# Medical AC-DC Enclosed Power Supply
## 24 V 200 W 2” x 4” High Density MDS-200ADB24 AA



# MDS-200ADB24 AA

### Highlights & Features

- Safety Approvals to IEC 60601-1 & IEC 62368-1
- Compliant with IEC 60601-1-2 Ed. 4 Requirements
- 2.5" x 4.5" x 1.8" Package
- Power Good Signal
- up to 800K Hours MTBF
- up to 120W convection, 200W forced air

### Safety Standards

CB Certified for worldwide use

**Model Number:** MDS-200ADB24 AA
**Unit Weight:** 345 g (0.762 lb)
**Dimensions (L x W x H):** 113.9 x 64.7 x 44.7 mm (4.5 x 2.5 x 1.8 inch)

### General Description

The MDS-200ADB24 AA enclosed power supply comes with universal AC input range from 90 Vac to 264 Vac. Other features include low leakage, Type BF Patient Access Leakage Currents, and electric shock protection compliance with 2 x MOPP requirements. The MDS-200ADB24 AA is certified for EMC standards according to EN/BS EN 55011 for industrial, scientific and medical (ISM) radio-frequency equipment; and, EN/BS EN 55032 for Industrial Technology Equipment (ITE) radio-frequency equipment.

The MDS-200ADB24 AA comes with both medical and ITE safety approvals, including UL/CE, and CB certification. Designs are compliant with RoHS Directive for environmental protection.

### Model Information

| Model Number | Input Voltage | Output Voltage | Convection Current Output | Forced Air Current Output |
|---|---|---|---|---|
| MDS-200ADB24 AA | 90-264 Vac | 24 Vdc | 0-5 A | 0-8.33 A* |

*With 5.5 CFM forced air

### Model Numbering

| MDS | - | 200 | A | D | B | ☐ | ☐ | AA |
|---|---|---|---|---|---|---|---|---|
| Delta Medical Power Supply | | Max wattage in the product Series. Maybe lower some voltage. 200 → 200 W | Family Code A~Z | Product Type D: Enclosed | Input Type Code B: 3pin Class I | Output Voltage 24 for 24 V | Blank | Revision Code |



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### Specifications

#### Input Ratings / Characteristics

| | |
|---|---|
| Nominal Input Voltage | 100-240 Vac |
| Input Voltage Range | 90-264 Vac |
| Nominal Input Frequency | 50-60 Hz |
| Input Frequency Range | 47-63 Hz |
| Input Current(max) | 2.5 A |
| Input Surge Voltage (max) | 300 Vac for 100 ms |
| Full load Efficiency (typ.) | 92% @ 115 Vac/60 Hz<br>93% @ 230 Vac/50 Hz, Reference Fig. 1 |
| Standby Power (max) | 0.5 W @ 115 Vac/60 Hz, 230 Vac/50 Hz |
| Inrush Current (max) | 60 A @ 230 Vac, cold start |
| Input-PE(protective earth) leakage current(max) | 0.1 mA @ NC, 0.3 mA @ SFC [1)] |
| Output-PE(protective earth) leakage current for Type BF application (max) | 0.1 mA @ NC, 0.5 mA @ SFC [1)] |
| Power Factor (min) | 0.95 @ 115 V/50 Hz, 230 V/50 Hz, 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 | 19.5 uA | 45.0 uA | 100 uA max | 5000 uA max |
| Single Fault Condition | 44.8 uA | 153.0 uA | 300 uA max | 10000 uA max |
| Output-PE Leakage Current for Type BF application | | | | |
| Normal Condition | 38.3 uA | 81.5 uA | 100 uA max | 100 uA max |
| Single Fault Condition | 43.4 uA | 129.4 uA | 500 uA max | 500 uA max |

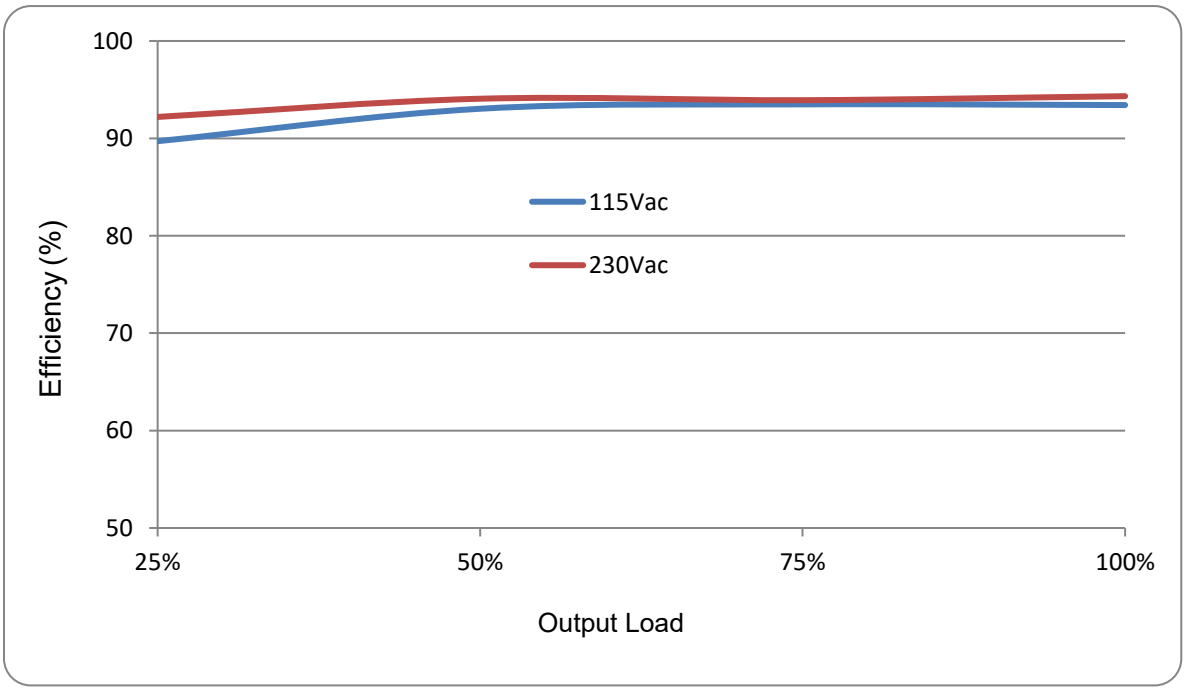



**Fig. 1 Efficiency versus output load**

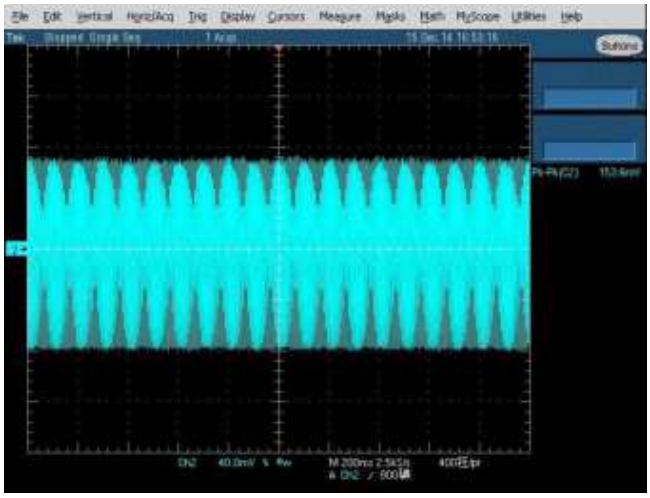


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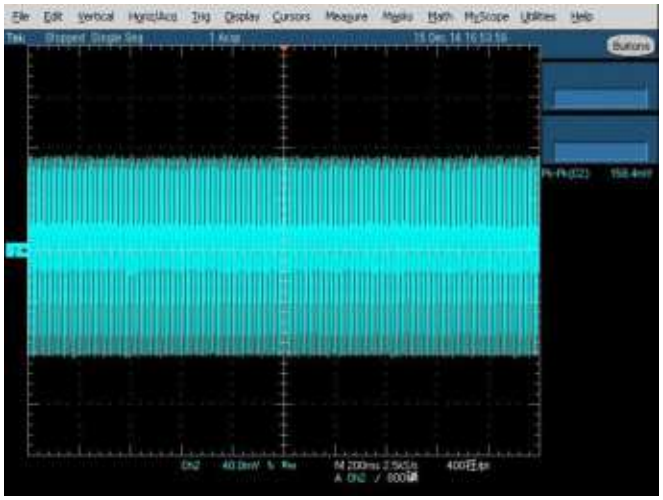
# Medical AC-DC Enclosed Power Supply
## 24 V 200 W 2” x 4” High Density MDS-200ADB24 AA

### Output Ratings / Characteristics

| | |
|---|---|
| Nominal Output Voltage (Vrated) | 24 V |
| Output Voltage Tolerance | ±3% |
| Output Power | 200 W 5.5 CFM air, up to 120 W convection air |
| Line Regulation (max) | ±0.5% |
| Load Regulation (max) | ±1% |
| Ripple& Noise(typ.) | 1% pk-pkVrated@ Full load, Reference Fig. 2 |
| Start-up Time(max) | 2000 ms@115 Vac |
| Hold-up Time(min) | 12 ms@115 Vac, tested with 120 W load |
| Dynamic Response(Overshoot & Undershoot O/P Voltage) | ±5% @50-100% load |
| Capacitive load (max) | 1000 uF |
| Rise time (max) | 100 ms |



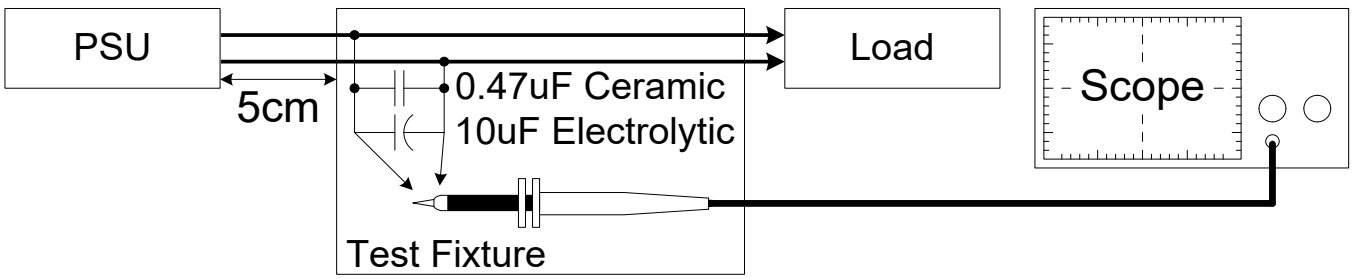
(a) 115 V (measured value=153 mV)



(b) 230 V (measured value=158 mV)

**Fig.2 Ripple & Noise example, 20 MHz BW**

### Ripple & Noise measurement circuit






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# Medical AC-DC Enclosed Power Supply
## 24 V 200 W 2” x 4” High Density MDS-200ADB24 AA

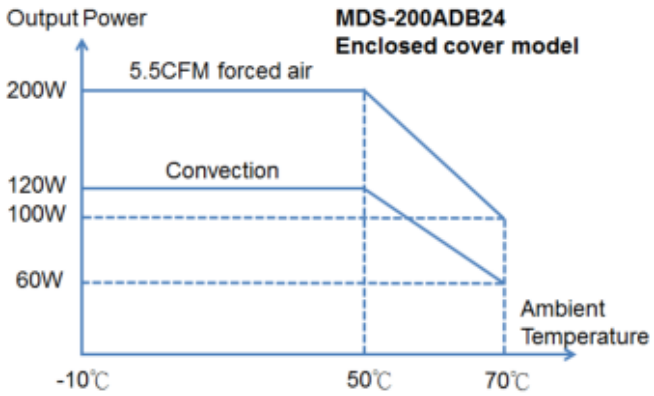
### Mechanical

| | |
|---|---|
| Case Cover | Enclosed Cover (SPCC) |
| Dimensions (L x W x H) | 113.9 x 64.7 x 44.7 mm (4.5 x 2.5 x 1.8 inch) |
| Unit Weight | 345 g (0.762 lb) |
| Indicator | NA |
| Cooling System | NA |

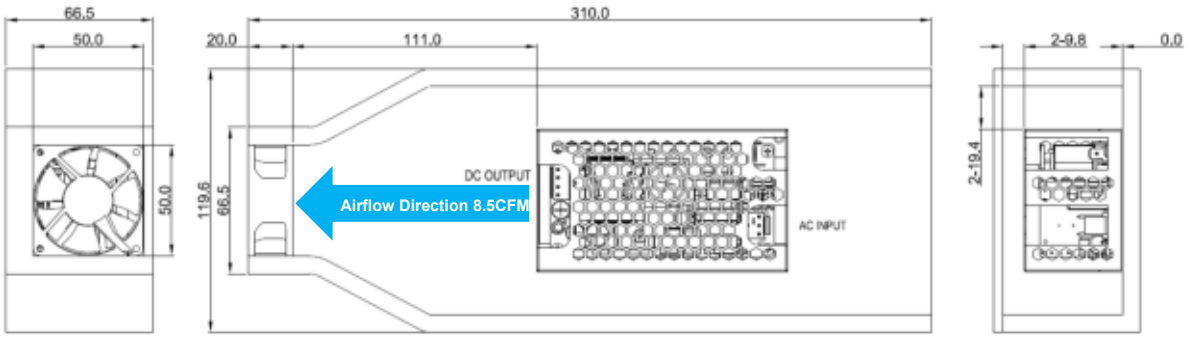
### Environment

| | | |
|---|---|---|
| Surrounding Air Temperature | Operating | Absolute Max<br>-10°C to+70°C, supported power linearly de-rate from 50°C to 50% rated up to 70°C<br>Note: see power de-rating curve |
| | Storage | -40°C to+85°C |
| Operating Humidity | | 5-95% RH (Non-Condensing) |
| Operating Altitude | | 5,000 meters (16,400 feet or 50 kPa) |
| Non-operating Altitude | | 5,000 meters (16,400 feet or 50 kPa) |
| Shock Test (Non-Operating) | | 50 G, 11 ms, 3 shocks for each direction |
| Vibration (Operating) | | 5-500 Hz, 2 Grms, 15 minute for each three axis |

### Power De-rating curve




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






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# Medical AC-DC Enclosed Power Supply
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### Protections

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

### Reliability

| | |
|---|---|
| MTBF(Minimum) at 115 Vac, 120 W, 35°C, Convection Air Flow | 800 kHrs based on Telecordia SR-332 |
| Operating life at 115 Vac, 120 W, ambient 25 °C, Convection Air Flow | 26,280 Hrs |

### Safety Standards / Directives

| | | |
|---|---|---|
| Medical Safety | | IEC 60601-1 CB report<br>TUV EN 60601-1<br>UL 60601-1+CAN/CSA 60601-1 |
| ITE Safety | | IEC 60950-1, IEC 62368-1 CB report<br>TUV 60950-1<br>UL 60950-1+CAN/CSA 60950-1 |
| CE | | In conformance with EMC Directive 2014/30/EU and Low Voltage Directive 2014/35/EU<br>EN 60601-1: 2006 + A11: 2011 + A1L 2013 + A12: 2014 & EN 60601-1-2: 2015 |
| UKCA | | In conformance with Electrical Equipment (Safety) Regulations 2016 and Electromagnetic Compatibility Regulations 2016, Medical Devices Regulations 2002 (UK MDR 2002) |
| Galvanic Isolation | Input to/Output (2XMOPP)<br>Input to/Ground (1XMOPP)<br>Output to/Ground (1XMOPP) | 4000 Vac<br>1500 Vac[1)]<br>1500 Vac ( Type BF application rated) |

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

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

| | | |
|---|---|---|
| EMC / Emissions | | EN/BS EN 55011, EN/BS EN 55032, FCC Title 47:Class B |
| Harmonic Current Emissions | IEC 61000-3-2 | Meet Class D limit |
| Voltage Flicker | IEC 61000-3-3 | |
| Immunity to | | |
| Electrostatic Discharge | IEC 61000-4-2 | Level 4 Criteria A[1)]<br>Air Discharge: 15 kV<br>Contact Discharge: 8 kV |
| Radiated Field | IEC 61000-4-3 | Criteria A[1)]<br>80 MHz-2700 MHz, 10 V/m AM modulation<br>385 MHz-5785 MHz, 28 V/m Pulse mode and other modulation |
| Electrical Fast Transient / Burst | IEC 61000-4-4 | Level 3 Criteria A[1)]: 2 kV |
| Surge | IEC 61000-4-5 | Level 3 Criteria A[1)]<br>Common Mode[3)]: 2 kV<br>Differential Mode[4)]: 1 kV |
| Conducted | IEC 61000-4-6 | Level 2 Criteria A[1)]<br>150 kHz-80 MHz, 3 Vrms, 6 Vrms at ISM bands and Amateur radio bands |
| Power Frequency Magnetic Fields | IEC 61000-4-8 | Criteria A[1)]<br>Magnetic field strength 30 A/m |
| Voltage Dips | IEC 61000-4-11 | Criteria A[1)]<br>0% $U_T$, 0.5 cycle (10ms),<br>0°/45°/90°/135°/180°/225°/270°/315°/360°<br><br>Criteria B[2)]<br>0% $U_T$, 1 cycle (20 ms), 0°<br><br>Criteria B[2)]<br>70% $U_T$, 25 cycle (500 ms), 0°<br><br>Criteria B[2)]<br>0% $U_T$, 250 cycle (5000 ms), 0° |

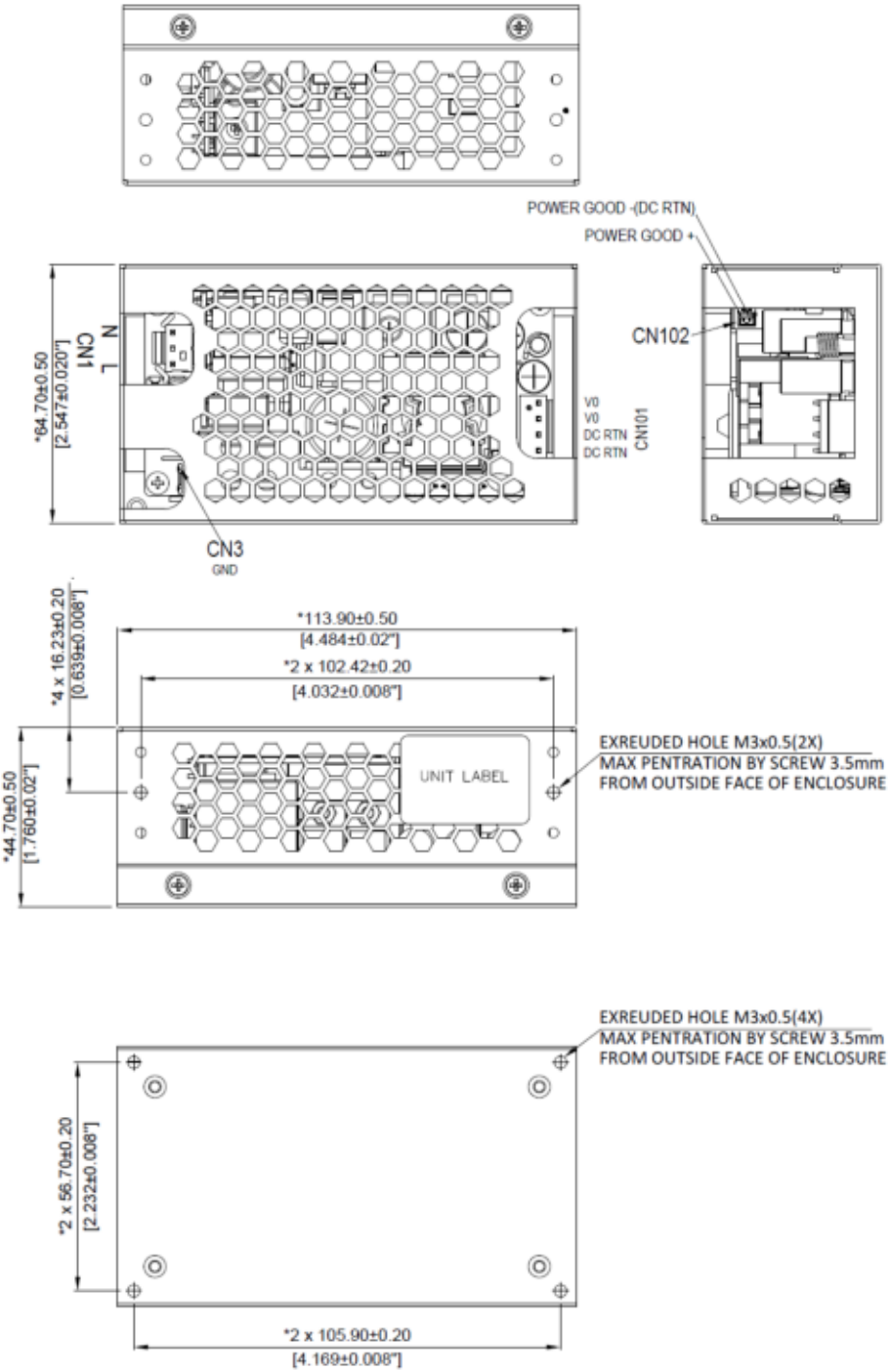
1) Criteria A: Normal performance within the specification limits
2) Criteria B: Output out of regulation, or shuts down during test. Automatically restore to normal operation after test.
3) Asymmetrical: Common mode (Line to earth)
4) Symmetrical: Differential mode (Line to line)

# Medical AC-DC Enclosed Power Supply
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### Dimensions

Mechanical Drawing (3Pin input type)

**L x W x H:** 113.9 x 64.7 x 44.7 mm




**Notes**

- Dimensions are in mm(inches)
- There are two locations where assembled power supply is connected to the customer’s product

a. Bottom mounting, use (4X) M3 screws to affix assembled power supply to product’s enclosure. Extruded hole with thread must be withstand 9Kgf.cm (7.81 lb-in) min. Maximum allowed screw penetration is 3.5 mm (0.138 inch).

b. Side mounting, use (2X) M3 screws to affix one side of assembled power supply to the product’s enclosure. Extruded hole with thread must be withstand 9 Kgf.cm (7.8 1lb-in) min. Maximum allowed screw penetration is 3.5 mm (0.138 inch).

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## 24 V 200 W 2” x 4” High Density MDS-200ADB24 AA

| Input Connector CN1 | |
|---|---|
| Pin 1 | Neutral |
| Pin 3 | Line |

- 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.

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

- CN101 mates with JST housing VHR-4N and JST terminal SVH-41T-P1.1.
- CN3: PINGOOD JP-13T or equivalent mate with KST FDFNYD1-187 or other applicable connectors

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

- CN102 mates with Molex housing 0874390200 and Molex 874210000 crimp terminals.

## Functions

### Start-up Time

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

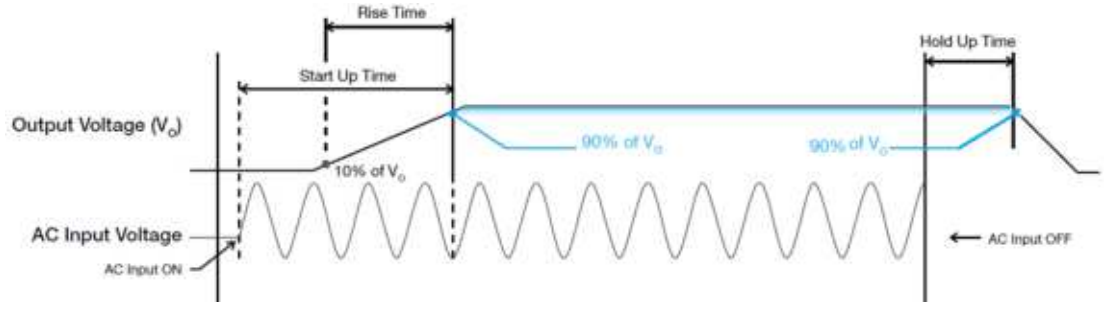
### Rise Time

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**





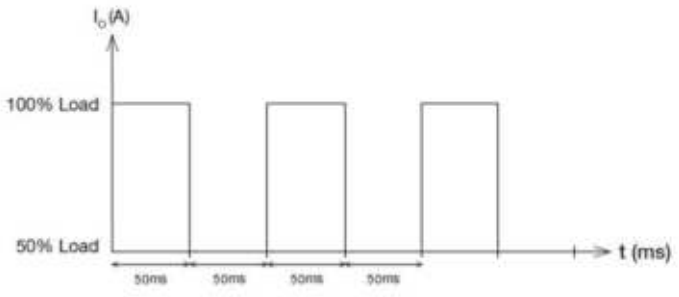

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### Dynamic Response

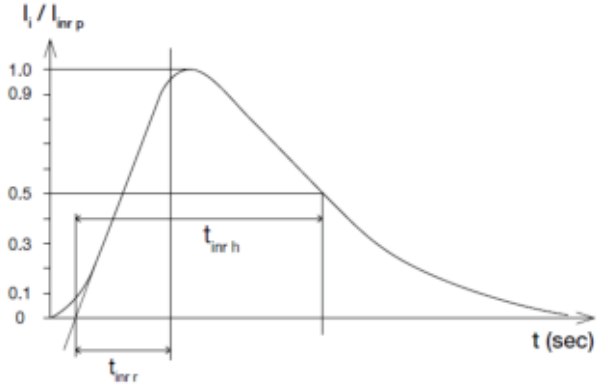
The power supply output voltage will remain within ±5% of its steady state value, when subjected to a dynamic load 50 to 100% of its rated current.

- 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.

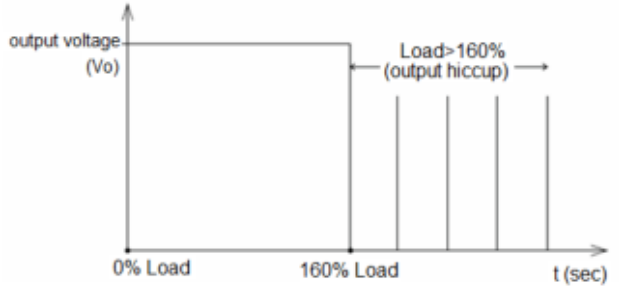



### Overvoltage Protection

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 & 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 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. Then, the power supply will be latched off, and require recycling of input voltage to restart it.

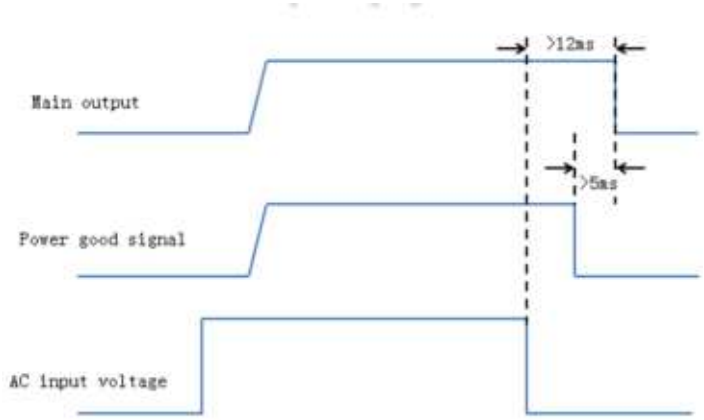
### Over Temperature Protection

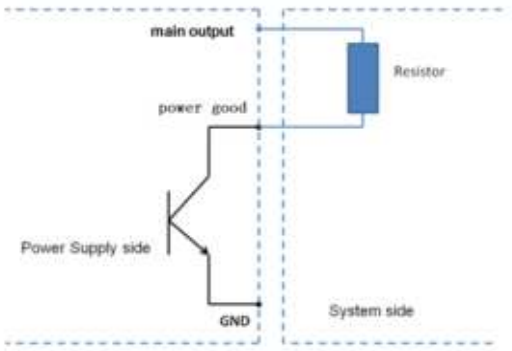
As mentioned above, the power supply also has Over Temperature Protection (OTP). This is activated when the overload condition persists for an extended duration and the output current is below the overload trigger point but >100% load. In the event of a higher operating temperature condition at 100% 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.

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### Power Good

Power Good+ pin is an open collector transistor (40 V/600 mA rating). A resistor (suggested value 20 Kohm, 1/8 W) can be added between output pin (or, other available pull-up voltage that is no greater than 30 V) 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 (at 120 W load) 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 Enclosed Power Supply
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### Certificate

Delta has been certified as meeting the requirement of ISO 13485: 2016 and EN ISO 13485:2016 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 IEC 62368-1. 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 PSU.deltaww.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.

Delta reserves the right to make changes to the information described in the datasheets without notice.

### Manufacturer and Authorized Representatives Information

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