

# Medical ATX Power Supply

## ATX 12V 1U Power Supply

# MDS-350AD701



### Highlights & Features

- ATX 12V standard function & form factor
- IEC60601-1 3.1 ed.(Medical) & IEC 60950-1(ITE) approvals
- Suitable for type BF patient access applications
- Built-in active PFC
- Maximum output power of 350 watts
- Compliant with IEC 60601-1-2 4<sup>th</sup> Ed. requirements

### Safety Standards



CB Certified for worldwide use

**Model Number:** MDS-350AD701 AA

**Unit Weight:** 1.2Kg (2.6 lb)

**Dimensions (W x L x H):** 100x194x40.5 mm  
3.94x7.64x1.59 inch

### General Description

The MDS-350AD701 series of internal ATX power supplies comes with universal AC input from 90Vac to 264Vac. Other features include low leakage, availability of risk management report, and electric shock protection compliant 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-350AD701 series comes with both Medical and ITE safety approvals, including UL/CE/CQC (5000m) and CB certification and are fully compliant with RoHS Directive 2011/65/EU for environmental protection.

### Model Information

Table 1 (For Maximum Output Power Limits, see “Output Power” requirements on Page 2)

Output Voltage	Minimum Load (A)	Normal Load (A)	Maximum Load (A)	Load Regulation	Ripple & Noise
+3.3V	0.5	8	16	+/- 5%	50mVpp
+5V	0.5	9	18	+/- 5%	50mVpp
+5Vsb	0.0	1.25	2.5	+/- 5%	150mVpp
+12V1	1.0	8	16	+/- 5%	120mVpp
+12V2	1.0	8	16	+/- 5%	120mVpp
-12V	0.0	0.25	0.5	+/- 10%	120mVpp
-5V	0.0	0.1	0.2	+/- 10%	50mVpp

### Model Numbering

<b>MDS</b> <small>Delta Medical Power Supply</small>	<b>350</b> <small>Max Wattage in the Product Series.</small>	<b>A</b> <small>Family Code A~ Z</small>	<b>D</b> <small>Product Type D: Enclosure</small>	<b>701</b> <small>Output Voltage 701: +3.3V, +5V, +5Vsb, +12V1, +12V2, -12V, -5V</small>	<b>A</b> <small>Revision Code</small>	<b>A</b> <small>Revision code</small>
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### Specifications

#### Input Ratings / Characteristics

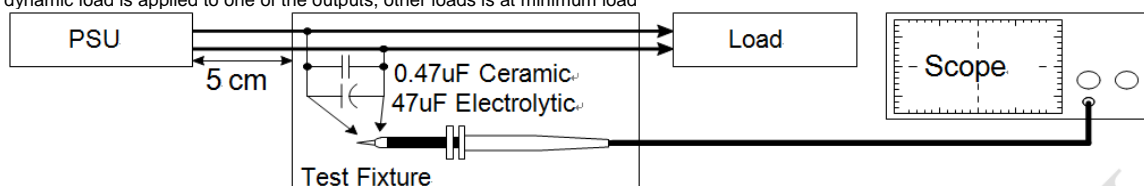
Nominal Input Voltage	100-240Vac
Input Voltage Range	90-264Vac
Nominal Input Frequency	50-60Hz
Input Frequency Range	47-63Hz
Input Current (max)	6A
Input Surge Voltage (max)	300Vac for 100ms
Full load Efficiency (typ.)	82% @ 115Vac/60Hz 85% @ 230Vac/50Hz
Inrush Current (max)	No damage, cold start
Leakage Current (max)	0.1mA @ NC, 0.3mA @ SFC <sup>1)</sup>
Output-PE (protective earth) Leakage current for BF application (max)	0.1mA @ NC, 0.5mA @ SFC
Power Factor (min)	0.90 @ 115V/50Hz, 230V/50Hz, full load

1) NC: normal condition, SFC: single fault condition

#### Output Ratings / Characteristics

Nominal Output Voltage (V rated)	+12V1, +12V2, +5V, +3.3V, +5Vsb, -5V, -12V
Output Voltage Tolerance	See Table 1 on page 1
Output Power	Maximum combined output power of +3.3V & +5V outputs, shall not exceed 130W. Maximum combined output power of +12V1, +12V2, +3.3V & +5V outputs shall not exceed 331W Maximum combined output power from all the outputs shall not exceed 350W
Line Regulation (max)	±0.5%
Load Regulation (max)	See Table 1
Ripple & Noise (typ.)	See Table 1
Start-up Time (max) (Remote on_off @ TTL Low, then AC applied)	1000ms @ 115 Vac
Hold-up Time (min)	17ms @ 115 Vac / 60Hz
Dynamic Response (Overshoot & Undershoot O/P Voltage)	± 10% @ 50-100% load <sup>1)</sup>
Rise time (max)	20ms
Remote On_Off/INHIBIT	TTL Active Low: Output Enable TTL Active High: Output Disable
Power Good (PG) Signal(See page 9 for details)	1. PG changes to TTL High 100-500 milliseconds after all outputs reach their final steady state value. 2. After input AC is removed, PG changes to TTL Low at least 1 millisecond before any output falls out of regulation range.

1) When the dynamic load is applied to one of the outputs, other loads is at minimum load



Ripple & Noise measurement circuit for each output

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### Mechanical

Case Chassis	SECC (Steel, Electrogalvanized, Cold Rolled, Coil)
Case Cover	SECC (Steel, Electrogalvanized, Cold Rolled, Coil)
Dimensions (W x L x H)	100 x 194 x 40.5 mm (3.94x7.64x1.59 inch)
Unit Weight (typ.)	1.2Kg (2.6 pounds)
Indicator	None
Cooling System	Forced Cooling

### Environment

Surrounding Air Temperature	Operating	0°C to +50°C
	Storage	-40°C to +85°C
Operating Humidity		5-95% RH (Non-Condensing)
Operating Altitude		5,000 meters (16,400 feet)
Shock Test (Non-Operating)		50G, 11ms, 3 shocks for each direction
Vibration (Operating)		5-500Hz, 2Grms, 15 minute for each three axis

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Protections (Latch Mode protection requires removal of fault, plus removal and reapplication of input AC voltage, in order to restart the power supply. See page 9 for additional details on the different types of protection.)

Overvoltage (max)	For +3.3V output, Maximum voltage < 4.8V For +5V output, Maximum voltage < 7V For +12V1 & +12V2 outputs, Maximum voltage < 16V Protection Method: Latch Mode For +5Vsb output, Maximum voltage < 10V Protection Method: Latch Mode
Over load / Over current (max)	For +3.3V output, Maximum current < 25A For +5V output, Maximum current < 25A For +12V1/+12V2 output, Maximum current < 25A Protection Method: Latch Mode For +5Vsb output, Maximum current < 5A Protection Method: Auto-recovery Mode
Over Temperature	Protection Method: Latch Mode
Short Circuit on any output.	+3.3V, +5V, +12V1 and +12V2, Protection Method: Latch Mode +5Vsb, Protection Method: Auto-recovery

### Reliability Data

MTBF (Minimum) at 115Vac, 35 °C with 350W	Forced Air Flow	500 K hrs based on Telecordia SR-332
Operating Life (Minimum) at 115Vac, 25°C with 350W	Forced Air Flow	26,280 hrs

### Safety Standards / Directives

Medical Safety	IEC 60601-1 Edition 3.1 (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 (Ed.2,2005), 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)	1500 Vac <sup>2)</sup>
	Output to/Ground(1XMOPP)	1500 Vac (Type BF application rated)

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

### EMC

EMC / Emissions	EN55011/EN55022,FCC Title 47:Class B	
Harmonic Current Emissions	IEC61000-3-2	Meet Class D limit
Immunity to		
Voltage Flicker	IEC61000-3-3	

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Electrostatic Discharge	IEC61000-4-2	Level 4 Criteria A <sup>1)5)</sup> Air Discharge: 15kV Contact Discharge: 8kV
Radiated Field	IEC61000-4-3	Level 3 Criteria A <sup>1)</sup> 80MHz-1000MHz, 10V/m AM modulation
	IEC60601-1-2	Criteria A <sup>1)5)</sup> 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 <sup>1)</sup> :2kV
Surge	IEC61000-4-5	Level 3 Criteria A <sup>1)5)</sup> Common Mode <sup>3)</sup> : 2kV Differential Mode <sup>4)</sup> : 1kV
Conducted	IEC61000-4-6	Level 2 Criteria A <sup>1)5)</sup> 150kHz-80MHz, 3Vrms, 6Vrms at ISM bands and Amateur radio bands
Power Frequency Magnetic Fields	IEC61000-4-8	Criteria A <sup>1)5)</sup> Magnetic field strength 30A/m
Voltage Dips <sup>5)</sup>	IEC60601-1-2	Criteria C <sup>2)</sup> 30% 500ms Criteria A <sup>1)</sup> 100% 10ms at step: 45 degree Criteria C <sup>2)</sup> 100% 20ms Criteria C <sup>2)</sup> 100% 5000ms

1) Criteria A: Normal performance within the specification limits

2) Criteria C: Output out of regulation, or shuts down during test. (Need to recycle AC power cord or reset enable signal to normal operation after test)

3) Asymmetrical: Common mode (Line to earth)

4) Symmetrical: Differential mode (Line to line)

5) Compliant with IEC-60601-1-2 4<sup>th</sup> edition requirements.

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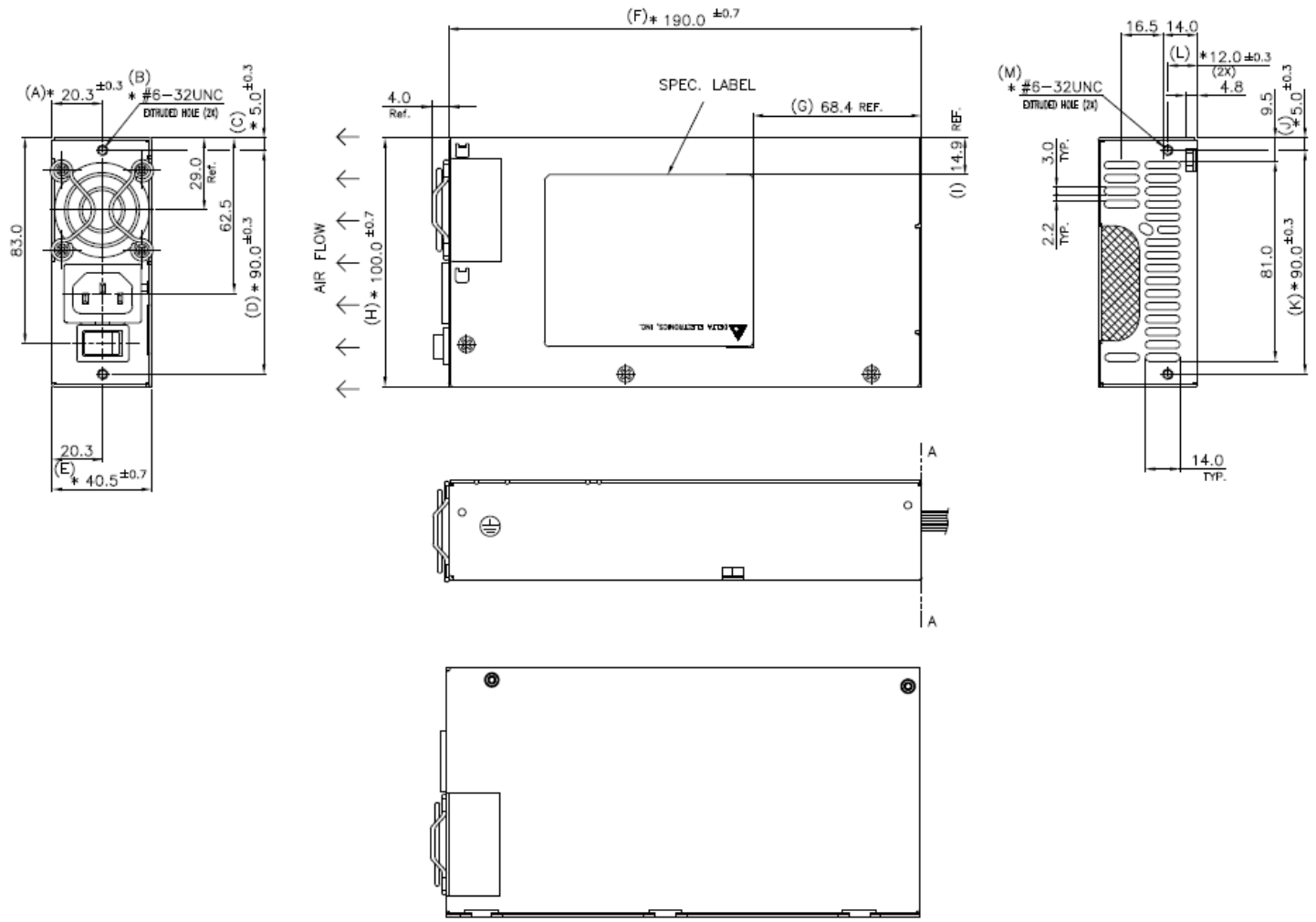
### Dimensions

W x L x H: 100 x 194 x 40.5 mm

### Mechanical drawing

### Notes

— Dimensions are in mm

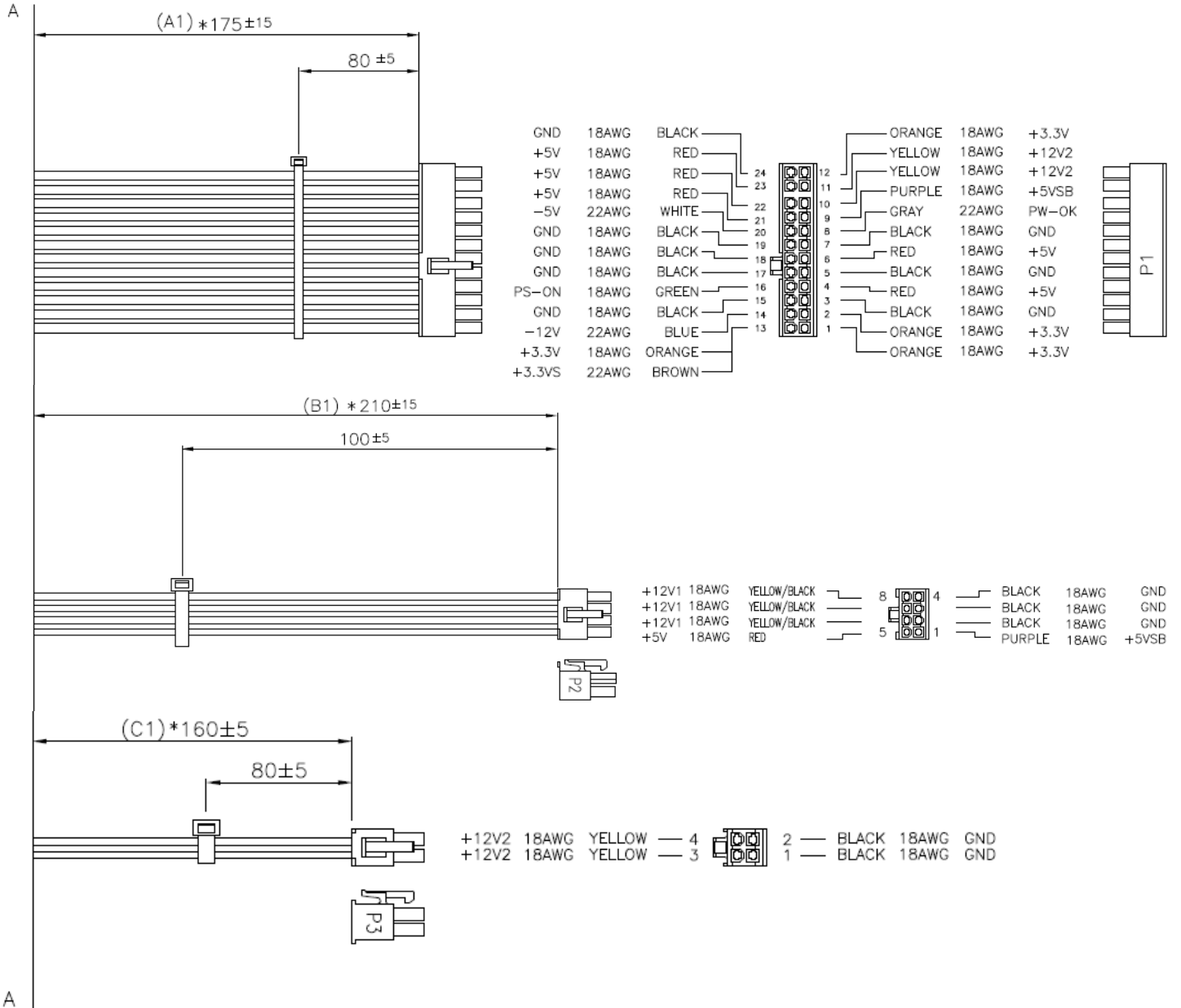


CONNECTOR	HOUSING
P1	MOLEX 39-01-2240 OR EQUIV.
P2	MOLEX 39-01-2080 OR EQUIV.
P3	MOLEX 39-01-2040 OR EQUIV.

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### DC Output Cable



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### Functions

#### Start-up Time

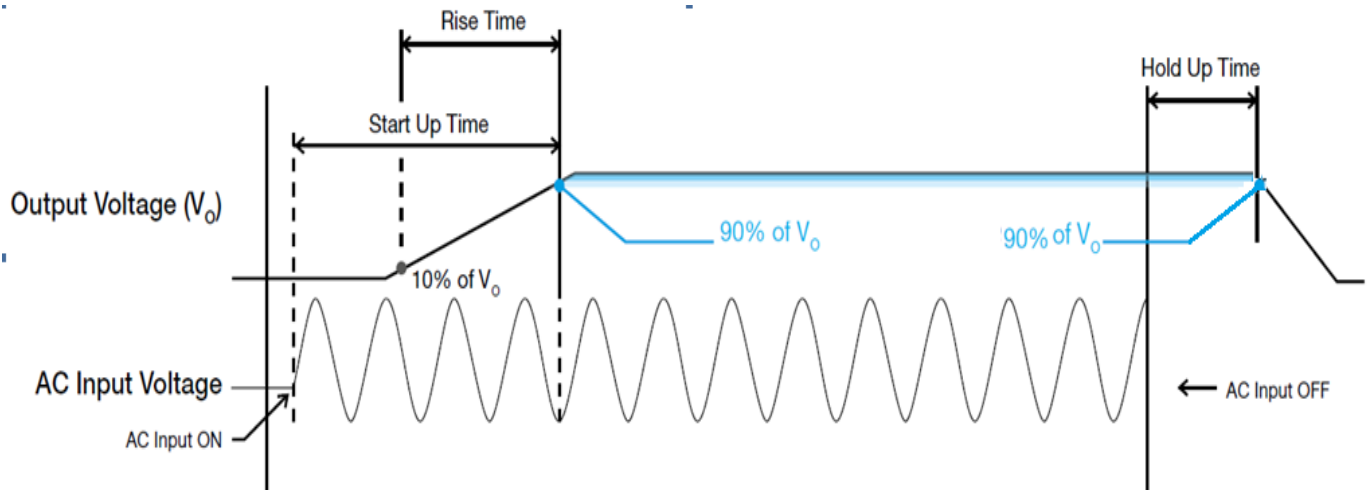
The time required for the output voltage to reach 90% of its final steady state value, after the input voltage is applied.

#### Rise Time

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

#### Hold-up Time

Hold-up Time is the time between removal of input AC voltage, and the subsequently falling output to reach 90% of its steady state value.





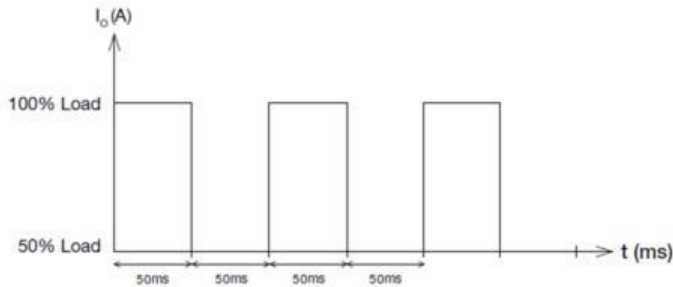
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### Dynamic Response

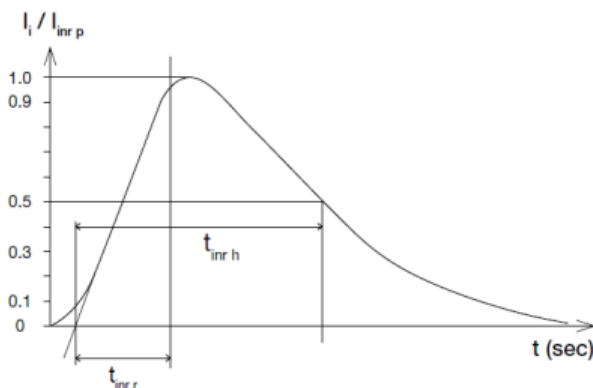
The power supply output voltage will remain within  $\pm 10\%$  of its steady state value, when subjected to a dynamic load 50 to 100% of its rated current.

■ 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 4 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 to any of the outputs, the power supply will latch off.

### Overload & Over current Protections

The power supply's Overload (OLP) and Over current (OCP) Protections will be activated before the output currents reach the limits defined on Page 4. Once the power supply has reached

their maximum power limit, the protection will be activated and the power supply will latch off.

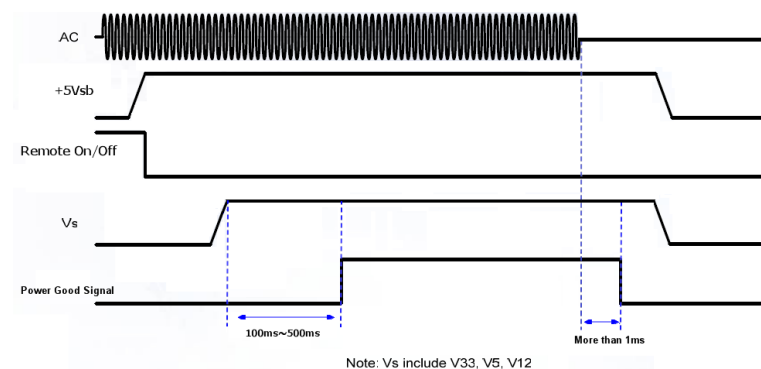
### Over Temperature Protection

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

The Power Good signal prevents a computer from attempting to operate on improper voltages and damaging itself by alerting it to improper power supply. The ATX specification defines the Power-Good signal as a +5 volt (V) signal generated in the power supply when it has passed its internal self-tests and the outputs have stabilized. This normally takes between 0.1 and 0.5 seconds after the power supply is switched on. The signal is then sent to the motherboard, where it is received by the processor timer chip that controls the reset line to the processor. When plug in AC power cord, +5Vsb will start first, then Remote On/Off will be pulled low by computer, +12V1/+12V2/+5V/+3.3V will power on and Power good signal will pull high after 100ms~500ms. After input AC is removed, Power Good signal changes to TTL Low at least 1 millisecond before any output falls out of regulation range.

Graph illustrating the AC input, +5Vsb, Remote On/Off, +12V1/12V2/5/3.3V, Power good signal



### Remote On\_Off/INHIBIT

Remote ON\_OFF/INHIBIT can be used to enable or disable all outputs, except for the +5 Volt Standby. This signal can be pulled down to a low level of 0.3 volts, or shorted to DC-Return, in order for the main output to be enabled; and, floated (no connection to the signal), or pulled up to a value greater than or equal to 3 volts, in order to disable the main output. When the main output is disabled, the +5V Standby output will continue to operate.

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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.