# Power Supply Specification

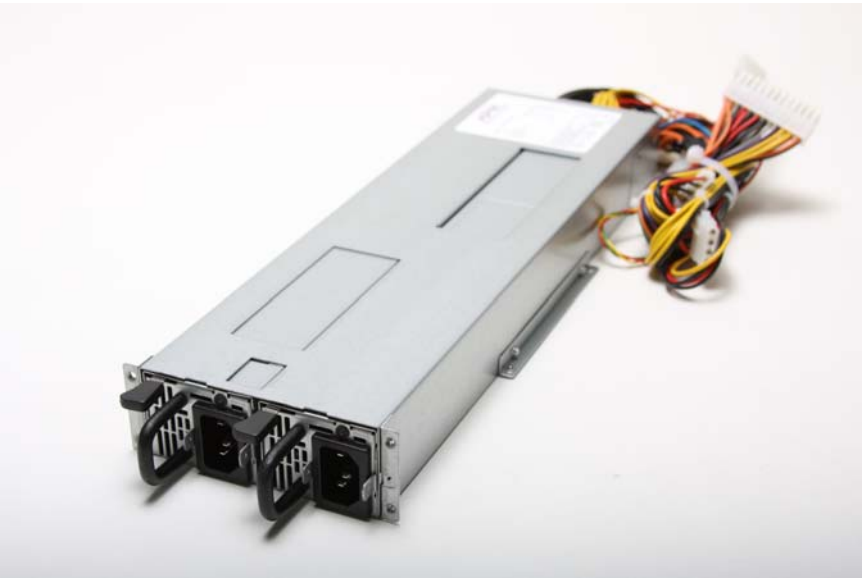
Model Number:

Power Supply Module
RSABxG; x=450, 550, 650, 750

Completed Power System
RRABxGH; x=450, 550, 650, 750, 1200, 1400

Revision: A-03

AC PFC Input,
450W~1400W, +12V W/+5Vsb or ATX12V 5 Outputs



## Revision History

| Rev | Description | Owner | Date |
|---|---|---|---|
| **A-01** | Initial release | C. P. Zhang | 06/08/11 |
| **A-02** | PSMI function and 1200W~1400W models added | C.P. Zhang | 03/05/12 |
| **A-03** | +5V and +3.3V output current increased | C.P. Zhang | 03/06/13 |
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# INDEX

# 1. Scope

This document defines a series of power supply systems with the output power range from 450W to 1400W and with +12V & +5Vsb output rails or ATX output rails for 1U system application. The power supply system consists of one (1), two (2), or three (3) power supply modules providing the +12V & +5Vsb output rails and one (1) power distribution backplane providing the removable or redundancy function of the power supply modules and also generating the +5V, +3.3V, and -12V output rails which are powered by +12V output. The power supply module is capable of "HOT SWAP" exchanging with active current sharing and OR-ing isolation MOSFETs built in for +12V output, and droop current sharing and OR-ing isolation diode built in for +5Vsb output. The AC input is rated 90-264Vrms with power factor corrected (PFC > 0.95). A 38mm high reliable Sanyo Denki fan is installed to the power supply module for cooling the power supply module, power devices on the distribution backplane and part of the system.

# 2. Electrical

The electrical specifications that follow are to be met over the environmental ranges specified in Section 3 unless otherwise noted.

## 2.1. AC Input

Table 1 lists AC input voltage and frequency range for continuous operation. The power supply is capable of supplying full-rated output power over the input voltage ranges specified.

| Parameter | Min | Nominal Input | Max | Unit |
|---|---|---|---|---|
| $V_{in}$ Voltage | 90 | 100-240 | 264 | Vrms |
| $V_{in}$ Frequency | 47 | 50/60 | 63 | Hz |
| $V_{in}$ Current /450W | | 6.0 | | A |
| $V_{in}$ Current /550W | | 8.0 | | A |
| $V_{in}$ Current /650W | | 10.0 | | A |
| $V_{in}$ Current /750W | | 10.0 | | A |
| $V_{in}$ Current /1200W | | 10.0 per module | | A |
| $V_{in}$ Current /1400W | | 10.0 per module | | A |

Table 1. AC input

- The inrush current of power supply module is less than 30A under the conditions of 240Vrms input and 25°C ambient cold start. The inrush current is limited to the extent that no damage will be done to the power supply under any specified line, load, and temperature conditions. The inrush current will not cause external protection devices (fuses) to trip.
- The leakage current of the power supply module is less than 1.0 mA measured at 240Vac input.
- The repetitive ON/OFF cycling of AC input voltage will not damage the power supply.
- The power supply can automatically recover from AC power loss.
- The primary fuse, F1, is installed for input over-current protection, and meet product safety requirement.

## 2.2. DC Output

### 2.2.1. DC Output Voltage Regulations

The DC output voltages remain within the regulation ranges shown in Table 2 for both power supply module and the completed power system when measured at the load end of the output connectors under all AC line, O/P loads, and environmental conditions. The voltage regulation will be maintained under continuous operation for a period of time equal to the MTBF specified in section 5.2 at any steady state temperature and operating conditions specified in section 3.

| | +12V | +5V | +3.3V | -12V | +5Vsb | Unit |
|---|---|---|---|---|---|---|
| Range | +5/-3% | +5/-3% | +5/-3% | ±10% | ±5% | Volt |
| Min | +11.64 | +4.85 | +3.20 | -10.80 | +4.75 | Volt |
| Nom | +12.00 | +5.00 | +3.30 | -12.00 | +5.00 | Volt |
| Max | +12.60 | +5.25 | +3.46 | -13.20 | +5.25 | Volt |

Table 2. DC Output Voltage Regulations

- The remote sensing is provided to +12V, +5V, and +3.3V outputs to compensate for excessive cable drops.
- +5V, +3.3V, and -12V outputs are located on the power distribution backplane.

### 2.2.2. DC Output Load Distributions

The Table 3A and 3B defines the power supply typical output load distribution.

| Output Voltage | Minimum Current (A) | 450W O/P Max. Current (A) | 550W O/P Max Current (A) | 650W O/P Max. Current (A) | 750W O/P Max. Current (A) |
|---|---|---|---|---|---|
| +12V | 2.0 | 37.0 | 45.0 | 54.0 | 62.5 |
| +5Vsb | 0.0 | 3.0 | 3.0 | 3.0 | 3.0 |

Table 3A. DC Output Load Distribution (power supply module)

| Output Voltage | Min. Current (A) | 450W Max. Current (A) | 550W Max Current (A) | 650W Max. Current (A) | 750W Max. Current (A) | 1200W Max. Current (A) | 1400W Max. Current (A) |
|---|---|---|---|---|---|---|---|
| +12V | 2.0 | 37.0 | 45.0 | 54.0 | 62.5 | 100.0 | 116.5 |
| +5V | 0.0 | 19.0/35.0 | 24.0/35.0 | 24.0/35.0 | 24.0/35.0 | 24.0/35.0 | 24.0/35.0 |
| +3.3V | 0.0 | 21.0/35.0 | 24.0/35.0 | 24.0/35.0 | 24.0/35.0 | 24.0/35.0 | 24.0/35.0 |
| -12V | 0.0 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| +5Vsb | 0.0 | 3.0 | 3.0 | 3.0 | 3.0 | 4.0 | 4.0 |
| The Max. combined O/P of +5V & +3.3V (Amp) | | 60.0 | 60.0 | 60.0 | 60.0 | 60.0 | 60.0 |
| The Max. combined O/P of +5V & +3.3V (Watt) | | 140.0 | 150.0 | 160.0 | 170.0 | 170.0 | 170.0 |

Table 3B. DC Output Load Distribution (completed power system)

a) The total continuous output power is 450W~750W max. for one (1) or two (2) modules installed, and 1200W~1400W max. for two (2) or three (3) modules installed.
b) The peak current of +12V output is 110% of max rated current and may last for 15 msec.
c) The maximum combined output current of +5V and +3.3V outputs is 60A.
d) The maximum combined output wattage of +3.3V and +5V is 140W max. (450W model), 150W max. (550W model), 160W max. (650W model), and 170W max. (750W, 1200W, and 1400W models) that is used for the purpose of the efficiency calculation only.
e) The smaller current listed for +3.3V and +5V output in the Table 3B is used for the purpose of the efficiency calculation only.

### 2.2.3. DC Output Efficiency

The power supply efficiency, with one (1) power supply module ON only (for 450W~750W), and with two (2) power modules ON only (for 1200W~1400W), is 80% minimum measured at 20%, 50%, full load and nominal line input, which is 115Vrms and 230Vrms conditions. The efficiency is calculated in accordance with the definition released by the 80 Plus Organization (Plug Load Solutions).

### 2.2.4. DC Output Ripple & Noise

The output ripple & noise specifications listed in Table 4 will be met throughout the load ranges as specified in section 2.2.2 and the nominal line input voltage conditions as specified in section 2.1. Ripple & noise is defined as periodic of random signals over a frequency band of 10Hz to 20MHz. Measurements should be made with an oscilloscope with 20MHz bandwidth. Add a 10uF electrolytic capacitor and a 0.1uF ceramic capacitor across output terminal during ripple & noise measurement.

| | +12V | +5V | +3.3V | -12V | +5Vsb | Unit |
|---|---|---|---|---|---|---|
| Max. Ripple | 120 | 50 | 50 | 120 | 50 | mV P-P |
| Max Ripple & Noise | 120 | 50 | 50 | 120 | 50 | mV P-P |

Table 4. DC Output Ripple & Noise

### 2.2.5. DC Output Transient Response

The output voltages will remain within the regulation limits specified in Table 2. The load-changing repetition rate is 50Hz to 10KHz, and the transient load slew rate 0.5A/us. The maximum step load size, and output capacitive loading are specified as followings in Table 5:

| | +12V | +5V | +3.3V | -12V | +5Vsb |
|---|---|---|---|---|---|
| Step Load Size (A) | 60% of Max Load | 30% of Max Load | 30% of Max Load | 0.1A | 0.5A |
| Capacitive Load (uF) | 10000 | 10000 | 10000 | 330 | 1000 |

Table 5. DC Output Ripple & Noise

### 2.2.6. DC Output Voltage Hold-up Time (2 module installed)

The power supply will maintain outputs in regulation per section 2.2.1 despite a loss of input power at the nominal range of AC input and at 80% of maximum continuous output load as applicable for a minimum of 16 ms.

## 2.3. Timing / Housekeeping / control

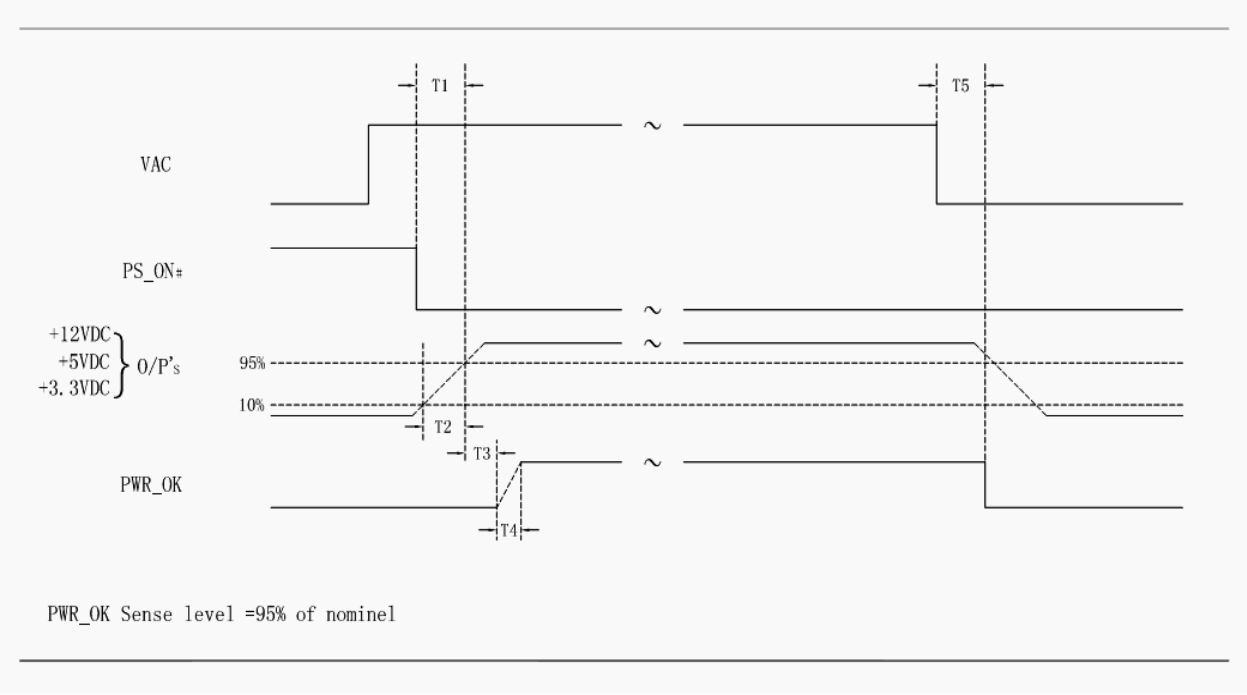



Figure 1. Power Supply Timing

Notes: T1 is defined is section 2.3.4
T2 is defined in section 2.3.5
T3, T4, and T5 are defined in Table 6

### 2.3.1. PWR_OK (Power Good Signal)

PWR_OK is a "power good" signal. It will be asserted high by the power supply to indicate that the +12V and/or +5V, +3.3V outputs are above the under voltage threshold listed in Table 2 of Section 2.2. PWR_OK will be de-asserted to a low state when the +12V and/or +5V, +3.3V output voltage fall below under voltage threshold, or when AC power has been removed for a time sufficiently such that power supply operation cannot work normally. The electrical and timing characteristics of the PWR_OK signal are given in Table 6 and in figure 1.

| | |
|---|---|
| Signal type | +5V TTL compatible |
| Logic level low | Less than 0.4V while sinking 10mA |
| Logic level high | Greater than 4.75V while sourcing 200uA |
| High-state output impedance | 1kΩ from output to common |
| PWR_OK delay | 100ms < $T_3$ <500ms |
| PWR_OK rise time | $T_4 \leq$ 10ms |
| AC loss to PWR_OK hold-up Time | $T_5 \geq$ 10ms (80% of maximum rated output load) |

Table 6. PWR_OK Signal Characteristics

### 2.3.2. PS_ON (DC Soft Start)

PS_ON is an active-low, TTL-compatible signal that allows a motherboard to remotely control the power supply in conjunction with features such as soft on/off, Wake on LAN, or wake-on modem. When PS_ON is pulled to low-level (0.8V max.), the power supply will turn on the main DC output rails: +12V, +5V, +3.3V, and –12V. When PS_ON is pulled to high-level (2.0V min.), the DC output rails will not deliver current and will be held at zero potential with respect to ground. PS_ON has no effect to the +5Vsb output, which is always enabled whenever the AC power is present. Table 7 lists PS_ON signal characteristics.

| | Min | Max |
|---|---|---|
| $V_{IL}$, Input Low Voltage | 0.0V | 0.8V |
| $I_{IL}$, Input Low Current (Vin = 0.4V) | | -1.6mA |
| $V_{IH}$, Input high Voltage (Iin = -200uA) | 2.0V | |
| $V_{IH}$, open circuit, Iin =0 | | 5.25V |

Table 7. PS_ON Signal Characteristics

### 2.3.3. +5Vsb (Standby Voltage Output)

+5Vsb is a standby voltage output that is active whenever the AC power is present. It provides a power source for circuits that must remain operational when the main DC output rails are in a disabled state. Example uses include soft power control, Wake on LAN, wake on modem, intrusion detection, or suspend state activities. There is over current protection on the +5Vsb output to ensure the power supply will not be damaged if external circuits draw more current than the supply can provide.

### 2.3.4. Power-on Time

The power-on time is defined as the time from when PS_ON is pulled low to when the12V, and /or +5V, +3.3V output are within the regulation ranges specified in Section 2.2.1. The power-on time will be less than 200ms ($T_1$ <200ms). +5Vsb has a power on time of two seconds max. after the valid AC Voltages applied.

### 2.3.5. Rise Time

The output voltage rise from ≤ 10% of nominal to within the regulation ranges specified in section 2.2.1 within 0.1 ms to 20 ms (0.1 ms ≤ $T_2$ ≤ 20 ms)

### 2.3.6. Power Sequencing

The +12V and +5V output levels are equal to or greater than the +3.3V output at all times during power-up and normal operation. The time between the +12V or +5V output reaching its minimum in-regulation level and +3.3V reaching its minimum in-regulation level is ≤ 20 msec.

### 2.3.7. Overshoot at Turn-on / Turn-off

The output voltage overshoot upon the application or removal of the input voltage, or the assertion / de-assertion of PS_ON will be less than 10% above the nominal voltage.

### 2.3.8. Reset after Shutdown

If the power supply latches into a shutdown state because of a fault condition on its outputs, the power supply can return to normal operation only after the fault condition has been removed and the PS_ON has been cycled OFF/ON with a minimum OFF time of 1 second.

### 2.3.9. +5Vsb at AC Power-down

After AC power is removed, the +5Vsb standby voltage output should remain at its steady state value for the minimum hold-up time specified in Section 2.2.6 until the output begins to decrease in voltage. The decrease can be monotonic in nature, dropping to 0.0V. There is no other perturbations of this voltage at or following removal of AC power.

## 2.4. Output Protection

### 2.4.1. Over Voltage Protection

The power supply can provide latch-mode over voltage protection as defined in Table 8.

| Output | Min. | Nom. | Max. | Unit |
|---|---|---|---|---|
| +12VDC | 13.6 | 14.6 | 15.6 | Volts |
| +5VDC | 5.5 | 6.25 | 7.0 | Volts |
| +3.3VDC | 3.7 | 4.1 | 4.5 | Volts |

Table 8. Over Voltage Protection

### 2.4.2. Over Current Protection

130% maximum for +12V output
150% maximum for +3.3V and +5V outputs

### 2.4.3. Short-circuit Protection

The power supply will shut down and latch off for shorting the +12VDC, +5VDC, and +3.3VDC rails to return or any other rails. Shorts between main output rails and +5Vsb will not cause any damage to power supply. The power supply will shut down and latch off for shorting the negative rail. +5Vsb is capable of being shorted indefinitely, but when the short is removed, the power supply will recover automatically or by cycling PS_ON. The power supply is capable of withstanding a continuous short circuit to the outputs without damage or overstress to the unit (for example, to components, PCB traces, connectors) under the input conditions specified in section 2.1.

### 2.4.4. No-load Operation

No damage or hazardous condition will occur with all the DC output connectors disconnected from the load. The power supply may latch into the shutdown state.

### 2.4.5. Isolation

| | |
|---|---|
| Primary to Secondary | 4242Vdc |
| Primary to Earth GND | 2800Vdc |

## 2.5. Output Signals (Redundant System)

### 2.5.1. Audible Alarm & Power Fail Signal

The Audible alarm and Power Fail signal are available from the signal card located on the backplane. The audible alarm is silence and Power Fail signal is "High" when all power modules are functioning properly. The audible alarm will be sound and Power Fail signal will be "Low" when following conditions happened:

a. One of the power supply module is not functioning and is still attached to the backplane.
b. One of the power supply module is attached to the backplane without AC power cord plugged in.

Removing the not functioning power module from backplane or pushing the reset switch provided will reset the audible alarm and also the Power Fail signal.

### 2.5.2. LED light

The LED light installed on the power supply module is functioning as followings:

a. Green color – Power module is ON and working properly.
b. Amber color – Power module is under Standby Mode.
c. No color – Power module is not working properly.

### 2.5.3. Fan Failed Signal (I2C/PSMI)

The Rotation Detector O/P signal is generated by fan: "0" fan is running well and "1" fan blade is locked or fan is not running properly.

### 2.5.4. PS Present Signal (I2C/PSMI)

The Power Supply Present signal: "0" power supply is present and "1" power supply is not present.

### 2.5.5. Power Good Signal (I2C/PSMI)

The Power Good signal: "0" power supply is fail and "1" power supply is good.

### 2.5.6. Temperature Warning Signal (I2C/PSMI)

The Temperature Warning signal: "0" PS is under normal condition and "1" PS is over heat (measured the temp. at secondary heatsink) under the condition of full load and ambient temperature over 55$^{o}$C.

### 2.5.7. AC/DC Input Signal (I2C/PSMI)

The AC/DC Input signal: "0" PS is DC Input and "1" PS is AC Input.

### 2.5.8. SMB_Alert signal (I2C/PSMI)

The SMB_Alert signal: "0": PS operation normal; "1": faulty conditions detected, automatically cleared upon host reads 0Bh.

### 2.5.9. Power Module Information (I2C/PSMI)

The I2C/PSMI Bus provides the power module information, i.e. 1). Model Number, 2). Serial Number, 3). Date Code 4). Revision, 5). uP Firmware Version.

**Note: Please refer to the PSMI specification attached for programming the firmware.**

## 3. Environmental

The following subsections define recommended environmental specifications and test parameters. Based on the typical conditions to which an ATX power supply may be subjected during operation or shipment.

### 3.1. Temperature

| | |
|---|---|
| Operating | -10°C to +50°C |
| Non-operating | -40°C to +85°C |

### 3.2. Humidity

| | |
|---|---|
| Operating | 10% to 90% relative humidity (non-condensing) |
| Non-operating | 5% to 95% relative humidity (non-condensing) |

### 3.3. Altitude

| | |
|---|---|
| Operating | 0 to 10,000 feet |
| Storage | 0 to 50,000 feet |

## 4. Electromagnetic Compatibility

The following subsections outline applicable product regulatory specifications for this power supply.

### 4.1. Emissions

The power supply can comply with FCC Part 15 and EN55022: 2006 meeting Class B for both conducted and radiated emissions with a 3 dB margin.

### 4.2. Immunity

The power supply can comply with EN 55024: 1998+A1: 2001+A2: 2003.

### 4.3. CE Testing

The following standards are applied during the CE testing

CE EN 55022: 2006 Class B
EN 61000-3-2: 20006 Class D
EN 61000-3-3: 1995+A1: 2001+A2: 2005
EN 55024: 1998+A1: 2001+A2: 2003, including
IEC 61000-4-2: Criterion B
IEC 61000-4-3: Criterion A
IEC 61000-4-4: Criterion B
IEC 61000-4-5: Criterion B
IEC 61000-4-6: Criterion A
IEC 61000-4-8: Criterion A
IEC 61000-4-11: Criterion B/C/C

# 5. Reliability

### 5.1. Component De-rating

The derating process promotes quality and high reliability. All electronic components are designed with conservative derating for use in commercial and industrial environments.

### 5.2. Mean Time between Failures (MTBF)

100K hours minimum at full load 25$^{o}$C

# 6. Safety

### 6.1. Safety

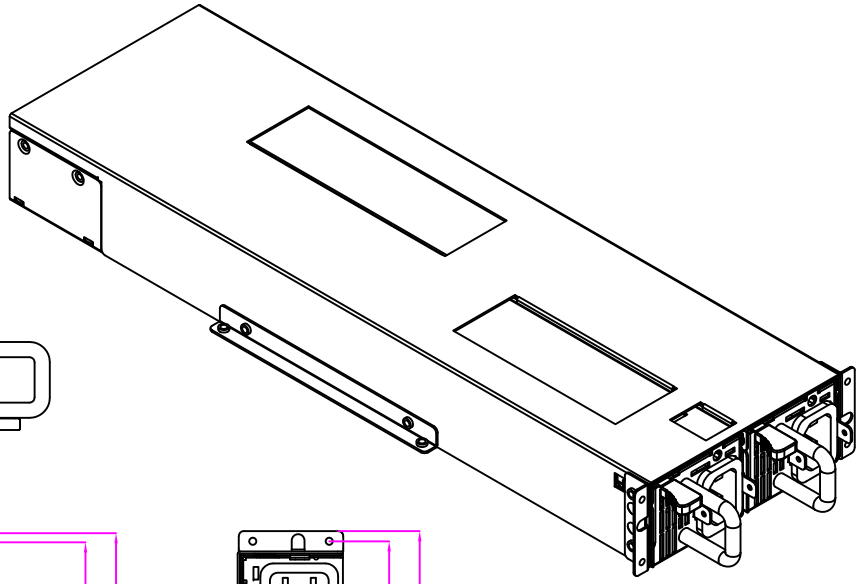
| | |
|---|---|
| cUL | UL 60950-1 (replaced by cTUVus) |
| TUV | EN 60950-1 |
| CB | IEC 60950-1: 2005 (2$^{nd}$ Edition) |
| CCC | |
| BSMI | |

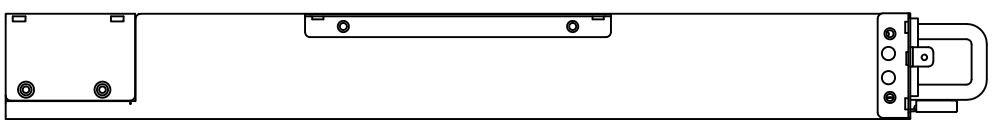
### 6.2. RoHS Compliance

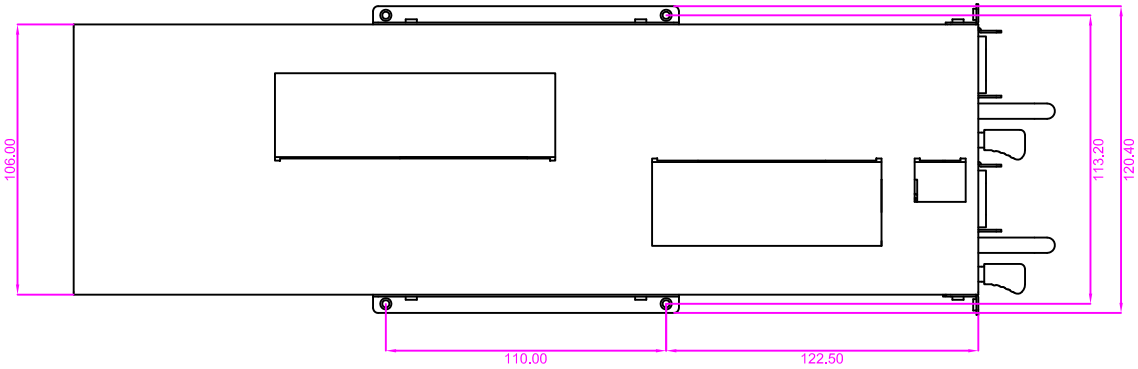
The power supply system meets the requirement of RoHS Compliance.

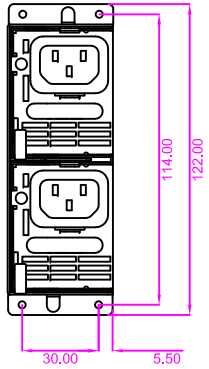
# 7. Mechanical

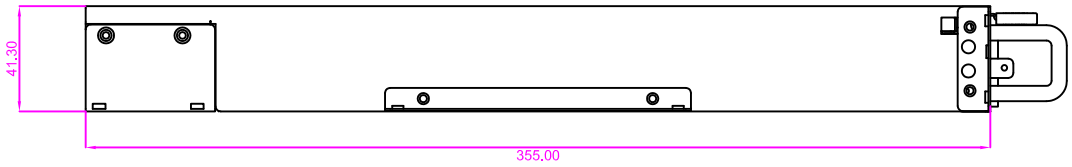
Please see attached outline drawing and output cable drawing in details.





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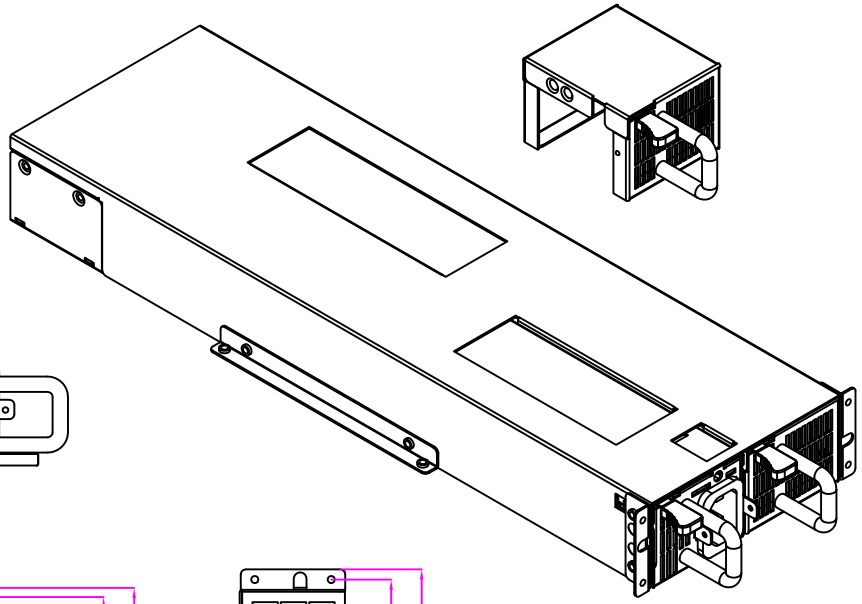
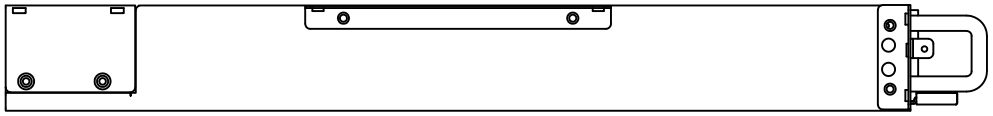
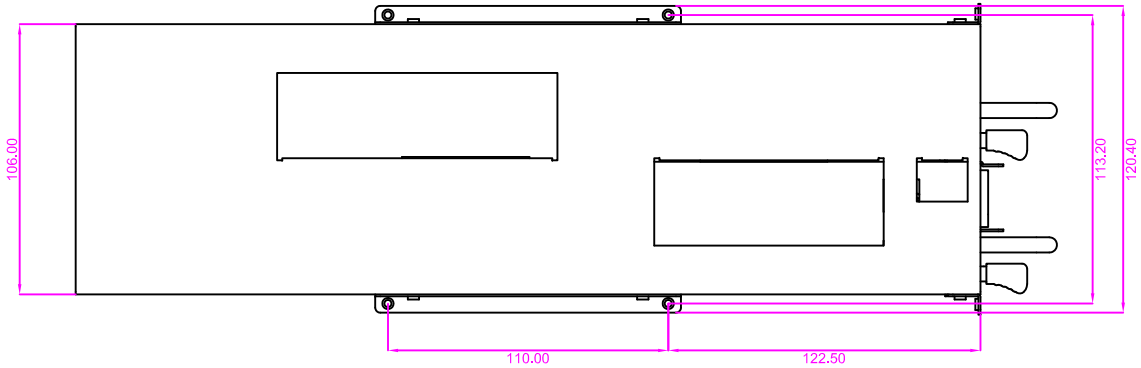
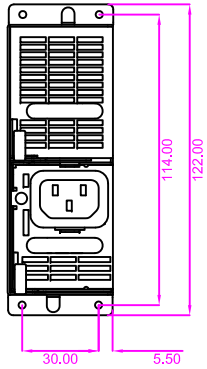
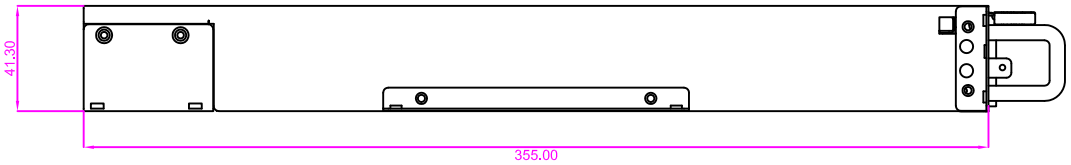
|---|---|---|---|---|---|
| APM INDUSTRIAL POWER SUPPLY | Drawing Number: GH-1U-AC04-22 | | | Dimension | Tolerance |
| | Model Number: RRAB GH Series | | | 0.0~10.0 | ±0.1 |
| | | | | 10~100 | ±0.2 |
| | Date: January 03, 2011 | REV. | 1.0 | 100~400 | ±0.25 |
| | Design: C.Y. Chen | UNIT | mm | 400~ | ±0.3 |





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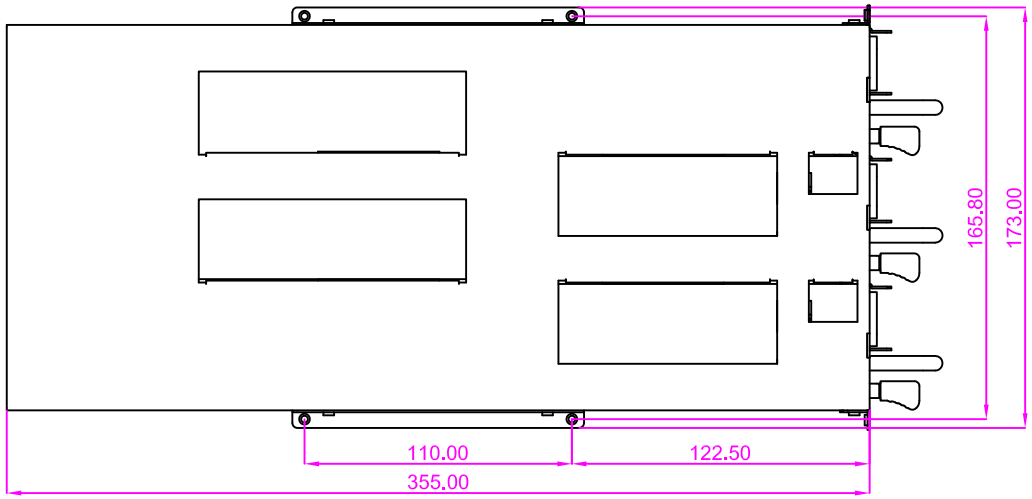
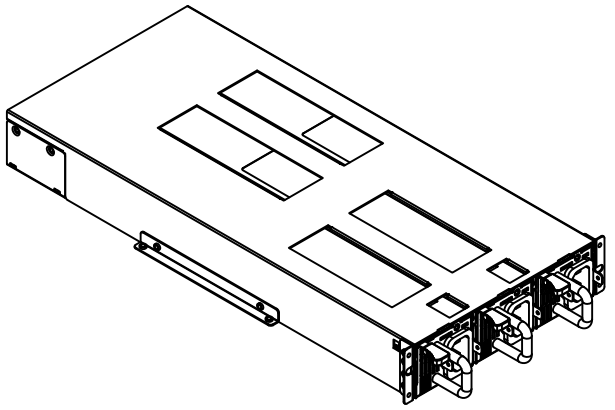
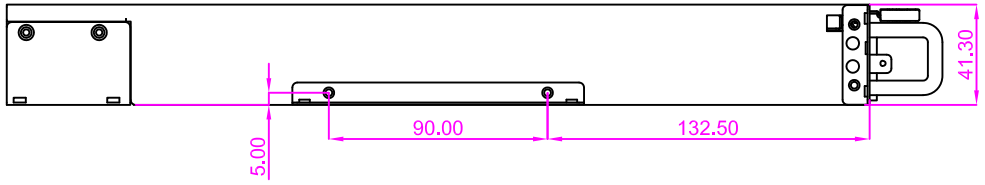
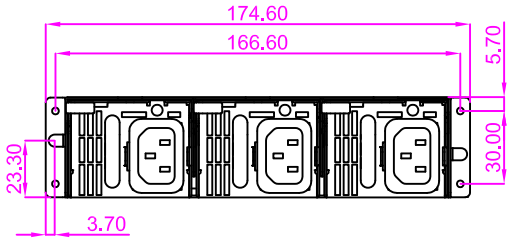
|---|---|---|---|---|---|
| APM INDUSTRIAL POWER SUPPLY | Drawing Number: GH-1U-AC04-21 | | | Dimension | Tolerance |
| | Model Number: RRAB GH Series | | | 0.0~10.0 | ±0.1 |
| | | | | 10~100 | ±0.2 |
| | Date: January 03, 2011 | REV. | 1.0 | 100~400 | ±0.25 |
| | Design: C.Y. Chen | UNIT | mm | 400~ | ±0.3 |

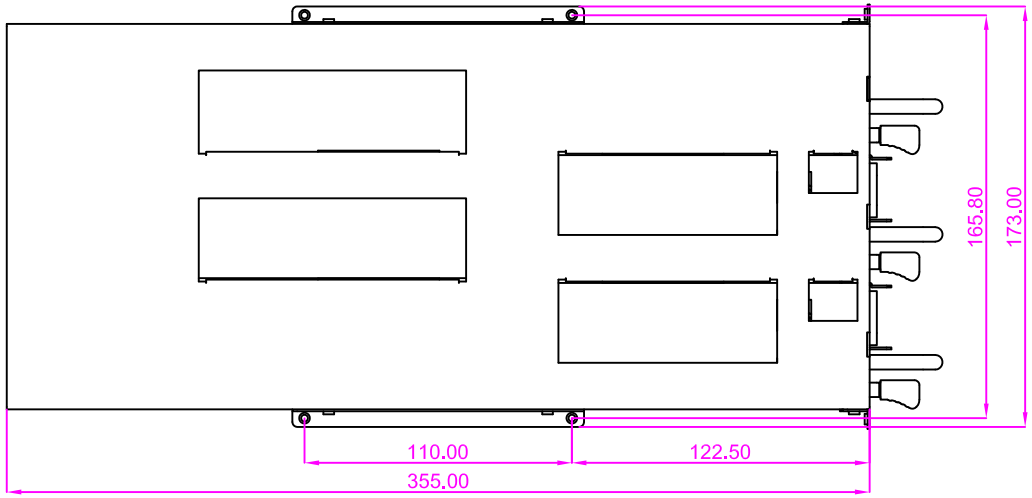


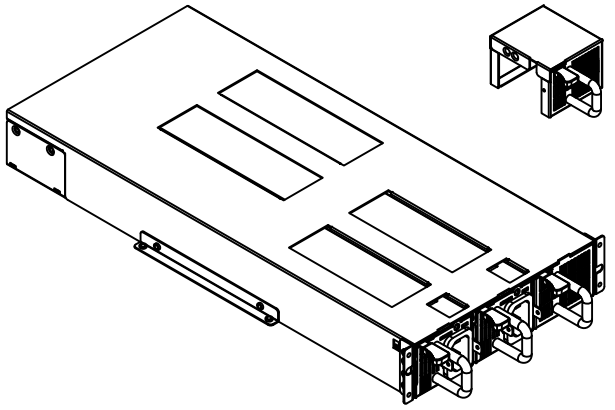



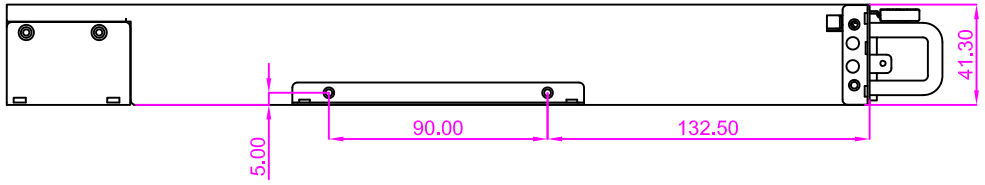


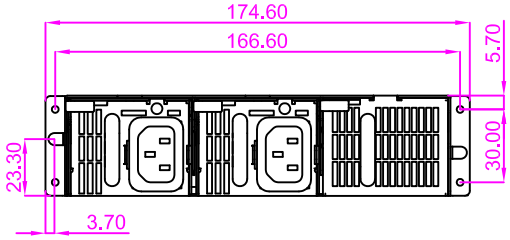




| | | | | | |
|---|---|---|---|---|---|
| APM INDUSTRIAL POWER SUPPLY | Drawing Number: GH-1U-AC04-33 | | | Dimension | Tolerance |
| | Model Number: RRAB GH Series | | | 0.0~10.0 | ±0.1 |
| | | | | 10~100 | ±0.2 |
| | Date: March 05, 2012 | REV. | 1.0 | 100~400 | ±0.25 |
| | Design: C.Y. Chen | UNIT | mm | 400~ | ±0.3 |






| | | | | | |
|---|---|---|---|---|---|
| APM INDUSTRIAL POWER SUPPLY | Drawing Number: GH-1U-AC04-32 | | | Dimension | Tolerance |
| | Model Number: RRAB GH Series | | | 0.0~10.0 | ±0.1 |
| | | | | 10~100 | ±0.2 |
| | Date: March 05, 2012 | REV. | 1.0 | 100~400 | ±0.25 |
| | Design: C.Y. Chen | UNIT | mm | 400~ | ±0.3 |

**Power Supply Management Interface Specification V5.1**
**03/08/2013**

## I2C Interface

The I2C interface of power supply units supports 100Kbps communication protocol in 7-bit address slave mode only. All power supply I2C base addresses are optional to set from 0xB0, 0xB2, 0xB4,…, 0xBE according to manufacturer's configuration. To prevent address conflict with other components on I2C bus, users may request other addresses in the range of 0xB0 to 0xBE to the manufacturer. The I2C interface of power supply unit is in slave mode and only support one byte read. When accessing registers, START and STOP bits are required for each register read. Multi-byte read and 10-bit address are **not** supported.

### I2C Slave Address Determination

The power supply unit I2C slave address is determined when the unit is plugged into the back plane, either with its own power or power provided by another unit through the back plane. In this case all units are inter changeable or can be easily changed with a new unit without configuring I2C slave address. However, it is important to note that the unit will not set I2C slave address until PS_Present is confirmed to be LOW (PS_Present = 0). Also the firmware in the power supply unit will not execute until I2C address is set.

## I2C Interface Signal Levels

SDA and SCL signals of I2C interface are floating at power supply and should be pulled up by the host. It is designed to support 3.3V and 5V logic, depends on the pull-up level at the host. It is important to pull up SDA and SCL since these signals are open drain at power supply. Fail to pull up these signals at host will make power supply I2C interface not able to function and potentially into damage. The DC characteristics of SDA and SCL signals are in the table below

| Symbols | Conditions | Min | Max | Unit |
|---|---|---|---|---|
| VIL | SCL, SDA | - | 0.8 | V |
| VIH | SCL, SDA | 2.0 | $V_{pull-up}$ | V |
| VOL | SDA | - | 0.6 | V |
| VOH | SDA | $V_{pull-up} – 0.7$ | - | V |
| CB | SCL, SDA<br>(Maximum bus capacitance permitted by I2C specification) | | 400 | pF |

## I2C Register Functions

The register map contains power supply information as
Model number, register 01h ~ 0Ah;
Power supply status, register 0Bh, 0Ch
Serial number, register 0Eh ~ 19h;
Revision code, register 1Bh ~ 1Eh;
Manufacturing date code, register 1Fh and 20h;
uP Firmware Version Code, register 21h;
Typical output voltage specification, register 2Fh ~ 36h;
Typical output current specification, register 39h ~ 40h;
Typical standby voltage specification, register 43h and 44h;
Typical standby current specification, register 45h and 46h;
Maximum output wattage specification, register 47h and 48h;

Register 00h, 0Dh, and 1Ah contain the number of register reserved for model number, serial number and revision code. In register map that 10 registers locations are reserved for model number, 12 register locations are reserved for serial number, and 4 register locations are reserved for revision code. However, due to manufacturer process that these registers may not be used in full.

## I2C Read

All registers in the register map (showing below) are read only. It is to prevent accidentally erase factory preset data. The procedure to read one register data are following:

1. host checks if I2C bus is idle;

2. host sends START bit, I2C device slave address (ex. 0xB0), write bit, register address, and STOP bit
3. host sends START bit, I2C slave address, read bit, then send clock to read back one byte and to send STOP bit to complete register read.
4. Once the register read is successful, release I2C bus.

### Power Supply Unit Status Register

The power supply unit status register contains status bits of PS_Present, SMBAlert, ac/dc input, PWR_OK(Power Good), OTP(Over Temperature Protection Warning), and Fan_Fail(Fan Failure Warning) in register address 0Bh and 0Ch, described as following:

### Status Register 0Bh

| b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 |
|---|---|---|---|---|---|---|---|
| PS_Present | 0 | 0 | 0 | PWR_OK | 0 | 0 | SMBAlert |

X: Reserved for future use. Default “0” when read back

SMBAlert: SMB Alert status bit.
When “1” fault status detected. This bit is cleared automatically upon host status register 0Bh
When “0” the power supply operating normally.

PWR_OK: Power good status bit.
When “1” the power supply unit is working properly. All outputs are within range.
When “0” the power supply unit is either malfunctioning or has shut down.

PS_Present: Power supply present status bit.
When “1” the power supply is not attached to system.
When “0” the power supply is attached to system.

### Status Register 0Ch

| b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | Fan_Fail | 0 | OTP | 0 | ac/dc |

ac/dc: Power good status bit.
When “1” the power supply unit is in AC input.
When “0” the power supply unit is in DC input.

OTP: Over Temperature Protection Warning
When “0” means power supply temperature is in normal range.
When “1” the power supply temperature is higher than normal condition. Over temperature protection function soon will be activated to shut down the power supply unit.

Fan_Fail: Cooling fan status
When “0” the fan is working properly.
When “1” the fan is not working correctly or not working at all.

Power supply status can be retrived at any time. Power supply monitors its own status constantly as long as standby supply is available. The standby supply can be provided by another power supply unit in the chasis. Which means as long as one power supply unit is operating properly, the monitoring circuits in all power supply units will constantly monitoring its own power supply status. When receiving I2C read command from host, the power supply monitor circuit will be interrupted immediately to service I2C read and return to monitoring power supply status once the once the I2C read process is completed.

## Power Supply Unit Present Detection and I2C Acknowledge

The power supply unit contain hardware PS_Present (Power Supply Unit Present) signal and there is PS_Present status bit in the status register. The host can check if one power supply unit is attached to the

system by reading PS_Present register bit through I2C bus. When read “0” it represents the power supply unit is attached to the system. When read “1” represents the power supply is missing.

The host can also determine if one power supply unit is presenting by checking the read back value of status register. When the power supply is missing, due to pull up of I2C data line, the data line will be pulled high all the time during read so the status register read back will be 0xFF. Since the non-used bits (marked as X) in status register are default “0”, there will be not possible to read back 0xFF if the power supply unit is presenting and the I2C communication circuit is working. When host reads back 0xFF from the status register ( or any register), the host can assume that the power supply unit is not presenting or, completely shut down, or its I2C communication is out of work. However, to make such determination that host should not wait for Acknowledge when initiating I2C communication. When host is waiting for Acknowledge while the power supply is not presenting, host I2C function will be hanging in an endless loop until it times out. If checking Acknowledge cannot be avoid when reading status register, a time-out mechanism or a watchdog timer needs to be implemented to prevent host holding I2C bus in an endless loop.

## Model Number

Model number is stored in registers 01h to 0Ah. Each register location is stored with one digit of the serial number in alphanumerical format. Depends on manufacturer process the serial number could be combined with number (0 ~ 9) and characters (A ~ Z). Not all 10 register locations may be used.

## Serial Number

Serial number is stored in registers 0Eh to 19h. Each register location is stored with one digit of the serial number in alphanumerical format. Depends on manufacturer process the serial number could be combined with number (0 ~ 9) and characters (A ~ Z). Not all 12 register locations may be used.

## Revision code

Revision code is stored in registers 1Bh to 1Eh. Each register location is stored with one digit of the serial number in alphanumerical format. Depends on manufacturer process the serial number could be combined with number (0 ~ 9) and characters (A ~ Z). Not all 4 register locations may be used.

## Date Code

Date code is stored in registers 1Fh and 20h. Register 1Fh stores the YEAR code from 00 ~ 99 (2000 ~ 2099) and register 20h stores the WEEK number from 01 to 53. Different than serial number and revision code that are in ASCII format, the date code is in unsigned integer format from 00h to 7Fh (0 ~ 127).

## uP Firmware Version Code

uP firmware version code is stored in register 21h in unsigned integer format. The version code is 0x51, representing version 5.1.

## Output Voltage and Output Current manufacturer Specification

Register 2Fh to register 46h store the power supply unit output specification. Register 2Fh to 36h store the output voltage specification and register 39h to register 40h store output current specification. All voltage or current specifications are represented in mV x $10^{x}$ or mA x $10^{x}$ format. For example, to read back +5V output voltage specification, host needs to read back register 2Fh and register 30h then to apply equation *(value of register 2Fh) x* $10^{(\text{value of register 30h})}$. For example if register 2Fh value is 52 (52mV) and register 30h value is 2 ($10^{2}$) then the +5V manufacturer default output specification would be 52mV x $10^{2}$ = 5200mV( +5.2V). All output voltage and output current specifications can be obtained in a same way. All registers stored output voltage and output current specifications are in 8 bits unsigned integer format.

## Output Wattage Specification Read Back

Power supply unit maximum output wattage specifications are stored in register 47h and 48h in 16 bits unsigned integer format. To read back, host should read back both values in register 47h and 48h and process as Register[48h] * 256 + Register[47h]. For example if register 47h and 48h have values as 0xee and 0x02, the maximum output power can be obtained as (0x02 * 256) + (0xee) = 750 (Watt).

## Register Map

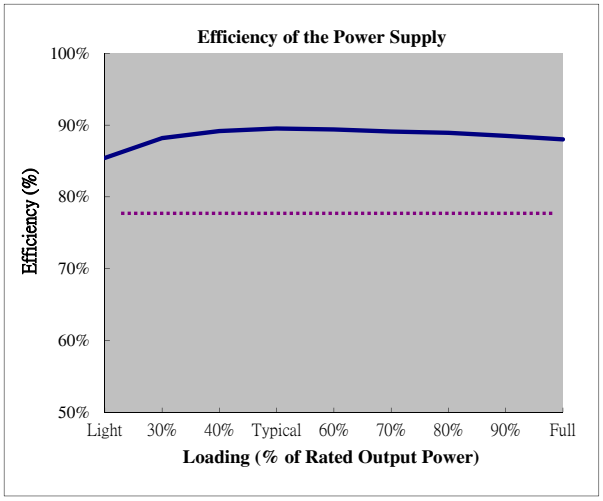
| Address | b7 | b6 | b5 | b4 | b3 | b2 | b1 | b0 | R/W | Format | Description |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 00h | Number of character | | | | | | | | RO | NUM | Number of character in Model Number |
| 01h | Model nimber Char #1 | | | | | | | | RO | ASCII | Model number |
| 02h | Model nimber Char #2 | | | | | | | | RO | ASCII | Model number |
| 03h | Model nimber Char #3 | | | | | | | | RO | ASCII | Model number |
| 04h | Model nimber Char #4 | | | | | | | | RO | ASCII | Model number |
| 05h | Model nimber Char #5 | | | | | | | | RO | ASCII | Model number |
| 06h | Model nimber Char #6 | | | | | | | | RO | ASCII | Model number |
| 07h | Model nimber Char #7 | | | | | | | | RO | ASCII | Model number |
| 08h | Model nimber Char #8 | | | | | | | | RO | ASCII | Model number |
| 09h | Model nimber Char #9 | | | | | | | | RO | ASCII | Model number |
| 0Ah | Model nimber Char #10 | | | | | | | | RO | ASCII | Model number |
| 0Bh | PS_Present[6] | X | X | X | PG[2] | X | X | SMBAlert[1] | RO | ASCII | Power Supply Status |
| 0Ch | X | X | X | Fan_Fail[5] | X | OTP[4] | X | ac/dc[3] | RO | ASCII | Power Supply Status |
| 0Dh | Number of character | | | | | | | | RO | NUM | Number of character in Serial Number |
| 0Eh | Serial number Char #1 | | | | | | | | RO | ASCII | Serial number |
| 0Fh | Serial number Char #2 | | | | | | | | RO | ASCII | Serial number |
| 10h | Serial number Char #3 | | | | | | | | RO | ASCII | Serial number |
| 11h | Serial number Char #4 | | | | | | | | RO | ASCII | Serial number |
| 12h | Serial number Char #5 | | | | | | | | RO | ASCII | Serial number |
| 13h | Serial number Char #6 | | | | | | | | RO | ASCII | Serial number |
| 14h | Serial number Char #7 | | | | | | | | RO | ASCII | Serial number |
| 15h | Serial number Char #8 | | | | | | | | RO | ASCII | Serial number |
| 16h | Serial number Char #9 | | | | | | | | RO | ASCII | Serial number |
| 17h | Serial number Char #10 | | | | | | | | RO | ASCII | Serial number |
| 18h | Serial number Char #11 | | | | | | | | RO | ASCII | Serial number |
| 19h | Serial number Char #12 | | | | | | | | RO | ASCII | Serial number |
| 1Ah | Number of character | | | | | | | | RO | NUM | Number of character in Revision Code |
| 1Bh | Revision code Char #1 | | | | | | | | RO | ASCII | Revision code |
| 1Ch | Revision code Char #2 | | | | | | | | RO | ASCII | Revision code |
| 1Dh | Revision code Char #3 | | | | | | | | RO | ASCII | Revision code |
| 1Eh | Revision code Char #4 | | | | | | | | RO | ASCII | Revision code |
| 1Fh | MFG year | | | | | | | | RO | NUM | XX, (0 - 255) |
| 20h | MFG Week | | | | | | | | RO | NUM | XX, (1-53) |
| 21h | Firmware Version | | | | | | | | RO | NUM | 0x51 |
| 22h | Reserved | | | | | | | | RO | ASCII | NA |
| 23h | Reserved | | | | | | | | RO | ASCII | NA |
| 24h | Reserved | | | | | | | | RO | ASCII | NA |
| 25h | Reserved | | | | | | | | RO | ASCII | NA |
| 26h | Reserved | | | | | | | | RO | ASCII | NA |
| 27h | Reserved | | | | | | | | RO | ASCII | NA |
| 28h | Reserved | | | | | | | | RO | ASCII | NA |
| 29h | Reserved | | | | | | | | RO | ASCII | NA |
| 2Ah | Reserved | | | | | | | | RO | ASCII | NA |
| 2Bh | Reserved | | | | | | | | RO | ASCII | NA |
| 2Ch | Reserved | | | | | | | | RO | ASCII | NA |
| 2Dh | Reserved | | | | | | | | RO | ASCII | NA |
| 2Eh | Reserved | | | | | | | | RO | ASCII | NA |
| 2Fh | +5V Output Voltage | | | | | | | | RO | NUM | in milliVolts |
| 30h | +5V Output Voltage Scale | | | | | | | | RO | NUM | 2 (10^2) |
| 31h | +12V Output Voltage | | | | | | | | RO | NUM | in milliVolts |
| 32h | +12V Output Voltage Scale | | | | | | | | RO | NUM | 2 (10^2) |
| 33h | -12V Output Voltage | | | | | | | | RO | NUM | in milliVolts |
| 34h | -12V Output Voltage Scale | | | | | | | | RO | NUM | 2 (10^2) |
| 35h | +3.3V Output Voltage | | | | | | | | RO | NUM | in milliVolts |
| 36h | +3.3V Output Voltage Scale | | | | | | | | RO | NUM | 2 (10^2) |
| 37h | Reserved | | | | | | | | RO | ASCII | NA |
| 38h | Reserved | | | | | | | | RO | ASCII | NA |
| 39h | +5V Output Current | | | | | | | | RO | NUM | in milliAmps |
| 3Ah | +5V Output Current Scale | | | | | | | | RO | NUM | 3 (10^3) |
| 3Bh | +12V Output Current | | | | | | | | RO | NUM | in milliAmps |
| 3Ch | +12V Output Current Scale | | | | | | | | RO | NUM | 3 (10^3) |
| 3Dh | -12V Output Current | | | | | | | | RO | NUM | in milliAmps |
| 3Eh | -12V Output Current Scale | | | | | | | | RO | NUM | 2 (10^2) |
| 3Fh | +3.3V Output Current | | | | | | | | RO | NUM | in milliAmps |
| 40h | +3.3V Output Current Scale | | | | | | | | RO | NUM | 3 (10^3) |
| 41h | Reserved | | | | | | | | RO | ASCII | NA |
| 42h | Reserved | | | | | | | | RO | ASCII | NA |
| 43h | Standby Output Voltage | | | | | | | | RO | NUM | in milliVolts |
| 44h | Standby Output Voltage Scale | | | | | | | | RO | NUM | 2 (10^2) |
| 45h | Standby Output Current | | | | | | | | RO | NUM | in Amps, (0 - 255) |
| 46h | Standby Current Scale | | | | | | | | RO | NUM | 3 (10^3) |
| 47h | Maximum Output Power Specification, Low Byte | | | | | | | | RO | NUM | in Watts |
| 48h | Maximum Output Power Specification, High Byte | | | | | | | | RO | NUM | in Watts |

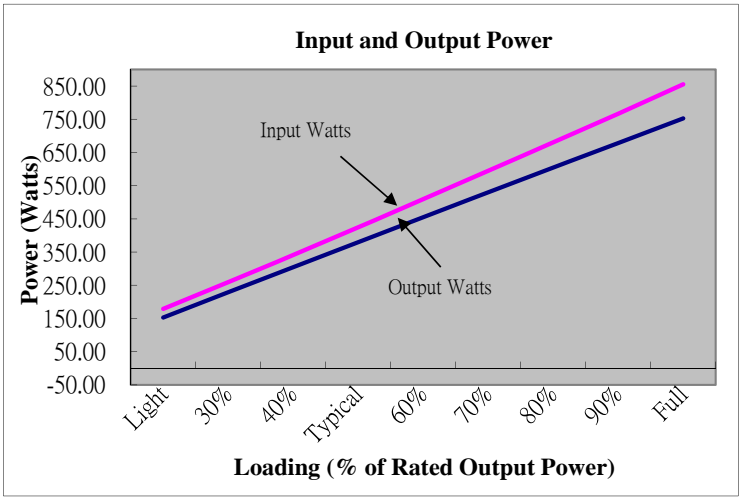
Notes:

1) "0": PS operation normal; "1": faulty conditions detected, automatically cleared upon host reads 0Bh
2) "1": PWR_OK ok; "0" PWR_OK failure detected
3) "1": AC input; "0" DC input
4) "0" Temperature ok: ; "1" Over temperature detected
5) "0" Fan ok; "1" Fan failed
6) "0" power supply attached; "1" power supply not attached

# RSAB750G Efficiency Report @230V

| | TOTAL 750W | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TOTAL 750W | | | | TOTAL 0W | | 0.00W | 0.00W | 15.00W | 765.00 | | |
| O/P Voltage | 12 | 12 | 12 | 12 | 3.3 | 5 | -12 | -5 | 5 | | | |
| O/P Current | 62.5A | 0.0A | 0.0A | 0.0A | 0.0A | 0.0A | 0.0A | 0.0A | 3.0A | | | |
| O/P Wattage | 750W | 0W | 0W | 0W | 0.0W | 0W | 0.0W | 0.0W | 15W | | | |
| **Ratio** | +12V1 | +12V2 | +12V3 | +12V4 | +3.3V | +5V | -12V | -5V | +5VSB | **Output power** | **Input power** | **Efficiency %** |
| Light | 12.25A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.59A | **152.84** | 178.9 | 85.43% |
| | 12.23V | | | | | | | | 5.03V | | | |
| 30% | 18.38A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.88A | **228.87** | 259.5 | 88.20% |
| | 12.21V | | | | | | | | 5.01V | | | |
| 40% | 24.51A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 1.18A | **304.39** | 341.4 | 89.16% |
| | 12.18V | | | | | | | | 4.98V | | | |
| Typical | 30.64A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 1.47A | **379.83** | 424.3 | 89.52% |
| | 12.16V | | | | | | | | 4.95V | | | |
| 60% | 36.76A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 1.76A | **455.02** | 509 | 89.40% |
| | 12.14V | | | | | | | | 4.93V | | | |
| 70% | 42.89A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 2.06A | **529.96** | 594.8 | 89.10% |
| | 12.12V | | | | | | | | 4.91V | | | |
| 80% | 49.02A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 2.35A | **604.62** | 680 | 88.91% |
| | 12.10V | | | | | | | | 4.88V | | | |
| 90% | 55.15A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 2.65A | **678.49** | 766.7 | 88.49% |
| | 12.07V | | | | | | | | 4.86V | | | |
| Full | 61.27A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 2.94A | **752.59** | 855.2 | 88.00% |
| | 12.05V | | | | | | | | 4.84V | | | |



# RSAB750G Efficiency Report @115V

| | TOTAL 750W | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TOTAL 750W | | | | TOTAL 0W | | 0.00W | 0.00W | 15.00W | 765.00 | | |
| O/P Voltage | 12 | 12 | 12 | 12 | 3.3 | 5 | -12 | -5 | 5 | | | |
| O/P Current | 62.5A | 0.0A | 0.0A | 0.0A | 0.0A | 0.0A | 0.0A | 0.0A | 3.0A | | | |
| O/P Wattage | 750W | 0W | 0W | 0W | 0.0W | 0W | 0.0W | 0.0W | 15W | | | |
| **Ratio** | +12V1 | +12V2 | +12V3 | +12V4 | +3.3V | +5V | -12V | -5V | +5VSB | **Output power** | **Input power** | **Efficiency %** |
| Light | 12.25A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.59A | **152.84** | 182 | 83.98% |
| | 12.23V | | | | | | | | 5.03V | | | |
| 30% | 18.38A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.88A | **228.87** | 265.6 | 86.17% |
| | 12.21V | | | | | | | | 5.01V | | | |
| 40% | 24.51A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 1.18A | **304.39** | 349.5 | 87.09% |
| | 12.18V | | | | | | | | 4.98V | | | |
| Typical | 30.64A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 1.47A | **379.83** | 435 | 87.32% |
| | 12.16V | | | | | | | | 4.95V | | | |
| 60% | 36.76A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 1.76A | **455.02** | 522.2 | 87.14% |
| | 12.14V | | | | | | | | 4.93V | | | |
| 70% | 42.89A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 2.06A | **529.96** | 611 | 86.74% |
| | 12.12V | | | | | | | | 4.91V | | | |
| 80% | 49.02A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 2.35A | **604.62** | 700 | 86.37% |
| | 12.10V | | | | | | | | 4.88V | | | |
| 90% | 55.15A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 2.65A | **678.49** | 791.7 | 85.70% |
| | 12.07V | | | | | | | | 4.86V | | | |
| Full | 61.27A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 0.00A | 2.94A | **752.59** | 884.8 | 85.06% |
| | 12.05V | | | | | | | | 4.84V | | | |