

1 General

This specification defines the functional parameters for common redundant power supply (SLIM TYPE) in the same form factor that offers different output power category (450 W) and efficiency (Platinum Plus) for IT system application (server, storage, networking, etc). The power supply supports two DC output rails: 12V (+12V) and 5V standby (+5VSB). The AC input is designed to support auto ranging feature and with power factor corrected.

2 Mechanical Overview

The physical size of the power supply family is 40 (H) x 50.5 (W) x 150 (L) in milli-meter which is defined as the SLIM TYPE, type respectively. The AC power cord plugs directly into the external face of the power supply. Refer to the SLIM TYPE mechanical drawing.

2.1 DC Output Connector

Each pin of the connector shall be defined in terms of Pin number, Signal Name, length of Pins,

Table 1 Output Pin Out Assignment

Pin #	Signal Name	Pin length/cable length
S1	+12VRS+	Normal
S2	+12VRS-	Normal
S3	12LS	Normal
S4	SMB_ALERT	Normal
S5	SDA	Short
S6	SCL	Short
S7	PSKILL	Short
S8	PSON	Short
S9	PWOK	Normal
S10	A1	Normal
S11	5VSB	Normal
S12	5VSB	Normal
S13	SMART_ON	Normal
S14	PRESENT	Normal
S15	A0	Normal
S16	N/A	Normal
S17	N/A	Normal
S18	N/A	Normal
S19	AC OK	Normal
S20	N/A	Normal
S21	N/A	Normal
S22	N/A	Normal
S23	5VSB	Normal
S24	5VSB	Normal
P1	+12V	Normal
P2	+12V	Normal
P3	SGND	Normal
P4	SGND	Normal

Note: S19 are optional signals for AC OK respectively.

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2.2 Airflow Direction

The power supply is designed for supporting bi-airflow directions cooling purpose. The normal airflow means the air enters the PSU at DC output side and exits through the AC inlet side.

2.3 LED Marking and Identification

The power supply has a single Bi-Color (Green-Amber) configuration.

The indicator LED in power supply module next to the Handle.

This LED shall have these kinds of status table as below:

Table 2 LED Characteristics

POWER SUPPLY CONDITION	Power supply LED status	
	GREEN LED	AMBER LED
PSU STATUS		
No AC power to this PSU only.	OFF	OFF
AC present /Only internal standby outputs.	1 SEC ON 1SEC OFF	OFF
Power supply DC outputs on and OK.	ON	OFF
Power supply in warning state. (Output OCW and OTW, PSU warning etc.)	OFF	1 SEC ON 1SEC OFF
Power supply in abnormal state. (Fan speed abnormal, Output OVP, OCP, SCP and OTP, PSU abnormal etc.)	OFF	ON
AC power lost or AC power cord unplugged; with another PSU still with AC input power in 1+1 mode.	OFF	ON
PSU in smart standby mode	1 SEC ON 1SEC OFF	OFF



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3 AC Input

3.1 Power Factor

The power factor shall meet the requirements which stated in the Energy Star® Program Requirements for Computer Servers. Table 3 shown the power supply power factor limits which according the Generalized Internal Power Supply Efficiency Testing Protocol Rev 6.7 at 230Vac, 50/60Hz and 115Vac, 60Hz conditions.

Table 3 Power Factor Limits

Load Condition	20% Load	50% Load	100% Load
Min. PF	0.8	0.95	0.99

3.2 N/A

N/A

3.3 AC Inlet Connector

The AC input connector shall be an IEC 320 C-14, 10A/250Vac rated power inlet.

3.4 AC Input Voltage

The power supply will operate over the range and limits shown in Table 5:

Table 5 AC Input Voltage Range

Parameter	Minimum	Nominal	Maximum	Unit
Vin (voltage)	90	100-240V	264	Vac
Vin (frequency)	47	50/60	63	Hz
Vin (turn-on)	81	85	89	Vac
Vin (turn-off)	73	78	83	Vac

Table 6 shown the max. loading limits under AC line Brown-in/out conditions over different PSU category.

NOTE : Maximum brown-out loading shall decrease to 400W if operating temperature is above 45C.

Table 6 Max. Brown-in/out Loading Limits

PSU Category	Max. Brown-in/out Loading
450W	100%

3.5 AC Line Dropout / Holdup Time

An AC line dropout is defined to be when the rated AC input drops to 0Vac at any phase of the AC line for any length of time. During an AC dropout the power supply shall meet dynamic voltage regulation limits. An AC line dropout of any duration shall not cause tripping of control signals or protection circuits. If the AC dropout lasts longer than the hold up time, the power supply will recover and meet all turn on sequences. The power supply shall meet the AC dropout limits over rated AC voltages and frequencies shown in Table 7. A dropout of the AC line for any duration shall not cause damage to the power supply.

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Table 7 AC Line Dropout / Holdup Time limits

PSU Category	70% Load	100% Load
450W	>20 msec	>10 msec

3.6 AC Line Fuse

The power supply incorporates a fast blow type fuse at AC input side. AC inrush current and all protection circuits in the power supply shall not cause the AC line fuse to blow under any condition unless a component in the power supply has failed.

Note : The AC line fuse could choose low I2t type for specified requirement (optional).

3.7 AC Inrush

When input power is applied to the power supply and any initial current surge or spike of 10ms or less shall not exceed 30A peak at cold start. The PSU shall meet this inrush limit for any rated AC voltage, during turn ON at any phase of AC voltage and over the specified temperature range. Inrush current caused by x- or y-caps is not considered.

3.8 AC Line Transient Specification

AC line transient conditions shall be defined as “sag” and “surge” conditions. “Sag” 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.

Table 8 and Table 10 define the power supply performance under the following AC line sag and surge conditions. Table 9 defines the power supply loading conditions when performing AC line sag tests.

Table 8 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%	Rated AC Voltage ranges	50/60Hz	No loss of function or performance
> 1 AC cycle	>30%	Rated AC Voltage ranges	50/60Hz	Loss of function acceptable, self recoverable

Table 9 AC Line Sag Test Condition

PSU Category	Max. Load (%)
450W	100

Table 10 AC Line Surge Transient Performance

AC Line Surge (10sec interval between each surging)				
Duration	Surge	Operating AC Voltage	Line Frequency	Performance Criteria
Continuous	10%	Rated AC Voltages	50/60Hz	No loss of function or performance
0 to 1/2 AC cycle	30%	Mid-point of rated AC Voltages	50/60Hz	No loss of function or performance

3.9 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.

4 Efficiency



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Table 11 shown the minimum efficiency of the power supply and according to the proportional loading method defined by 80 Plus in Generalized Internal Power Supply Efficiency Testing Protocol Rev 6.7 at 230Vac and 25°C condition.

Table 11 PSU Efficiency

Efficiency	20% Load	50% Load	100% Load
Platinum Plus	91%	94%	93%

5 DC Output

5.1 Output Currents

Table 12 and defines the power supply output current limits. The power supply shall meet both static and dynamic voltage regulation limits for all conditions unless otherwise specified. No damaged shall be occurred under no load condition. Protection circuits shall stay active and shall not disable the power supply.

Table 12 Output Currents Limits

PSU Category	+12V	+5VSB	Units
	90~264Vac		
450W	37.5	3	A

5.2 Standby Output

The +5VSB output shall present when AC input greater than the power supply start up voltage.

5.3 Voltage Regulation

The power supply output voltages must stay within the following voltage limits when operating at steady state and dynamic loading conditions. These limits include the peak-peak ripple/noise. These shall be measured at the output connectors.

Table 13 Voltage Regulation Limits

PARAMETER	TOLERANCE	MIN	NOM	MAX	UNITS
+12V	- 5% / +5%	+11.40	+12.00	+12.60	V _{rms}
+5VSB	- 5% / +5%	+4.75	+5.00	+5.25	V _{rms}

5.4 Dynamic (step) Loading

The output voltages have remain within limits specified in Table 14 for the step loading and capacitive loading. The load transient repetition rate shall be tested between 50Hz and 5KHz at duty cycles ranging from 10% to 90%.

Table 14 Step Load Limits

Output	Δ Step Load Size	Load Slew Rate	Test with Capacitive Load
+5VSB	1.0A	0.5 A/μsec	250 μF
+12V	60% of max load	0.5 A/μsec	2200 μF

Note: The min. load for the test condition on +12V rail shall be 1A.

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5.5 Capacitive Loading

The power supply shall be stable and meet all limits with the following capacitive loading ranges which shown in Table 15.

Table 15 Capacitive Loading Conditions

Output	MIN	MAX	Units
+5VSB	47	1000	μF
+12V	2200	30,000	μF

5.6 Grounding

The output ground (GND) 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 is provided with a reliable protective earth ground. All secondary circuits is connected to protective earth ground. Resistance of the ground returns to chassis shall not exceed 1.0 mΩ.

5.7 Closed loop stability

The power supply is unconditionally stable under all line/load/transient load conditions including capacitive load ranges specified in Section 5.6. Under full load condition with minimum of 45 degrees phase margin and 10dB gain margin is designed.

5.8 Residual Voltage Immunity in Standby mode

The power supply is immune to any residual voltage placed on its outputs (Typically a leakage voltage through the system from standby output) up to 500mV.

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.

5.9 Common Mode Noise

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

5.10 Soft Starting

The power supply contains a 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.

5.11 Hot Swap

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 will remain within the limits with the capacitive load specified. The hot swap test conducted while the system is operating under static, dynamic, and zero loading conditions. The power supply used a latching mechanism to prevent insertion and extraction of the power supply when the AC power cord is inserted into the power supply.

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5.12 Load Sharing

The +12V output has active load sharing function by tying all of 12VLS signals together. To support active load sharing, all the remote sense pins (+12VRS+ and +12VRS-) of power supplies must be placed at the same point on +12V and return path at system side. The supplies shall be able to load share in parallel and operate in a hot-swap / redundant configurations with load share within 5% at full load. The failure of a power supply will not affect the load sharing or output voltages of the other supplies still operating.

The +5VSB output is without actively share current between power supplies (passive sharing). The +5VSB output of the power supplies are connected together in the system so that a failure or hot swap of a redundant power supply does not cause these outputs to go out of regulation in the system. +5VSB current sharing performance depends on the placement on system side. System side shall evaluate this performance when system +5VSB loading over one single PSU's max. loading.

The % of current share error is defined as follows for 1+1 power supplies:

$$\%Error = 100 \times (PS1 \text{ current} - PS2 \text{ Current}) / (PS1 \text{ current} + PS2 \text{ Current})$$

The same formula can be extended for N+1 (maximum N=3) power supplies operating in parallel as follows:

$$\%Error = 100 \times (\text{Max. PSU current} - \text{Min. PSU current}) / (\text{Max. PSU Current} + \text{Min. PSU current})$$

In paralleling mode, the system loading shall be gradually increased to the specified max. rating. It should not be greater than one single PSU's max. loading before PWOK asserted during turn on period, and the following step loading (include start-up, AC-off and hot- swap).

5.13 Ripple / Noise

The maximum output ripple/noise of the power supply is defined in Table 16.

This is measured over a bandwidth of 10Hz to 20MHz at the power supply output connectors and with a minimum capacitive loading (refer to Table 16) on each of output. A 10 μ F ceramic capacitor in parallel with a 0.1 μ F ceramic capacitor is placed at the point of measurement.

Table 16 Ripple and Noise

PSU Category	+12V	+5VSB
450W	120mVp-p	50mVp-p

Note: The minimum load for the test condition on + 12V rail shall be 1A.

5.14 Timing

Figure 2 and Table 17 define the timing sequence when power supply being turned on and off via the AC input, with PSON# held low and via the PSON# signal, with the AC input applied. $T_{\text{vout_rise}}$ is defined when the output voltages are rise from 10% to within regulation limits. Both +12V and +5VSB outputs shall rise monotonically.

Figure 2 Turn On/Off Timing

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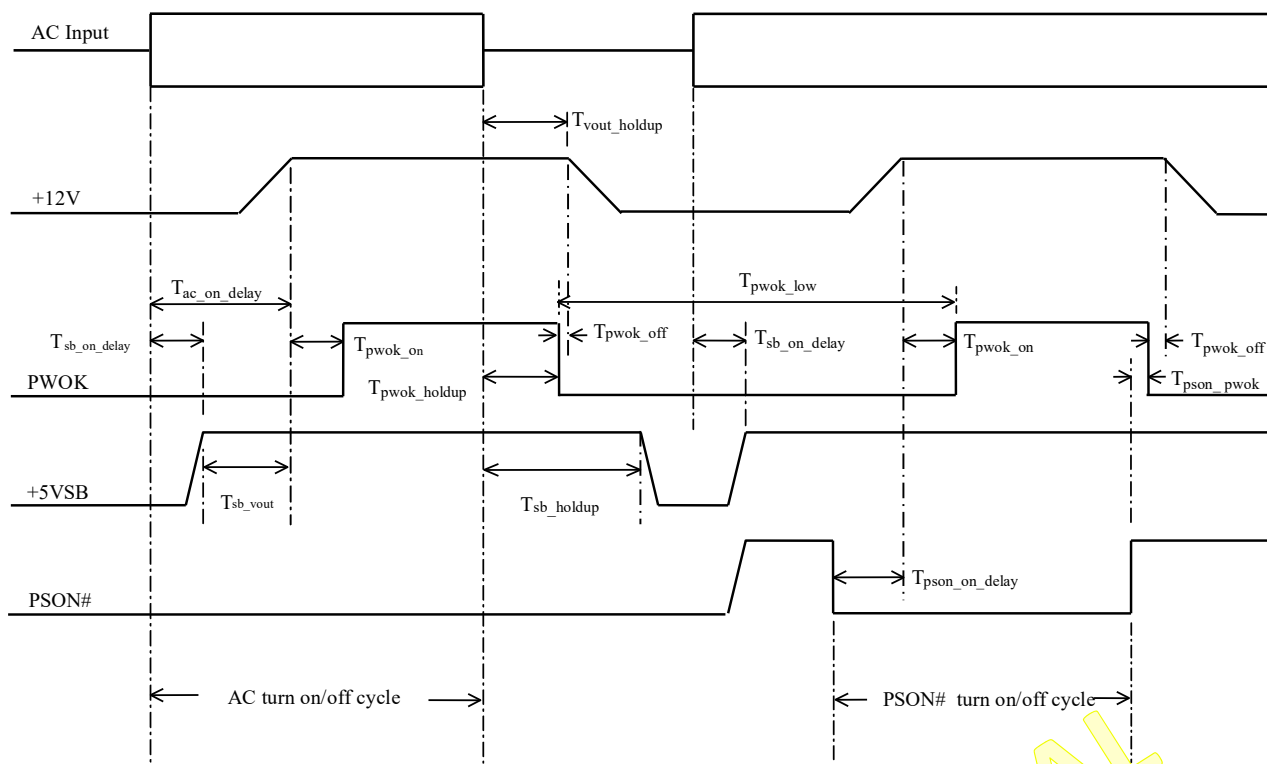


Table 17 Power Supply Timing

Item	Description	Min.	Max.	Units
Tvout_rise	Output voltage rise time for +12V	5	50	msec
	Output voltage rise time for +5VSB	1	25	msec
Tsb_on_delay	Delay from AC being applied to +5VSB being within regulation		1500	msec
Tac_on_delay	Delay from AC being applied to all output voltages being within regulation		2000	msec
Tvout_holdup	Time +12V output voltage stay within regulation after loss of AC	11		msec
Tpwok_holdup	Delay from loss of AC to de-assertion of PWOK	10		msec
Tpson_off_delay	Delay from PSON# de-asserted to power supply turning off		5	msec
Tpson_on_delay	Delay from PSON# active to output voltages within regulation limits	5	400	msec
Tpson_pwok	Delay from PSON# deactivate to PWOK being de-asserted		5	msec
Tpwok_on	Delay from output voltages within regulation limits to PWOK asserted at turn on	100	500	msec
Tpwok_off	Delay from PWOK de-asserted to output voltages dropping out of regulation limits	1		msec
Tpwok_low	Duration of PWOK being in the de-asserted state during an off/on cycle using AC or the PSON signal	100		msec
Tsb_vout	Time the +5VSB output voltage stays within regulation at AC turn on	50	1000	msec
Tsb_holdup	Time the +5VSB output voltage stays within regulation after loss of AC	70		msec



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6 Protection Circuits

Protection circuits inside the power supply shall cause only the power supply's main outputs to shutdown. If the power supply latches off due to a protection circuit tripping, an AC cycle OFF for 15sec and a PSON# cycle HIGH for 1sec shall be able to reset the power supply.

6.1 Current Limit (OCP)

The power supply shall have current limit to prevent the outputs from exceeding the values shown in table below. If the current limits are exceeded the power supply shall shutdown and latch off. The latch will be cleared by toggling the PSON# signal or by an AC power interruption. The power supply shall not be damaged from repeated power cycling in this condition. +5VSB will be auto-recovered after removing OCP limit.

Table 18 Over Current Protection

Output	Over Current Limits	OCP Delay Timing Limits
+12V	120~140 (%)	30~200 msec
+5VSB	120~200 (%)	>2 msec (Shutdown, Hiccup mode)

6.2 N/A

N/A

6.3 Over Voltage Protection (OVP)

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 19 when measured at the power connectors 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. +5VSB will be auto-recovered after removing OVP limit.

Table 19 Over Voltage Protection (OVP) Limits

Output Voltage	Min. (V)	Max. (V)
+12V	13.2	14.5
+5VSB	5.5	6

6.4 Over Temperature Protection (OTP)

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 shutdown. When the power supply temperature drops to within specified limits, the power supply shall restore power automatically, while the +5VSB remains always on. The OTP circuit has built in a margin such that the power supply will not oscillate on and off due to temperature recovering condition. The OTP trip level shall have a minimum of 4°C of ambient temperature margin.

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7 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

7.1 PSON# Input Signal (Pin S8)

The PSON[#] signal is required to remotely turn on/off the power supply. PSON[#] is an active low signal that turns on the +12V power rail. When this signal is not pulled low by the system, or left open, the outputs (except the +5VSB) turn off. This signal is pulled to an internal +3.3V by a 20kΩ pull-up resistor in the power supply. Refer to Figure 10 and Table 16 for the PSON[#] signal characteristics.

Figure 3 PSON# Signal Characteristics

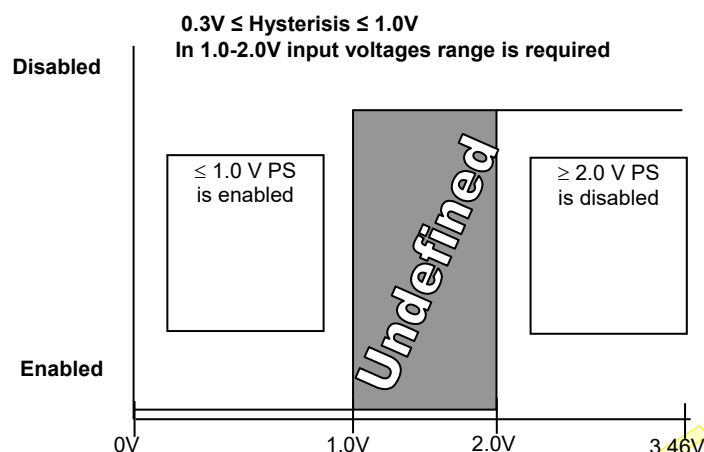


Table 27 PSON# Signal Characteristics

Signal Type (Active Low)	Accepts an open collector/drain input from the system. Pull-up to +3.3V located in power supply.	
PSON# = Low	ON	
PSON# = High or Open	OFF	
	Min.	Max.
Logic level low (power supply ON)	0V	1.0V
Logic level high (power supply OFF)	2.0V	3.46V
Source current, PSON# = Low		4mA

7.2 PWOK (Power OK, Pin S9)

PWOK is a power OK signal and will be pulled HIGH by the power supply to indicate that +12V output is within the regulation limits of the power supply. When 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-

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asserted to a LOW state. The start of the PWOK delay time shall inhibited as long as +12V output is in current limit. Refer to Table 28 for the PWOK signal characteristics.

Table 28 PWOK Signal Characteristics

Signal Type	Output from power supply. Pull-up to +3.3V 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, Isource=2mA	2.4V	3.46V
Source current, PWOK = High		2mA
PWOK rise and fall time		100μsec

7.3 +12VRS- (Return Remote Sense, Pin S2)

The power supply has return remote sense (+12VRS-) to regulate out ground drops in the system for the main output voltage. The return remote sense is able to regulate out a maximum of 200mV of drop on the ground output. Refer to Sec. 5.12 Load Sharing.

7.4 +12VRS+ (+12V Remote Sense, Pin S1)

The power supply uses +12V remote sense (+12VRS+) to regulate out +12V drops in the system for the main output voltage. The +12V remote sense is able to regulate out a maximum of 200mV of drop on the +12V output. Refer to Sec. 5.12 Load Sharing.

7.5 Present (Pin S14)

This signal is an active low type signal and is connected to the power supply's output ground internally. The mating pin of this signal in system side should have a pull-up resistor which limit the max. current <4mA to go through from this signal pin to the power supply. A LOW state on this signal indicates the PSU is physically presents.

7.6 PS_KILL (Pin S7, Optional)

The purpose of the PS_KILL pin is to enhance for hot swapping of the power supply. The PS_KILL pin on the power supply is shorter than the other signal pins. When a power supply is operating in parallel with other power supplies and then extracted from the system, the PS_KILL pin will quickly turn off the power supply main output +12V and prevent arcing of the DC output contacts. When the PS_KILL signal pin is not pulled down or left opened (power supply is extracting from the system), the power supply shuts down regardless of the condition of the PSON# signal. The mating pin of this signal in the system should be tied to ground. Internal to the power supply, the PS_KILL pin is connected to an internal +3.3V voltage through a 10kΩ pull-up resistor. Upon receiving a LOW state signal at the PS_KILL pin, the power supply will be allowed to turn on via the PSON# signal. A LOW state on this pin by itself will not turn on the power supply +12V output. Table 30 shown the PS_KILL signal characteristics.

Table 30 PS_KILL Signal Characteristics

Singal States	+12V
PS_KILL = LOW, PSON# = LOW	ON
PS_KILL = HIGH or OPEN, PSON# = LOW	OFF
PS_KILL = LOW, PSON# = HIGH or OPEN	OFF

7.7 SDA (Pin S5)

SMBus Data: A 10kΩ pull-up resistor pulled to internal +3.3V in the PSU.

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Date	Drawn	Design (EE)	Design (ME)	DOCUMENT NAME. :	REV.
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7.8 SCL (Pin S6)

SMBus Clock: A 10k Ω pull-up resistor pulled to internal +3.3V in the PSU.

7.9 A0 (Pin S15)

Address Bit 0: A 10k Ω pull-up resistor pulled to internal +3.3V in the PSU.

7.10 A1 (Pin S10)

Address Bit 1: A 10k Ω pull-up resistor pulled to internal +3.3V in the PSU.

7.11 +12VLS (Pin S3)

This pin supports an active current sharing function for main output +12V by connecting all the +12VLS signals together. Refer to Sec. 5.12 Load Sharing.

7.12 PMBus Reporting Accuracy

Table 32 define the accuracy under rated AC input ranges.

Table 32 Platinum 450W PMBus Accuracy

	Pin<100W	Pin>100W	
Pin	$\pm 10W$	$\pm 5\%$	
	lin: 0.25~1.2A	lin: >1.2A	
lin	$\pm 0.06A$ (TBD)	$\pm 5\%$	
	10%~20% of Max. Load	20%~50% of Max. Load	50%~100% of Max. Load
Iout	$\pm 5\%$ or $\pm 1A$	$\pm 3\%$	$\pm 2\%$
Pout	$\pm 5\%$ or $\pm 10W$	$\pm 3\%$	$\pm 2\%$
	0%~20% of Max. Load	20%~50% of Max. Load	50%~100% of Max. Load
Vout	$\pm 3\%$	$\pm 3\%$	$\pm 3\%$
Vin	$\pm 5\%$	$\pm 5\%$	$\pm 5\%$

7.13 SMBAlert# Signal (Pin S4)

This is an active low signal and 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, over-current, over-voltage, under-voltage, failed fan. This signal may also indicate the power supply is operating in an environment exceeding the specified limits. A 1k Ω pull-up resistor pulled to +3.3V in the power supply. Refer to Table 29 for the SMBAlert# signal characteristics.

Table 29 SMBAlert# Signal Characteristics

Signal Type (Active Low)	Output from power supply and pulled to internal +3.3V in the power supply.	
PWOK = High	OK	
PWOK = Low	Power Alert to system	
	Min.	Max.
Logic level low voltage, Isink=400uA	0V	0.4V
Logic level high voltage, Isource=2mA	2.4V	3.46V
Sink current, SMBAlert# = Low		4mA
Sink current, SMBAlert# = High		50 μA
Alert# rise and fall time		100 μsec



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7.14 SMART_ON (Pin S13)

This pin is used in the smart on mode control which all of SMART_ON signals should be tied together. When the pin is HIGH in the SMART_ON mode, the slave power supply will enter the Smart Standby mode, and when the pin is LOW in the SMART_ON mode, the Smart Standby mode power supplies will in normal redundancy mode.

7.15 AC OK (Pin S19, optional)

The AC_OK signal indicates that input voltage is applied to the power supply and that the input voltage meets the requirements of section 3.4 within 2ms after the input voltage drop to 0V the output must be driven low. In parallel mode, the AC_OK signal is always low at the power supply that has no line.

8 Environmental Requirements

8.1 Temperature

Operating, refer to Table 33

Table 33 Operating Temperature Ranges

PSU	Input Range	Air Flow Direction	Units
		O/p to I/p	
450W	180V-264V	-5~55	°C
400W	180V-264V	-5~60	°C

PSU	Input Range	Air Flow Direction	Units
		O/p to I/p	
450W	110V-132V	-5~55	°C
400W	90V-110V	-5~55	°C

Non-Operating: (-40) ~ 70°C

8.2 Humidity

Operating: To 85% relative humidity (non-condensing)

Non-Operating: To 95% relative humidity (non-condensing)

8.3 Altitude

Operating: to 5000 m

Non-Operating: to 15000 m

8.4 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.

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8.5 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

8.6 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.

9. Reliability and Safety

9.1 AL (Electrolytic) Cap Life

The power supply shall support 5 year calculated life for following conditions:

- 100Vac and 240Vac input
- Inlet temperature: 50°C
- 80% of max. load

9.2 Mean Time Between Failures (MTBF)

The power supply shall have a minimum MTBF at continuous operation of 200,000 hours at the condition of 230Vac, 80% of max. load, 50°C amb., and as calculated by Telcordia SR332.

9.3 Leakage (Touch) Current

Table 34 defines the max. limits over different PSU category.

Table 34 Leakage Current Limits

PSU Category	Limits	AC Input
450W	<1mA	264Vac/63Hz

Note: When the touch current over 3.5mA in system application, such as N+1 configuration, system side could follow IEC60950 "Equipment with touch current exceeding 3.5mA" Section to get safety approval.

9.4 Product EMC Compliance – Class B

EN55024 - Immunity (Europe)

- EN61000-4-2 Electrostatic Discharge
- EN61000-4-3 Radiated RFI Immunity
- EN61000-4-4 Electrical Fast Transients
- EN61000-4-5 Electrical Surge (DM: +/- 1kV ; CM: +/-2kV)
- EN61000-4-6 RF Conducted
- EN61000-4-8 Power Frequency Magnetic Fields
- EN61000-4-11 Voltage Dips and Interruptions

9.5 Product Safety Compliance

Table 35 defines the safety compliance of power supply.

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Table 35 Safety Compliance

Country	Agency/Mark	Safety & MEC Required	Standard
International	CB certificate and report	Issued by CBTL, TUV	EN 60950-1, EN 62368-1
Germany	TUV	Safety	EN 60950-1, EN 62368-1
Canada	cUL	Safety	CAN/CSA C22.2 No. 60950-1, 62368-1
United States	UL	Safety	UL60950-1, UL62368-1
United States	FCC	EMI	47 CFR FCC Part 15,
Canada	ICES-003	EMI	ICES-003
Taiwan	BSMI	Safety, EMI	CNS14336-1 (safety), CNS13438(EMI)
China	CCC	Safety, EMI	GB4943 (safety) GB 9254 (EMC) GB 17625.1 (Harmonics) (2000m or 5000m requirement)
European Union	CE	Safety, EMI	Low Voltage Directive 2014/35/EU
			EMC Directive 2014/30/EU
			RoHS Directive 2011/65/EU
South Korea	KC mark for Safety	Safety	K 60950-1, K 62368-1
	KC mark for EMI	Safety	KN32; KN35
India	BIS	Safety	IS 13252 (Part 1): 2010,A1,A2

10. FRU Requirements

10.1. FRU Data

The FRU data format shall be compliant with the *IPMI ver.1.0 (per rev.1.1 from Sept.25, 1999)* specification. The following is the exact listing of the EEPROM content. During testing this listing shall be followed and verified.

10.2 FRU Device Protocol

The FRU device will implement the same protocols as the commonly used AT24C02 device, including the Byte Read, Sequential Read, Byte Write, and Page Read protocols.

End of document.

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Mfg Date & Time:					
2021/09/01		09:30:00 AM			
DPS-450AB-24 A FRU MEMORY MAP					
ITEM	ADDRESS	BYTE VALUE (DEC)	BYTE VALUE (hex)	DESCRIPTION	BLOCK TITLE
1	0000H	1	01	FORMAT VERSION NUMBER	COMMON HEADER
2	0001H	0	00	INTERNAL USE AREA OFFSET	
3	0002H	0	00	CHASSIS INFO AREA OFFSET	
4	0003H	0	00	BOARD AREA OFFSET	
5	0004H	1	01	PRODUCT INFO AREA OFFSET	
6	0005H	9	09	MULTI RECORD AREA OFFSET	
7	0006H	0	00	PAD (ALWAYS ZERO)	
8	0007H	245	F5	ZERO CHECK SUM (100H TOTAL BYTES)	
1	0008H	1	01	BOARD AREA FORMAT VERSION	PRODUCT INFORMATION AREA
2	0009H	8	08	BOARD AREA LENGTH (#BYTES / 8)	
3	000AH	25	19	LANGUAGE (ENGLISH)	
4	000BH	197	C5	Manufacturers Name Type/Length	
5	000CH	68	44	D	
6	000DH	69	45	E	
7	000EH	76	4C	L	
8	000FH	84	54	T	
9	0010H	65	41	A	
10	0011H	206	CE	Product Name Type/Length	
11	0012H	68	44	D	
12	0013H	80	50	P	
13	0014H	83	53	S	
14	0015H	45	2D	-	
15	0016H	52	34	4	
16	0017H	53	35	5	
17	0018H	48	30	0	
18	0019H	65	41	A	
19	001AH	66	42	B	
20	001BH	45	2D	-	
21	001CH	50	32	2	
21	001DH	52	34	4	
22	001EH	32	20		
23	001FH	65	41	A	
24	0020H	206	CE	PART / MODEL NO. LENGTH	
25	0021H	48	30	0	To be updated
26	0022H	48	30	0	To be updated
27	0023H	48	30	0	To be updated
28	0024H	48	30	0	To be updated
29	0025H	48	30	0	To be updated
30	0026H	48	30	0	To be updated
31	0027H	48	30	0	To be updated
32	0028H	48	30	0	To be updated
33	0029H	48	30	0	To be updated
34	002AH	48	30	0	To be updated
35	002BH	48	30	0	To be updated
36	002CH	48	30	0	To be updated
37	002DH	48	30	0	To be updated
38	002EH	48	30	0	To be updated
39	002FH	196	C4	Product Version No. Type/Length	
40	0030H	88	58	X	To be updated
41	0031H	88	58	X	To be updated
42	0032H	32	20		To be updated
43	0033H	32	20		To be updated
44	0034H	206	CE	Product Serial No. Type/Length	
45	0035H	88	58	X : FOR DELTA MODEL	To be updated
46	0036H	88	58	X	To be updated
47	0037H	88	58	X	To be updated
48	0038H	88	58	X : D = DELTA CHINA , C = DELTA TAIWAN , T = THAILAND ,M = MEXICO , S = SCOUISH	To be updated
49	0039H	88	58	X YEAR (MAX 99) ;(DATE CODE)	To be updated
50	003AH	88	58	X	To be updated
51	003BH	88	58	X WEEK (MAX 52)	To be updated
52	003CH	88	58	X	To be updated

53	003DH	88	58	X (P / S SERIAL NUMBER MAX : 999999)	To be updated
54	003EH	88	58	X	To be updated
55	003FH	88	58	X	To be updated
56	0040H	88	58	X	To be updated
57	0041H	88	58	X	To be updated
58	0042H	88	58	X	To be updated
59	0043H	192	C0	Asset Tag Type/Length	
60	0044H	192	C0	FRU File ID Type/Length	
61	0045H	193	C1	End of Fields	
63	0046H	0	00	PAD (ALWAYS ZERO)	
64	0047H	198	BC	CHECKSUM (100H - ((LOWER BYTE (SUM OF BYTES)))	To be updated
1	0048H	0	00	RECORD TYPE ID 0X00 = POWER SUPPLY INFORMATION	MULTIRECORD
2	0049H	2	02	7 : 7 END OF LIST , 6 : 4 = 000B , 3 : 0 RECORD FORMAT VERSION = 2	HEADER
3	004AH	24	18	RECORD LENGTH OF MULTIRECORD	
4	004BH	215	D7	RECORD CHECKSUM	
5	004CH	15	0F	HEADER CHECKSUM	
6	004DH	194	C2	15-12 : RESERVED , WRITE AS 0000B	450W
7	004EH	1	01	11-0 : OVERALL CAPACITY (WATTS)	450W
8	004FH	194	C2	PEAK VALUE	450W
9	0050H	1	01	LSB FIRST	450W
10	0051H	30	1E	INRUSH CURRENT FFH IF NOT SPECIFIED	30A
11	0052H	10	0A	SET TO 0 IF NO INRUSH CURRENT SPECIFIED	10mS
12	0053H	16	10	LOW END INPUT VOLTAGE RANGE 1 200V = 4E20H	100V
13	0054H	39	27		100V
14	0055H	192	C0	HIGH END INPUT VOLTAGE RANGE 1 240 = 5DC0H	240V
15	0056H	93	5D		240V
16	0057H	40	28	LOW END INPUT VOLTAGE RANGE 1 180V = 4650H	90V
17	0058H	35	23		90V
18	0059H	32	20	HIGH END INPUT VOLTAGE RANGE 1 264 = 6720H	264V
19	005AH	103	67		264V
20	005BH	47	2F	LOW END INPUT FREQUENCY RANGE 47HZ = 2FH	47Hz
21	005CH	63	3F	HIGH END INPUT FREQUENCY RANGE 63HZ = 3FH	63Hz
22	005DH	10	0A	A / C DROPOUT TOLERANCE IN mS 12mS = 0CH	10mS
23	005EH	26	1A	7-5 : RESERVED , WRITE AS 000B	
				4 : TACHOMETER PULSES PER ROTATION / PREDICTIVE FALL POLARITY YES = 1	
				(FAIL = 1 , PASS = 0)	
				3 : HOT SWAP / REDUNDANCY SUPPORT YES = 1	
				2 : AUTOSWITCH YES = 1	
				1 : POWER FACTOR CORRECTION YES = 1	
				0 : PREDICTIVE FALL SUPPLY YES = 1	
24	005FH	194	C2	PEAK WATTAGE 15-12 : HOLD UP TIME IN SECONDS 1S = 1H	450W
25	0060H	1	01	11-0 PEAK CAPACITY (WATTS) (LSB FIRST) 450W = 01C2H	0S
26	0061H	0	00	COMMBINED WATTAGE 7-4 : VOLTAGE 1 , 3-0 : VOLTAGE 2 = 00 H	
27	0062H	0	00	BYTE 2 : 3 TOTAL COMBINED WATTAGE (LSB FIRST) W = 0000H	
28	0063H	0	00		
29	0064H	0	00	PREDICTIVE FAIL TACHOMETER LOWER THRESHOLD (RPM / 60) 2000/60 --> 21h	
1	0065H	1	01	RECORD TYPE ID 0X01 = DC OUTPUT Record	MULTIRECORD
2	0066H	2	02	7 : 7 END OF LIST , 6 : 4 = 000B , 3 : 0 RECORD FORMAT VERSION = 2	HEADER
3	0067H	13	0D	RECORD LENGTH OF MULTIRECORD	
4	0068H	93	5D	RECORD CHECKSUM	
5	0069H	147	93	HEADER CHECKSUM	
6	006AH	1	01	+12V 7 : STANDBY = 0 , 6-4 : RESERVED 000B , 3-0 : OUTPUT NUMBER = 0001B	+12V
7	006BH	176	B0	NOMINAL VOLTAGE (10mV) 1200 = 04B0H	12.0V
8	006CH	4	04		12.0V
9	006DH	116	74	MAXIMUM NEGATIVE VOLTAGE DEVIATION (10mV)	11.4V
10	006EH	4	04		11.4V
11	006FH	236	EC	MAXIMUM POSITIVE VOLTAGE DEVIATION (10mV)	12.6V
12	0070H	4	04		12.6V
13	0071H	120	78	RIPPLE AND NOISE PK-PK 10Hz TO 20MHz (mV) 120mV = 0078H	120mV
14	0072H	0	00		120mV
15	0073H	0	00	MINIMUM CURRENT DRAW(mA)	0A
16	0074H	0	00		0A
17	0075H	124	7C	MAXIMUM CURRENT DRAW(mA)	37.5A
18	0076H	146	92		37.5A
1	0077H	1	01	RECORD TYPE ID 0X01 = DC OUTPUT Record	MULTIRECORD
2	0078H	130	82	7 : 7 END OF LIST , 6 : 4 = 000B , 3 : 0 RECORD FORMAT VERSION = 2	HEADER
3	0079H	13	0D	RECORD LENGTH OF MULTIRECORD	

4	007AH	149	95	RECORD CHECKSUM	
5	007BH	219	DB	HEADER CHECKSUM	
6	007CH	130	82	+12VSB 7 : STANDBY = 0 , 6-4 : RESERVED 000B , 3-0 : OUTPUT NUMBER = 0010B	+12VSB
7	007DH	244	F4	NOMINAL VOLTAGE(10mV)	5V
8	007EH	1	01		5V
9	007FH	219	DB	MAXIMUM NEGATIVE VOLTAGE DEVIATION(10mV)	4.75V
10	0080H	1	01		4.75V
11	0081H	13	0D	MAXIMUM POSITIVE VOLTAGE DEVIATION(10mV)	5.25V
12	0082H	2	02		5.25V
13	0083H	50	32	RIPPLE AND NOISE PK - PK 10Hz TO 20MHz(mV) 50mV = 0032H	50mV
14	0084H	0	00		50mV
15	0085H	0	00	MINIMUM CURRENT DRAW(mA) 0mA = 0000H	0A
16	0086H	0	00		0A
17	0087H	208	D0	MAXIMUM CURRENT DRAW(mA)	2A
18	0088H	07	07		2A
1	0089H	0	00	Unused Area	
2	008AH	0	00	Unused Area	
3	008BH	0	00	Unused Area	
4	008CH	0	00	Unused Area	
5	008DH	0	00	Unused Area	
6	008EH	0	00	Unused Area	
7	008FH	0	00	Unused Area	
8	0090H	0	00	Unused Area	
9	0091H	0	00	Unused Area	
10	0092H	0	00	Unused Area	
11	0093H	0	00	Unused Area	
12	0094H	0	00	Unused Area	
13	0095H	0	00	Unused Area	
14	0096H	0	00	Unused Area	
15	0097H	0	00	Unused Area	
16	0098H	0	00	Unused Area	
17	0099H	0	00	Unused Area	
18	009AH	0	00	Unused Area	
19	009BH	0	00	Unused Area	
20	009CH	0	00	Unused Area	
21	009DH	0	00	Unused Area	
22	009EH	0	00	Unused Area	
23	009FH	0	00	Unused Area	
24	00A0H	0	00	Unused Area	
25	00A1H	0	00	Unused Area	
26	00A2H	0	00	Unused Area	
27	00A3H	0	00	Unused Area	
28	00A4H	0	00	Unused Area	
29	00A5H	0	00	Unused Area	
30	00A6H	0	00	Unused Area	
31	00A7H	0	00	Unused Area	
32	00A8H	0	00	Unused Area	
33	00A9H	0	00	Unused Area	
34	00AAH	0	00	Unused Area	
35	00ABH	0	00	Unused Area	
36	00ACH	0	00	Unused Area	
37	00ADH	0	00	Unused Area	
38	00AEH	0	00	Unused Area	
39	00AFH	0	00	Unused Area	
40	00B0H	0	00	Unused Area	
41	00B1H	0	00	Unused Area	
42	00B2H	0	00	Unused Area	
43	00B3H	0	00	Unused Area	
44	00B4H	0	00	Unused Area	
45	00B5H	0	00	Unused Area	
46	00B6H	0	00	Unused Area	
47	00B7H	0	00	Unused Area	
48	00B8H	0	00	Unused Area	
49	00B9H	0	00	Unused Area	
50	00BAH	0	00	Unused Area	
51	00BBH	0	00	Unused Area	
52	00BCH	0	00	Unused Area	

53	00BDH	0	00	Unused Area	
54	00BEH	0	00	Unused Area	
55	00BFH	0	00	Unused Area	
56	00C0H	0	00	Unused Area	
57	00C1H	0	00	Unused Area	
58	00C2H	0	00	Unused Area	
59	00C3H	0	00	Unused Area	
60	00C4H	0	00	Unused Area	
61	00C5H	0	00	Unused Area	
62	00C6H	0	00	Unused Area	
63	00C7H	0	00	Unused Area	
64	00C8H	0	00	Unused Area	
65	00C9H	0	00	Unused Area	
66	00CAH	0	00	Unused Area	
67	00CBH	0	00	Unused Area	
68	00CCH	0	00	Unused Area	
69	00CDH	0	00	Unused Area	
70	00CEH	0	00	Unused Area	
71	00CFH	0	00	Unused Area	
72	00D0H	0	00	Unused Area	
73	00D1H	0	00	Unused Area	
74	00D2H	0	00	Unused Area	
75	00D3H	0	00	Unused Area	
76	00D4H	0	00	Unused Area	
77	00D5H	0	00	Unused Area	
78	00D6H	0	00	Unused Area	
79	00D7H	0	00	Unused Area	
80	00D8H	0	00	Unused Area	
81	00D9H	0	00	Unused Area	
82	00DAH	0	00	Unused Area	
83	00DBH	0	00	Unused Area	
84	00DCH	0	00	Unused Area	
85	00DDH	0	00	Unused Area	
86	00DEH	0	00	Unused Area	
87	00DFH	0	00	Unused Area	
88	00E0H	0	00	Unused Area	
89	00E1H	0	00	Unused Area	
90	00E2H	0	00	Unused Area	
91	00E3H	0	00	Unused Area	
92	00E4H	0	00	Unused Area	
93	00E5H	0	00	Unused Area	
94	00E6H	0	00	Unused Area	
95	00E7H	0	00	Unused Area	
96	00E8H	0	00	Unused Area	
97	00E9H	0	00	Unused Area	
98	00EAH	0	00	Unused Area	
99	00EBH	0	00	Unused Area	
100	00ECH	0	00	Unused Area	
101	00EDH	0	00	Unused Area	
102	00EEH	0	00	Unused Area	
103	00EFH	0	00	Unused Area	
104	00F0H	0	00	Unused Area	
105	00F1H	0	00	Unused Area	
106	00F2H	0	00	Unused Area	
107	00F3H	0	00	Unused Area	
108	00F4H	0	00	Unused Area	
109	00F5H	0	00	Unused Area	
110	00F6H	0	00	Unused Area	
111	00F7H	0	00	Unused Area	
112	00F8H	0	00	Unused Area	
113	00F9H	0	00	Unused Area	
114	00FAH	0	00	Unused Area	
115	00FBH	0	00	Unused Area	
116	00FCH	0	00	Unused Area	
117	00FDH	0	00	Unused Area	
118	00FEH	0	00	Unused Area	
119	00FFH	0	00	Unused Area	

FRU DATA FOLLOW WITH SPEC LABEL, SPEC LABEL SHOULD BE CONFIRMED BY M.E.

Table showing DPS-450AB-24 A HEX Information:

Update 2021/09/01

Rev: V02

Addr	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0000	01	00	00	00	01	09	00	F5	01	08	19	C5	44	45	4C	54
0010	41	CE	44	50	53	2D	34	35	30	41	42	2D	32	34	20	41
0020	CE	30	30	30	30	30	30	30	30	30	30	30	30	30	30	C4
0030	58	58	20	20	CE	58	58	58	58	58	58	58	58	58	58	58
0040	58	58	58	C0	C0	C1	00	0C	00	02	18	D7	0F	C2	01	C2
0050	01	1E	0A	10	27	C0	5D	28	23	20	67	2F	3F	0A	1A	C2
0060	01	00	00	00	00	01	02	0D	50	93	01	B0	04	74	04	EC
0070	04	78	00	00	00	7C	92	01	82	0D	95	DB	82	F4	01	DB
0080	01	0D	02	32	00	00	00	D0	07	00	00	00	00	00	00	00
0090	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00A0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00B0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00C0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00D0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00E0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00
00F0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00

CHECK LIST

All data written to EEPROM should be ASCII code in hexadecimal format

Note: All of the Check Sum are Calculated by Zero Check Sum

NO.	Item	Address	Byte	Description	Value
1	Checksum1	07H	1	100H - (Low Byte Sum(00H~06H))	F5
2	Checksum2	47H	1	100H - (Low Byte Sum(08H~46H))	Updated
3	Checksum3	4BH	1	100H - (Low Byte Sum(4DH~64H))	D7
4	Checksum4	4CH	1	100H - (Low Byte Sum(48H~4BH))	0F
5	Checksum6	68H	1	100H - (Low Byte Sum(6AH~76H))	5D
6	Checksum7	69H	1	100H - (Low Byte Sum(65H~68H))	93
7	Checksum8	7AH	1	100H - (Low Byte Sum(7CH~88H))	95
8	Checksum9	7BH	1	100H - (Low Byte Sum(77H~7AH))	DB
9	Manufacturer Name	0CH~10H	5	Use the ASCII Code	"DELTA"
10	Product Name	12H~1FH	14	Use the ASCII Code	"DPS-450AB-24 A"
11	PART / Model No.	21H~2EH	14	Use the ASCII Code*(the value must to accord with #3)	"866-861619-XXX"
12	Product Version No.	30H~33H	4	Use the ASCII Code*(the value must to accord with #1), 0x20 for no use bytes	"XX "
13	Product Serial No.	35H~42H	14	XXXXXXXXXXXX*(the value must to accord with #2)	Updated
14	Unused Area	89H~FFH			0



台達電子工業股份有限公司
台达电子工业股份有限公司
DELTA ELECTRONICS, INC.

SWITCHING POWER SUPPLY
开关电源
交換式電源供應器

MODEL(型号 / 型號): DPS-450AB-24 A REV(版本) S1 #1

INPUT(输入 / 輸入): 100-240V~, 50-60Hz, 6.0 A

OUTPUT(输出 / 輸出): 450W MAX. (最大输出450W / 最大輸出450W)

+12V === / 37.5A

+5VSB === / 2A



S/N XXXXXXXXXXXX #2

MADE IN THAILAND (DCGP)
(製造地: 中國/ 制造地: 中国)