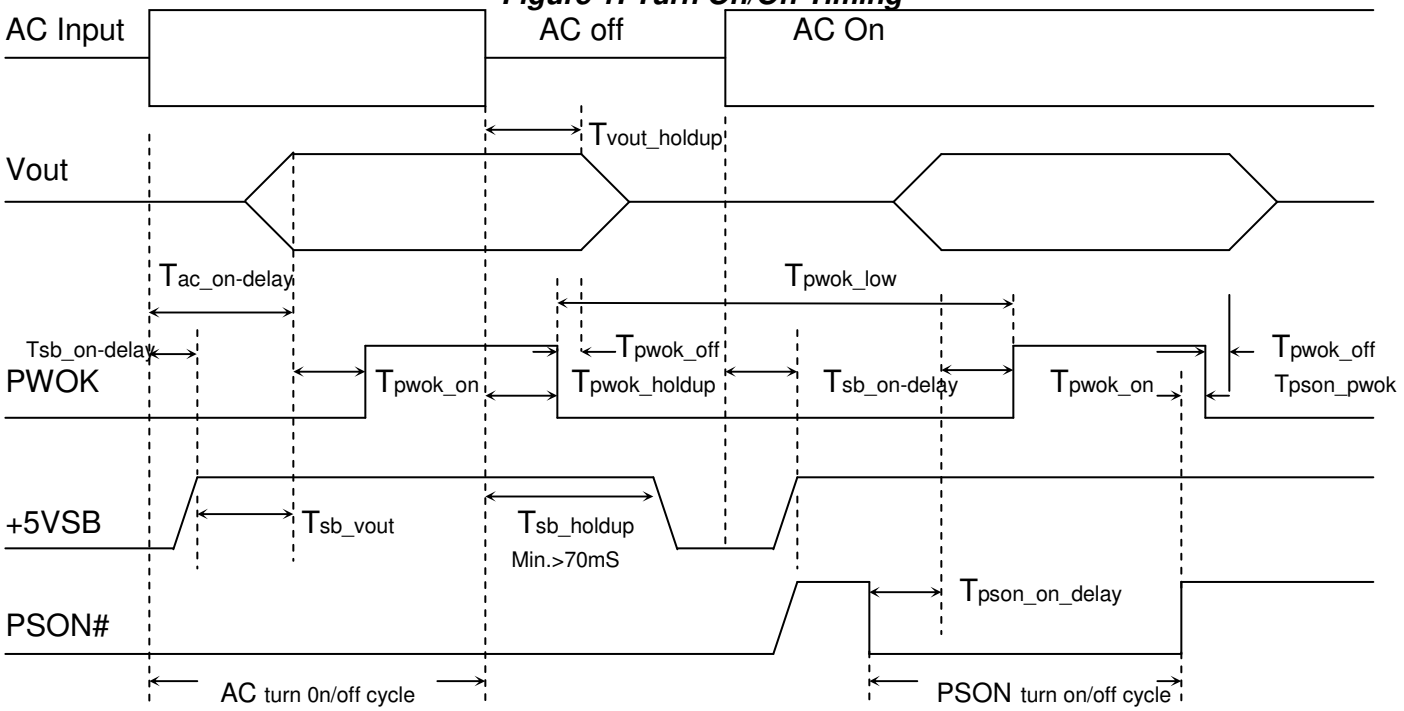
Table 8: Output Voltage Timing

Item	Description	MIN	MAX	Units
Tvout_rise	Output voltage rise time from each main output	1	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.		2000	mS
Tvout_holdup	Time all output voltage stay within regulation after loss of AC tested at 50% of maximum load and 115VAC input	16		mS
Tpwok_holdup	Delay from loss of AC deassertion of PWOK tested at 50% of maximum load and 115VAC input	15		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	500	mS
Tpwok_off	Delay from PWOK deasserted to output voltages dropping out of regulation limits. Tested at 50% of maximum load and 115VAC input	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 1: Turn On/Off Timing



3.7 Efficiency

a. The power efficiency shall meet 80PLUS Platinum Level test criteria.
b. The power efficiency shall be at least 88% tested at ATE, 230Vac input, full load.

3.8 Hot-Swap and Current Load Share

The power module supports hot-swap and active load sharing. The 12V outputs among N+1(N=1~7) modules will be balanced within ±10% of maximum load condition. Tested from 20% ~100% of Load condition.

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 +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
+12V	N/A	120%	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
+12V	+13.3V	+14.5V	Latch Off

4.3 Short Circuit Protection
The power supply shall shut down in latch off mode when the output voltage is short circuit.

4.4 No Load Operation
No damage or hazardous condition should occur .The power supply will operate but the DC output maybe outside of its specified range. Specifically, the output voltage may exceed nominal condition values for this power supply.

4.5 Over Temperature Protection (OTP)
The power supply will latch off when an over temperature condition occurs. No damage shall be caused.

5. Power Signals
5.1 PRESENT
This power pin is grounded in power module. TTL logic LOW indicates power module inserted, while HIGH indicates extracted from system.

5.2 PS_ON (Remote On/Off)
This is control signal pin to start DC main outputs. +12V output are enabled when signal is pulled LOW; disabled while being pulled HIGH.

5.3 PWR_OK
This is the power good signal and should be asserted HIGH by power supply to indicate +12V main output are within regulation limit listed in ***Table 5: Regulation, ripple and noise***
The signal and should be de-asserted to LOW by power supply to indicate +12V main output falls under regulation limit listed in ***Table 5: Regulation, ripple and noise***

5.4 PS_KILL
The power signal should be pulled LOW by system to enable +12V main output. If floating the power shall be turned off. The signal shall be grounded at system mid-plane.

5.5 12VCSR (Current Share Pin)
The power signal allows 2 or more power modules to work in parallel. Refer to 3.8 for current sharing requirement.

5.7 Power Fail Detect Signal (PFD)
Power fail signal is a 5V TTL signal that will pull HIGH as normal state, while LOW means fail.

The failure mode could be a. Power Fail (Not operating), b. Blower Fail, c. AC Loss, d. Voltage out of Spec e. Over Current, exceed 110% of max. load, f. OTP (Ambient and Hotspot)
Logic level HIGH: 2.4~5.25V; Logic Level LOW: 0~0.4V

6. Environmental Requirements

6.1 Temperature

Operating Ambient, normal mode (inlet air): 0℃ ~ 40℃. Refer to de-rating curve at appendix.
Non-operating Ambient:: -40℃ ~ 70℃

6.2 Humidity

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

6.3 Altitude

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

6.4 Mechanical Shock

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

6.5 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.

6.6 Electromagnetic Compatibility

Table 13: 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/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	Input leakage current from line to ground will be less than 3.5mA/N, (N=Total amount of power modules). Measurement will be made at 240VAC and 50Hz.		

6.7 Safety Agency Requirements

This power supply is design to meet the following safety

Table 14: Product Safety

Product Safety:	UL,cUL UL60950-1 CB IEC60950-1 TUV EN60950-1 CCC

7 Reliability

7.1 Mean Time Between Failures (MTBF)

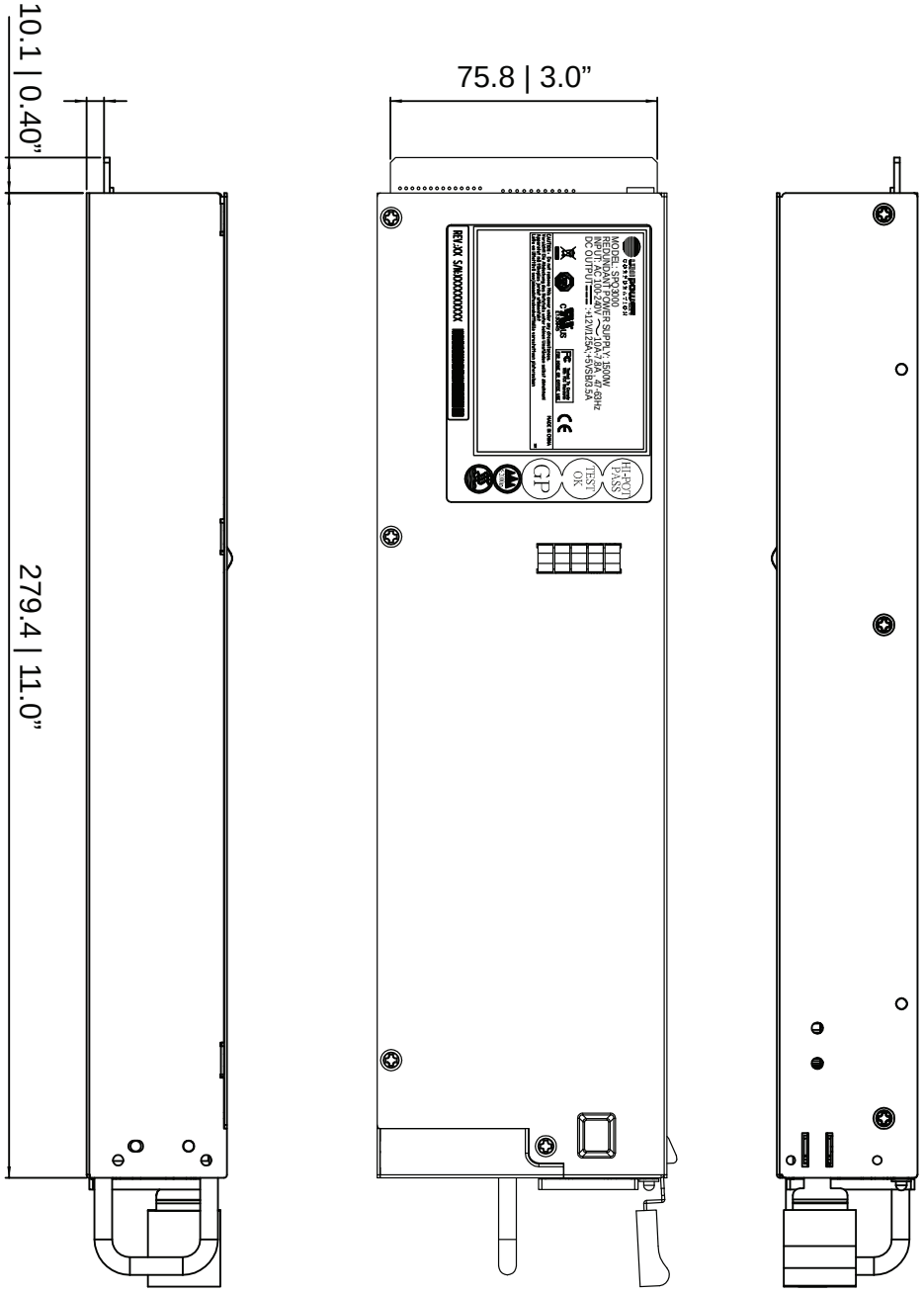
The MTBF of the power supply shall be calculated utilizing the Part-Stress Analysis method of MIL217F. The calculated MTBF of the power supply shall be greater than 100,000 hours under the following conditions:

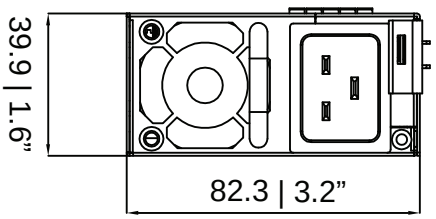
Full rated load; 120V AC input

8. Mechanical Requirements(TBD)

8.1 Dimension: 82.3mm(W) x 40mm(H) x 279.4mm(D)

Weight: 2 Kg





Unit: mm | Inches

8.2 Output Pin Assignment
(Mating Connector: ALLTOP C21001-10101-Y, Pitch=2.54mm)

Table 15: Power Signal/ Power Pin Out Assignment

+12V	30	+12V	29
+12V	31	+12V	28
+12V	32	+12V	27
+12V	33	+12V	26
+12V	34	+12V	25
+12V	35	+12V	24
+12V	36	+12V	23
+12V	37	+12V	22
+12V	38	+12V	21
+12V	39	+12V	20
+12V Return	40	+12V	19
+12V Return	41	+12V Return	18
+12V Return	42	+12V Return	17
+12V Return	43	+12V Return	16
+12V Return	44	+12V Return	15
+12V Return	45	+12V Return	14
+12V Return	46	+12V Return	13
+12V Return	47	+12V Return	12
+12V Return	48	+12V Return	11
+12V Return	49	+12V Return	10
+12V Return	50	+12V Return	9
+12VRS-	51	+12VRS+	8
+5VSB Return	52	+5VSB	7
12VCSR	53	A0	6
Returns	54	A2	5
A1	55	PWR_OK	4
PS_ON	56	SCL	3
PS_KILL	57	Present	2
PFD	58	SDA	1
Signal	**Pin #**	**Signal**	**Pin #**
BOT		**TOP**	

9. LED Indicators

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

Table 16: LED Color and Power Status

Power Supply Status	Color
Power Switch On	Blinking Green → Red → Green
Normal State	Green
Standby (Only +5VSB output)	Blinking Green
Power Fail	Red
Fan Fail	Blinking Red

10.FRU/Power PMBus Device Address

For redundant systems there are 3 signals to set the address location once it is installed to system: A2/A1/A0

Table 17: Device Address Locations

PDB address A2/A1/A0	0/0/0	0/0/1	0/1/0	0/1/1	1/0/0	1/0/1	1/1/0	1/1/1
PSU IPMI FRU Device	A0h	A2h	A4h	A6h	A8h	AAh	ACh	AEh
PSU PMBUS Device	B0h	B2h	B4h	B6h	B8h	BAh	BCh	BEh

11. PMBus Command Code Summary

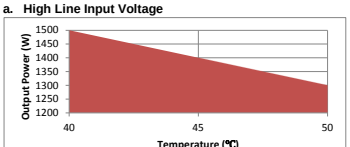
Table 18: PMBus Command Code Summary

Command Code	Command Name	SMBus Transaction Type	Number of Data Bytes
19h	CAPABILITY	Read Byte	1
1Ah	QUERY	Read Byte	1
88h	READ_VIN(Note1)	READ WORD	2
89h	READ_IIN	READ WORD	2
8Bh	READ_VOUT	READ WORD	2
8Ch	READ_IOUT	READ WORD	2
8Dh	READ_TEMPERATURE_1	READ WORD	2
90h	READ_FAN_SPEED_1	READ WORD	2
91h	READ_FAN_SPEED_2	READ WORD	2
96h	READ_POUT	READ WORD	2
97h	READ_PIN	READ WORD	2
98h	PMBUS_REVISION	READ BYTE	1

Appendix A: Derating Curves

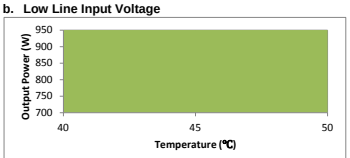
Output vs Temperature De-rating

a. High Line Input Voltage



Temperature (℃)	40	45	50
Output (W)	1500	1400	1300

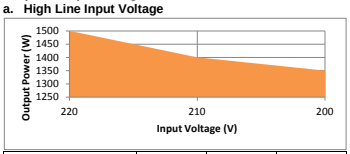
b. Low Line Input Voltage



Temperature (℃)	40	45	50
Output (W)	950	950	950

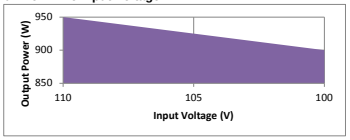
Output vs Input Voltage

a. High Line Input Voltage



Input Voltage (VAC)	200	210	220
Output (W)	1350	1400	1500

b. Low Line Input Voltage



Input Voltage (VAC)	100	105	110
Output (W)	900	925	950

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