Medical AC-DC Open Frame Power Supply

12V/200W 2”x4” High Density MDS-200A Series

MDS-200A Series

Highlights & Features

- 2" x 4" x 1.4" Package
- Power Good
- 800K Hours MTBF
- 140W convection, 200W force air
- IT & Medical Safety Approvals

Safety Standards

CB Certified for worldwide use

Model Number: MDS-200A
Unit Weight: 200g
Dimensions (W x L x H): 50.8x101.6x35.6mm
2x4x1.4 inch

General Description

The MDS-200A series of internal open frame power supplies come 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 series is certified for EMC standards according to EN 55011 for industrial, scientific and medical (ISM) radio-frequency equipment; and, EN 55022 for Industrial Technology Equipment (ITE) radio-frequency equipment. In addition, only recognized Japanese capacitors are used to ensure long product life.

The MDS-200A series comes with both medical and ITE safety approvals, including UL/CE/CQC (5000 meters), and CB certification. Designs are compliant with RoHS Directive 2011/65/EU for environmental protection.

Model Information

Medical AC-DC Open Frame

Model Number	Input Voltage	Output Voltage	Convection Current Output	Forced Air Current Output
MDS-200APB12 AA	90-264Vac	12Vdc	10.83A	16.67A*

* With 5CFM force air

Model Numbering

MDS	200	A	P	B	12	A	A
Delta Medical power Supply	Max wattage in the product Series. Maybe lower at some voltage. 060 → 60W 150 →150W 1K2 → 1,200W	Family Code A～ Z	Product Type P: Open Frame	Input Type Code B: 3pin Classl	Output Voltage 12 for 12V	Revision Code	Revision code

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Specifications

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
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, SFC: single fault condition

Leakage Current

Input-PE Leakage Current	100Vac/60Hz (Typ)	264Vac/60Hz(Typ)	Delta Limit	IEC60601-1 Limit
Normal Condition	17.5uA	43.5uA	100uA max	5000uA max
Single Fault Condition	32.9uA	90.7uA	300uA max	10000uA max
Output-PE Leakage Current for Type BF application				
Normal Condition	28.5uA	86.7uA	100uA max	100uA max
Single Fault Condition	42.9uA	128.6uA	500uA max	500uA max

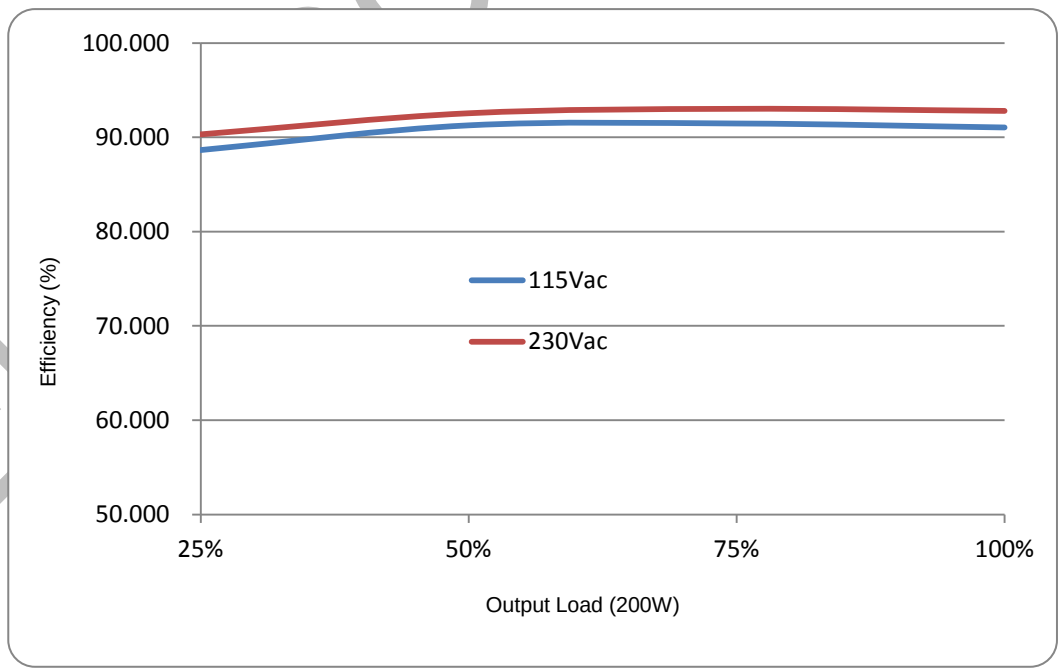

Fig.1 Efficiency versus output load

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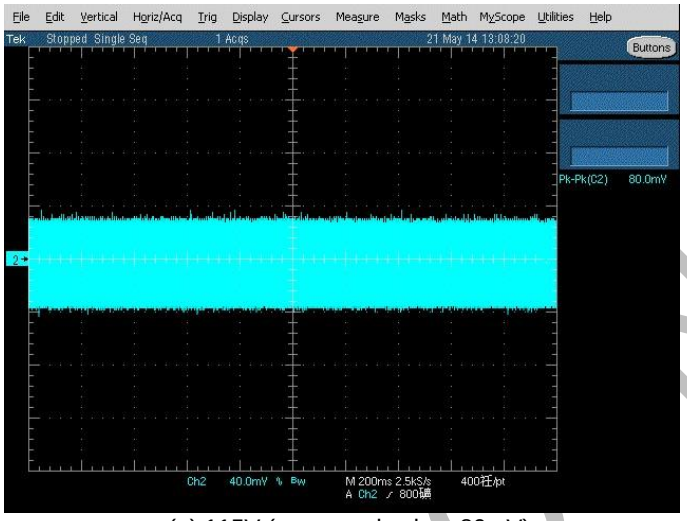
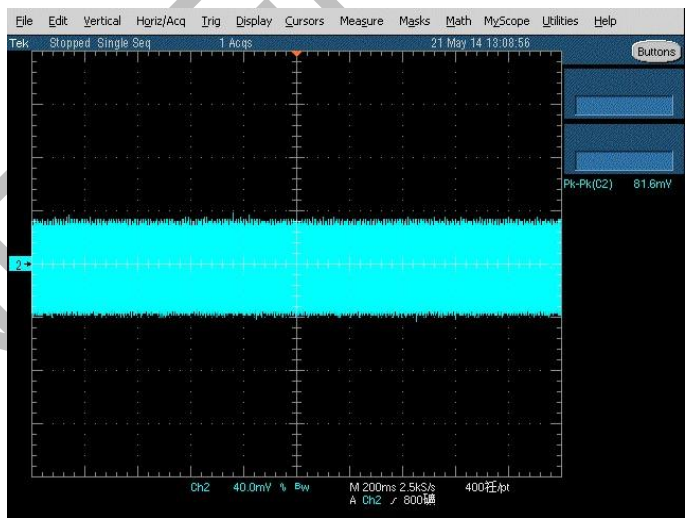
Output Ratings / Characteristics

Nominal Output Voltage (Vrated)	12V
Output Voltage Tolerance	± 3%
Output Power	200W max with 5CFM air cooling
Line Regulation (max)	±0.5%
Load Regulation (max)	±1%
Ripple & Noise (typ.)	1% pk-pk Vrated@ Full load, Reference Fig. 2
Start-up Time (max)	2000ms @ 115Vac
Hold-up Time (min)	12ms @ 115Vac, tested with 130W load
Dynamic Response (Overshoot & Undershoot O/P Voltage)	± 5% @ 50-100% load
Capacitive load (max)	4000uF@200W 6000uF@130W
Rise time (max)	100ms



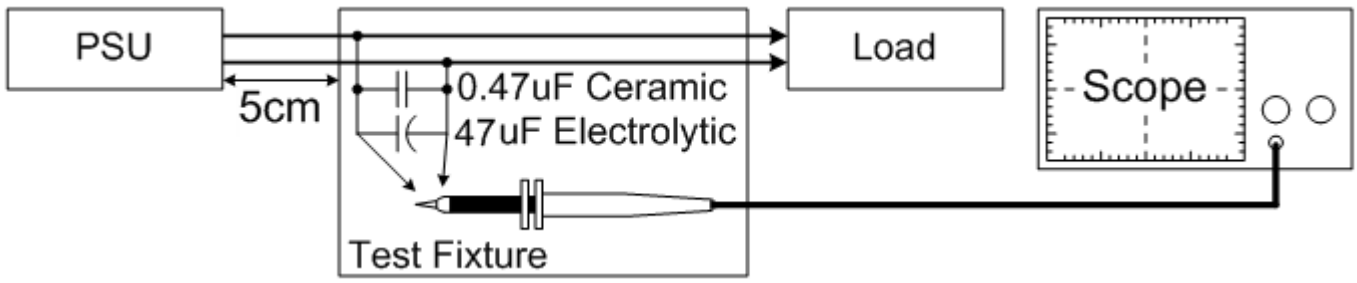
(a) 115V (measured value=80mV)



(b) 230V(measured value=82mV)

Fig.2 Ripple & Noise example, 20MHz BW

Ripple & Noise measurement circuit



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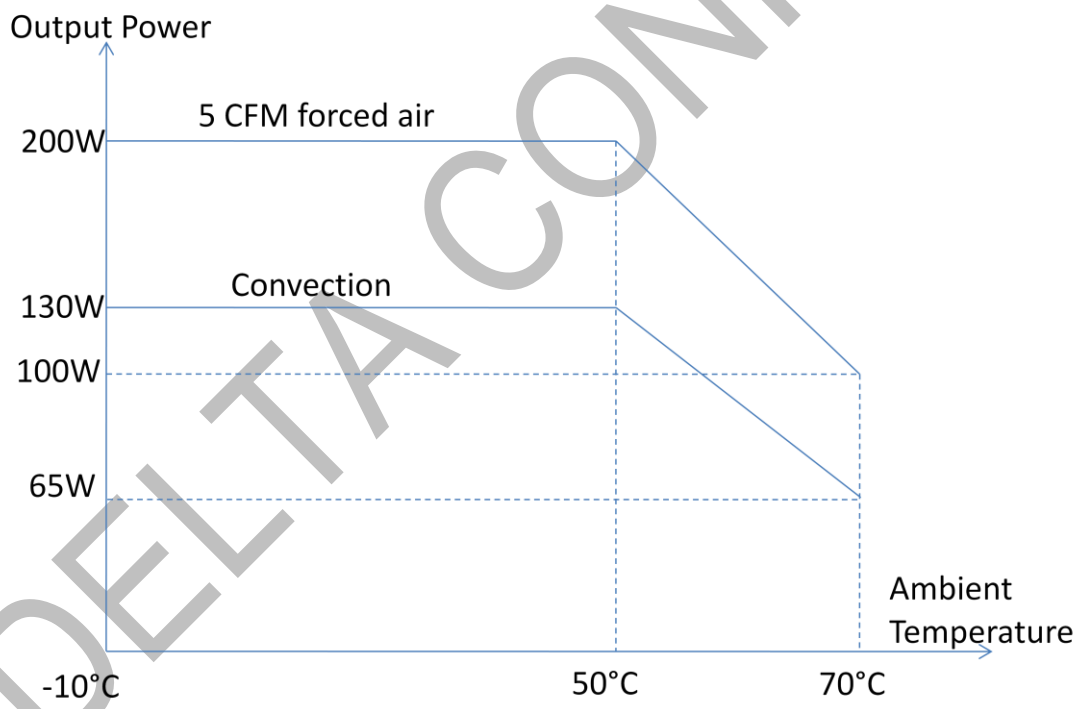
Mechanical

Case Cover	NA
Dimensions(W x L x H typ.)	50.8x101.6x35.6mm 2x4x1.4inch
Unit Weight	200g
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)
Operating Altitude		5,000 meters
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



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Protections

Overvoltage (max)	125% of rated voltage, Latch Mode
Over load / Over current (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) at 115Vac, 130W, 35 °C,	Convection Air Flow	1500 kHrs based on Telecordia SR-332
Operating life at 115Vac, 130W, ambient 25 °C, Convection Air Flow		26,280Hrs

Safety Standards / Directives

Medical Safety		IEC60601-1 2nd and 3rd edition CB report TUV EN60601-1:2006 UL60601-1+CAN/CSA 60601-1: (Ed.3.2005)
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) Input to/Ground(1XMOPP) Output to/Ground(1XMOPP)	4000 Vac 1500 Vac[1)] 1500 Vac (Type BF application rated)

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

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EMC

EMC / Emissions		Class I model: EN55011, EN55022, 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 3 Criteria A[1)] Air Discharge: 8kV Contact Discharge: 6kV
Radiated Field	IEC61000-4-3	Level 2 Criteria A[1)] 80MHz-2.5GHz, 3V/M with 1kHz tone / 80% 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[2)]: 2kV Differential Mode[3)]: 1kV
Conducted	IEC61000-4-6	Level 2 Criteria A[1)] 150kHz-80MHz, 3Vrms
Power Frequency Magnetic Fields	IEC61000-4-8	Criteria A[1)] Magnetic field strength 3A/Meter
Voltage Dips	IEC61000-4-11	30% 10ms Criteria A[1)] ; 60% 100ms and 100% 5000ms Criteria B[2)]
Voltage Dips and interruption	IEC60601-1-2	100% 10ms, Criteria A[1)] ; 60% 100ms, Criteria B[2)] ; 30% 500ms, Criteria B[2)] ; 100% 5000ms. Criteria B[2)] :

1) Criteria A: Normal performance within the specification limits
2) Criteria B: Output out of regulation, or shuts down during test. Automatically restored to normal operation after test.
3) Asymmetrical: Common mode (Line to earth)
3) Symmetrical: Differential mode (Line to line)

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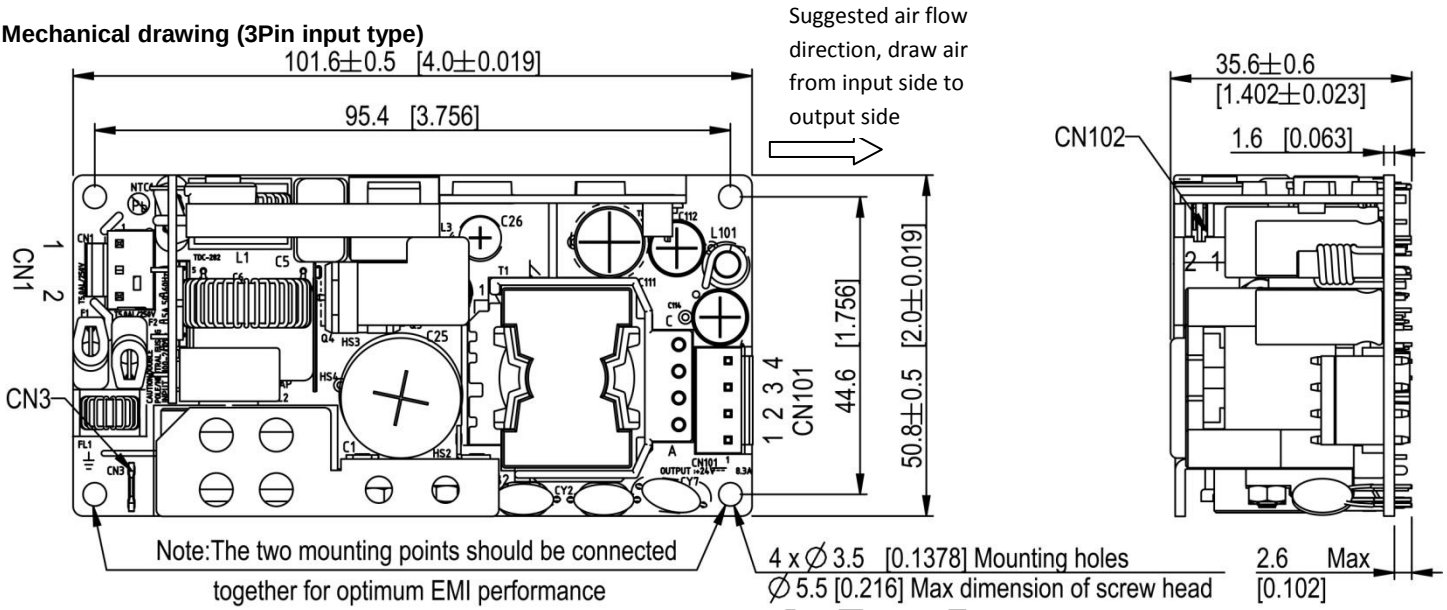
Dimensions

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

Mechanical drawing (3Pin input type)



Notes

— Dimensions are in mm(inches)

Input Connector CN1	
Pin 1	Neutral
Pin 2	Line

CN1 mates with Molex housing 26033031 and Molex series 6838 crimp terminals.

Signal Connector CN102	
Pin 1	Power Good -(DC RTN)
Pin 2	Power Good +

CN1 mates with Molex housing 0874390200 and Molex 874210000 crimp terminals.

Output Connector CN101	
Pin1	DC RTN
Pin2	DC RTN
Pin3	Vo
Pin4	Vo

CN101 mates with JST housing VHR-4N and JST terminal SVH-41T-P1.1.

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.

Functions

Start-up Time

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

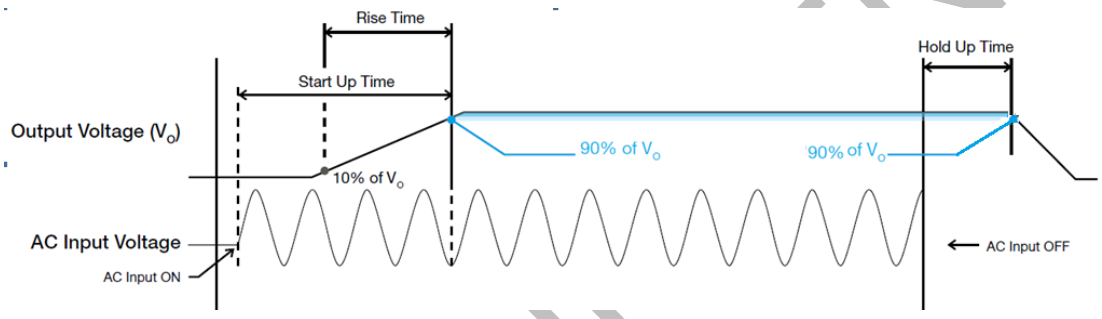
Rise Time

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**



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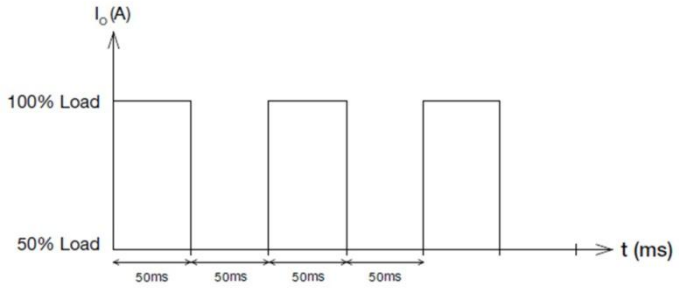
Dynamic Response

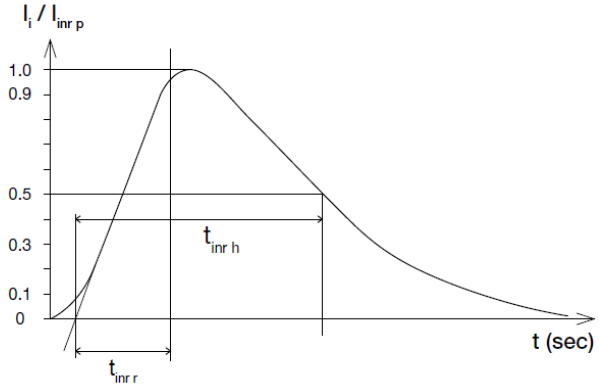
The power supply output voltage will remain within ±5% of its steady state value, when subjected to a dynamic load 50 to 100% of its rated current.

■ 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.

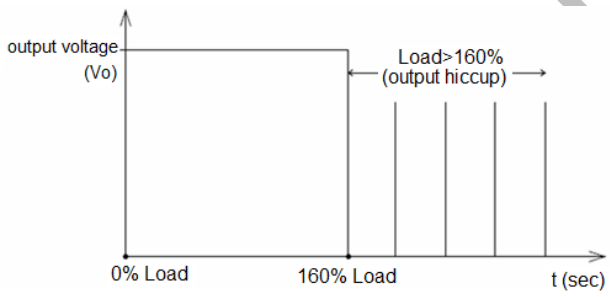


Overvoltage Protection

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 & Over current Protections

The power supply’s Overload (OLP) and Over current (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.

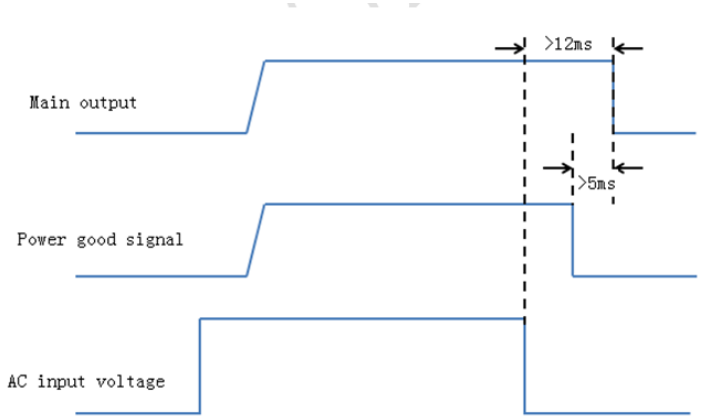
Additionally, if the Iout is <160% but >100% for a prolong period of time (depending on the load), the Over Temperature Protection (OTP) will be activated due to high temperature on critical components. The power supply will then go into latch mode.

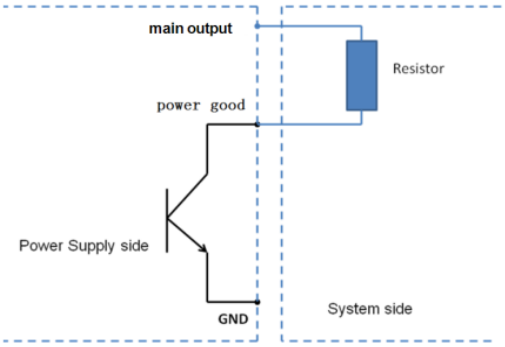
Over Temperature Protection

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.

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.





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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