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台達電子工業股份有限公司
DELTA ELECTRONICS, INC.

DESCRIPTION :
電氣規格 (Electrical Specification)

MODEL NO. :
DPS-1200AB-16 B

Date	Drawn	Design (EE)	Design (ME)
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DOCUMENT NAME. : **ES-1200AB-16 B**

REV. **01**

1. INTRODUCTION

This document specifies the performance characteristics and requirements for a wide range redundant and hot swap 1200W/1000W (1200W @ high line/1000W @ low line) power supply. The power supply has active power factor correction and follows the PMBus design guide. The designs are optimized to reduce the power dissipation over the entire load range and are acoustically optimized.

2. BASIC REQUIREMENTS FOR PSU

- The PSU must work in worldwide power environments.
- PSU Redundancy modes 1+1 have to be supported.
- The PSU have to provide +12VSB standby power and +12V normal power
- The inlet (10A e320 C14 socket) of the PSU supports the power cord connector 10A IEC320 C14.
- The PSU have to provide a PMBus compliant management Interface.
- Via PMBus ON_OFF_CONFIG command the mechanism for PSU turn On/Off can be configured. Default setting should allow a switch ON/OFF by PMBus commands, only ON_OFF_CONFIG data = 0b00011001)
- The PSU should provide a mechanism which avoids unintentional cable removal.

2.1 Dimensions

The power supply dimension is 73.5(W) x 40/39(H) x 185(L) mm include golden finger portion. The PSU form factor must have a lock mechanism, relevant detail information please refer to mechanical outline drawing. Besides, output pin-assignment also refers to mechanical outline drawing.

2.2 Airflow

The air intake is from the golden finger side and out at the ac connector side.

3. Electrical Data

3.1 AC Input Data

3.1.1 Power Factor Correction

The power supply must meet the power factor requirements stated in the Energy Star® Program Requirements for Computer Servers. These requirements are stated below.

Output power	10% load	20% load	50% load	100% load
Power factor	> 0.65	> 0.80	> 0.90	> 0.95

Tested at 230Vac, 50Hz and 60Hz and 115VAC, 60Hz

3.1.2 AC Input Specification

The power supply operates within all specified limits over the following input voltage range at normal temperature condition. Total harmonic distortion of up to 10% does not cause the power supply to go out of specified limits.
Application of an input voltage below 85VAC shall not cause damage to the power supply, including a blown fuse.

Table 1 AC Input Voltage Range

nominal input voltage range of low line	100V-127V
nominal input voltage range of high line	200V-240V
min/max input voltage range of low line	90V-140V
min/max input voltage range of high line	180V-264V
line frequency	47Hz – 63Hz
true RMS input power at full load	230V/1330W; 100V/1170W(without fan)
true RMS input power at full load	230V/1345W; 100V/1185W (with fan)
apparent power	230V/1400VA; 100V/1231VA(without fan)
apparent power	230V/1416VA; 100V/1247VA(with fan)
crest factor (input current)	< 1.8(50%-100% load)
input RMS current at full load	200V/7A; 100V/12.31A (without fan)
input RMS current at full load	200V/7.08A; 100V/12.47A (with fan)
Start up voltage range(VAC)	85VAC +/- 4VAC
Power off voltage range(VAC)	75VAC +4VAC/ -5VAC

*Short input transients of 285VAC (<1 minute) will not cause any damage to the PSU

3.1.3 Efficiency

This power supplies for power distribution (+12V/+12VSB) have a minimum efficiency according table at 25 degree condition stated in this document (meet EPA and CSCI definition). At zero load condition the PSU must have minimized losses. The fan losses are not included in the efficiency calculation and measurements. In parallel mode a special output control circuit ensures that the unit is running at its pre-defaulted efficiency working point.

Table 2: Efficiency

	10% Load	20% Load	50% Load	100% Load
230VAC/ 50Hz	85%	90%	94%	91%

3.1.4 Inrush Current

AC line inrush current shall not exceed 55A peak, for up to one-quarter of the AC cycle, after which, the input current should be no more than the specified maximum input current. The peak inrush current shall be less than the ratings of its critical components (including input fuse, bulk rectifiers, and surge limiting device).The power supply must meet the inrush requirements for any rated AC voltage, during turn on at any phase of AC voltage, during a single cycle AC dropout condition as well as upon recovery after AC dropout of any duration, and over the specified temperature range (Top).

3.1.5 AC Leakage Current

The maximum leakage current to protective earth is <1.3mA measured at 240VAC, 50Hz.

3.1.6 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 line fusing shall be acceptable for all safety agency requirements. The input fuse shall be a slow blow type. 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.

3.1.7 AC Dropout

An AC dropout is defined to be when the AC input drops to 0VAC at any phase of the AC for any length of time. During an AC dropout the power supply must meets dynamic voltage regulation requirements. An AC dropout does not cause any tripping of control signals or protection circuits. If the AC dropout lasts longer than the hold up time the power supply should recovers and meets all turn on requirements. The power supply meets the AC dropout requirement over rated AC voltages, frequencies, and output loading conditions. Any dropout of the AC does not cause damage to the power supply.

Table 3: AC Dropout

Loading	Holdup time
70%	10msec

3.1.8 Line Surge

AC 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 dropping below nominal voltage conditions. “Surge” will be defined to refer to conditions when the AC rises above nominal voltage .The power supply shall meet the requirements under the following AC sag and surge conditions. The output loading is 70% of Max load.

Table 4: Line Sag Transient Performance

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 ranges	50/60Hz	No loss of function or performance
> 1 AC cycle	>30%	Nominal AC Voltage ranges	50/60Hz	Loss of function acceptable, self

Table 5: Line Surge Transient Performance

AC Line **Surge**				
Duration	Surge	Operating AC Voltage	Line Frequency	Performance Criteria
Continuous	10%	Nominal AC Voltages	50/60Hz	No loss of function or performance
0 to 1/2AC	30%	Mid-point of nominal AC	50/60Hzz	No loss of function or performance

3.1.9 AC Turn On

The power supply tries only to start, if the AC input voltage is within a range, that the supply is able to start-up under full load condition. After restoring a mains failure, the PSU starts up automatically.

3.1.10 AC Fast Transient Specification

The power supply meets the EN61000-4-5 directive with the following conditions and exceptions:

- These input transients do not cause any out-of-regulation conditions, such as overshoot and undershoot, nor does it cause any nuisance trips of any of the power supply protection circuits.
- The surge-withstand test does not produce damage to the power supply.
- The supply meets surge-withstand test conditions under maximum and minimum DC-output load conditions

3.1.11 AC Line Isolation Requirements

The power supply shall meet all safety agency requirements for dielectric strength. Additionally, power supply vendor must provide customer with written confirmation of dielectric withstand test which includes: voltage level, duration of test and identification detailing how each power supply is marked to indicate dielectric withstand test had been completed successfully. Transformers' isolation between primary and secondary windings must comply with the 3000Vac (4242Vdc) dielectric strength criteria. If the working voltage between primary and secondary dictates a higher dielectric strength test voltage the highest test voltage should be used. In addition the insulation system must comply with reinforced insulation per safety standard IEC 950. Separation between the primary and secondary circuits, and primary to ground circuits, must comply with the IEC 950 spacing requirements.

3.2 DC Output Data

3.2.1 DC Output Connector

The output gold finger connector connects the power as well as the signal to the system or power backplane board.

3.2.1.1 Signal Description

Table 6: Signal description

Signal	Description
+12V	+ 12V output
+12VSB	+12V standby output
GND	0V ground
12VLS	+12V load share bus
12VS	+12V remote sense
RETURN_SENSE	0V remote sense
NC	Not used
PWOK	Output Power ok
PSON	Power enable / disable
SCL	SMBus Clock
SDA	SMBus Data
A0	SMBus address bit 0
A1	SMBus address bit 1
SMBAlert	I2C alert signal
SMART_ON	Control signal for smart redundancy (power save)

3.2.1.2 Connector Pin-Out

Please refer to Mechanical outline drawing.

3.2.2 +12V Standby Voltage

The +12VSB is available, if the PSU is connected to the mains. After applying the line voltage to the power supply, the standby voltage is the first voltages, which is in its nominal ranges and after a mains failure this voltage is the last, which leaves its nominal range. The standby output is permanent short-circuit, overload and over voltage protected. The +12VSB holdup time is >70ms after AC loss goes LOW over entire input voltage range and at full load.

3.2.3 Output Currents

The combined output power of all outputs shall not exceed 1000W max@ 90V AC to 140 AC input. The combined output power of all outputs shall not exceed 1200W max @ 180V to 264VAC input. The combined output power of all outputs shall not exceed 800W when AC input voltage under 89V AC input (this condition only for brown-out testing). Each output has a maximum and minimum current rating shown in the table below. After normal operation 12Vstby must provide 4.0A with two power supplies in parallel.

Table 7: output currents

Output	+12V	+12VSB
Under 89VAC	65A	2.1A
Low line@90VAC-140VAC	82A	2.1A
High line@180VAC-264VAC	98A	2.1A
Min Static	0A	0A

3.2.4 Voltage Regulation

3.2.4.1 Static Regulation

The power supply voltage must stay within the following voltage limits when operating at steady state load conditions. These limits do not include the peak-peak ripple/noise specified in section 3.2.8. All outputs are measured with reference to the +12VS and RETURN_SENSE signal. The +12VSB is measured at the output connector.

Table 8: Static regulation

	Min	Nom	Max	Tolerance
+12V	11.4V	12.0V	12.6V	+5%/-5%
+12VSB	11.4V	12.0V	12.6V	+5%/-5%

3.2.4.2 Dynamic Regulation

The output voltages remains within the limits specified in the first table for the step loading, turn ON/OFF and capacitive loading specified in the second table. The dynamic tolerance includes the static regulation tolerance. The load transient repetition rate is tested between 10Hz and 10 KHz.

Table 9: Dynamic regulation

	Min	Max	Tolerance
+12V	11.4V	12.6V	+5% / -5%
+12VSB	11.4V	12.6V	+5% / -5%

	Step Load Size	Slew Rate	Capacitive Load
+12V	50% of max load	0.5A/msec	1,000uF
+12VSB	50% of max load	0.5A/msec	150uF

Note:

1. For dynamic condition +12V Min loading is 1A.
2. While +12V dynamic Min load less than 2A, 12V shall follow +/-10% regulation.
3. When 12VSB current change from maximum loading to minimum loading and slew rate as the as above table define. The power supply can not shutdown but the output regulation can be loss.

3.2.5 Audible Noise

No abnormal audible noise is allowed to be generated by the PSU.

3.2.6 Residual Voltage

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 500mV. There shall be no additional heat 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. The residual voltage at the power supply outputs for no load condition shall not exceed 100mV when AC voltage is applied and the PSON# signal is de-asserted.

3.2.7 Capacitive Loading

The power supply is stable and meets all requirements with the following capacitors.

Table 10: Capacitive Loading

	Min	Max
+12V	1,000uF	25,000uF
+12VSB	150uF	5000uF

3.2.8 Ripple /Noise

The maximum allowed ripple/noise output of the power supply is defined in the table below at normal temperature. This is measured over a bandwidth of 0Hz to 20MHz at the power supply output connector and the entire load range. A 10uF ceramic capacitor in parallel with a 0.1 F ceramic capacitor and minimum capacitive load (12V/1000uF, 12Vsb/150uF) are placed at the point of measurement. The ripple measured need use minimum capacitor loading at test fixture.

Table 11: Ripple/Noise

+12V	+12VSB
120mVp-p	120mVp-p

3.2.9 Return and Frame connection

All DC Returns (GND) are internally connected to frame ground.

3.2.10 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).

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 100 m . This path may be used to carry DC current

3.2.11 Common Mode Noise （N/A）

The Common Mode noise on any output shall not exceed 350mV pk-pk over the frequency band of 10Hz to 20MHz.

1. The measurement shall be made across a 100Ω resistor between each of DC outputs, including ground at the DC power connector and chassis ground (power subsystem enclosure).

2. The test set-up shall use a FET probe such as Tektronix model P6046 or equivalent.

3.2.12 Soft Starting

The Power Supply shall contain control circuit which provides monotonic soft start for its outputs without overstress of the AC line or any power supply components at any specified AC line or load conditions.

3.2.13 Closed loop stability

The power supply shall be unconditionally stable under all line/load/transient load conditions including capacitive load ranges specified in Section 3.2.7. A minimum of: 45 degrees phase margin and -10dB-gain margin is required. The power supply manufacturer shall provide proof of the unit's closed-loop stability with local sensing through the submission of Bode plots. Closed-loop stability must be ensured at the maximum and minimum loads as applicable.

4. PSU Mode / Parallel Mode / Redundancy / Smart_ON Redundancy

4.1 Standby Mode

The PSU can be set to standby mode via PSOFF. In standby mode the +12V main output is turned OFF, only the +12VSB standby output is powered.

4.2 Parallel Mode (General)

For power extension and for redundancy, a minimum of 4 PSUs can be connected in parallel to reach the necessary output power and/or to fulfill redundancy, phase redundancy and dual feed requirements.

4.3 Power Calculation in Parallel Mode

Table13: Output Current in Parallel Mode

	1+1 or 1+0	
	+12V	+12VSB
Low Line(90V-140V)	82A	2.1A
High Line(180V-264V)	98A	2.1A
min. dynamic	1A	0A
min. static	0A	0A

4.4 Mixed Mode Operation (N/A)

A mix of 650W, 800W and 1200W PSUs will not cause the units to shut down and will not have any impact to the system. Redundancy is only guaranteed if the total maximum power of all low power versions will not be exceeded. Power sharing under mix mode operation is fully supported.

4.5 Hot Swap Requirement

Hot swapping a PSU is the process of inserting and extracting a PSU from an operating power system. During this process the output voltages (including +12VSB) remain within the limits specified. The hot swap test is executed when the system is operating under both, static and dynamic conditions.The PSU can be hot swapped by the following methods:

Extraction:

1. System management turns off only one of the PSUs before it is removed from the system.
2. The AC input of one of the PSUs is unplugged before the PSU is extracted from the running system.

Insertion:

1. A PSU is inserted into the system. The PSOFF signal is immediately applied to the newly inserted PSU.
2. Depending on the state of the system (ON or OFF), the inserted PSU stays in standby mode or is turned ON via its PSOFF signal after a period of time.
3. In general, a failed (off by internal latch or external control) PSU can be removed and replaced by a new PSU; However, hot swap can work with operational as well as failed PSUs. The newly inserted PSU can get turned ON by insertion, by plugging input voltage into the external face, or by system management recognizing an inserted PSU and explicitly turning it on.

Note: For hot swap condition, the +12V voltage regulation spec is +/-8%.

4.6 PMBus command for Smart On(N/A)

4.6.1 Hardware Connection

Before enabling Smart On function, make sure pin B22 (SMART ON) on output golden finger of each PSU is connected together.

4.6.2 Configuring Smart On with SMART_ON_CONFIG (D0h)

The PMBus manufacturer specific command MFR_SPECIFIC_00 is used to configure the operating state of the power supply related to Smart On. We will call the command SMART_ON_CONFIG (D0h). Below is the definition of the values used with the

Read-Write Byte SMBus protocol with PEC.

Table 14: SMART_ON_CONFIG command

SMART_ON_CONFIG (D0h)		
Value	State	Description
00h	Standard Redundancy (default power on state)	Turns the power supply ON into standard redundant load sharing mode. The power supply's SRED_OK# signal (pin54, IC703) will always keep high to pull the SMART_ON# (pin35, IC703)low make sure no other PSU enter Smart_On mode.
01h	Smart On Active	Defines this power supply to be the one that is always ON in a Smart On configuration. The power supply's SRED_ACTIVE# (pin55, IC703) will set low to pull the SMART_ON# (pin35, IC703) up.
02h	Smart Standby 1	Defines the power supply that is first to turn on in a cold redundant configuration as the load increases.
03h	Smart Standby 2	Defines the power supply that is second to turn on in a cold redundant configuration as the load increases.
04h	Smart Standby 3	Defines the power supply that is third to turn on in a cold redundant configuration as the load increases.
05h - FFh	reserved	

The default state of power supply is in Standard Redundancy mode. Power supply need to be re-specified a state whenever initial power on or any power supply in the system is in fault situation.

The SMART_ON_CONFIG command will reset to 00h (Standard Redundancy) when any fault or over current happened. The faults include AC loss, over hot spot temperature, over ambient temperature, +12V short internally (under voltage), +12V over voltage, fan locked.

4.7 Smart Standby Power Supply Operating State(N/A)

A power supply is put into Smart Standby whenever PSON# is asserted, SMART_ON# is de-asserted, and SMART_ON_CONFIG value is set to 02h, 03h, or 04h.In the Smart Standby mode the power supply must:

1. Power ON when Smart_On bus is driven LOW
2. Keep PWOK asserted
3. No PMBus fault or warning conditions reported via STATUS commands
4. keep all fans rolling
5. LED is green blinking

4.7.1 Powering on Smart Standby supplies to maintain best efficiency

Power supplies in Smart Standby state shall monitor the shared voltage level of the load share signal to sense when it needs to power on. Depending upon which position the system defines that power supply to be in the Smart Standby configuration; will slightly change the load share threshold that the power supply shall power on at.

4.7.2 Powering on Smart Standby supplies during a fault or over current condition

Some warnings happen or 12V output shutdown due to any fault will cause SRED_OK# driven low.When an active power supply asserts its SRED_OK# signal, all parallel power supplies in Smart Standby mode shall power on immediately.

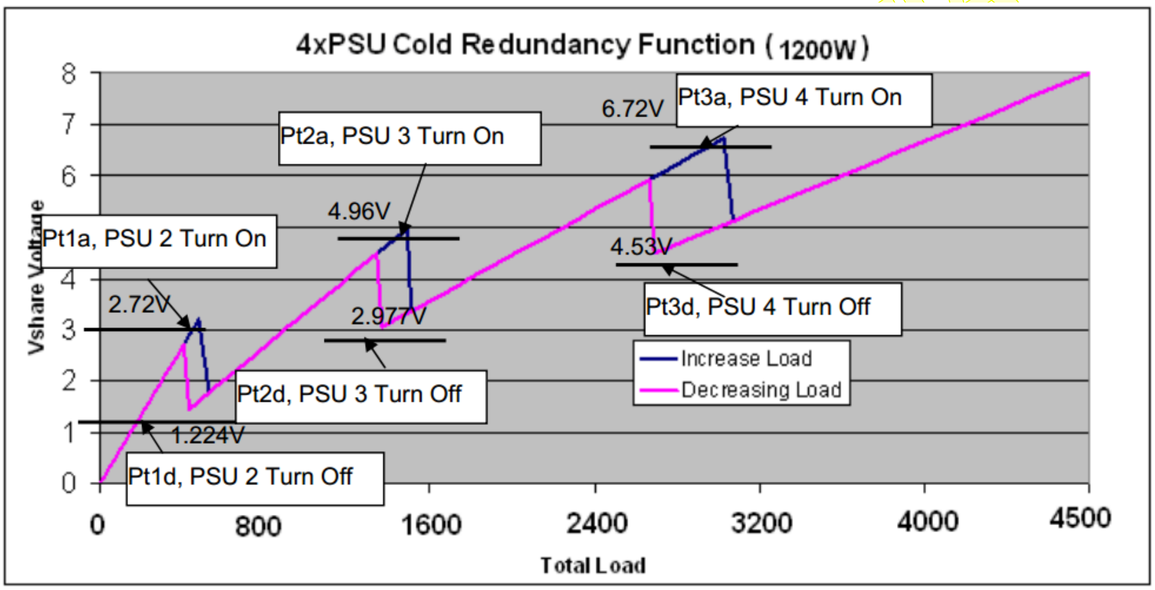
The trigger condition:

1. 12V OC warning/ fault happens
2. 12V OVP fault
3. 12V UVP (lower than 11V)
4. OTP warning/ fault
5. Fan speed warning/ fault
6. AC loss (lower than 75V +/-5V)
7. Send 00h to PMBus D0h command

When an active power supply asserts its SRED_OK# signal, all parallel power supplies in Smart Standby mode shall power on immediately.

4.8 The Way to Enable Smart_On Function(N/A)

Here are the steps to put PSU into smart on mode. PSU which is assigned as smart on standby can operate in a power-off state and turn on main power if necessary.



Power On/Off of power supplies in Cold Redundant Mode (4x1200W PSUs)

Symbols Definition:

Max load: maximum of total load based on the amount of PSU for nominal input voltage range of high line (98A*4=392A)
Pt1a: 8.5% of High line Max load => 98A*34%=33.32A
Pt1d: 7.65% of High line Max load => 98A*34%*0.9=29.99A
Pt2a: 31% of High line Max load => 98A*2*62%=121.52A
Pt2d: 27.9% of High line Max load => 98A*2*62%*0.9=109.4A
Pt3a: 63% of High line Max load => 98A*3*84%=246.96A
Pt3d: 56.7% of High line Max load => 98A*3*84%*0.9=222A
The trigger levels above may have a +/-10% tolerance for actual application. For nominal input voltage range of low line, maximum of total load should be less than (82*4=328A) while 4 PSUs connected in parallel
Step1: Make sure every PSU has AC power cord applied. Use write byte command to set command 0XD0 for each PSU to has it own role (must one PSU as active role).
The command format for Smart On function will be as following example.
B0 in smart_on_active (S B0 w D0 01 PEC P)
B2 in smart_on_standby (S B2 w D0 02 PEC P)
B4 in smart_on_standby (S B4 w D0 03 PEC P)
B6 in smart_on_standby (S B6 w D0 04 PEC P)
Step2: PSU will enter smart slave mode once the load is lower than the corresponding trigger point.
Step3: If SMART_ON# signal falls to low, all PSU will turn on the main power and reset smart_config to 0x00 (standard redundancy). System needs to re-assign the roles for all PSU to enable smart on function again.
Via PMBus command SMART_ON_CONFIG (D0h) the PSU can be set into a power saving mode. Depending on the necessary power, only a minimum of the paralleled PSUs are supplying into the output rail for working at optimum efficiency. The other PSUs stay in Standby Mode until their additional power is needed due to increasing load. If one of the PSUs fails or detects a line drop and cannot ensure to continue operation, all other PSUs will immediately take over the power to guarantee continuous operation of the system. In Smart_ON Mode there is no loss of PSU redundancy. The SMART_ON signal pin (B22) of all PSUs must be connected on system side.
By default this function is disabled and must be activated via PMBus command SMART_ON_CONFIG (D0h). When using Smart_ON mode, it is not allowed to turn OFF an active unit via the PSOFF interface. This will disable the Smart_ON function.

4.9 Load Sharing

4.9.1 Forced Load Sharing

The main outputs have forced load sharing. The outputs share within 10% at 100%

output load. All current sharing functions are implemented inside the PSU by making use of load share signals. On system side, the load share signals of the paralleled PSUs must be connected to each other. The PSUs are able to load share with up to 4 PSUs in parallel. There is no support for achieving a symmetrical load share on the +12VSB between PSUs. For efficiency optimization it may be possible to turn OFF the share function.

Sharing accuracy is not measured under transient conditions. Load sharing must be active ≤500ms after PSU start- up and before PWOK is asserted.

4.9.2 Load Share Signal

The PSUs share its load on the main outputs by using a single load share bus signal (12VLS) connected between the PSUs. If the load sharing is disabled by shorting the load share bus to ground, the power system continues operating within regulation limits for loads less than or equal to one PSU. A failure of a paralleled PSU does not affect the load sharing or output voltages of the other PSUs that are still operating.

4.9.2.1 Load Share Signal Characteristics

The load share signal characteristics are only intended for the load sharing function under normal operation and not if Smart_ON is activated. The exact characteristics of the load share signal can be defined by the vendor. The delay from output voltages in regulation to load sharing active with maximum load of one PSU and four PSUs in parallel is 500ms maximum.

Table 15: Load Share Signal Characteristics

Item	Description	Min	Nominal	Max
Vshare; Iout = maximum	Voltage of load share bus at specified maximum output current	7.76V	8.0V	8.24V
Tshare; Iout = maximum	Delay from output voltages in regulation to load sharing active with maximum load of one PSU and two PSUs in parallel.			500ms

5. Protection Circuits

Protection circuits inside the PSU cause only its main outputs to shut-down. The +12VSB output remains powered ON if the failure does not involve this output. When a protection circuit shuts down the PSU, the PWOK signal will go LOW, the bi-color LED will change from GREEN to solid AMBER. If the PSU latches off due to an output over current, short circuit or output over voltage protection circuit tripping, the PSU user has to apply an AC-reset (input power OFF/ON cycle of all paralleled PSUs for more than 15s) or a PSOFF-reset (PSOFF toggle) for more than 1s to reset the PSU and clear the latch.

5.1 Maximum Over Current Protection

Over current is a fault condition defined as a 10A/s current ramp starting from full load applied to the output under test. The other outputs may be set to any condition defined in section 3.2.3. If the output current exceeds the 150% of Imax threshold it may turn OFF after a period of time. When 12V current occur the over current protection and then the power supply will shut down after 50ms delay. If 12V current is over quick OCP level (higher than regular OCP), the shutdown delay time may be less than 50ms (within 10ms~50ms) .

Table 16: Over Current protection

Vin Range	Pmax(W)	OCP Limits			
		12V		12VSB	
		Min	Max	Min	Max
90Vac-140Vac	1000W	90.2A	123A	2.4A	7A
180Vac-264Vac	1200W	107.8A	147A		

The current limits shown in the table will be satisfied throughout the entire operation. An over current on the +12VSB output will not latch OFF the power supply. It will return to normal operation once the fault is removed Any over load condition except the +12VSB will cause the PWOK signal to go LOW, the bi-color LED will change from GREEN to AMBER.

5.2 Short Circuit Protection

A short circuit (impedance <0.1 ohms) applied to any output during start-up or while running will not cause any damage to the power supply. The power supply shuts down and latches OFF for short on main outputs but recovers upon PSON assertion or a PMBus initiated ON/OFF cycle command or AC toggle. The +12VSB is capable of being shorted indefinitely, and all outputs shuts down upon a short circuit of the +12VSB and when the short is removed the power supply shall recover automatically.

5.3 Over Voltage Protection

In case of an over voltage internal of a power supply due to a failure only the faulty power supply switches off. The power supply shuts down in a latch off mode after an over voltage condition. This latch can be cleared by a PSON assertion or PMBus ON/OFF command or by an AC power interruption. The table below contains the over voltage limits. The values are measured at the remote sense line input, the +12VSB at the power supply's DC connector. Any over voltage condition will cause the PWOK signal to go LOW, the bi-color LED will change from GREEN to AMBER. The control path and the protection path are separated by components and traces.

Table17: Over Voltage Protection

Output	OV Protection Point
+12V	13.0V ~14.5V
+12VSB	13.0V ~ 14.5V

*The over voltage shall perform at minimum output load condition.

5.4 Over Temperature Protection

There are three temp sensors in the power supply, first is in the heat sink of full bridge MosFET, second is in the heat sink of PFC MosFET and the other one is in the inlet location. The power supply is protected against over temperature conditions caused by loss of fan cooling or excessive ambient temperature. In an OTP condition the PSU shuts down. The standby outputs may also shut down or remain powered on. When the power supply temperature drops to (within) specified limits, the power supply restores power automatically. The OTP circuit has a built in at least 4 degree ℃ hysteretic such that the power supply does not oscillate on and off due to temperature recovering condition. At an OTP condition the PSOK signal goes LOW and the bi-color LED changes from GREEN to AMBER.

6. Control Signals

6.1 PSON

The PSON signal is required to remotely turn on/off the power supply. PSON is an active low signal that turns on the power rails. When this signal is not pulled low by the system, or left open, the outputs (except the standby voltage) turn OFF. In parallel standby mode a non-operation PSU (no line voltage or faulty) does not cause to switch ON the standby operating PSU via the PSON signal.
If this signal is left open the unit follows the PMBus commands.

Table18: PSON signal Characteristics

PSON = Low	ON	
PSON = Open	OFF or follows PMBus commands	
PSON = High	OFF	
	Min	Max
Logic level low (power supply ON)	0V	0.4V
Logic level high	2V	3.45 V

Source current, VPSON = low		4mA

6.2 PSU ON/OFF Function

Via a PMBus command the power supply can be turned ON, OFF. PSU turns on main power once OPERATION command is set to 80h or PSON signal is driven to low. In the case of OFF command, PSU shuts off main power if OPERATION command is set to 00h and PSON is pulled to high.

6.3 PWOK

PWOK is a power OK signal and will be pulled HIGH by the power supply to indicate that all the outputs are within the regulation limits of the power supply. When any output voltage falls below regulation limits or when AC 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. A 22nF ceramic capacitor should be placed at the point of measurement. The start of the PWOK delay time shall inhibited as long as any power supply output is in current limit.

Table 20 PWOK Signal Characteristics

Signal Type	Open collector/drain output from power supply. Pull-up to VSB located in the power supply.	
PWOK = High	Power OK	
PWOK = Low	Power Not OK	
	MIN	MAX
Logic level low voltage, Isink=400uA	0V	0.4V
Logic level high voltage,	2.4V	3.45V
PWOK rise and fall time		100msec

6.4 SMBALERT

This low active, sideband and open collector signal indicates that the PSU is experiencing a problem, warning or fault that the system agent should investigate. A 10nF ceramic capacitor should be placed at the point of measurement. The signal can be reset by clearing the fault bits in the corresponding STATUS registers.

Table 21 SMBALERT Signal Characteristics

Signal type	Open Collector, pull up is located inside PSU
SMBALERT = High	OK

SMBALERT = Low	Alert to system	
	Min	Max
Logic level low voltage, Isink ≤ 4mA	0V	0.4V
Logic level high voltage, Isource =	3V	3.45V
SMBALERT rise and fall time		100msec

By default the SMBAlert# signal is asserted for the following cases.

1. AC input voltage drops below the fault threshold Vin < 75V +/-5V) of the power supply for > 200msec
2. AC input voltage is lower than warning threshold. (the slew rate of voltage drop should less than -1V/s)
3. Thermal sensor on a hot spot inside the power supply has exceeded its warning temperature.
4. 12VSB abnormal condition.

Table 22: Power Supply SMBAlert# Timing Requirements

Item	Description	PMBus command	MIN	MAX
Talert_ac	Timing from input voltage dropping to 0VAC to SMBAlert# going low	STATUS_INPUT UV Warning		4 msec
Tover_temp	Hot spot temp > warning threshold(TBD)	STATUS_TEMPERATURE Over temp warning		1second

The SMBAlert# signal shall be cleared and re-armed by the following methods.
Clearing STATUS bits causing the asserted SMBAlert# signal.
Power cycling with PSON or with AC power. (12V turns off then on again)
12VSB escapes from protection event and recovers to normal state.

6.5 SMART_ON

Via SMART_ON interface (B22) the different PSU's are communicating to control the Smart_ON mode. All SMART_ON signals of the different PSUs must be connected on system side.

6.6 Function Table

Table23: Function Table

	Output		Remarks
	+12V	+12VSB	
PSU waiting for command	OFF	ON	First AC ON

Command OFF	OFF	ON	And PSON stays high level
Command ON	ON	ON	Or PSON is low

6.7 12VS and RETERN_S

Please refer to the 3.2.9.

6.8 12VLS

Load share is a shared line between the PSU modules that allows dynamic load sharing (within 10%) between redundant Power Supplies. Please refer to the 4.9.2 for detail.

6.9 SDA and SCL

One pin is the serial clock (SCL), and the other pin is used for serial data (SDA). The SCL and SDA signals are pulled up by system, both pins are bi-directional, open drain signals, and are used to form a serial bus

6.10 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 resister should be located in the PSU and pull-up voltage should be limited to 3.3V. The address line should be either float or pull low with equal to or less than 100 ohm in the motherboard design.

6.11 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 resister should be located in the PSU and pull-up voltage should be limited to 3.3V. The address line should be either float or pull low with equal to or less than 100 ohm in the motherboard design.

7. Timing

7.1 Output Voltage Timing

The timings are for single power supply operation. All outputs rise monotonically.

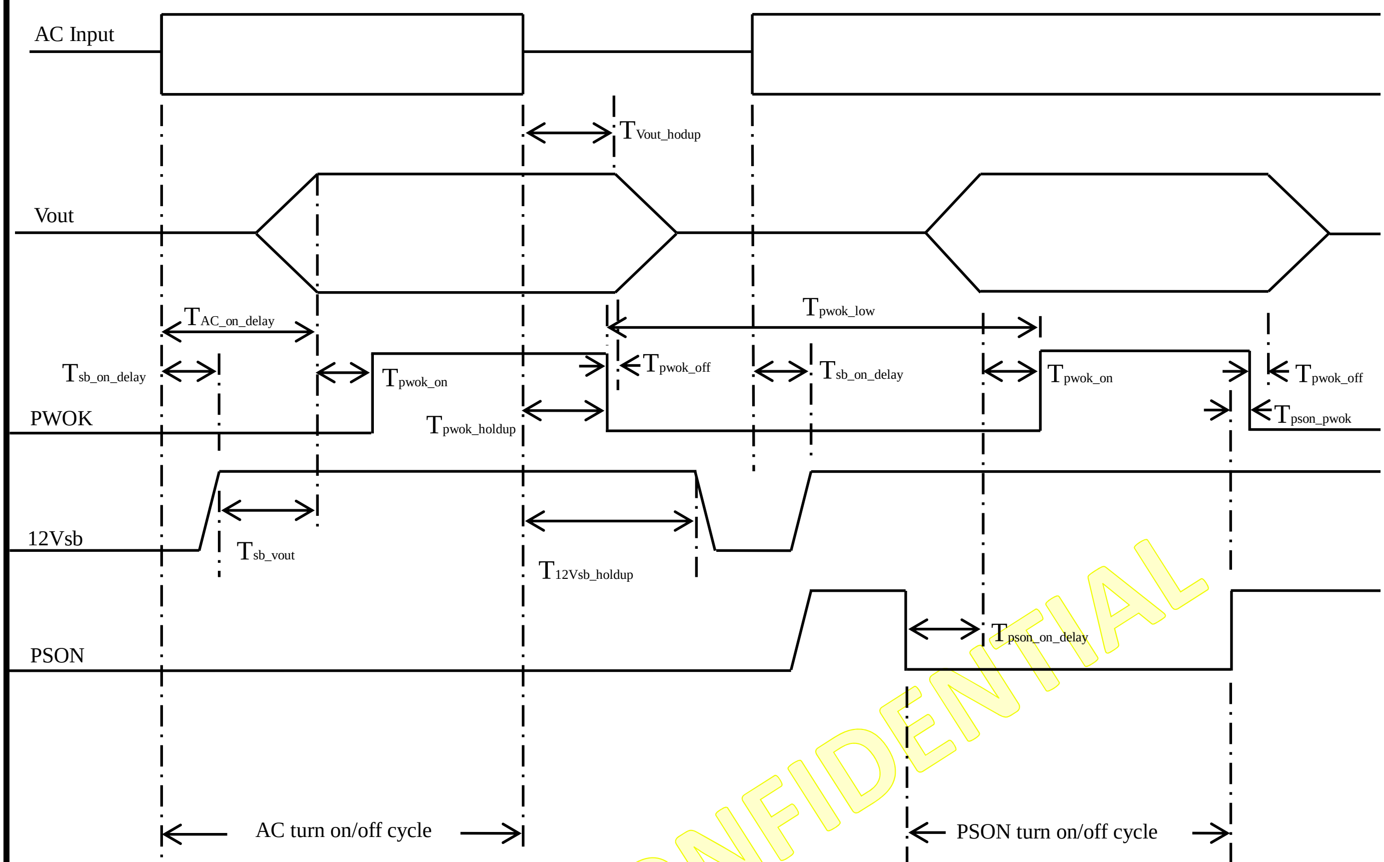
7.2 Turn ON/OFF Timing

The turn ON/Off timing shows the timing of a single power supply being turned ON and OFF via the AC input, and PMBus ON/OFF command.

Figure 1: Turn On Off Timing

ITEM	DESCRIPTION	MIN	MAX	UNITS
Tsb_on_delay	Delay from AC being applied to 12VSB being within regulation.		1500	ms
T12Vsb_rise	12Vsb Output voltage rise time	1	25	ms
T12V_rise	12V Output voltage rise time	5	70	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 (At 70% load)	11		ms
Tpwok_holdup	Delay from loss of AC to de-assertion of PWOK (At 70% load)	10		ms
Tpson_on_delay	Delay from PSON# active to output voltages within regulation limits.	5	400	ms
T pson_pwok	Delay from PSON# de-active to PWOK being de-asserted.		5	ms
Tpwok_on	Delay from output voltages within regulation limits to PWOK asserted at turn on.	100	500	ms
T pwok_off	Delay from PWOK de-asserted to 12V output voltage dropping out of regulation limits.	1		ms
Tsb_vout	Delay from 12Vsb being in regulation to O/Ps being in regulation at AC turn on.	5	1000	ms
T12VSB_holdup	Time the 12Vsb output voltage stays within regulation after loss of AC.	70		ms

Figure 2 Turn On/Off Timing (Power Supply Signals)



8. Over Power Protection (N/A)

The power supply shall support over power protection (OPP) level low enough to protect the power supply running in this mode for repeated 1msec durations at a 1% duty cycle. The power supply shall be stable operating at any load point from rated power up to the OPP point. SMBAlert shall always assert ahead of the OPP threshold being exceed.
If system operation time TDP>10sec, Pdyn>9ms, Pmax>100us and/or the output power above Pmax definition which allowable PSU can shut down in protection mode.

9. Peak Power Requirements (N/A)

All of the peak power requirement only for high line operation applications and then all of the components need meet component specification 100% rating when PSU working at peak power application.

9.1 Over Power Protection(OPP)

The power supply shall support over power protection (OPP) level low enough to protect the power supply running in this mode for repeated 1msec durations at a 1% duty cycle. The power supply shall be stable operating at any load point from rated power up to the OPP point.
OPP threshold: 1800W +/-72W
SMBAlert shall always assert ahead of the OPP threshold being exceeded
If system operation from rated power up to OPP point TDP>10sec, Pdyn>9ms, Pmax>100us and/or step down from above to rated power<10min then allowable PSU can shut down in protection mode.

9.2 Over Power Protection testing without system bulk capacitance

A. Apply rated PSU load in constant resistance mode
B. Drop load resistance to +20% over the OPP level so that the voltage folds back to 9.60V for a 1msec pulse duration
C. Repeat test at a 10% duty cycle
D. Pass/Fail criteria: stable voltage fold back, no PSU shutdown, no PSU overheating

9.3 Fast output current sensing testing

A. Apply maximum rated PSU load
B. Drop load resistance to +5% over the OPP level so that the voltage folds back to 11.40V for a 1msec pulse duration
C. Measure the timing from output current exceeding Ithrottle to SMBAlert asserting
D. Measure timing SMBAlert is held low; Tsmbalert_latch.

9.4 Peak load support testing with system bulk capacitance

A. Setup System capacitance
B. Set load to 1200W
C. Apply peak load duration to power supply; ramp rate = 0.5A/µsec
D. Monitor output voltage at remote sense; must maintain +/-5% and no more than -2% undershoot
E. Test with various system capacitances & peak power duration

Table 24: peak power support testing with system capacitance load

Peak Load	Peak Load Duration	System Capacitance	Voltage undershoot
1600W	100µsec	4,000 µF	-5%

1800W	100µsec	11,000 µF	- 5%
2000W	100µsec	18,000 µF	- 5%

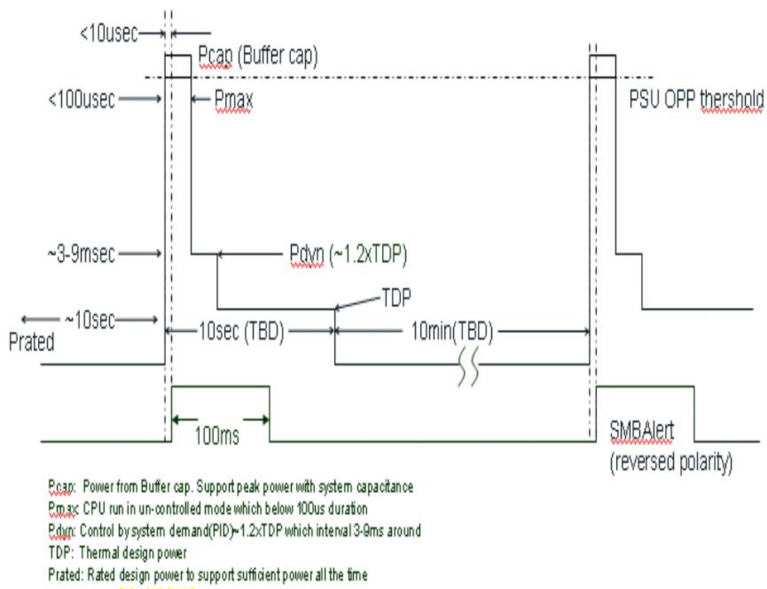
Assumption:

Starting power = 1200W; step up to peak power at a rate of 0.5A/µsec throttle trip threshold assumed to be 140.8A

9.5 Timing diagram for peak power support with throttling

Below is the peak load profile the system applies to the PSU for a high peak power levels that represent a virus condition. Under this condition the PSU will assert the fast SMBAlert# signal to quickly bring down the system power by throttling processors performance.
SMBAlert shall asset while hit fold back level to guarantee Pmax levels will be shortened to < 100µsec (system PID control).

Figure 3: PSU load vs Time (throttling mode)



* TBD is reserved define range which depend on PSU real test result.

10. LED Indicator

There is one bicolor LED located at the front side (ac input side) of the power supply, which shows the status of the power supply.

10.1 Indication Matrix

LED Color Characteristics

	Nominal λd Wavelength	Units
Green	573	nm
Amber	639	nm

Table 25 Indication matrix

Power Supply Condition	LED State
Output ON and OK	GREEN
No AC power to all power supplies	OFF
AC present / Only 12VSB on (PS off) or PS in Cold redundant state	1Hz Blink GREEN
AC cord unplugged or AC power lost; with a second power supply in parallel still with AC input power.	AMBER
Power supply warning events where the power supply continues to operate; high temp, high power, high current, slow fan.	1Hz Blink Amber
Power supply critical event causing a shutdown; failure, OCP, OVP, Fan Fail	AMBER

* It is just nominal value, the actual value will related with component tolerance. PMBus

11. Firmware Description

11.1 Electrical Layer

The PMBus electrical driving levels shall comply with high power DC specifications given in Section 3.1.3. of SMBus Specification version 2.0.

11.2 FRU Data Format

For identification of the power supply an internal 256x8 bit EEPROM with PMBus interface is used. The information in the EEPROM follows the IPMI (Platform Management FRU Information Storage Definition) guidelines Document Revision 1.1 from November 15, 1999 and Siemens Norm SN77250

11.3 FRU Signals

Four pins will be allocated for the FRU information on the Power Supply connector. One pin is the serial clock (SCL). The second pin is used for serial data (SDA). Three pins are for address lines A0-A1 to indicate to the power supply's EEPROM which position the power supply is located in the system. The SCL and SDA signals are pulled up by system, the address lines are also pulled up by system.

Table 26: FRU Signals

A1	A0	EEPROM	µP	PSU
0	0	A0	B0	1
0	1	A2	B2	2
1	0	A4	B4	3
1	1	A6	B6	4

11.4 Data Formats

The data format for current, voltage, power, temperature, and fan speed shall use the PMBus Literal format.

Literal data format: X = Y · 2^N

X = the sensor value in volts, amps, watts, degrees C, or RPM

Y = mantissa

The mantissa is the variable components that changes as the sensor value changes.

Y is a 16 bit unsigned value for the READ_VOUT command. For all other READ commands Y is a 11 bit signed 2's compliment value.

N = exponent. The exponents are fixed for each power supply and define the resolution for each sensor.

11.5 VOUT_MODE

For reading output voltages the power supply shall support the VOUT_MODE command to report the output voltage formatting for the READ_VOUT command. The VOUT_MODE shall be set to Linear and the exponent (N) shall be set to -9.

Table 11: VOUT_MODE settings for reading output voltage(s).

Mode	Bit[7:5]	Bit[4:0]
Linear	000b	10111b(-9)

11.6 PMBus Command Set

Via the PMBus the computer system can communicate with the power supply to access currents, voltages, fan control and speed and temperatures. The communication follows the Power System Management Protocol Specification. As soon as AC Power is connected to the PSU the PMBus functionality must be available.

Following Table shows mandatory PMBus commands to be supported by the PSU.

Table 27: Supported PMBus Command Set

Command Code	Primergy Commands	Read/Write R/W	Number of Data Bytes	Comment
01h	OPERATION	R/W	1	80h=ON, 00h=Off
03h	Clear_Fault	Send Byte	0	
05h	PAGE_PLUS	?		Reserved for NM
20h	VOUT_MODE	R/W	1	
30h	COEFFICIENT	R/W	Block	
3Ah	FAN_CONFIG_1_2	R/W	1	
3Bh	FAN_COMMAND_1	R/W	2	
40h	VOUT_OV_FAULT_LIMIT	R/W	2	
44h	VOUT_UV_FAULT_LIMIT	R/W	2	
45h	VOUT_UV_FAULT_RESPONSE	R/W	1	
46h	IOUT_OC_FAULT_LIMIT	R/W	2	
47h	IOUT_OC_FAULT_RESPONSE	R/W	1	
48h	IOUT_OC_LV_FAULT_LIMIT	R/W	2	
49h	IOUT_OC_LV_FAULT_RESPONSE	R/W	1	
4Ah	IOUT_OC_WARN_LIMIT	R/W	2	
51h	OT_WARN_LIMIT	R/W	2	Vendor specified
5Bh	IIN_OC_FAULT_LIMIT	R/W	2	Value depends on the input voltage
5Ch	IIN_OC_FAULT_RESPONSE	R/W	1	
5Dh	IIN_OC_WARN_LIMIT	R/W	2	Value depends on the input voltage
6Ah	POUT_OP_WARN_LIMIT	R/W	2	
6Bh	PIN_OP_WARN_LIMIT	R/W	2	Value depends on the input voltage
79H	STATUS_WORD	R/W	2	
(Low)7	BUSY			
6	OFF			
5	VOUT_OV_FAULT			
4	IOUT_OC			
3	VIN_UV			
2	TEMPERATURE			
1	CML			
0	NON OF THE ABOVE			
(High)7	VOUT			
6	IOUT/POUT			

5	INPUT			
4	MFR_SPECIFIC			
3	POWER_GOOD#			
2	FANS			
1	OTHER			
0	UNKNOWN			
7Ah	STATUS_VOUT	R/W	1	
7	VOUT_OV_FAULT			
4	VOUT_UV_FAULT			
7Bh	STATUS_IOUT	R/W	1	
7	Iout OC fault			
5	Iout OC warning			
1	Pout OP fault			
0	Pout OP warning			
7Ch	STATUS_INPUT	R/W	1	
5	Vin UV warning			
4	Vin UV fault			
3	Unit off for insufficient input			
1	Iin OC warning			
0	Pin OP warning			
7Dh	STATUS_TEMPERATURE	R/W	1	
7	OT fault			
6	OT warning			
7Eh	STATUS_CML	R/W	1	
81h	STATUS_FANS_1_2	R/W	1	
7	Fan 1 fault			
5	Fan1 warning			
88h	READ_VIN	R	2	
89h	READ_IIN	R	2	
8Bh	READ_VOUT	R	2	
8Ch	READ_IOUT	R	2	
8Dh	READ_TEMPERATURE_1	R	2	Ambient
8Eh	READ_TEMPERATURE_2	R	2	Hotspot
8Fh	READ_TEMPERATURE_3	R	2	
90h	READ_FAN_SPEED_1	R	2	
96h	READ_POUT	R	2	
97h	READ_PIN	R	2	
98h	PMBUS_REVISION	R	1	

99h	MFR_ID	R/W	Variable	
9Ah	MFR_MODEL	R/W	Variable	
9Bh	MFR_REVISION	R/W	Variable	
9Ch	MFR_LOCATION	R/W	Variable	
9Dh	MFR_DATE	R/W	Variable	
9Eh	MFR_SERIAL	R/W	Variable	
A0h	MFR_VIN_MIN	R	2	
A1h	MFR_VIN_MAX	R	2	
A2h	MFR_IIN_MAX	R	2	Value depends on the input voltage
A3h	MFR_PIN_MAX	R	2	Value depends on the input voltage
A4h	MFR_VOUT_MIN	R	2	
A5h	MFR_VOUT_MAX	R	2	
A6h	MFR_IOUT_MAX	R	2	
A7h	MFR_POUT_MAX	R	2	
A8h	MFR_TAMBIENT_MAX	R	2	
AAh	MFR_EFFICIENCY_LL	R/W	14	At 10%%20%/50%/100% load
ABh	MFR_EFFICIENCY_HL	R/W	14	At 10%%20%/50%/100% load
D0h	READ_EIN	R	2	
D1h	SMBAlert_MASK	R/W	1	
D2h	LPO_CONFIG	R/W	1	
D3h	MFR_TAMBIENT_MAX	R	1	Reserved for NM
D4h	MFR_TEMP2_MAX	R	1	Reserved for NM
D5h	READ_FAN_CURRENT	R	2	
D6h	SLEEP	R/W	1	80h=ON, 00h=Off
D7h	FIRMWARE_REVISION	R	2	
D8H	MFR_EIN_Max	R	2	Reserved for NM
D9h	MASK_IOUT_OC_WARN	R/W	1	
DAh	MASK_IOUT_OC_FAULT	R/W	2	
DBh	READ_EOUT	R	2	Must be clarified
DFh	PIN_OP_FAULT_LIMIT	R/W	2	Value depends on the input voltage
E0h	PIN_OP_FAULT_RESPONSE	R/W	1	
E1h	READ_FAN_POWER	R	2	
E3h	ERROR_LED_ON_OFF	R/W	1	80h=ON, 00h=Off
FCh	SMART_ON_CONFIG	R/W	1	

11.6.1 PMBus Temperature Read Commands

The following temperature read commands as documented by the PMBus specification Part II version 1.1 should be supported.

- READ_TEMPERATURE_1, should provide the PSU inlet temperature.
- READ_TEMPERATURE_2, should provide the temperature of the assumed hottest
- point in the PSU.

11.6.2 MFR_EFFICIENCY_LL

The MFR_EFFICIENCY_LL command sets or retrieves information about the efficiency of the device while operating at a low line condition. Not including the PEC byte, if used, and the byte count byte, there are fourteen data bytes as described below.The efficiency is specified at one input voltage and three data points consisting of output power and the efficiency at that output power. The three power ratings are typically referred as low, medium and high output power and are transmitted in thatorder. For example, the low, medium and high output power mightcorrespond to 10%， 20%,50% and 100% of the rated output power. The exact values at which the power is specified is left to the PMBus device manufacturer.Each value (voltage, power or efficiency) is transmitted as two bytes in Linear format.

Table 28: MFR_EFFICIENCY_LL

Byte Number	Byte Order	Description
0	Low Byte	The input voltage, in volts, at which the low line efficiency data is applicable. Note that byte 0 is the first data byte transmitted as part of the block transfer.
1	High Byte	
2	Low Byte	Power, in watts, at which the low power efficiency is specified
3	High Byte	
4	Low Byte	The efficiency, in percent, at the specified low power.
5	High Byte	
6	Low Byte	Power, in watts, at which the low power efficiency is specified
7	High Byte	
8	Low Byte	The efficiency, in percent, at the specified low power.
9	High Byte	
10	Low Byte	Power, in watts, at which the medium power efficiency is specified
11	High Byte	
12	Low Byte	The efficiency, in percent, at the specified medium

13	High Byte	power.
14	Low Byte	Power, in watts, at which the high power efficiency is specified
15	High Byte	
16	Low Byte	The efficiency, in percent, at the specified high power. Note that byte 13 is the last data byte transmitted as part of the block transfer.
17	High Byte	

11.6.3 MFR_EFFICIENCY_HL

The MFR_EFFICIENCY_HL command sets or retrieves information about the efficiency of the device while operating at a high line condition. Not including the PEC byte, if used, and the byte count byte, there are fourteen data bytes as described below. The efficiency is specified at one input voltage and three data points consisting of output power and the efficiency at that output power. The three power ratings are typically referred as low, medium and high output power and are transmitted in that order. For example, the low, medium and high output power might correspond to 10%, 20%,50% and 100% of the rated output power. The exact values of the output power is specified is left to the PMBus device manufacturer. Each value (voltage, power or efficiency) is transmitted as two bytes in linear format.

Table 29:MFR_EFFICIENCY_HL

Byte Number	Byte Order	Description
0	Low Byte	The input voltage, in volts, at which the high line efficiency data is applicable. Note that byte 0 is the first data byte transmitted as part of the block transfer.
1	High Byte	
2	Low Byte	Power, in watts, at which the low power efficiency is specified
3	High Byte	
4	Low Byte	The efficiency, in percent, at the specified low power.
5	High Byte	
6	Low Byte	Power, in watts, at which the low power efficiency is specified
7	High Byte	
8	Low Byte	The efficiency, in percent, at the specified low power.
9	High Byte	
10	Low Byte	Power, in watts, at which the medium power efficiency is specified
11	High Byte	
12	Low Byte	The efficiency, in percent, at the specified medium power.
13	High Byte	
14	Low Byte	Power, in watts, at which the high power efficiency is

15	High Byte	specified
16	Low Byte	The efficiency, in percent, at the specified high power. Note that byte 13 is the last data byte transmitted as part of the block transfer.
17	High Byte	

11.6.4 PMBus Commands accuracy

Table 30 : Power commands accuracy

	Required Accuracy (+/-x% of reading)(Vin range=(100Vac~127Vac) or (200Vac~240Vac)or(180Vdc~300Vdc)		
Output Loading condition	<10%	10%~20%	>20%~100%
READ_VIN(88h)	+/-5%	+/-5%	+/-5%
READ_IIN(89h)	No spec	+/-5% or +/-0.3A	+/-5% or +/-0.3A
READ_PIN(97h)	No spec	+/-5% or +/-5W	+/-5% or +/-5W
READ_VOUT(8Bh)	+/-5%	+/-5%	+/-5%
READ_IOUT(8Ch)	No spec	+/-10%	+/-5%
READ_POUT(96h)	No spec	+/-10%	+/-5%

12.Smart On Function

12.1 PMBus command for Smart On

12.1.1 Powering on Smart Standby supplies to maintain best efficiency

Power supplies in Smart Standby state shall monitor the shared voltage level of the load share signal to sense when it needs to power on. Depending upon which position (1, 2, or 3) the system defines that power supply to be in the Smart Standby configuration; will slightly change the load share threshold that the power supply shall power on at.

12.1.2 Configuring Smart On with SMART_ON_CONFIG (D0h)

The PMBus manufacturer specific command MFR_SPECIFIC_00 is used to configure the operating state of the power supply related to Smart On. We will call the command SMART_ON_CONFIG (D0h). Below is the definition of the values used with the Read-Write Byte SMBus protocol with PEC.

SMART_ON_CONFIG (D0h)		
Value	State	Description

00h	Standard Redundancy (default power on state)	Turns the power supply ON into standard redundant load sharing mode. The power supply's SRED_OK# signal (pin54, IC703) will always keep high to pull the SMART_ON# (pin35, IC703)low make sure no other PSU enter Smart_On mode.
01h	Smart On Active	Defines this power supply to be the one that is always ON in a Smart On configuration. The power supply's SRED_ACTIVE# (pin55, IC703) will set low to pull the SMART_ON# (pin35, IC703) up.
02h	Smart Standby 1	Defines the power supply that is first to turn on in a cold redundant configuration as the load increases.
03h	Smart Standby 2	Defines the power supply that is second to turn on in a cold redundant configuration as the load increases.
04h	Smart Standby 3	Defines the power supply that is third to turn on in a cold redundant configuration as the load increases.
05h - FFh	reserved	

The default state of power supply is in Standard Redundancy mode. Power supply need to be re-specified a state whenever initial power on or any power supply in the system is in fault situation.
The SMART_ON_CONFIG command will reset to 00h (Standard Redundancy) when any fault or over current happened. The faults include AC loss, over hot spot temperature, over ambient temperature, +12V short internally (under voltage), +12V over voltage, fan locked.

12.1.3 Powering on Smart Standby supplies during a fault or over current condition

Some warnings happen or 12V output shutdown due to any fault will cause SRED_OK# driven low. When an active power supply asserts its SRED_OK# signal, all parallel power supplies in Smart Standby mode shall power on immediately.

The trigger condition:

1. 12V OC warning/ fault happens
2. 12V OVP fault
3. 12V UVP (lower than 11V)
4. OTP warning/ fault
5. fan speed warning/ fault
6. AC loss (lower than 75V +/-5V)
7. send 00h to PMBus D0h command

When an active power supply asserts its SRED_OK# signal, all parallel power supplies in Smart Standby mode shall power on immediately.

13 Environment Condition

13.1 Airflow Requirements

The power supply shall incorporate a single rotor fan (40x28mm) for cooling the power supply when installed in the system. The airflow direction shall be from the card edge connector side to the AC inlet side of the power supply. The fan speed is controlled by the power supply but the system can increase the fan speed via a PMBus command.

13.2 Temperature

Table 31: Temperature

Description	Min	Max
Operating temperature range	0°C	50°C
Non-operating temperature range	-40°C	70°C

13.3 Humidity

Operating: To 85% relative humidity (non-condensing)
Non-Operating: To 95% relative humidity (non-condensing)
NOTE: 95% relative humidity is achieved with a dry bulb temperature of 55°C and a wet bulb temperature of 54°C.

13.4 Altitude

Operating: to 5000 m
Non-operating: to 15200 m

13.5 Mechanical Shock

Non-operating: 50 G Trapezoidal Wave, Velocity change = 170 in. / sec.
Three drops in each of six directions are applied to each of the samples.

13.6 Random Vibration

Non-operating
Sine sweep:
5Hz to 500Hz @ 0.5gRMS at 0.5 octave/min; dwell 15 min at each of 3 resonant points;
Random profile:
5Hz @ 0.01g²/Hz to 20Hz @ 0.02g²/Hz (slope up); 20Hz to 500Hz @ 0.02g²/Hz (flat);
Input acceleration = 3.13gRMS; 10 min. per axis for 3 axis on all samples

13.7 Thermal Shock (Shipping)

Non-operating: -40°C to +70°C, 50 cycles, 30°C /min.≥transition time≥15°C /min., duration of exposure to temperature extremes for each half cycle shall be 30 minutes.

14 Housing

For future successors with same dimensions and to avoid fool proof, the PSU has a mechanical coding. To avoid a hot surface of the handle, the handle is covered by plastic or contents of plastic.

15 Agency Requirements

Table 30: Agency Requirements

Protection class:	I
Safety requirements:	UL/CSA 60950-1 March 2007 IEC60950-1 December 2005 EN 60950-1; 2006
Approvals and Logos:	TÜV (NEMKO) CB-Report+ all national deviations CSA/UL-Report+ certificate BSMI-Certificate CCC-Certificate (not mandatory if power is >1300W) KC mark
RFI Emission: Radiated: 30…6000MHz Conducted: 0.15…30MHz	EN55022:2006 (CISPR22:2005): Class A Limits Must comply at 100V-127V / 50Hz, 60Hz 200V-240V / 50Hz, 60Hz (requirement CISPR22 covers also FCC, CSA, VCCI, BSMI, C-tick)
PFC, Harmonic current	EN 61000-3-2 2006 JEIDA (Japanese Standard)
Electro Magnetic fields	EN 50371 03/2002
Flicker	EN 61000-3-3: 1995, A1:2001,A2:2005
Immunity against:	EN55024: 1998 + A1: 2001 + A2: Jan 2003
-Radiated field strength:	EN 61000-4-2 min 8kV contact discharge min 8kV air discharg (additional all conductive parts)

-Electrostatic discharge:	EN 61000-4-3 min 3V/m
-Fast transients:	EN 61000-4-4 min 2kV AC input lines min 1kV on data lines
-Surge voltage:	EN 61000-4-5 common mode 2kv, differential mode 1kv : operating common mode 4kv, differential mode 2kv : can auto restart
-Immunity to ratio frequency common mode	EN 61000-4-6 3V; 0.15-80MHz ; 80% AM (1KHz) Performance criteria A
-Immunity to power frequency magnetic field	EN 61000-4-8 50Hz 1A/m Performance criteria A
The power supply must be RoHS6 compliant.	

16 Reliability and Quality

16.1MTBF

The power supply has a minimum MTBF of 200.000h at 100% load and 50°C, as calculated by Bellcore RPP or 400.000h demonstrated at 100% load and 50°C.

16.1.1Capacitors

All electrolytic caps must be 105°C types. All used electrolytic caps must have a useful life time which exceeds 44.000h at 100% load and 50°C power supply ambient temperature (24h/day operation).

16.1.2 Fans

The used fan must have a L10 lifetime of 45.000h at 50°C ambient temperature of the power supply with 100% load at PSU.

16.2 Catastrophic Failure Protection

Power supply circuit design and components specified in the same shall be such that should a component failure occur, the power supply shall not exhibit: flame, excessive smoke, charred PCB, fused PCB conductors and starting noise.

16.3 Boost Voltage

Power supply's boost power factor circuit shall protect against bulk capacitor over voltage due to boost control circuit or component failure. When a boost over voltage condition is detected, the output shall turn off and remain turn off until the AC mains power is removed for 30seconds then reapplied.

17 Glossary of terms and abbreviations

Table 31: Terms and abbreviations

Term or abbreviation	Description
BMC	Board Management Controller
BOM	Bill of Material
BSMI	BUREAU OF STANDARDS, METROLOGY AND INSPECTION (Taiwan)
CCC	China Compulsory Certification
CE	Conformance European
CFM	Cubic Feet per Minute (airflow unit)
CSA	Canadian Standards Association
EN	European Norm
FRU	Field Replaceable Unit
IEC	International Electrotechnical Commission
KV	Kilo Volt
MTBF	Mean Time Between Failure
PA	Pascal (pressure unit)
PCB	Printed Circuit Board
PMBus	Power Management Bus
ppm	Parts per million
PSU	Power Supply Unit
RoHS	Restriction of the use of certain hazardous substances in electrical and electronic equipment
RPP	Reliability Prediction Procedure (Bellcore)
PMBUS_SCL	Serial Clock
PMBUS_SDA	Serial Data
SMbus	System Management Bus

SN	Siemens Norm
TBD	To be Defined
UL	Underwriters Laboratories Inc.
MFR	Manufacturer