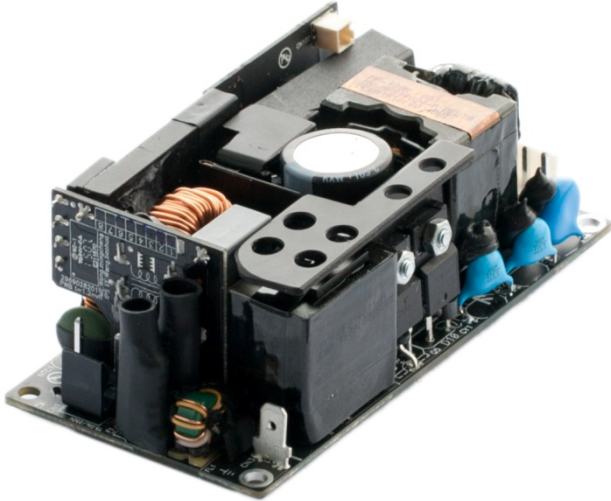


Medical AC-DC Open Frame Power Supply

200W 2"x4" High Density / MDS-200APB□ AA



MDS-200APB□ AA

Highlights & Features

- Safety Approvals to IEC 60601-1 3.1rd ed. & IEC 60950-1
- Compliant with IEC 60601-1-2 4th Ed. Requirements
- Power Good Signal
- 2xMOPP Isolation for Medical Applications
- Up to 120W~140W convection, 200W forced air

Safety Standards



CB Certified for worldwide use

Model Number: MDS-200APB□ AA
Unit Weight: 200g (0.441lb)
Dimensions (W x L x H): 50.8 x 101.6 x 35.6mm
 (2 x 4 x 1.4 inch)

General Description

Delta's MDS-200APB□ AA internal open frame power supply comes with universal AC input range from 90Vac to 264Vac. Other features include low leakage, Type BF Patient Access Leakage Currents, and electric shock protection compliance with 2 x MOPP requirements. The MDS-200APB□ AA is certified for EMC standards according to EN 55011 for industrial, scientific and medical (ISM) radio-frequency equipment; and EN 55032 for Industrial Technology Equipment (ITE) radio-frequency equipment. In addition, only recognized Japanese capacitors are used to ensure long product life.

The MDS-200APB□ AA comes with both medical and ITE safety approvals, such as UL/CE/CCC (5,000meters), and CB certification. Designs are compliant with RoHS Directive 2011/65/EU for environmental protection.

Model Information

Model Number	Input Voltage	Output Voltage	Convection Current Output	Forced Air Current Output
MDS-200APB12AA	90-264Vac	12Vdc	0-10.83A	0-16.67A**
MDS-200APB24AA		24Vdc	0-5.83A	0-8.33A*
MDS-200APB36AA		36Vdc	0-3.33A	0-5.56A*

*With 5.5CFM forced air

**With 8.5CFM forced air

Model Numbering

MDS	200	A	P	B	□	AA
Delta Medical power Supply	Max wattage in the product Series. Maybe lower at some voltage. 200→200W	Family Code A ~ Z	Product Type P: Open Frame	Input Type Code B: 3pin Class I	Output Voltage 12 for 12V 24 for 24V 36 for 36V	Revision code

Medical AC-DC Open Frame Power Supply

200W 2"x4" High Density / MDS-200APB□ AA

Specifications

Model Number	MDS-200APB12 AA	MDS-200APB24 AA	MDS-200APB36 AA
Input Ratings / Characteristics			
Nominal Input Voltage	100-240Vac		
Input Voltage Range	90-264Vac		
Nominal Input Frequency	50-60Hz		
Input Frequency Range	47-63Hz		
Input Current (max)	2.5A		
Input Surge Voltage (max)	300Vac for 100ms		
Full load Efficiency (typ.)	91% @ 115Vac/60Hz 93% @ 230Vac/50Hz, Reference Fig.1	92% @ 115Vac/60Hz 93% @ 230Vac/50Hz, Reference Fig.2	91.5% @ 115Vac/60Hz 94% @ 230Vac/50Hz, Reference Fig.3
Standby Power (max)	0.5W @ 115Vac/60Hz, 230Vac/50Hz		
Inrush Current (max)	60A@230Vac, cold start		
Input-PE(protective earth) leakage current(max)	0.1mA @ NC, 0.3mA @ SFC ¹⁾		
Output-PE(protective earth) leakage current for Type BF application (max)	0.1mA @ NC, 0.5mA @ SFC ¹⁾		
Power Factor (min)	0.95 @ 115V/50Hz, 230V/50Hz, full load		

1) NC: normal condition

2) SFC: single fault condition

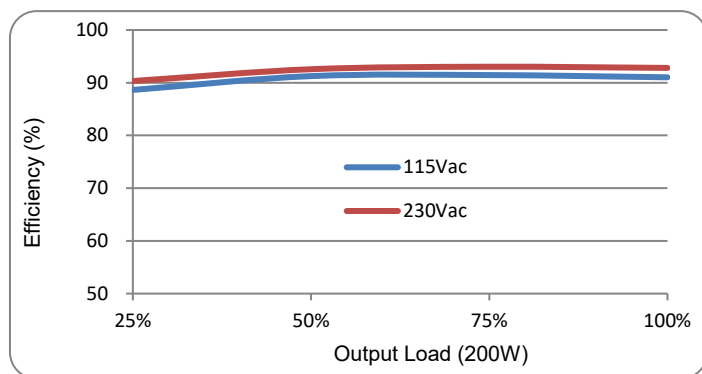


Fig.1 Efficiency versus output load(MDS-200APB12 AA)

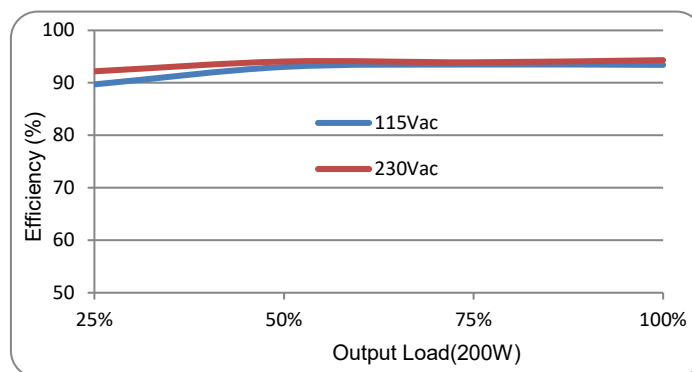


Fig.2 Efficiency versus output load(MDS-200APB24 AA)

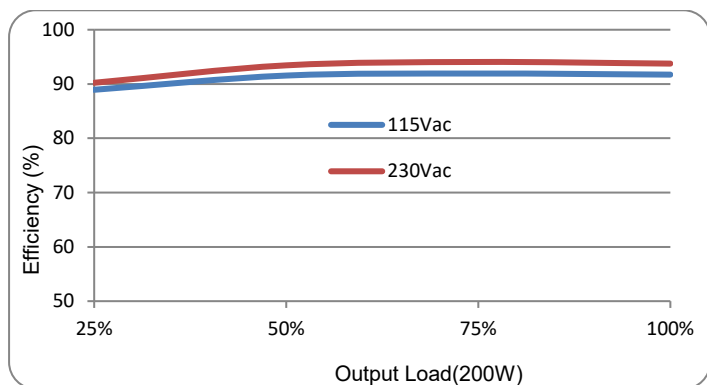


Fig.3 Efficiency versus output load(MDS-200APB36 AA)

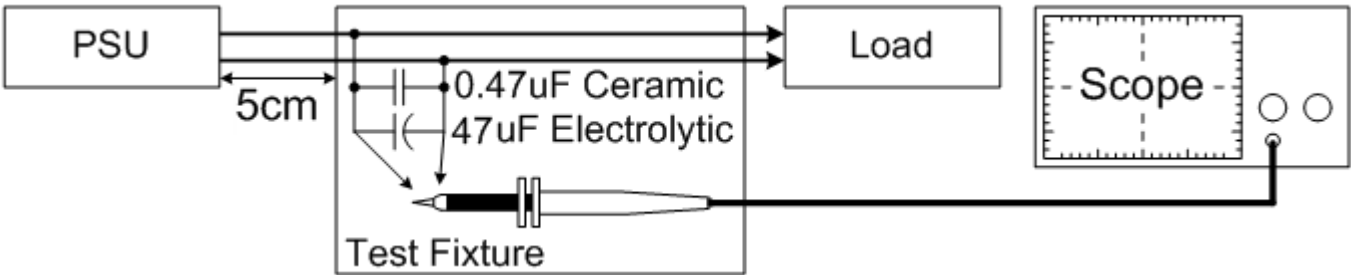
Medical AC-DC Open Frame Power Supply

200W 2"x4" High Density / MDS-200APB□ AA

Output Ratings / Characteristics

Model Number	MDS-200APB12 AA	MDS-200APB24 AA	MDS-200APB36 AA
Nominal Output Voltage (Vrated)	12V	24V	36V
Total Regulation (max.)	±3%	±3%	±3%
Output Power	200W 8.5CFM air Up to 130W convection air	200W 5.5CFM air Up to 140W convection air	200W 5.5CFM air Up to 120W convection
Line Regulation (max)	±0.5%		
Load Regulation (max)	±2.5%		
Ripple& Noise (typ.)	1%pk-pkVrated @ Full load		
Start-up Time(max)	2000ms@115Vac		
Hold-up Time(min)	12ms@115Vac, tested with 130W load	12ms@115Vac, tested with 130W load	12ms@115Vac, tested with 120W load
Dynamic Response(Overshoot & Undershoot O/P Voltage)	±5% @50-100% load (Slew Rate: 0.5A/μS, 50% duty cycle @ 10Hz&10KHz)		
Capacitive load (max)	1000uF @200W 1500uF @130W	1000uF @200W 1500uF @140W	1000uF @200W 1500uF @120W
Rise time (max)	100ms		

Ripple & Noise measurement circuit



Medical AC-DC Open Frame Power Supply

200W 2"x4" High Density / MDS-200APB□ AA

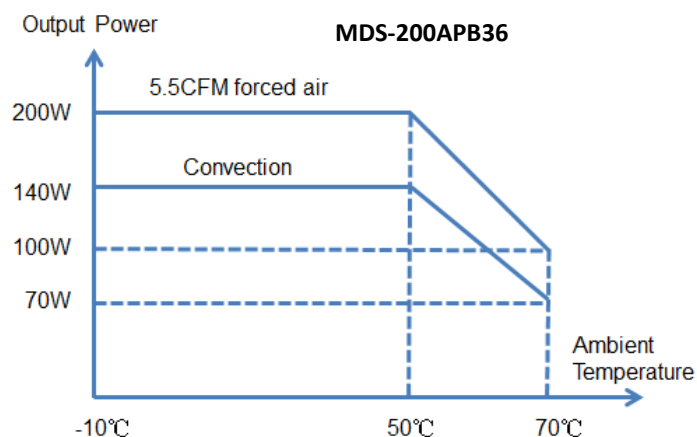
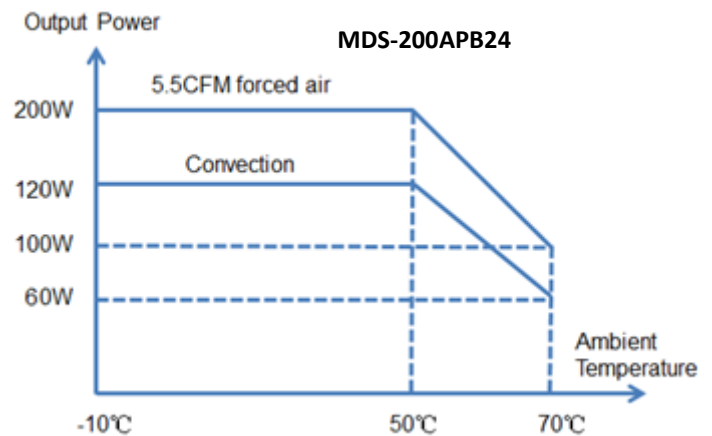
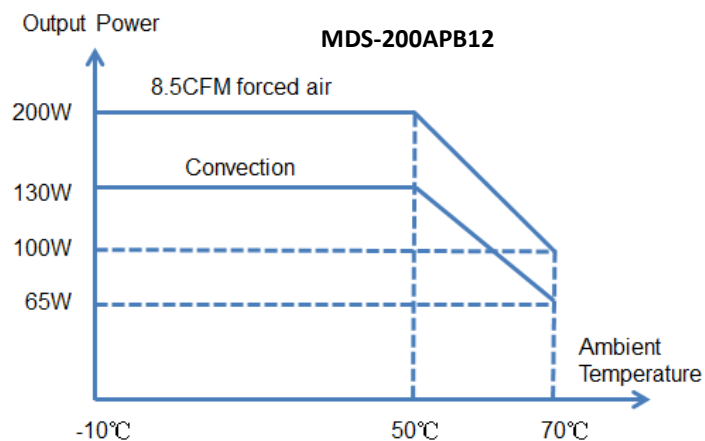
Mechanical

Case Cover	NA
Dimensions (W x L x H typ.)	50.8x101.6x35.6mm (2x4x1.4inch)
Unit Weight	200g(0.441lb)
Indicator	NA
Cooling System	NA

Environment

Surrounding Air Temperature	Operating	Absolute Max -10°C to +70°C, supported power linearly de-rate from 50°C to 50% rated up to 70°C Note: see power de-rating curve
	Storage	-40°C to +85°C
Operating Humidity		5-95% RH (Non-Condensing)
Storage Humidity		5-95% RH (Non-Condensing)
Operating Altitude		Up to 5,000 meters (up to 16402 feet or 106-54kPa)
Shock Test (Non-Operating)		50G, 11ms, 3 shocks for each direction
Vibration (Operating)		5-500Hz, 2Grms, 15 minute for each three axis

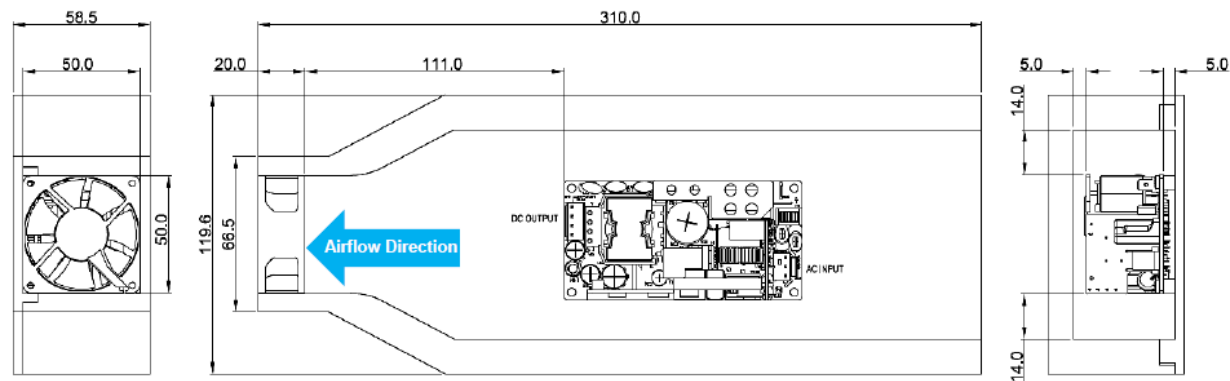
Power De-rating curve



Medical AC-DC Open Frame Power Supply

200W 2"x4" High Density / MDS-200APB□ AA

Load De-rating Fixture and Test Setup. Fan is DELTA Part Number AFB0512HHD



Protections

Overvoltage (max)	125% of rated voltage, Latch Mode
Overload / Overcurrent (max)	Main output 160% of rated current Hiccup Mode(Non-Latching, Auto-Recovery)
Over Temperature	Latch Mode
Short Circuit	Hiccup Mode, (Non-Latching, Auto-Recovery)

Reliability

MTBF(Minimum) 115Vac, 130W, 35°C, Convection Air Flow(MDS-200APB12 AA) 115Vac, 140W, 35°C, Convection Air Flow(MDS-200APB24 AA) 115Vac, 120W, 35°C, Convection Air Flow(MDS-200APB36 AA)	800 kHrs based on Telecordia SR-332
Operating life 115Vac, 130W, 25°C, Convection Air Flow(MDS-200APB12 AA) 115Vac, 140W, 25°C, Convection Air Flow(MDS-200APB24 AA) 115Vac, 120W, 25°C, Convection Air Flow(MDS-200APB36 AA)	26,280Hrs

Medical AC-DC Open Frame Power Supply

200W 2"x4" High Density / MDS-200APB□ AA

Safety Standards / Directives

Medical Safety	IEC60601-1 2nd and 3.1rd edition CB report IEC60601-1 edition 3.1rd (2012), EN60601-1 (2006) + A11 + A1 + A12, CAN/CSA-C22.2 NO. 60601-1:14, ANSI/AAMI ES60601-1:2005/(R)2012
ITE Safety	IEC60950-1 CB report TUV60950-1 UL60950-1+CAN/CSA60950-1 GB4943.1-2011, GB9254-2008, GB17625.1-2003
CE	MDD Directive 93/42/EEC
Environmental	RoHS Directive 2011/65/EU Compliant
Galvanic Isolation	Input to/Output (2XMOPP) 4000 Vac Input to/Ground(1XMOPP) 1500Vac¹⁾ Output to/Ground(1XMOPP) 1500Vac (Type BF application rated)

1) PSU can support PoE applications with Primary to FG 2500Vac test.

Medical AC-DC Open Frame Power Supply

200W 2"x4" High Density / MDS-200APB□ AA

EMC (Compliant with IEC 60601-1-2 4th Ed. Requirements)

EMC / Emissions		EN55011 & compliant with EN55032, FCC Title 47: Class B
Harmonic Current Emissions	IEC61000-3-2	Meet Class D limit
Immunity to		
Voltage Flicker	IEC61000-3-3	
Electrostatic Discharge	IEC61000-4-2	Level 4 Criteria A ¹⁾ Air Discharge: 15kV Contact Discharge: 8kV
Radiated Field	IEC61000-4-3	Criteria A ¹⁾ 80MHz-2700MHz, 10V/m AM modulation 385MHz-5785MHz, 28V/m Pulse mode and other modulation
Electrical Fast Transient / Burst	IEC61000-4-4	Level 3 Criteria A ¹⁾ :2kV
Surge	IEC61000-4-5	Level 3 Criteria A ¹⁾ Common Mode ³⁾ : 2kV Differential Mode ⁴⁾ : 1kV
Conducted	IEC61000-4-6	Level 2 Criteria A ¹⁾ 150kHz-80MHz, 3Vrms, 6Vrms at ISM bands and Amateur radio bands
Power Frequency Magnetic Fields	IEC61000-4-8	Criteria A ¹⁾ Magnetic field strength 30A/m
Voltage Dips	IEC61000-4-11	Criteria A ¹⁾ 0% U _T , 0.5 cycle (10ms) , 0°/45°/90°/135°/180°/225°/270°/315°/360° Criteria B ²⁾ 0% U _T , 1 cycle (20ms), 0° Criteria B ²⁾ 70% U _T , 25 cycle (500ms), 0° Criteria B ²⁾ 0% U _T , 250 cycle (5000ms), 0°

1) Criteria A: Normal performance within the specification limits

2) Criteria B: Output out of regulation, or shuts down during test. Automatically restore to normal operation after test.

3) Asymmetrical: Common mode (Line to earth)

4) Symmetrical: Differential mode (Line to line)

Medical AC-DC Open Frame Power Supply

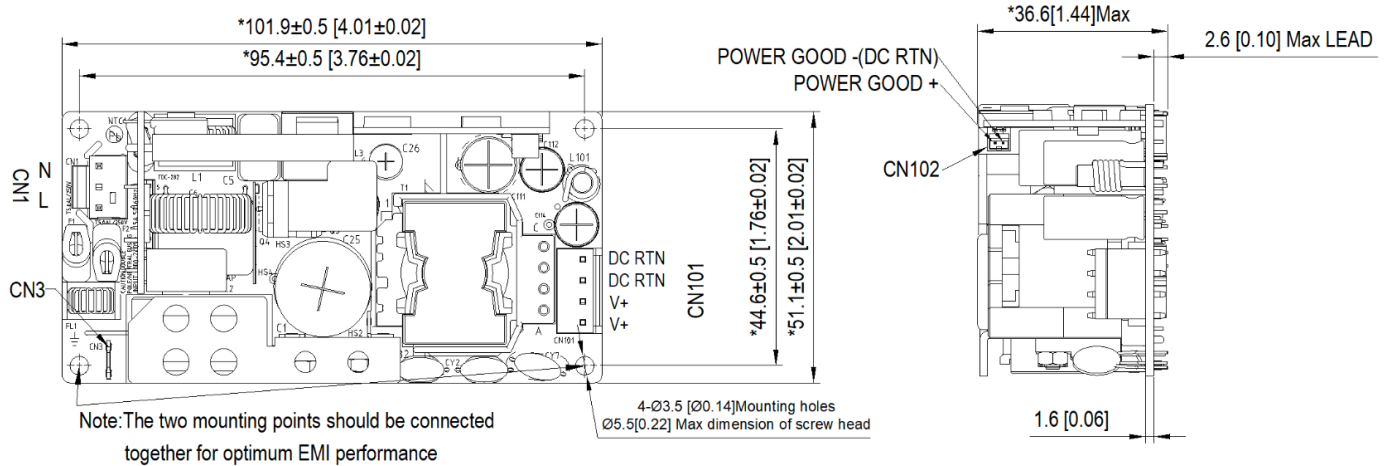
200W 2"x4" High Density / MDS-200APB□ AA

Dimensions

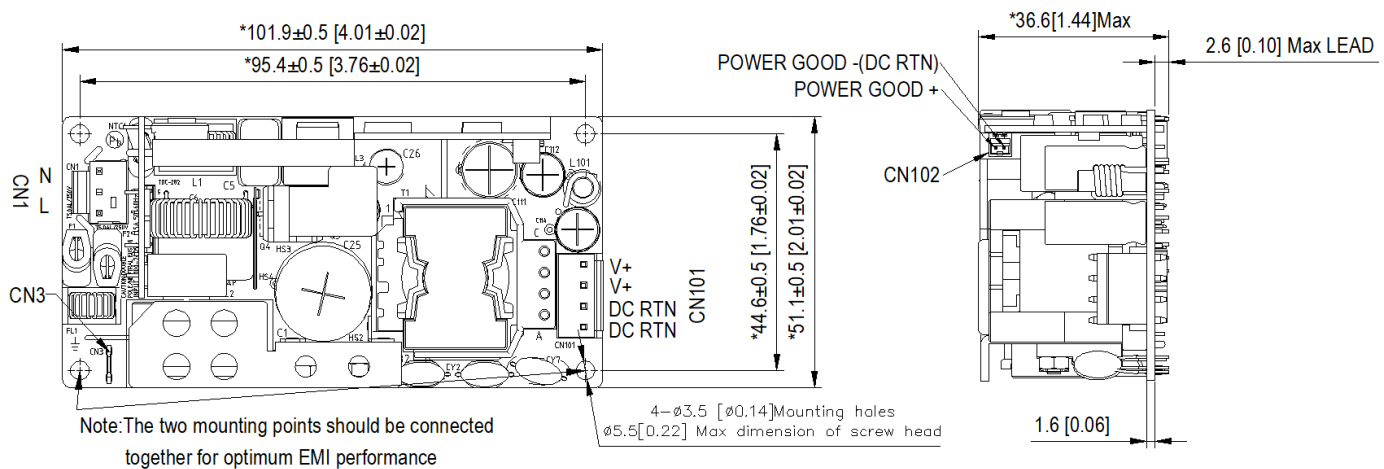
W x L x H: 50.8 x 101.6 x 35.6 mm

Mechanical drawing (3Pin input type)

MDS-200APB12 AA



MDS-200APB24 AA & MDS-200APB36 AA



Notes

— Dimensions are in mm

- CN1 mates with Molex housing 26-03-4030 and Molex series 6838 crimp terminals. Input Line can also be connected to Neutral, and Input Neutral can be connected to Line.
- CN101 mates with JST housing VHR-4N and JST terminal SVH-41T-P1.1.
- CN102 mates with Molex housing 0874390200 and Molex 874210000 crimp terminals.
- CN3: PINGOOD JP-13T or equivalent mate with KST FDFNYD1-187 or other applicable connectors
- Two mounting points in mechanical drawing need to be connected to system earth case together, Protective bonding conductor from the end product protective earth terminal (if any) can be tied to CN3 for open frame model.

Medical AC-DC Open Frame Power Supply

200W 2"x4" High Density / MDS-200APB□ AA

Functions

Start-up Time

The time required for the output voltage to reach 90% of its set value, after the input voltage is applied.

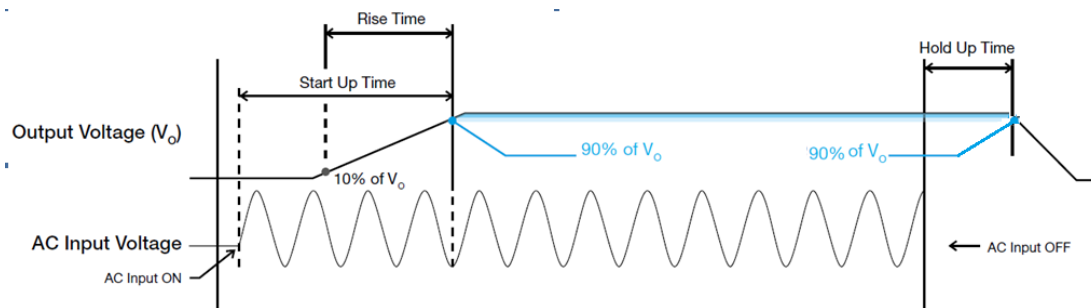
Rise Time

The time required for the output voltage to change from 10% to 90% of its set value.

Hold-up Time

Hold up time is the time when the AC input collapses and output voltage retains regulation for a certain period of time. The time required for the output to reach 90% of its set value, after the input voltage is removed.

■ Graph illustrating the Start-up Time, Rise Time, and Hold-up Time



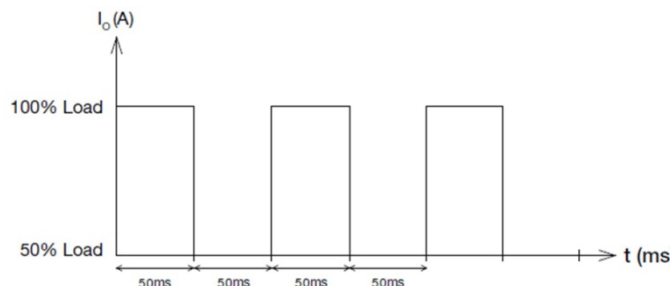
Medical AC-DC Open Frame Power Supply

200W 2"x4" High Density / MDS-200APB□ AA

Dynamic Response

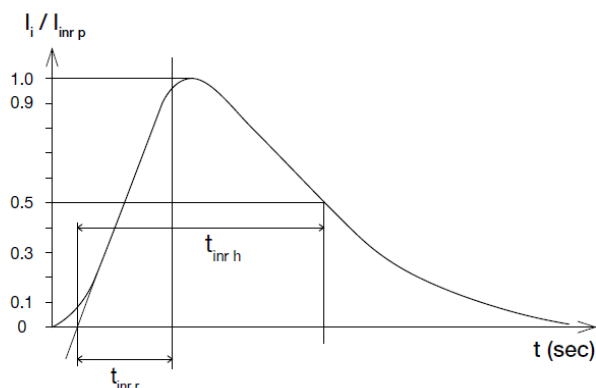
The power supply output voltage will remain within $\pm 5\%$ of its steady state value, when subjected to a dynamic load 50 to 100% of its rated current.

■ 50 to 100% Load



Inrush Current

Inrush current is the peak, instantaneous, input current measured and, occurs when the input voltage is first applied. For AC input voltages, the maximum peak value of inrush current will occur during the first half cycle of the applied AC voltage. This peak value decreases exponentially during subsequent cycles of AC voltage.

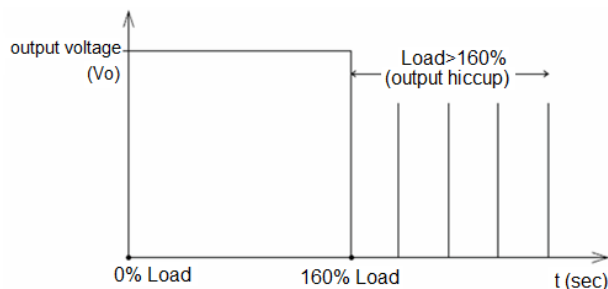


Overvoltage Protection

The power supply's overvoltage circuit will be activated when its internal feedback circuit fails. The output voltage shall not exceed its specifications defined on Page 6 under "Protections". Power supply will latch off, and require removal/re-application of input AC voltage in order to restart.

Short Circuit Protection

The power supply's output OLP/OCP function also provides protection against short circuits. When a short circuit is applied, the output current will operate in "Hiccup mode", as shown in the illustration in the OLP/OCP section on this page. The power supply will return to normal operation after the short circuit is removed.



Overload & Overcurrent Protections

The power supply's Overload (OLP) and Overcurrent (OCP) Protections will be activated before output current under 160% of I_o (Max load). Upon such occurrence, V_o will start to drop. Once the power supply has reached its maximum power limit, the protection will be activated and the power supply will go into "Hiccup mode" (Auto-Recovery). The power supply will recover once the fault condition causing the OLP and OCP is removed and I_o is back within the specified limit.

Additionally, if the I_{out} is $< 160\%$ but $> 100\%$ for a prolong period of time (depending on the load), the Over Temperature Protection (OTP) will be activated due to high temperature on critical components. Then, the power supply will be latched off, and require recycling of input voltage to restart it.

Over Temperature Protection

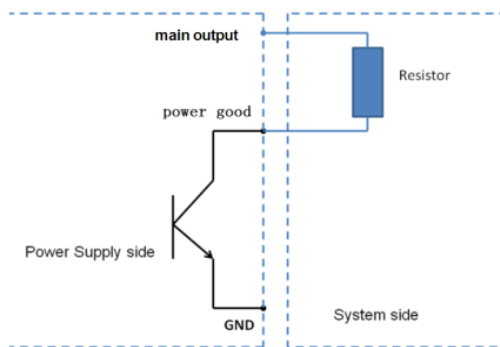
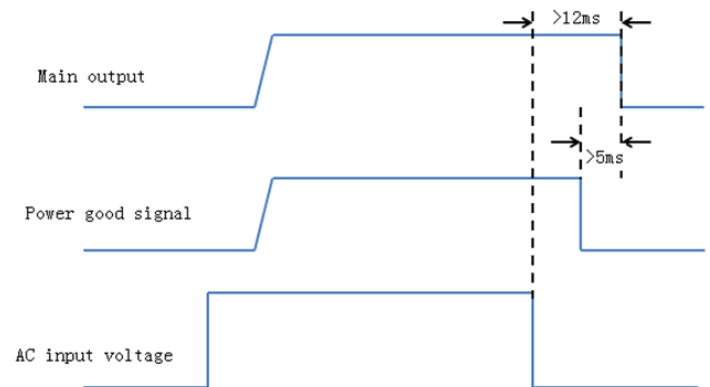
As mentioned above, the power supply also has Over Temperature Protection (OTP). This is activated when the overload condition persists for an extended duration and the output current is below the overload trigger point but $> 100\%$ load. In the event of a higher operating temperature condition at 100% load, the power supply will run into OTP when the surrounding air temperature is higher than the operating temperature. When activated, the output voltage will go into latch mode until the input voltage is removed; then, reapplied, and the surrounding air temperature drops to its normal operating temperature.

Medical AC-DC Open Frame Power Supply

200W 2"x4" High Density / MDS-200APB□ AA

Power Good

Power Good+ pin is an open collector transistor (40V/600mA rating). A resistor (suggested value 20Kohm, 1/8W) can be added between output pin (or, other available pull-up voltage that is no greater than 30V) and the Power Good+ pin (refer to figure below). Value of pull-up resistor may have to be adjusted, depending on voltage used, and other end-use conditions of the Power Good+ pin connection to the product. When AC input is on, Power Good+ pin will be high. When AC input is off, Power Good+ pin will be low. There will be a minimum of 5 milliseconds (with 120W convection output power) between the time the power good goes to low level, and the time when the output reaches 90% of its rated value.



Medical AC-DC Open Frame Power Supply

200W 2"x4" High Density / MDS-200APB□ AA

Certificate



All Delta Medical Power products conform to the European directive 2011/65/EU. RoHS is the abbreviation for "Restriction of the use of certain hazardous substances"



Delta has been certified as meeting the requirement of ISO 13485: 2003 and EN ISO 13485:2012 for the design and manufacture of switching power supply and adaptor for medical device.



In addition to a UL Total Certification Program (TCP) approved client laboratory for IEC60950 and IEC60065. Delta also has participated UL Client Test Data Program (CDTP) for IEC 60601

Attention

Delta provides all information in the datasheets on an "AS IS" basis and does not offer any kind of warranty through the information for using the product. In the event of any discrepancy between the information in the catalog and datasheets, the datasheets shall prevail (please refer to www.DeltaPSU.com for the latest datasheets information). Delta shall have no liability of indemnification for any claim or action arising from any error for the provided information in the datasheets. Customer shall take its responsibility for evaluation of using the product before placing an order with Delta.

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