SILVERSTONE

Gemini Series

Gemini 2000C Titanium Module

2000W Replacement Module for Gemini 2000C Titanium (SST-GM2000C-TF)

- PSU For Silverstone CRPS 2000W Switching Power Supply SST-GM2000C-TF
- 1U height with CRPS form factor: 73.5mm (W) x 39mm (H) x 185mm (D)
- Active PFC (full range) with 80PLUS Titanium certification
- All Japanese electrolytic capacitors, polymer capacitors and support PMBus 1.2
- Hot-swappable design with convenient pull-out handle bars
- Cold Redundancy support
- Smart Ride Through that Allow the system to quickly obtain SMBAlert signals
- Supports High Voltage Direct Current (HVDC) input up to 310VDC.
- 12.2V Main Output and 12V Standby Output
- 3 A max standby output current

SPECIFICATION
SilverStone Gemini Series

Gemini 2000C Titanium Module
SST-GM2000C-TFU
CRPS AC to DC Power Supply
80PLUS Titanium efficiency certified.
2000W

1.GENERAL SCOPE

This specification describes the performance characteristic of a 2000W off-line modular, hot pluggable, dual output of +12.2V and +12Vsb redundant power supply. The power supply may be used in a non-redundant, single unit or N+M(N+M≤4) redundant configuration. The power supply shall be totally self-contained with internal fan(s) for force air-cooling.

1.1.Mechanical Overview
The physical size of the power supply enclosure is 73.5mm x 39mm x 185mm (WxHxL). The input voltage inserts directly into the external face of the power supply.

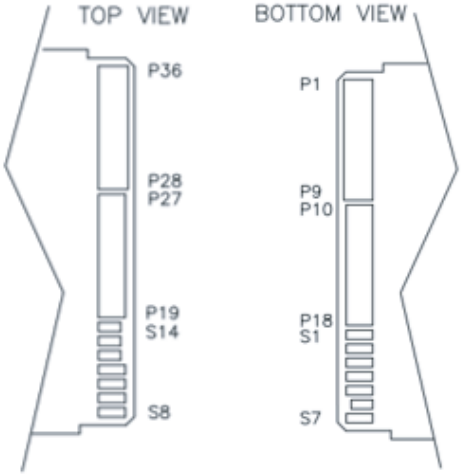
1.2.DC outputs, Signal outputs, Control inputs

1.2.1.Card Edge Output Connector
The output connector shall be a card-edge extension of the PC board internal to the power supply and shall blind mate with a P36 + S14 position, (P18+S7 each side), top and bottom of card edge receptacle.
Pin number assignment relates to the card edge finger position as shown in Table 2-1. Card edge fingers are dimensioned and numbered according to the details shown in Figure 2-1/2-2.

Table 2-1 – Output Connector Description

Pins	Function	Description
P1-P9, P28-P36	GND	Main Return and Standby Return
P10-P18, P19-P27	+12.2V	+12.2V Main output
S1	A0	Address pin 0
S2	A1	Address pin 1
S3	+12VSB	12V standby output
S4	C_R	Cold Redundancy
S5	+12VLS	+12V Load share bus
S6	PRESENT	Power supply present signal
S7	INPUT_OK	Input voltage ok signal
S8	PW_OK	Output voltage OK signal
S9	+VSENCE	+12V Remote Sense
S10	-VSENCE	12V standby Return sense.
S11	SMB_Alert#	PS Alert signal for failure notification
S12	PSON	+12V output on/off control signal
S13	SCL	PMBus Clock
S14	SDA	PMBus Data

Figure 2-1 – Top view Output connector
Figure 2-2 – Bottom view Output connector



1.3.Handle Retention

The power supply shall have a handle to assist extraction. The module shall be able to inserted and extracted without the assistance of tools. The power supply shall have a latch which retains the power supply into the system and prevents the power supply from being inserted or extracted from the system when the AC power cord is inserted or extracted from the power supply. The handle shall protect the operator from any burn hazard.

1.4.LED Marking and Indicator

The power supply shall use bi-colored LED (Green,Yellow) on the AC inlet side . Table 2-2 shows the LED states for each power supply operating state, indication of the power supply status. The LED is driven by an internal circuitry and should even illuminate in an N+M configuration even without AC power.
The LED and its location shall meet ESD requirements required for the power supply. The LED shall be securely mounted in such a way that incidental pressure on the LED will not cause it to become displaced.

Table 2-2 – LED States Information

Power Supply Condition	LED State
Output ON and OK	Green
PSU standby state when AC present / Only 12Vsb on	1Hz Blink Green
No AC power to all power supplies	Off
Power supply is cold standby state or always standby state as defined in the Cold Redundancy section	1Hz Blink Green
AC cord unplugged or AC power lost; with a second power supply in parallel still with AC input power.	0.5Hz Blink Yellow
Power supply critical event causing a shutdown; failure, over current, short circuit, over voltage, fan failure, over temperature	Yellow
Power supply warning events where the power supply continues to operate; high temp, high power, high current, slow fan.	1Hz Blink Yellow
Power supply FW updating	2Hz Blink Green

1.5.Power Supply FAN and Orientation

Power supply shall contain one single rotor 40mm x 40mm x 28mm to cool the power supply and provide some additional system cooling and ventilation.
The power supply's internal design provides the option to create two airflow directions. Internal Fan can be mounted to draw air through the power supply with inlet air being pulled in through the DC output face or the fan can be mounted to push air through the power supply with exhaust air being blown out the DC output face.
For definition of the air flow direction can rely on the eject color,
with the pull in air through the DC connector (Rear to Front, AFO), the eject handle color is BLACK,
with the pull air through the power supply (Front to Rear, AFI), the eject color is GREEN.

1.6.Airflow Requirements

The power supply shall be capable of supplying the airflow that is sufficient for self-cooling when installed in different system airflow impedances. System may present a negative pressure to the power supply's airflow. The internal fan shall be capable of providing airflow specified in Table 2-3 depending on power supply configuration. The conditions must be satisfied under the maximum inlet temperature and altitude limits as specified in the table. All airflow shall pass through the power supply at operating temperature and not over the exterior surfaces of the power supply. Recommended air flow is a minimum of 16.5CFM. The system impedances design should meet the requirements shown in table.

1.6.1.Acoustic Requirements

The power supply shall incorporate variable speed fan(s).The power supply internal fan shall be controllable through PWM control. The fan speed shall vary based on output loading and ambient temperature. The Fan shall also be controllable through PMBus or SMBus command.

The declared sound power level (LwAd) of the power supply must meet the requirements shown in the Table 2-3 . Sound power must be measured according to ECMA 74 (www.ecma-international.org) and report according to ISO 9296/ISO7779. The sound pressure measurement must be measured at a distance of one meter from the face of the fan. Centered on the AC connector face of the power supply.

Table 2-3 – PSU airflow impedance& Acoustic level (AFO)

Operating condition		Ambient temperature condition(°C)/FAN Duty					
Load current(A)		Falling	Rising	Falling	Rising	Falling	Rising
Rising	Falling	<33°C	<37°C	>33°C,<42°C	>37°C,<45°C	>42°C	>45°C
<40	<34	40%	40%	60%	60%	70%	70%
>40	>34	50%	50%	70%	70%	80%	80%
>56	>50	60%	60%	80%	80%	90%	90%
>72	>66	70%	70%	90%	90%	100%	100%
>88	>82	80%	80%	100%	100%	100%	100%
>104	>98	90%	90%	100%	100%	100%	100%
>120	>114	100%	100%	100%	100%	100%	100%

Operating condition		Ambient temperature condition (°C)/ Volumetric flow, stand-alone (Min. CFM)					
Load current(A)		Falling	Rising	Falling	Rising	Falling	Rising
Rising	Falling	<33°C	<37°C	>33°C,<42°C	>37°C,<45°C	>42°C	>45°C
<40	<34	6.509	6.509	9.643	9.643	11.249	11.249
>40	>34	7.747	7.747	11.249	11.249	13.223	13.223
>56	>50	9.643	9.643	13.223	13.223	14.948	14.948
>72	>66	11.249	11.249	14.948	14.948	16.5	16.5
>88	>82	13.223	13.223	16.5	16.5	16.5	16.5
>104	>98	14.948	14.948	16.5	16.5	16.5	16.5
>120	>114	16.5	16.5	16.5	16.5	16.5	16.5

Operating condition		Ambient temperature condition (°C)/ Acoustic(db)					
Load current(A)		Falling	Rising	Falling	Rising	Falling	Rising
Rising	Falling	<33°C	<37°C	>33°C,<42°C	>37°C,<45°C	>42°C	>45°C
<40	<34	57.8	57.8	71.3	71.3	73.6	73.6
>40	>34	65.1	65.1	73.6	73.6	78.2	78.2
>56	>50	71.3	71.3	78.2	78.2	90%	90%
>72	>66	73.6	73.6	78.8	78.8	80.9	80.9
>88	>82	78.2	78.2	80.9	80.9	80.9	80.9
>104	>98	78.8	78.8	80.9	80.9	80.9	80.9
>120	>114	80.9	80.9	80.9	80.9	80.9	80.9

2.AC Input Requirement

2.1.AC Inlet Connector

The power supply shall incorporate a standard IEC 60320-1 C20 power inlet.

2.2.Input Voltage Specification

The power supply shall operate within all specified limits over the following input range in Table

3-1. Harmonic distortions of up to 10% of the rated line voltage will not cause the power supply to go out of specified limits.
The power supply shall power off if the AC input is below VACpower_offt and shall start (auto recover) if VACstart_up is reached. Input of VAC is below VACpower_off shall not cause any damage to the power supply, including the input fuse.
The power supply shall supply the full output power in the voltage range of 90VAC to 264VAC.

Table 3-1 – AC input voltage range

Parameter	Min. input	Rated Input	Max. input	Start up VAC	Power off VAC
115VAC	$90V_{rms}$	$100\text{-}120V_{rms}$	$132V_{rms}$	85VAC+/-5VAC	75VAC+/-5VAC
230VAC	$180V_{rms}$	$200\text{-}240V_{rms}$	$264V_{rms}$		
Frequency	47Hz	50/60Hz	63Hz		

2.2.1.HVDC Input Voltage

The power supply supports High Voltage Direct Current (HVDC) input. Allowed HVDC input range as shown in Table 3-2. The power supply shall operate within all specified limits when HVDC input requirements defined in this chapter.

Table 3-2 – HVDC input voltage range

Parameter	Min. input	Rated Input	Max. input	Start up VDC	Power off VDC
240VDC	190VDC	240VDC	310VDC	175V+/-5VDC	170V+/-5VDC

2.2.2.240HVDC Input Voltage Polarity

IEC 60320-1 C20 power inlet may be used to connect DC input voltage to the power supply. Table 3-3 summarizes the valid input DC connections.

Table 3-3 – VALID DC input voltage connections

Input HVDC Range	LINE	NEURAL	EARTH
190-310VDC	+VDC	Return	GND
	+VDC	Return*	GND*
	Return	+VDC	GND
	Return*	+VDC	GND*
	-VDC	Return	GND
	-VDC	Return*	GND*
	Return	-VDC	GND
	Return*	-VDC	GND*

Notes: The input terminals shown in Table 3-3 when marked with a (*) indicates that they have the same input terminal connection. The GND terminal shall not be used for power connections.

2.3.Input current

The maximum input current defines the maximum possible input current in Table 3-4 to ensure the proper function of the power supply to meet all defined specifications.

Table 3-4 – Maximum input current

Input voltage	Input current	Max. power
100-120VAC	14A	1000W
200-240VAC	14A	2000W
240HVDC	14A	2000W

2.4.Line Fuse

The PSU can support two types of input voltage ,one is AC input only ,other one is AC compatible with HVDC , base on specific input voltage with appropriate fuse type.

2.4.1.AC/HVDC Line Fuse (AC/HVDC)

The power supply shall incorporate one input fuse on the line side for input over-current protection to prevent damage to the power supply and meet product safety requirements. The input fuse shall be a fast blow fuse, which is to meet safety certificated with AC/HVDC voltage. AC or HVDC inrush current shall not cause the line fuse to blow under any conditions. All protection circuits in the power supply shall not cause the AC/HVDC fuse to blow unless a component in the power supply has failed. This includes DC output load short conditions.

2.4.2.AC Line Fuse (AC input only)

The power supply shall incorporate one input fuse on the line side for input over-current protection to prevent damage to the power supply and meet product safety requirements. The input fuse shall be a fast blow fuse. AC inrush current shall not cause the AC line fuse to blow under any conditions. All protection circuits in the power supply shall not cause the AC fuse to blow unless a component in the power supply has failed. This includes DC output load short conditions.

2.5.AC/HVDC Line Inrush

The power supply must meet inrush requirements for any rated AC/HVDC voltage; during turn on at any phase of AC/HVDC voltage, during a single cycle AC dropout condition, during repetitive ON/OFF cycling of AC/HVDC, and over the specified temperature range (TOP). The peak Inrush current shall be less than the ratings of its critical components (including input fuse, bulk rectifiers, and surge limiting device).

The maximum AC/HVDC line inrush current for this power has defined in below table 3-5 over the entire input voltage range.

Table 3-5 – AC/HVDC Line inrush current definition

Input Voltage	Initial Cold Start Inrush Current	Initial Cold Start Inrush Current	Initial Cold Start Inrush Current
90-132 VAC	50 A for 2 μs	40 A for 200 μs	40 A for 5 ms
180-264 VAC	100 A for 2 μs	40 A for 200 μs	60 A for 5 ms
190-310 VDC	100 A for 2 μs	40 A for 200 μs	60 A for 5 ms

Notes:
1.Inrush current shall be measured at an ambient temperature of 25 degree C after the input voltage has been removed from the power supply for a minimum of 10 minutes.
2.The inrush current due to the EMI filter capacitors can be ignored.

2.6.iTHD and Power Factor
The power supply shall incorporate universal input with active power factor correction which shall reduce line harmonics in accordance with EN 61000-3-2 and JEIDA MITI standards in Table 3-6.

Table 3-6 – Power iTHD requirement

Output power	≥ 20%	≥ 50%	100%
Current iTHD	≤15%	≤10%	≤10%
Input conditions	115VAC to 230VAC & 50Hz / 60Hz		

In addition, whenever the PFC converter is ON, the power factor shall be equal to or greater than the requirements as defined in Table 3-7. Power factor measurements shall be performed with source impedance of less than 0.1 ohm. It is expected that the boost converter will operate at the lowest output voltage possible to meet specification for given loading and input conditions.

Table 3-7 – Power factor requirement

Output power	20% load	50% load	100% load
Power factor	> 0.95	> 0.98	> 0.99
Input conditions	200VAC to 240VAC & 50Hz / 60Hz		

2.7.AC/HVDC line dropout/Hold up
An AC/HVDC line dropout is the condition when AC/HVDC input drops below minimum rated input voltage at any phase of the AC/HVDC line for any length of time. During an AC/HVDC dropout of one half cycles or less, the power supply shall meet the dynamic voltage regulation limits defined in section 4.4 over 100% of the rated load. An AC/HVDC line dropout of one half cycles or less shall not cause malfunction of control signals or protection circuits.

AC/HVDC line dropout of any duration shall not cause tripping of control signals or protection circuits other than the SMB_Alert# signal. If the AC/HVDC dropout time is long enough such that the power supply shuts down, the power supply shall recover safely and meet all turn on requirements. The power supply shall meet the AC/HVDC dropout requirement over rated AC/HVDC input voltages, frequencies, and output loading conditions. Any dropout of the AC/HVDC line shall not cause damage to the power supply . The input ok signal shall indicate when AC/HVDC input is valid as defined in section 5.4.

Table 3-8 – AC Hold-up /Dropout

Loading during AC dropout/Holdup	Main output	Standby output
100%	6ms	70ms
70%	10ms	70ms

The +12Vsb output voltage shall stay in regulation under its full load(static or dynamic) during an AC/HVDC dropout duration up to 70ms whether the power supply is in ON or OFF state (PSON# asserted or de-asserted).

2.8.AC Line Transient Specification

AC line transient conditions shall be defined as “sag” and “surge” conditions. “Sag” conditions are also commonly referred to as “brownout”, these conditions will be defined as the AC line voltage dropping below nominal voltage conditions.

“Surge” will be defined to refer to conditions when the AC line voltage rises above nominal voltage.

The power supply shall meet the requirements under the following AC line sag and surge conditions.

Table 3-9 – AC Line SAG transient performance.

AC Line Sag (10sec interval between each sagging)				
Duration	Sag	Operating AC voltage	Line frequency	Performance criteria
0 to 1/2 AC cycle	95%	Nominal AC voltage	50/60Hz	Loss of function acceptable, self- recoverable.
>1 AC cycles	>30%	Nominal AC voltage	50/60Hz	Loss of function acceptable, self- recoverable.

Table 3-10 – AC Line SURGE transient performance.

AC Line Surge				
Duration	Surge	Operating ac voltage	Line frequency	Performance criteria
Continuous	10%	Nominal AC voltage	50/60Hz	No loss of function or performance.
0 to 1/2 AC cycle	30%	mid-point of nominal AC voltage	50/60Hz	No loss of function or performance.

2.9.Power Recovery
The power supply shall recover automatically after an AC power failure. AC power failure is defined to be any loss of AC power that exceeds the dropout criteria.

2.10.AC Line Leakage Current
The maximum leakage current to ground for each power supply module shall not exceed 1.75mA when tested at 240Vac/60Hz.
Note:
When the touch current over 5mA in system application, such as N+M configuration, system side could follow IEC 62368-1" Equipment with touch current exceeding 5mA" section to get safety approval.

2.11. Efficiency

Table 3-11 – Efficiency Requirements

Loading	10% of maximum	20% of maximum	50% of maximum	100% of maximum
Titanium efficiency	90%	94%	96%	91%

3.DC Output Specification

3.1.Output Power/Currents
The following Table 4-1 defines the power and current rating of the 2000W power supply. The combined output power of all outputs shall not exceed the rated output power. The power supply must meet both static and dynamic voltage regulation requirements.

Table 4-1 – Output Power/ Current Ratings

Input Voltage	Outputs				Combined Max. Output Power(W)
Range	+12Vsb		+12.2V		
	Minimum Current(A)	Maximum Current(A)	Minimum Current(A)	Maximum Current(A)	
90-132VAC	0	3	1	82	1000W
180-264VAC	0	3	1	164	2000W
190-310HVDC	0	3	1	164	2000W

3.2.Auxiliary Output (Standby)
The +12Vsb output shall be present when an AC/HVDC input greater than the power supply turn on voltage is applied. There should be load sharing in the standby rail.

3.3.No load operation
The power supply shall meet all requirements except for the transient loading requirements when operated at no load on all outputs.

3.4.Voltage Regulation

The power supply shall meet the Voltage regulation under all operating conditions (AC/HVDC line, transient loading, output loading). These limits include the peak-peak ripple/noise. The regulation of Table 4-2 shall be measured at the output connector of the power supply.

Table 4-2 – Output Voltage regulation limits

PSU Status	Output	Minimum	Nominal	Maximum	Tolerance
Static	+12.2V	11.834V	12.2V	12.566V	+/-3%
	+12Vsb	11.64V	12.0V	12.36V	+/-3%
Dynamic	+12.2V	11.59V	12.2V	12.81V	+/-5%
	+12Vsb	11.4V	12.0V	12.6V	+/-5%

3.5.Ripple and Noise Regulation

Ripple and Noise is defined in Table 4-3. Ripple and Noise shall be measured over a Bandwidth of 10Hz to 20MHz at the power supply output connector. A high frequency 0.1μF ceramic capacitor and 10μF of tantalum capacitor shall be placed at each point of measurement. The measurement points shall be as close as possible to the point of load. To help reduce switching ripple further, an additional 6,600μF low ESR electrolytic capacitor may be placed in parallel. The ripple and noise specification shall be meet over all load ranges and AC/HVDC line voltages with N+M power supplies in parallel operation.

Table 4-3 – Ripple and Noise Regulation

Output Voltage	Ripple/Noise pk-pk
+12.2V	120mV
+12Vsb	120mV
Signals	**Ripple/Noise pk-pk**
PWOK	400mV
PSON	400mV
SMB_Alert#	400mV

3.6.Dynamic loading

The output voltage shall remain within limits specified for the step loading and capacitive loading specified in Table 4-4.

The load transient repetition rate shall be tested between 50Hz to 5kHz at duty cycles ranging from 10%-90%. The load transient repetition rate is only a test specification. The Δ step load may occur anywhere within the minimum load to the peak load condition.

Table 4-4 – Transient Load Requirements

Output	Δ Step load size	Load Slew Rate	Test Capacitive Load
+12.2V	60% of Max.	0.5A/μs	2,200μF
+12Vsb	1.0A	0.5A/μs	100μF

Note: For dynamic conditions +12.2V min loading is 3A.

3.7.Capacitive loading
The power supply shall be stable and meet all requirements with the following capacitive loading ranges defined in below Table 4-5

Table 4-5 – Capacitive Loading Conditions

Output	Min.	Max.
+12.2V	1000μF	22,000μF
+12Vsb	100μF	2,000μF

3.8.Closed loop stability
The power supply shall be unconditionally stable under all line/load/transient load conditions including capacitive load ranges. A minimum of: 45 degrees Phase Margin and -10dB Gain Margin is required.
Closed-loop stability must be ensured at the maximum and minimum loads as applicable.

3.9.Grounding
The output ground of the pins of the power supply provides the output power return path. The output connector ground pins shall be connected to the safety ground (power supply enclosure). This grounding should be well designed to ensure passing the max allowed Common Mode Noise levels.
The power supply shall be provided with a reliable protective earth ground. All secondary circuits shall be connected to protective earth ground. Resistance of the ground returns to chassis shall not exceed 0.1Ω. This path may be used to carry DC-current not exceed 32A.

3.10.Soft starting
The power supply shall contain control circuit which provides monotonic soft start for its outputs without overstress of the AC/HVDC line or any power supply components at any specified AC/HVDC line or load condition.

3.11.Residual Voltage Immunity in Standby mode
The power supply should be immune to any residual voltage placed on its outputs (typically a leakage voltage through the system from standby output) up to 100mV. There shall be no additional heat neither generated nor stressing of any internal components with this voltage applied to any individual or all outputs simultaneously. It also should not trip the protection circuits during turn on/off.
The residual voltage at the power supply outputs for no load condition shall not exceed 100mV when AC/HVDC voltage is applied and the PSON# signal is de-asserted.

3.12.Common mode noise
The Common Mode noise on any output shall not exceed 350mV pk-pk over the frequency bandwidth of 10Hz to 20MHZ.
The measurement shall be made across a 100 ohm resistor between each of DC outputs. Including ground at the DC power connector and chassis ground (power subsystem enclosure).

3.13.Overshoot
Any output overshoot at turn on shall be less than 5% of the nominal output value. Any overshoot shall recover to within the specified regulation in less than 0.5mS

3.14.Undershoot
Any output shall not undershoot at turn on or off cycle under any circumstances.

3.15.Temperature coefficient
After operating for 30 minutes or longer at 25° C ambient, the output voltages shall not change by more than ☒ 0.05 % per degree C for any given line and load conditions.

3.16.Hot Swap Requirements
Hot Swapping a power supply is the process of inserting and extracting a power supply from an operating power system. During this process the output voltages shall remain within the limits with the capacitive load specified.
The hot swap test must be conducted when the system is operating under static, dynamic and zero loading conditions. The power supply shall use a latching mechanism to prevent insertion and extraction of the power supply when the input power cord is inserted into the power supply.
The power supply can be hot swapped by the following method:

Extraction: The power supply may be removed from the system while operating with PSON# asserted, while in standby mode with PSON# de-asserted or with no AC applied. No connector damage should occur during un-mating of the power supply from the power distribution board (PDB) or system.

Insertion: The power supply may be inserted into the system with PSON# asserted, with PSON# de-asserted or with no AC power present for that supply. No connector damage should occur due to the mating of the output and input connector.
In general, a failed power supply may be removed, then replaced with a good power supply, however, hot swap needs to work with operational as well as failed power supplies. The newly inserted power supply will get turned on into standby or Power On mode once inserted.

3.17.Load sharing control

The +12.2V output shall have active load sharing. When operating at 50% of full load, the output current of any N+1 or N+M(N+M≤4) power supplies shall be within (+/-10%), When operating at 20% to 49% load, the output current of any N+1 or N+M(N+M≤4) power supplies shall be within (+/-15%). For example of 1+1 configuration, if power supply #1 is operating at 12A, then all other power supplies within the system shall be operating between 10.8A to 13.2A (+/- 10% of 12A). All current sharing functions shall be implemented internal to the power supply by making use of the +12VIBUS signal. The system side or PDB must connect the +12VIBUS signals between the power supplies together. The power supply shall be able to share with up to N+1 or N+M supply in parallel. The failure of a power supply shall not affect the load sharing or output voltages of the other supplies still operating. The power supplies must be able to load share with 100mV of drop between different power supply's outputs.

If the load sharing is disabled by shorting the load share bus to ground, the power supply shall continue to operate within regulation limits for loads less than or equal to the rating of one power supply.

Table 4-6 – Load share bus output characteristics

Item	Description	Min	Nominal	Max	Units
+12VIBUS; I_{out}=164A	Voltage of load share bus at 164A.		8		V
$\triangle V_{share}/\triangle I_{out}$	Slope of load share bus voltage with changing load.		$8/I_{164A}$		V/A
$I_{shareSINK}$	Amount of current the load share bus output from each power supply is allowed to sink.		1.5		mA
$I_{shareSOURCE}$	Amount of current the load share bus output from each power supply needs to source.		1.5		mA
T_{share}; I_{out}=Max.	Delay from output voltages in regulation to load sharing active with maximum load of one power supply and two power supplies in parallel. (remote on/off only)			100	msec

3.18.Timing Requirements

These are the timing requirements for the power supply operation. All outputs must rise monotonically. Table 4-7 shows the timing requirements for the power supply being turned on and off via two different ways; 1) via the AC input with PSON held low; 2) via the PSON signal with the AC input applied.

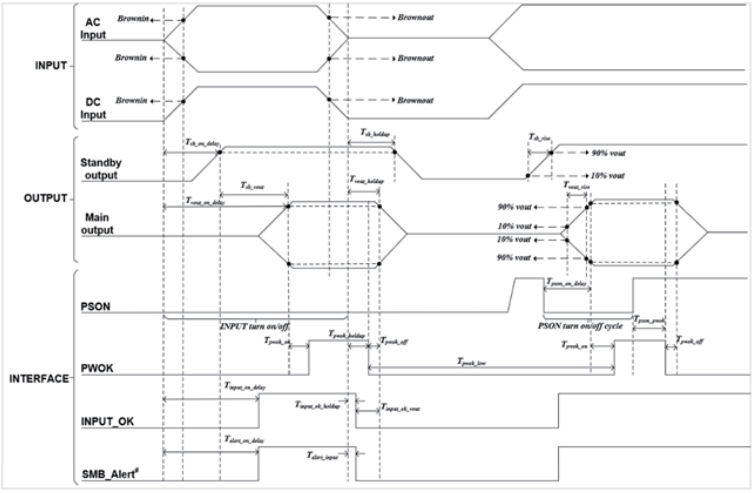
3.18.1.Output Voltage Timing

The timing of signals and outputs are specified in below Table 4-7 and illustrated in Figure 4-1.

Table 4-7 – Timing Requirements

Item	Description	MIN	MAX	UNITS
T_{vout_rise}	Output voltage rise time for all main output.	1	80	mS
T_{sb_rise}	Output voltage rise time for standby output.	1	80	
$T_{sb\_on\_delay}$	Delay from input voltage being applied to standby voltage being within regulation.		2,500	
$T_{vout\_on\_delay}$	Delay from input voltage being applied to all main output voltage being within regulation.		3,000	
T_{vout_holdup}	Time all main output voltages stay within regulation after loss of input voltage.	4		
T_{sb_holdup}	Time the standby output voltage stays within regulation after loss of input voltage.	70		
T_{pwok_holdup}	Delay from loss of input voltage to de-assertion of PWOK.	3		
$T_{pson\_on\_delay}$	Delay from PSON active to output voltages within regulation limit.	5	400	
T_{pson_pwok}	Delay from PSON deactivate to PWOK being de-asserted.		5	
T_{pwok_on}	Delay from main output voltage within regulation limits to PWOK asserted at turn on.	100	500	
T_{pwok_off}	Delay from PWOK de-asserted to output voltages dropping out of regulation limits.	1		
T_{pwok_low}	Duration of PWOK being in the de-asserted state during an off/on cycle using Input voltage or the PSON signal.	100		
T_{sb_vout}	Delay from standby voltage being in regulation to main output being in regulation at input voltage turn on.	50	1,000	
$T_{input\_on\_delay}$	Delay from input voltage applied to INPUT_OK going high during power-up.		1,000	
$T_{alert\_on\_delay}$	Delay from input voltage applied to SMB_Alert# going high during power-up.		1,000	
$T_{input\_ok\_holdup}$	Timing from input voltage dropping to 0VAC to INPUT_OK going low.		4	
$T_{input\_ok\_vout}$	Timing from INPUT_OK going low to main output falling out of regulation at input voltage turn off.	2		
T_{alert_input}	Timing from input voltage dropping to 0V to SMBAlert# going low.		4	

Figure 4-1 – Turn On/Off Timing (Power Supply Signals)



4.Control and Indicator functions

The following sections define the input and output signals from the power supply. Signals that can be defined as low true use the following convention:
Signal# = low true.

4.1.PSON# (Input Signal of Power supply enable)

The PSON# signal is required to remotely turn on/off the main output of the power supply.
PSON# is an active low signal that turns on the 12.2V power rail. When this signal is not pulled low by the system or left open, the outputs (except the +12Vsb) turn off.
This signal (PSON#) is pulled to 3.3V voltage by a 2K ohm pull-up resistor internal to the power supply.

Table 5-1 – PSON# Required Signal Characteristics

Signal Type	**Accepts an open collector/drain input from the system. Pull-up to 3.3V with 2K ohm resistor located in power supply.**	
$PSON^{\#}$ = Low	ON	
$PSON^{\#}$ = High or Open	OFF	
	MIN	MAX
Logic level low (power supply ON)	0V	0.8V
Logic level high (power supply OFF)	2.0V	3.46V
Source current, V_{pson} = low		0.28mA
Power off delay: $T_{pson\_off\_delay}$		50msec
Power up delay: $T_{pson\_on\_delay}$	5msec	400msec
PWOK delay: T_{pson_pwok}		5msec

4.2.PWOK (Power Ok) Output Signal

PWOK is a power good signal and will be pulled HIGH by the power supply to indicate that all outputs are within regulation limits of the power supply. When any output voltage falls below regulation limits or when AC/HVDC power has been removed for a time sufficiently long so that power supply operation is no longer guaranteed, PWOK will be de-asserted to a LOW state. See Table 5-2 for a representation of the timing characteristics of PWOK. The start of the PWOK delay time shall inhibited as long as any power supply output is in current limit.

Table 5-2 – PWOK Signal Characteristics

Signal Type	**Open collector/drain output from power supply. Pull-up to 3.3V with 2.43K ohm resistor located in the power supply.**	
PWOK=High	Power OK	
PWOK=Low	Power Not OK	
	MIN	MAX
Logic level low voltage, I_{sink}=400μA	0V	0.4V
Logic level high voltage, I_{source} = 200μA	2.4V	3.46V
Sink current, PWOK=low		4mA
Source current, PWOK=high		0.2mA
PWOK delay: T_{pwok_on}	100msec	500msec
PWOK rise and fall time		100μsec
Power down delay: T_{pwok_off}	1ms	200ms

4.3.INPUT_OK (Input Good Output Signal)

INPUT_OK# is an AC good signal and will be pulled up by the power supply to indicate that AC input is within the operation range.

Table 5-3 – INPUT_OK signal characteristics

Signal Type	**Open collector/drain output from power supply. Pull-up to 3.3V with 2.4K ohm resister located in the power supply.**	
INPUT_OK = Low	Input Voltage doesn't meet the input range.	
INPUT_OK = High	Input Voltage meet the input range.	
	MIN	MAX
Logic level low; Isink current=4mA	0 V	0.4 V
Logic level high; Isource current=200μA	2.0 V	3.46V

4.4.Present Signal (PRESENT)

This signal pin is recessed within the connector and will contact only once all other connector contacts are closed. This active-low pin is used to indicate to a power distribution unit controller that a supply is plugged in. the maximum current on PRESENT# pin should not exceed 10mA. This signal has a 4.7 ohm/0.1W pull low resistor.

4.5.A0

PSU Module Address Line 0. This signal line is provided for determining the address for the specific PSU FRU and SMBus address. The pull-up resistor should be located in the system and the pull-up voltage should be limited to 3.3V. The address line should be pull low with equal to or less than 100 ohm in the motherboard design.

This signal is defined by system for PMBus communication to allocate address of power supply unit in particular slot location .
This signal has pull 4.7K ohm to internal 3.3V located in the power supply.

Table 5-4 – A0 signal characteristics

Signal Type	Pull-up to 3.3V with 4.7K ohm resister located in power supply.	
SMB Address_A0=high	Address 1	
SMB Address_A0=low	Address 0	
	MIN	MAX
Logic level low, I_{sink} current=4mA	0 V	0.4 V
Logic level high, I_{source} current=200μA	2.0 V	3.46V

4.6.A1
PSU Module Address Line 1. This signal line is provided for determining the address for the specific PSU FRU and SMBus address. The pull-up resistor should be located in the system and the pull-up voltage should be limited to 3.3V. The address line should be pull low with equal to or less than 100 ohm in the motherboard design.
This signal is defined by system for PMBus communication to allocate address of power supply unit in particular slot location.
This signal has pull 4.7K ohm to internal 3.3V located in the power supply.

Table 5-5 – A1 signal characteristics

Signal Type	Pull-up to 3.3V with 4.7K ohm resister located in power supply.	
SMB Address_A1=high	Address 1	
SMB Address_A1=low	Address 0	
	MIN	MAX
Logic level low, I_{sink} current=4mA	0 V	0.4 V
Logic level high, I_{source} current=200μA	2.0 V	3.46V

4.7.12VS and 12VRS
The power supply uses remote sense to regulate output drops in the system for the main outputs. The +12.2V output only uses remote sense with reference to the Return Sense signal. The remote sense input impedance to the power supply must be greater than 10 ohm on the main outputs and is 10 ohm on Return Sense. These are the values of the resistors connecting the remote senses to the output voltage internal to the power supply. Remote sense is able to regulate out a minimum of 300mV of drop on the +12.2V output.
The power supply has remote sense return (12VRS) to regulate output ground drops for all output voltages. The remote sense return is able to regulate out drops of 300mV as well. The current in any remote sense line shall be less than 5mA to prevent voltage sensing errors. The power supply operates within specification over the full range of voltage drops from the power supply's output connector to the remote sense points.

4.8.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. The signal shall activate in the case of critical component temperature reached a warning threshold, general failure, over-current, over-voltage, under-voltage, failed fan. This signal may also indicate the power supply is reaching its end of life or is operating in an environment exceeding the specified limits.

This signal is to be asserted in parallel with LED behavior ,Detail characteristics defined in

Table 5-6. Table 5-6 – SMB_Alert# signal characteristics

Signal Type	**Open collector/drain output from power supply. Pull-up to 3.3V with 2.4K ohm resister located in the power supply.**	
SMB_Alert#=High	Power OK	
SMB_Alert#=Low	Power Alert to system	
	MIN	MAX
Logic level low voltage, I_{sink}=4mA	0V	0.4V
Logic level high voltage, I_{sink} = 50μA	2.4V	3.46V
Sink current, SMB_Alert#=low		4mA
Source current, SMB_Alert#=high		50μA

Note: SMB_Alert# Recovery Method

1.Over Current: SMB_Alert# shall be recovered when the output current is back within the normal operating range.

2.Input Under Voltage: SMB_Alert# shall be recovered when the input voltage is back within the normal operating range.

3.Over Temperature: SMB_Alert# shall be recovered when the temperature is back to normal.

4.When PSU into warning events, SMB_Alert# signal go low and LED turning 1Hz Blink Yellow.

5.When PSU into protection mode, SMB_Alert# signal go low and LED turning Yellow.

6.When PSU primary side running abnormal or into remote on/off control from system,
SMB_Alert# signal go low and LED will be running at 0.5Hz Blink Yellow.

4.9.SDA and SCL

Two pins at the power supply connector are allocated for the I2C serial clock (SCL) and serial data (SDA) signals. Both pins are bi-directional and are used to from the serial I2C bus, capable of speeds up to 400 kHz. I2C data and clock signals shall be used to communicate power supply status with the end use system as defined in Section 7.

Hardware requirements:
1.No Internal Connection: SCL and SDA do not need pull up resistors inside the power supply. Capacitance on each signal internal to the Power Supply shall be less than 68pF.
2.System Side Connection: SCL and SDA shall be pulled up externally by the system with 3K ohm– 10K ohm resistors. SCL and SDA on the system side shall be pulled up to a 3.3V rail.

Measurement Requirements:
1.Signal noise when measured at the I2C device (e.g. EEPROM, microcontroller etc.) shall be less than 80% peak to peak of the device rating 20 MHz bandwidth.
2.Signal noise when measured at the mating connector end of the card edge shall be less than 250mV peak to peak at 20 MHz bandwidth.
3.Signal noise when measured in the end use system shall be designed to be less than 500mV peak to peak at 20 MHz bandwidth.

5.Protection circuits

Protection circuits inside the power supply shall cause only the main output to shutdown. If the power supply latches off due to a protection circuit assert, an Input Power cycle OFF for 15sec. or a PSON# cycle HIGH for 1sec. shall be able to reset the power supply.
The auxiliary output shall not affect by any protection circuit, unless the auxiliary output itself is affected.

5.1.Over Current Warning, Over Current Protection, Short Circuit Protection and Over Power Protection(OCW,OCP,SCP)

The power supply shall have over current warning (OCW), over current protection (OCP), short circuit protection (SCP) limits as defined in Table 6-1 . These are defined to protect the PSU and to allow peak currents to power the system without the PSU shutting down.
OCW levels are defined to assert SMB_Alert# to allow the system to throttle power to protect the PSU; but also to allow peak current to the system without throttling the system.
When OCP/SCP trips; it shall shutdown and latch OFF the PSU. This shall be cleared by toggling the PSON# or by an AC power interruption. The power supply shall not be damaged from repeated power cycling in this condition.
12Vsb will be auto-recovered after removing OCP limit.
Table 6-1 – OCW and OCP Requirements

Table 6-1 – OCW and OCP Requirements

Spec	Description	Thresholds	
OCP	Slow over current protection (shutdown and latch after MIN/MAX timing)	Rating + 16A	Rating + 20A
OCW [1]	Slow over current warning (SMB_Alert#)	Rating + 10A	Rating + 14A
12Vsb OCP	Stand by output over current protection (shut down,hiccup mode)	4.2A	4.8A

Notes:
1.OCW threshold must be set below the OCP threshold.

5.2.Over Voltage Protection
The power supply over voltage protection shall be locally sensed. The power supply shall shutdown and latch off after an over voltage condition occurs. This latch shall be cleared by toggling the PSON# signal or by an AC power interruption . The values are measured at the output of the power supply's connectors. The voltage shall never exceed the maximum levels defined in Table 6-2 when measured at the power connector of the power supply connector during any single point of fail. The voltage shall never trip any lower than the minimum levels when measured at the power connector . The latch on the main output can be cleared by asserting the PSON signal or use the input power to clear the latch mode of the main output and standby output.

Table 6-2 – Over Voltage Protection Requirements

Output Voltage	MIN (V)	MAX (V)
+12.2V	12.8	14.2
+12Vsb	12.8	14.2

5.3.Over Temperature Protection (OTP)
The power supply shall have minimum of two thermal sensors to measure the environmental (TEnv.) and critical component (THot-spot1,2..etc)temperature. The power supply will be protected against over temperature conditions caused by loss of fan cooling or excessive ambient temperature. In an OTP condition the PSU will shut down. OT warning SMB_Alert# assertion must always precede the OTP shutdown. When the power supply temperature drops to within specified limits, the power supply shall restore power automatically, while the 12Vsb remains always on. The OTP circuit must have built in margin such that the power supply will not oscillate on and off due to temperature recovering condition. The OTP trip temperature level shall be at least 5 degree C higher than SMB_Alert# over temperature warning threshold level.
The power supply shall alert the system of the OTPAR(Auto Recover) condition via SMB_Alert# and fail LED indicator. The power supply will auto recover from this condition, when the temperature is dropping within specification again. If the OTPAR(Auto Recover) is caused due to a defective fan, the power supply shall latch off and not auto recover.

Table 6-3 – Over Temperature Protectionary (AFO)

Condition	Warning in °C	Critical in °C	Timing for SMB_Alert# /LED	Note
$T_{out\_Env\ (T1)}$	57	62	1msec	Ambient (Output side)
$T_{Hot\text{-}spot1\ (T2)}$	91	96	1msec	Hot Spot (Master)

Note: The thermal sensors shall have an accuracy of ±5°C

5.4.Fan Failure Protection
The power supply shall have an internal circuit to monitor the power supply internal fan. The fan failure protection shall monitor the fan speed and should assert SMB_Alert# and fail LED signal in case the fan Rotation Per Minute (RPM) drop lower threshold or set PWM Δ as defined in below Table 6-4.
The protection circuit shall shutoff the main outputs only and let them auto recover when the fan failure had been cleared.

Table 6-4 – Fan Failure Protection

Condition	FAN RPM	Timing for SMB_Alert#/LED
Critical	6500	1sec

6.Firmware Requirements

This section contains power supply to system interface protocol, control, monitoring and reporting requirements of power supply operation through I2C data and I2C clock signals.

6.1.PMBus
The power supply should support access to PMBUS information via the I2C.

6.1.1.Hardware Requirments
The power supply shall include a microcontroller (μC) for power mornitoring functionality and an external EEPROM memory device capable of storing staged images for the primary and secondary microcontrollers required Event Log record and the 256 bytes FRU record. The microcontroller shall use I2C to communicate with the system. The external EEPROM must be on a communication bus and connected to the microcontroller or system BMC. The Event log and FRU must always be accessed via the assigned commands in the microcontroller or system. All communications internal to the power supply must be robust and data integrity must be verified to ensure EEPROM data is correctly stored.
Two pins at the power supply connector are allocated for the I2C serial Clock(SCL) signal and the Serial Data(SDA) signal. Both pins are bi-directional and are used for a serial I2C bus . Pins A0,A1 are also allocated at the power supply connector for selecting the I2C address of communication device inside the power supply.

6.1.2.Addressing
The PSU PMBus device address locations are shown in Table 7-1. For redundant systems there are up to two signals to set the address location of the PSU once it is installed in the system; Address1, Address0.

Table 7-1 – PMBus Device Address Locations

Addresses used:	PM1	PM2	PM3	PM4
System Addressing Address1[1]/ Address0 [3]	0/0	0/1	1/0	1/1
PMBus device read / write addresses [2]	B0h/B1h1	B2h/B3h	B4h/B5h	B6h/B7h

1.Non-redundant power supplies will use the 0/0 address location
2.The addressing method uses the 7 MSB bits to set the address and the LSB to define whether a device is reading or writing. The addresses defined above use 8 bits including the read/write bit.
3.The '0' and '1' correspond to '0' = signal is grounded; '1' = signal is not grounded.
The PSU shall have an IPMI FRU (field replaceable unit) serial EEPROM. It shall be located at the following addresses shown in Table 7-2. This is shall be a separate physical device from the PMBus device. This is intended to align with existing IPMI standards.

Table 7-2 – FRU Device Address Locations

Addresses used:	PM1	PM2	PM3	PM4
System Addressing Address1[1]/ Address0 [3]	0/0	0/1	1/0	1/1
FRU device read / write addresses [2]	A0h/A1h1	A2h/A3h	A4h/A5h	A6h/A7h

1.Non-redundant power supplies will use the 0/0 address location.
2.The addressing method uses the 7 MSB bits to set the address and the LSB to define whether a device is reading or writing. The addresses defined above use 8 bits including the read/write bit.
3.The '0' and '1' correspond to '0' = signal is grounded; '1' = signal is not grounded.

6.1.3.PMBus Power Sourcing
The circuits inside the power supply shall derive their power from the standby output. For redundant power supplies the device(s) shall be powered from the system side of the OR'ing device. The PMBus device shall be on whenever Input power is applied to the power supply or a parallel redundant power supply in the system.

6.1.4.Pull ups
The main pull-up resistors are provided by the system and may be connected to 3.3V or 5V. For the system design, the main pull-ups shall be located external to the power supply and derive their power from the standby rail.

6.1.5.Data Speed
The PMBus device in the power supply shall operate at the full 100 kbps SMBus speed and using clock stretching that maybe slow down the bus. For example, the power supply can clock stretch while parsing a command or a power supply servicing multiple internal interrupts or NACK may require some use of clock stretching. Unsupported commands may respond with a NACK but must always set the communication error status bit in STATUS_CML.
The PMBus device shall support SMBus cumulative clock low extend time (Tlow:sext) if < 30msec. This requires the device to extend the clock time no more than 30msec between START and STOP for any given message.

6.1.6.Bus Errors
The PMBus device shall support SMBus clock-low timeout (Ttimeout). This capability requires the device to abort any transaction and drop off the bus if it detects the clock being held low for >30ms, and be able to respond to new transactions 10ms later.

The device must recognize SMBus START and STOP conditions on ANY clock interval. (These are requirements of the SMBus specifications, but are often missed in first-time hardware designs.) The device must not hang due to 'runt clocks', 'runt data', or other out-of-spec bus timing. This is defined as signals, logic-level glitches, setup, or hold times that are shorter than the minimums specified by the SMBus specification. The device is not required to operate normally, but must return to normal operation once 'in spec' clock and data timing is again received. Note if the device 'misses' a clock from the master due to noise or other bus errors, the device must continue to accept 'in spec' clocks and re-synch with the master on the next START or STOP condition.

6.1.7.Additional SMBus hardware requirements
300ns maximum fall time with a 400pF capacitive load and 2.7K ohm pull up to 3.3V.
10ns minimum fall time with a 20pF capacitive load and 2.7K ohm pull up to 3.3V.
The power supply shall not load the SMBus if it has no input power.

6.1.8.SMB_Alert#
The SMB_Alert# signal may be asserted by the PSU for any of the supported STATUS events. The events that control SMB_Alert# can be masked using the SMBALERT_MASK command. Default masking is shown in section 0.
By default the SMB_Alert# signal is asserted for the following cases.

1.STATUS_INPUT (UV Fault bit): input voltage drops below the fault threshold of the PSU for > 2ms.
2.STATUS_IOUT (Iout OC Warning bit): Output current exceeds the PSU capability but PSU has not shutdown.
3.STATUS_TEMPERATURE (OT Warning): Thermal sensor for PS inlet temperature or on a hot spot inside the PSU has exceeded its warning temperature.

Table 7-3 – PSU SMB_Alert#

Item	Description	PMBus command	MIN	MAX
Talert_input	Timing from input voltage dropping to 0VAC to SMB_Alert# going low	STATUS_INPUT UV Fault		4 msec
TOC_Warning	Timing from output over current warning to SMB_Alert# going low	STATUS_IOUT	10 msec	20 msec
TOC_Warning_latch	Time the PSU holds the SMB_Alert# signal asserted after an over current warning event	STATUS_IOUT		30sec
TOC_pmaxprotection	Timing from output tripping	None		20µsec
Tover_temp	Hot spot temp > warning threshold	STATUS_TEMPERATURE Over temp warning		1 sec
Tsmbalert_shutdown	Minimum time PSU must continue to operate within voltage regulation limits and PWOK asserted after the SMB_Alert# signal has been asserted due to an over temperature event.	NA	1sec	
Tmax_warning	Hot spot temperature inside the PSU that causes SMB_Alert# to assert.	MFR_TEMP2_MAX	Tmax_ continuous	Tshutdown

6.1.9.SMB_Alert# operation in standby mode
The PSU shall assert the SMB_Alert# signal only when the main outputs are ON. SMB_Alert# shall stay de-asserted when the PSU is in standby mode when any bits in the STATUS commands get asserted.

6.2.Sensors
The following PMBus commands shall be supported for the purpose of monitoring current, voltage, power, temperature and Fan speed. All sensors shall continue providing real time data as long as the PMBus device is powered. This means in standby mode the main output(s) of the PSU shall be zero amps and zero volts. Sensors shall meet requirements from 100VAC to 120VAC and from 200VAC to 240VAC.

6.2.1.Accuracy requirements (Vin, Iin, Pin, Vout, Iout, Pout,Temp, Fan rpm)
The power supply shall follow PMBus commands for the purpose of monitoring current, voltage, power, temperature and Fan state. All sensors shall continue providing real time data as long as the PMBus device is powered. This means in standby mode the main output(s) of the PSU shall be zero amps and zero volts. They shall be tested down to 5% load.

Table 7-4 – Voltage /Current / Power / Temperature /Fan Monitoring

Sensor	< 20% load	> 20% - 75% load	> 75% - 100% Load
Input Voltage	± 3%	± 3%	± 3%
Input Current	*	± 3%	± 3%
Input Power	*	± 3%	± 3%
Temperature	± 5°C with Δ5%		
FAN	± 10% from Spec.		
Output Voltage	± 3%	± 3%	± 3%
Output Current	*	± 3%	± 3%
Output Power	*	± 3%	± 3%

Note : The power supply accuracy requirement must meet all the specified defined of input, output and temperature range.

6.3.Black Box
The power supply shall save the latest PMBus data and other pertinent data into nonvolatile memory when a critical event shuts down the power supply. This data shall be accessible via the SMBus interface with an external source providing power to the 12Vsb pins. No AC power need to be applied to the power supply.

6.3.1.Data saving in Black Box
• General Fault
• Over voltage on output
• Over current on output
• Loss of AC input
• Input voltage fault
• Fan Failure
• Over temperature

6.4.In-System Firmware Upload

The Power supply shall have the capability to update its firmware via the PMBus interface. This FW can be updated when in the system and in standby mode or outside of the system with power applied to 12Vsb pins of power supply. The primary and secondary sides have their own backup image in an external EEPROM or internal FLASH. If the FW updated finally, the PSU could be able to recover output with the backup version firmware.

6.5.Supported PMBus Commands list

Table 7-5 – Supported PMBus

Code	Pages	Command	SMBus Transaction Type Status bit mapping
00h	NA	PAGE	Write Byte / Read Byte w/PEC
01h	NA	OPERATION	Write Byte w/PEC
02h	NA	ON_OFF_CONFIG	Write Byte w/PEC
03h	NA	CLEAR_FAULTS	Send Byte w/PEC
05h	NA	PAGE_PLUS_WRITE (used with STATUS_WORD, STATUS_IOUT, STATUS_INPUT, STATUS_TEMPERATURE)	Block Write w/PEC Used with STATUS_INPUT, STATUS_TEMPERATURE, STATUS_IOUT
06h	NA	PAGE_PLUS_READ (used with STATUS_WORD, STATUS_IOUT, STATUS_INPUT, STATUS_TEMPERATURE)	Write Block Read Block Process Call w/PEC Used with STATUS_INPUT, STATUS_TEMPERATURE, STATUS_IOUT, STATUS_WORD
19h	NA	CAPABILITY	Read Byte w/PEC
1Ah	NA	QUERY (used with any command)	Block Write Block Read Process Call w/ PEC
1Bh	NA	SMBALERT_MASK (used with STATUS_INPUT, STATUS_TEMPERATURE, STATUS_IOUT)	Reading: Write Block Read Block Process Call w/PEC Writing: Write Word
20h	NA	VOUT_MODE	Read Byte w/PEC
30h	NA	COEFFICIENT (used with READ_EIN)	Block Write Block Read Process Call w/PEC
3Ah	NA	FAN_CONFIG_1_2	
3Bh	NA	FAN_COMMAND_1	
4Ah	NA	IOUT_OC_WARN_LIMIT	Write Word / Read Word w/PEC
51h	NA	OT_WARN_LIMIT (used to support testing CLST)	Write word w/PEC
79h	00h, 23h	STATUS_WORD	Read Word w/PEC
(Low) 6		OFF	PS off
4		IOUT_OC	Indeterminate (Use STATUS_IOUT)
2		TEMPERATURE	Indeterminate (Use STATUS_TEMPERATURE)
3		VIN_UV	Indeterminate (Use STATUS_INPUT)
1		CML	
Code	**Pages**	**Command**	**SMBus Transaction Type Status bit mapping**
(High) 7		VOUT	Failure
6		IOUT/POUT	Indeterminate (Use STATUS_IOUT)
5		INPUT	Indeterminate (Use STATUS_INPUT)
4		MFR_SPECIFIC (Incompatible Power Supply)	
3		POWER_GOOD#	
2		FANS	Indeterminate (Use STATUS_FANS)
7Ah	NA	STATUS_VOUT	Read Byte w/PEC
7		VOUT_OV_FAULT	Failure
4		VOUT_UV_FAULT	Predictive failure
7Bh	00h, 23h	STATUS_IOUT	Read Byte w/PEC
7		Iout OC fault	Failure
5		Iout OC warning	Predictive failure
1		Pout OP fault	Failure
0		Pout OP warning	Predictive failure
7Ch	00h, 23h	STATUS_INPUT	Read Byte w/PEC
5		Vin UV warning	Predictive failure

4		Vin UV fault	AC Loss
3		Unit off for insufficient input	AC Loss
1		Iin over current warning	Predictive failure
0		Pin over power warning	Predictive failure
7Dh	00h, 23h	STATUS_TEMPERATURE	Read Byte w/PEC
7		OT fault	Fault
6		OT warning	Predictive fault
7Eh	00h	STATUS_CML	
5		PEC Error	Communication PEC Error
81h	00h	STATUS_FANS_1_2	Read Byte w/PEC
7		Fan 1 fault	Failure
6		Fan 2 fault	Failure
5		Fan 1 warning	Predictive failure
4		Fan 2 warning	Predictive failure
86h	NA	READ_EIN	Block Read w/ PEC
87h	NA	READ_EOUT	Block Read w/ PEC
88h	NA	READ_VIN	Read Word w/PEC
89h	NA	READ_IIN	Read Word w/PEC
8Bh	NA	READ_VOUT	Read Word w/PEC
8Ch	NA	READ_IOUT	Read Word w/PEC
8Dh	NA	READ_TEMPERATURE_1 (Ambient)	Read Word w/PEC
Code	**Pages**	**Command**	**SMBus Transaction Type Status bit mapping**
8Eh	NA	READ_TEMPERATURE_2 (PFC Hot Spot)	Read Word w/PEC
8Fh	NA	READ_TEMPERATURE_3 (SR Hot Spot)	Read Word w/PEC
90h	NA	READ_FAN_SPEED_1	Read Word w/PEC
96h	NA	READ_POUT	Read Word w/PEC
97h	NA	READ_PIN	Read Word w/PEC
98h	NA	PMBUS_REVISION	Read Byte w/PEC
99h	NA	MFR_ID	Block Read w/ PEC
9Ah	NA	MFR_MODEL	Block Read w/ PEC
9Bh	NA	MFR_REVISION	Block Read w/ PEC
9Ch	NA	MFR_LOCATION	Block Read w/ PEC
9Dh	NA	MFR_DATE	Block Read w/ PEC
9Eh	NA	MFR_SERIAL	Block Read w/ PEC
9Fh	NA	APP_PROFILE_SUPPORT	Block Read w/ PEC
A0h	NA	MFR_VIN_MIN	Read Word w/PEC
A1h	NA	MFR_VIN_MAX	Read Word w/PEC
A2h	NA	MFR_IIN_MAX	Read Word w/PEC
A3h	NA	MFR_PIN_MAX	Read Word w/PEC
A4h	00h,23h	MFR_VOUT_MIN	Read Word w/PEC

A5h	00h,23h	MFR_VOUT_MAX	Read Word w/PEC
A6h	NA	MFR_IOUT_MAX	Read Word w/PEC
A7h	NA	MFR_POUT_MAX	Read Word w/PEC
A8h	NA	MFR_TAMBIENT_MAX	Read Word w/PEC
A9h	NA	MFR_TAMBIENT_MIN	Read Word w/PEC
AAh	NA	MFR_EFFICIENCY_LL	Block Read w/ PEC
ABh	NA	MFR_EFFICIENCY_HL	Block Read w/ PEC
B1h	NA	PSU Internal Air Flow	Read Byte w/PEC
B2h	NA	READ_TEMPERATURE_4 (Oring Hot Spot)	Read Word w/PEC
C0h	NA	MFR_MAX_TEMP_1	Read Word w/PEC
C1h	NA	MFR_MAX_TEMP_2	Read Word w/PEC
C2h	NA	MFR_MAX_TEMP_3	Read Word w/PEC
C3h	NA	MFR_FAN_SPEED_MAX	Read Word w/PEC
C4h	NA	MFR_FAN_SPEED_MIN	Read Word w/PEC
C5h	NA	MFR_FW_ID1(ex: SECSR202AMP3A200A00)	Block Read w/PEC
CCh	NA	Remote Control	Write Byte w/PEC
CDh	NA	Delay Time of Remote Control	Write Byte w/PEC
D0h	NA	MFR_COLD_REDUNDANCY_CONFIG	Read Byte w/PEC
D1h	NA	MFR_FW_ID	Block Read w/PEC
D2h	NA	MFR_FW_REVISION	Block Read w/PEC
D3h	NA	MFR_FW_DATE	Block Read w/PEC
Code	**Pages**	**Command**	**SMBus Transaction Type Status bit mapping**
D4h	NA	MFR_HW_COMPATIBILITY	Block Read w/PEC
D5h	NA	MFR_FWUPLOAD_COMPATIBILITY	Block Read w/PEC
D6h	NA	MFR_FWUPLOAD_MODE	Read Byte w/PEC
D7h	NA	MFR_FWUPLOAD	Block Write w/PEC
D8h	NA	MFR_FWUPLOAD_STATUS	Block Read w/PEC
D9h	NA	MFR_FW_REVISION	Block Read w/PEC
DCh	NA	MFR_BLACKBOX	Block Read w/ PEC (154 byes)
DDh	NA	MFR_REAL_TIME_BLACK_BOX	Block Write/Read w/ PEC (4 bytes)
DEh	NA	MFR_SYSTEM_BLACK_BOX	Block Read w/ PEC (40 byes)
DFh	NA	MFR_BLACKBOX_CONFIG	Read/Write Byte with PEC
E0h	NA	MFR_CLEAR_BLACKBOX	Send Byte with PEC

7.FRU Requirements

7.1.FRU Data

The FRU Data format shall be compliant with the IPMI ver. 1.0 specification. The following is the exact listing of the EEPROM content. During testing this should be followed and verified.

7.2.FRU Device protocol

The FRU device will implement the same protocols as the commonly used memorydevice, including Byte Read, Sequential Read, Byte Write and Page Read protocols.

7.2.1.FRU Data Format

The information to be contained in the FRU device is shown in the following table 8-1.

Table 8-1 – FRU Data format

Area Type	**Description**
Common Header	As defined by the FRU document
Internal Use Area	Not required, do not reserve
Chassis Info Area	Not applicable, do not reserve
Board Info Area	Not applicable, do not reserve
Product Info Area	As defined by the IPMI FRU document. Product information shall be defined as follows:
Field Name	**Field Description**
Manufacturer Name	SilverStone
Product Name	SST-GM2000C-TFU
Product part/model number	SST-CM2000GFTI-A
Product Version	Defined based on the latest version of the model.
Product Serial Number	{Defined at time of manufacture}
Asset Tag	{Not used, code is zero length byte}
FRU File ID	SEGSR202AMP3V100XXX
PAD Bytes	{Added as necessary to allow for 8-byte offset to next area}
Multi-Record Area	As defined by the IPMI FRU document. The following record types shall be used on this power supply: - Power Supply Information (Record Type 0x00) - DC Output (Record Type 0x01) No other record types are required for the power supply. Multi-Record information shall be defined as follows:
Field Name (PS Info)	**Field Information Definition**
Overall Capacity (watts)	2000
Peak VA	2800
Inrush current (A)	40
Inrush interval (msec)	5
Low end input voltage range 1	90
Field Name (PS Info)	**Field Information Definition**
High end input voltage range 1	132
Low end input voltage range 2	180
High end input voltage range 2	264
AC input dropout total. (msec)	6
Binary flags	Set for: Hot Swap support.
Peak Wattage	Set for: 2440Watts
Combined wattage	None
Predictive fail tach support	Supported
Field Name (Output)	Field Description: Two outputs are to be defined from #1 to #2, as follows: +1 .2.2V and +12Vsb.
Output Information	Set for: Standby on +12Vsb, No Standby on all others.
All other output fields	Format per IPMI specification, using parameters in this specification.

Table 8-2 – EEPROM Addressing (Example reference)

	0x0	0x1	0x2	0x3	0x4	0x5	0x6	0x7	0x8	0x9	0xA	0xB	0xC	0xD	0xE	0xF
0x00	01	00	00	00	01	0D	00	F1	01	0C	19	C8	46	53	50	47
0x01	52	4F	55	50	CA	59	4E	45	45	30	37	35	30	42	4D	D2
0x02	59	4E	45	45	30	37	35	30	42	4D	2D	32	52	30	31	50
0x03	31	30	C3	41	30	31	D3	46	37	35	31	30	41	54	39	30
0x04	34	30	30	56	30	35	30	30	30	31	3	15	09	01	D3	4E
0x05	45	45	53	52	37	35	31	41	4D	50	33	51	36	30	30	41
0x06	30	31	C1	00	00	00	00	A2	00	02	18	6B	7B	EE	02	0
0x07	00	3C	00	28	23	20	67	0	0	0	0	2F	3F	0A	1F	00
0x08	00	00	00	00	00	01	02	0D	53	9D	01	B0	04	74	04	EC
0x09	04	78	00	00	00	24	F4	01	82	0D	A9	C7	82	F4	01	DB
0xA0	01	0D	02	32	00	00	00	B8	0B	FF	FF	FF	FF	FF	FF	FF
0xB0	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
0xC0	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
0xD0	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
0xE0	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
0xF0	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF

8.Environmental

The power supply shall operate normally, and sustain no damage as a result of the environmental conditions listed in this chapter.
The defined operation condition includes temperature, humidity, altitude, shock and vibration.

8.1.Temperature Requirements

The power supply shall operate within all specified limits over Top temperature range. All airflow shall pass through the power supply and not over the exterior surfaces of the power supply.
The power supply shall withstand thermal storage specified in Tnon-OP without any damage.

Table 9-1 – Temperature Requirements

Item	Description	MIN	MAX	Unit
T_{OP}	Operating temperature range.	-10	50	°C
ΔT	Max temperature rise across power supply		15	°C
$T_{non\text{-}OP}$	Non-Operating temperature range.	-40	70	°C
T_{Δ_change}	Rate of temperature change.		10	°C/hrs

8.2.Humidity
The power supply shall operate within all specified humidity Range defined in Table 9-2.

Table 9-2 – Humidity Requirements

Item	Description	MIN	MAX	Unit
H_{OP}	Operating humidity range, non-condensing	5	85	%
H_{non-OP}	Non-Operating humidity range, non-condensing	5	95	%

Note: 95% relative humidity is achieved with a dry bulb temperature of 50°C and a wet bulb temperature of 54°C.

8.3.Altitude
The power supply shall operate within all specified limits over Aop Altitude range. The change pressure condition shall not harm the power supply and the operation within specified regulations shall be assured.
The power supply shall withstand Altitude storage specified in Anon-OP without any damage.

Table 9-3 – Altitude Requirements

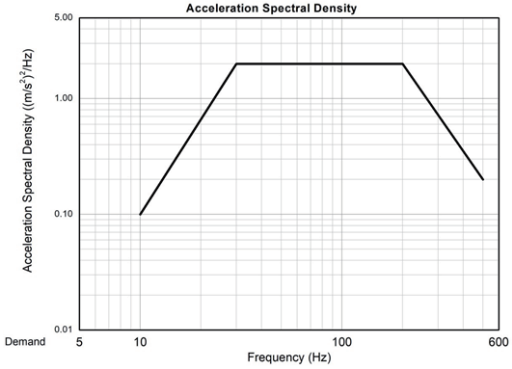
Item	Description	Max.
A_{OP}	Operating Altitude range.	5,000m
Anon-OP	Non-Operating Altitude range.	12,000m

8.4.Vibration
a)Operation(Random Vibration)：
Each device shall be tested in three axes for a minimum of 30 minutes per axis. The device shall be powered for the duration of the test at nominal input voltage and no load.

Table 9-4 – Operating Vibration

Operating Vibration Profile Charts		
Frequency	Class II Acceleration Specification	
Hz	$(m/s^2)^2/Hz$	G^2/Hz
10	0.1	0.00046
30	2	0.0052
200	2	0.0052
500	0.2	0.0001
	Grms=2.40	

Figure 9-1 – Acceleration Spectral Density



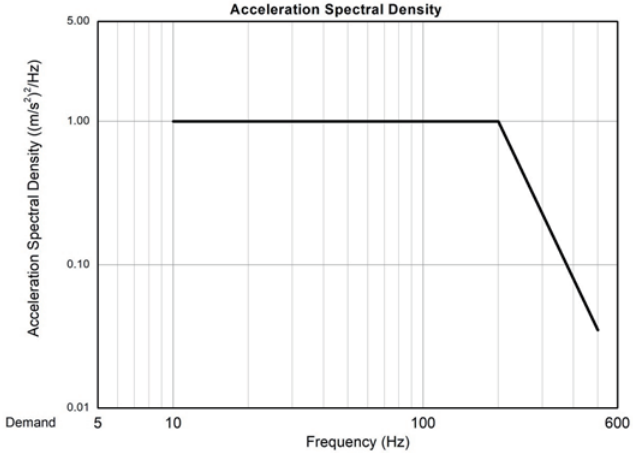
b)Non-Operation(Random Vibration)：

The products are in the shipping packaging shall be comply with non-operating vibration testing for 3 resonant points with dwell 15min.

Table 9-5 – Non-Operating Vibration Profile Charts

Non-Operating Vibration Profile Charts		
Frequency	**Class II Acceleration Specification**	
Hz	$(m/s^2)^2/Hz$	G^2/Hz
5	5	0.052
200	5	0.052
500	0.3	0.003
	Grms=3.80	

Figure 9-2 – Acceleration Spectral Density



8.5.Thermal shock (Shipping)
The thermal shock -40°C to +65°C, non-operating, 10 cycles, transfer time shall not exceed 5 minutes, duration of exposure to temperature extremes shall be 20 minutes.

8.6.Shock (Operating)
Each tested device shall be exposed to three shocks in each of three axes.
The amplitude of each shock shall be no less than 30g with a half sine wave shape and duration of 11ms.

9.Regulatory Requirements

This product was evaluated as Information Technology Equipment (ITE), which may be installed in offices, schools, computer rooms, and similar commercial type locations. The suitability of this product for other product categories and environments (such as: medical, industrial, telecommunications, NEBS, residential, alarm systems, test equipment, etc.) other than ITE application, may require further evaluation.

9.1.Product Safety Compliance
a)UL/CUL (62368-1)
b)TUV(EN 62368-1)
c)CB (IEC 62368-1)
d)CE
e)FCC

9.2.Product EMC Compliance
The information contained in this section is the criteria and approvals of Power Supply EMC requirements, The product is required to comply with RF EMISSIONS of EN 55032,CISPR 32 with minimum 6dB margin to Class A limit.
The power supply shall meet the following electrical EMS IMMUNITY requirements with EN 55035,CISPR 32 which defined in this section and Table 10-1,Table 10-2.
EN 61000-4-2 Electrostatic Discharges(ESD)
EN 61000-4-3 Radio Frequency Electromagnetic Field(RS)
EN 61000-4-4 Fast Transients Common Mode(EFT)
EN 61000-4-5 Surges
EN 61000-4-6 Radio Frequency Common Mode(CS)
EN 61000-4-8 Power Frequency Magnetic Field(PFMF)
EN 61000-4-11 Voltage Dips and Interruptions(DIP)
EN 61000-3-2 Harmonics Current Measurement
EN 61000-3-3 Voltage Fluctuations and Flicker Measurement

Table 10-1 – EMC Performance

Level	Description
A	The apparatus shall continue to operate as intended. No degradation of performance.
B	The apparatus shall continue to operate as intended. No degradation of performance beyond spec limits.
C	Temporary loss of function is allowed provided the function is self-recoverable or can be restored by the operation of the controls.

Table 10-2 – Product EMC Compliance

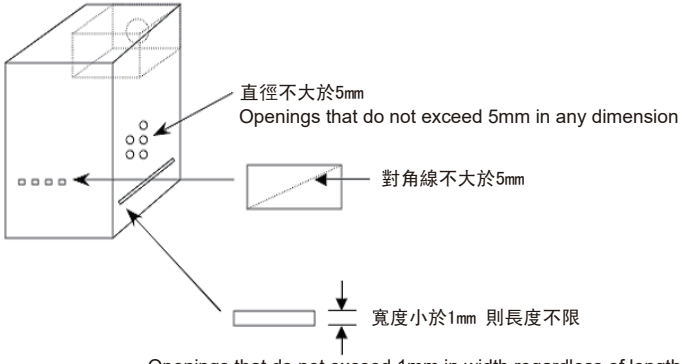
Category	Standard	Description	Level / Limits	Performance Criteria
EMISSIONS				
Radiated Emissions	EN 55032	30MHz – 1GHz	Class A	Class A 6dB Margin
Conducted Emissions	EN 55032	150KHz - 30MHz	Class A	Class A 6dB Margin
IMMUNITY				
Electrostatic Discharges (ESD)	EN 61000-4-2	Contact discharge +/-8KV	Level 4	A
		Air discharge +/-15KV	Level 4	A
Radio Frequency Electromagnetic Field (RS)	EN 61000-4-3	3V/m	Level 2	A
Fast Transients Common Mode (EFT)	EN 61000-4-4	+/- 2 kV		A
Surges	EN 61000-4-5	CM±2KV (12 ohm) DM±1KV (2 ohm)	Level 3	A
Radio Frequency Common Mode (CS)	EN 61000-4-6	3Vrms	Level 2	A
Power Frequency Magnetic Field (PFMF)	EN 61000-4-8	1A/m	Level 1	A
Voltage Dips and Interruptions (DIP)	EN 61000-4-11	Voltage Residual(%) : <5	0.5 cycle	B
		Voltage Residual(%) : 70	25 cycle	B
		Voltage Residual(%) : <5	250 cycle	B
Harmonics Current Measurement	EN 61000-3-2	AC supply <16Amps per phase	Refer to standard	
Voltage Fluctuations and Flicker Measurement	EN 61000-3-3	AC supply <16Amps per phase	Refer to standard	

9.3.Hi-Pot

The power supply module shall comply with the minimum production Hi-Pot (High Potential)Test at 1800Vac/ 3Seconds with a trigger of 15mA current. The test shall be applied between Primary (AC Line and Neutral) and Earth Ground (Chassis/Input Receptacle ground terminal).

9.4.Mean Time between Failures (MTBF)

The power supply shall have a minimum MTBF at continuous operation of 200,000 hours calculated at 100%, according to Telcordia SR-332 Issue 3 at 25°C excluding the Fan MTBF, and at least 100,000 hours including the fan MTBF.



2. 本產品輸出含有危險能量，為避免操作時發生危險，須於裝入系統機殼並將所有設備安裝妥當後才可開啟電源。
3. 本產品之電源輸出非屬電力限制型電源，請連接使用具防火外殼之周邊，以避免火災危險發生。

BSMI ROHS 資訊
http://www.silverstonetek.com/downloads/PSU/RSD.pdf

开关电源供应器　有毒有害物质/元素及其化学含量表

部件名称	铅 (Pb)	汞 (Hg)	镉 (Cd)	六价铬 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
外壳	○	○	○	○	○	○
接头	○	○	○	○	○	○
风扇	○	○	○	○	○	○
电子卡	○	○	○	○	○	○
线材	○	○	○	○	○	○
螺丝	○	○	○	○	○	○
包材	○	○	○	○	○	○

本表格依据SJ/T 11364的规定编制

○：表示该有毒有害物质在该部件所有均质材料中的含量均在GB/T 26572 规定的限量要求以下。

×：表示该有毒有害物质至少在该部件的某一均质材料中的含量超出GB/T 26572 规定的限量要求。

10 产品合格证
检验员：检01
生产日期：见产品条码

This device complies with Part 15 of the FCC Rules.

Operation is subject to the following two conditions:

(1) this device may not cause harmful interference, and
(2) this device must accept any interference received,
including interference that may cause undesired operation.

Model (safety certification): SST-CM2000GFTI-A
SST-CM2400GFTI-A

The equipment a Class | Switching Power Supply intended to use
for information technology equipment or Audio and Video equipment.

本製品は2000W ;2400Wの出力が可能な高出力電源となります。
・一般家庭のコンセント(1500W)の場合は、1300W未満の消費電力でご利用ください。
・日本国内向けに販売されている本製品の付属電源ケーブルは100V(最大15A)専用となります。
・本製品に200V用電源ケーブル、および100V/20A用電源ケーブルの同梱はございません。
・100V/15A以外の環境でご利用の際は、安全の為、必要な電源ケーブルを別途ご用意ください。

※付属の電源コードは当該製品専用です。他の機器に使用しないでください。

Please refer to SilverStone website for latest specifications updates.

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