TECHNICAL DATASHEET

Medical ATX Power Supply
ATX 12 V 1 U Power Supply

MDS-350AD701

Highlights & Features

- ATX 12 V standard function & form factor
- IEC60601-1 (Medical) & IEC 62368-1 (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 4th Ed. Requirements

Safety Standards

E356265 E131881

CB Certified for worldwide use

Model Number: MDS-350AD701 AA
Unit Weight: 1.2 kg (2.6 lb)
Dimensions (L x W x H): 194 x 100 x 40.5 mm
7.64 x 3.94 x 1.59 inch

General Description

The MDS-350AD701 series of internal ATX power supplies comes with universal AC input from 90 Vac to 264 Vac. 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/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-350AD701 series comes with both Medical and ITE safety approvals, including UL/CE (5000 m) and CB certification and are fully compliant with RoHS Directive 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
+3.3 V	0.5	8	16	+/- 5%	50 mVpp
+5 V	0.5	9	18	+/- 5%	50 mVpp
+5 Vsb	0.0	1.25	2.5	+/- 5%	150 mVpp
+12 V1	1.0	8	16	+/- 5%	120 mVpp
+12 V2	1.0	8	16	+/- 5%	120 mVpp
-12 V	0.0	0.25	0.5	+/- 10%	120 mVpp
-5 V	0.0	0.1	0.2	+/- 10%	50 mVpp

Model Numbering

MDS	350	A	D	701	☐	A	A
Delta Medical Power Supply	Max Wattage in the Product Series.	Family Code A ~ Z	Product Type D: Enclosure	Output Voltage 701: +3.3 V, +5 V, +5 Vsb, +12 V1, +12 V2, -12 V, -5 V	Blank	Revision Code	Revision Code

All parameters are specified at 25°C ambient unless otherwise noted.
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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)	6 A
Input Surge Voltage (max)	300 Vac for 100 ms
Full load Efficiency (typ.)	82% @ 115 Vac/60 Hz 85% @ 230 Vac/50 Hz
Inrush Current (max)	No damage, cold start
Leakage Current (max)	0.1 mA @ NC, 0.3 mA @ SFC[1)]
Output-PE (protective earth) Leakage current for BF application (max)	0.1 mA @ NC, 0.5 mA @ SFC
Power Factor (min)	0.90 @ 115 V/50 Hz, 230 V/50 Hz, full load

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

Output Ratings / Characteristics

Nominal Output Voltage (V rated)	+12 V1, +12 V2, +5 V, +3.3 V, +5 Vsb, -5 V, -12 V
Output Voltage Tolerance	See Table 1 on page 1
Output Power	Maximum combined output power of +3.3 V & +5 V outputs, shall not exceed 130 W. Maximum combined output power of +12 V1, +12 V2, +3.3 V & +5 V outputs shall not exceed 331 W Maximum combined output power from all the outputs shall not exceed 350 W
Line Regulation (max)	±0.5%
Load Regulation (max)	See Table 1
Ripple & Noise (typ.)	
Start-up Time (max) (Remote on_off @ TTL Low, then AC applied)	1000 ms @ 115 Vac
Hold-up Time (min)	17 ms @ 115 Vac / 60 Hz
Dynamic Response (Overshoot & Undershoot O/P Voltage)	± 10% @ 50-100% load[2)]
Rise time (max)	20 ms
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.

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

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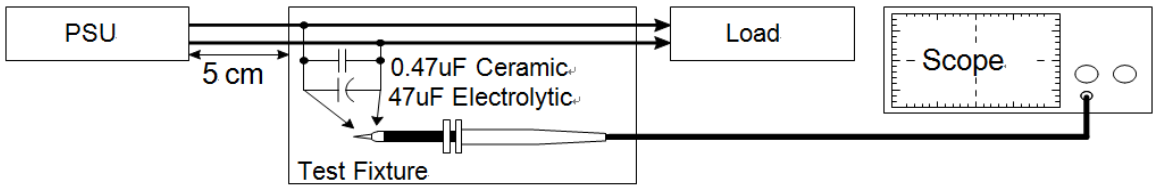

Ripple & Noise measurement circuit for each output

Mechanical

Case Chassis	SECC (Steel, Electrogalvanized, Cold Rolled, Coil)
Case Cover	SECC (Steel, Electrogalvanized, Cold Rolled, Coil)
Dimensions (L x W x H)	194 x 100 x 40.5 mm (7.64 x 3.94 x 1.59 inch)
Unit Weight (typ.)	1.2 kg (2.6 lb)
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)		50 G, 11 ms, 3 shocks for each direction
Vibration (Operating)		5-500 Hz, 2 Grms, 15 minute for each three axis

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

Reliability Data

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

Safety Standards / Directives

Medical Safety		IEC 60601-1 EN60601-1 CAN/CSA-C22.2 No. 60601-1 ANSI/AAMI ES60601-1
ITE Safety		IEC 60950-1 (Ed.2,2005) & IEC 62368-1 CB report, CCC GB 17625.1; GB 4943.1; GB/T 9254.1
CE		In conformance with EMC Directive 2014/30/EU and Low Voltage Directive 2014/35/EU EN 60601-1: 2006 + A11: 2011 + A1: 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) Input to/Ground (1XMOPP) Output to/Ground (1XMOPP)	4000 Vac 1500 Vac[3)] 1500 Vac (Type BF application rated)

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

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EMC

EMC / Emissions		EN/BS EN 55011 & Compliant with 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)5)] Air Discharge: 15 kV Contact Discharge: 8 kV
Radiated Field	IEC 61000-4-3	Level 3 Criteria A[1)] 80 MHz-1000 MHz, 10 V/m AM modulation
	IEC 60601-1-2	Criteria A[1)5)] 80 MHz-2700 MHz, 10 V/m AM modulation 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)5)] Common Mode[3)]: 2 kV Differential Mode[4)]: 1 kV
Conducted	IEC 61000-4-6	Level 2 Criteria A[1)5)] 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)5)] Magnetic field strength 30 A/m
Voltage Dips[5)]	IEC 60601-1-2	Criteria C[2)] 30% 500 ms Criteria A[1)] 100% 10 ms at step: 45 degree Criteria C[2)] 100% 20 ms Criteria C[2)] 100% 5000 ms

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 4th edition requirements.

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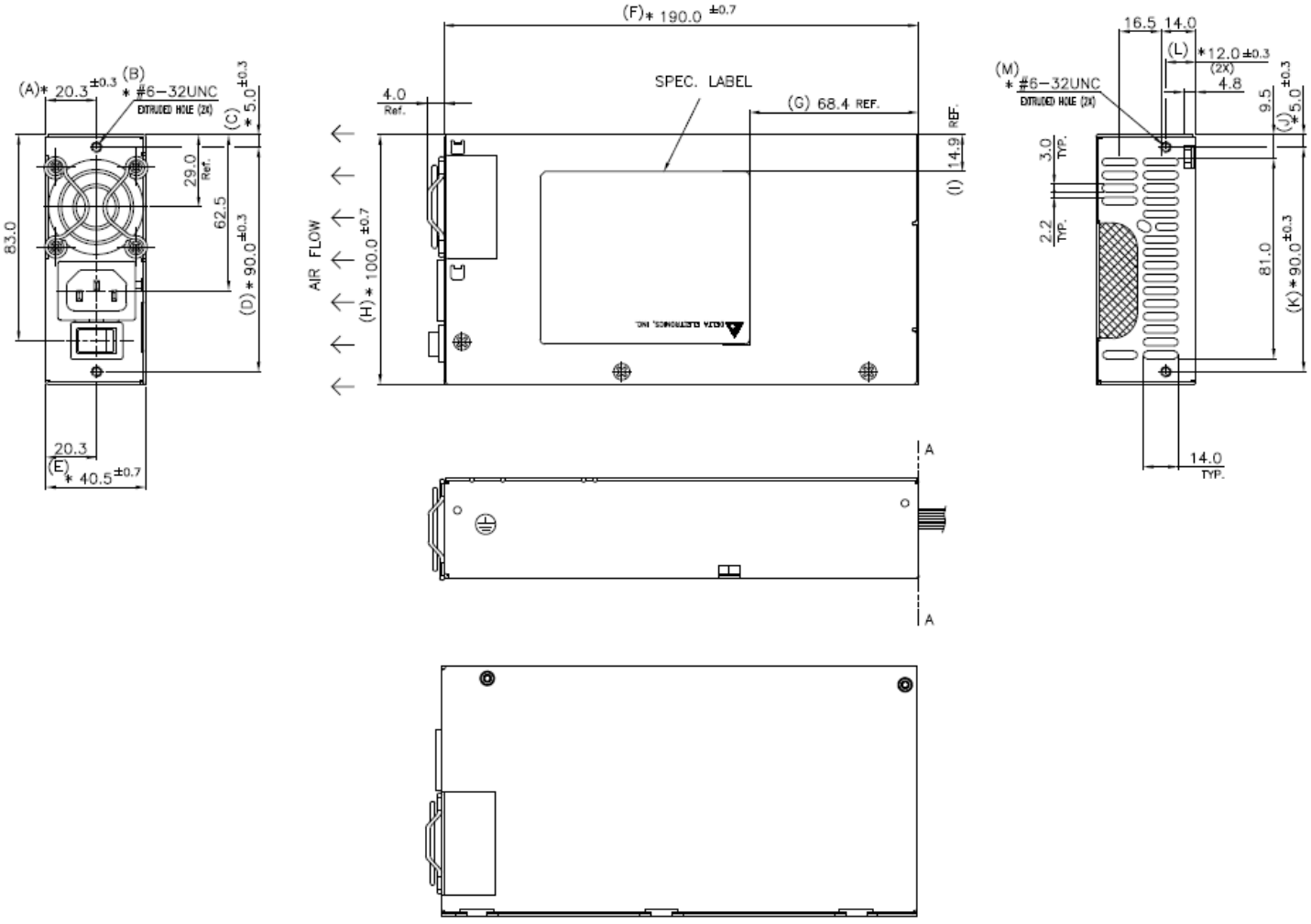
Dimensions

L x W x H: 194 x 100 x 40.5 mm (7.64 x 3.94 x 1.59 inch)

Mechanical Drawing

Notes

- Dimension are in mm (inches)
- Built-in cooling fan. Must prevent dust suction into power supply, or use natural convection power supply if any concerns.



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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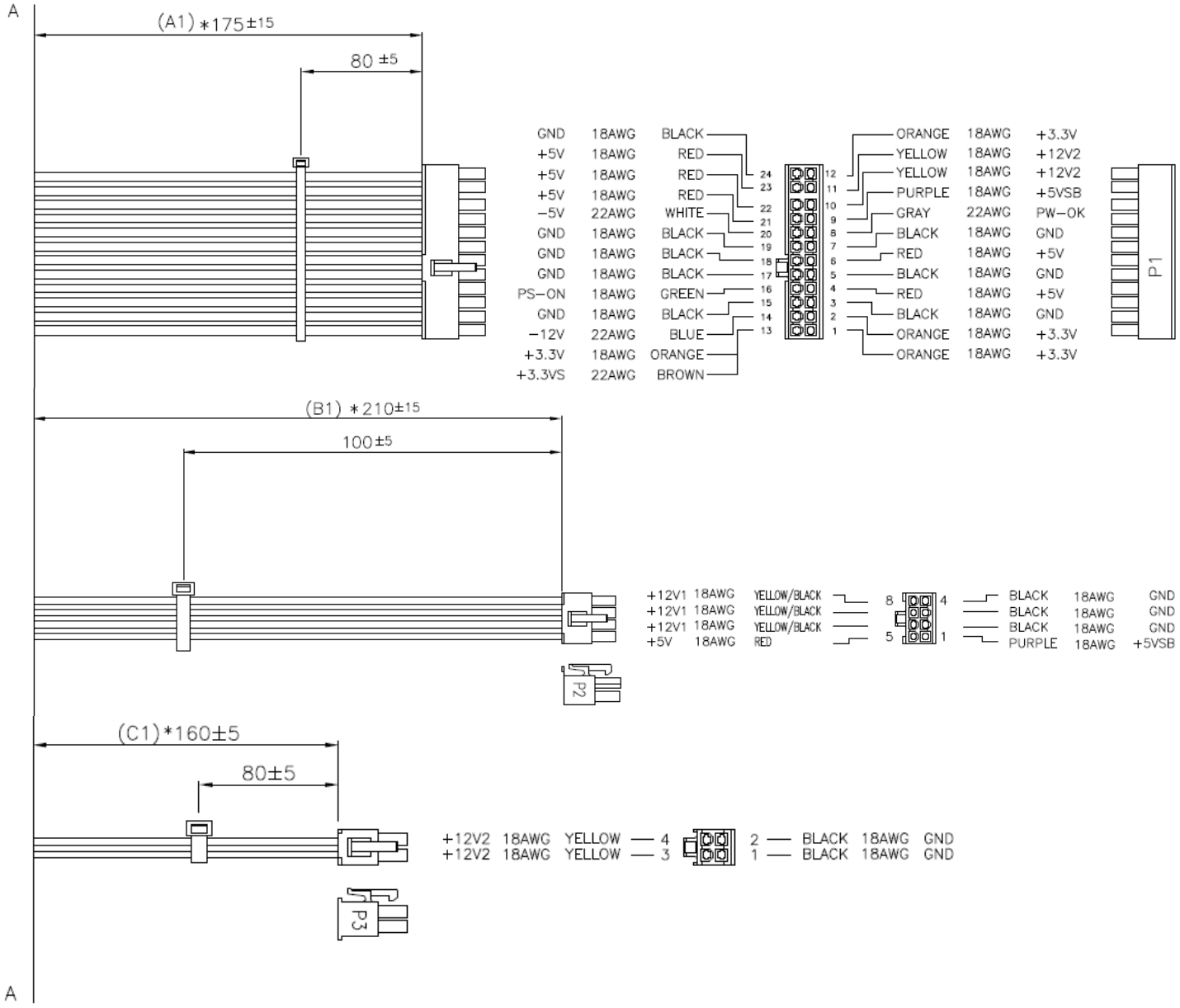
DC Output Cable



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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.

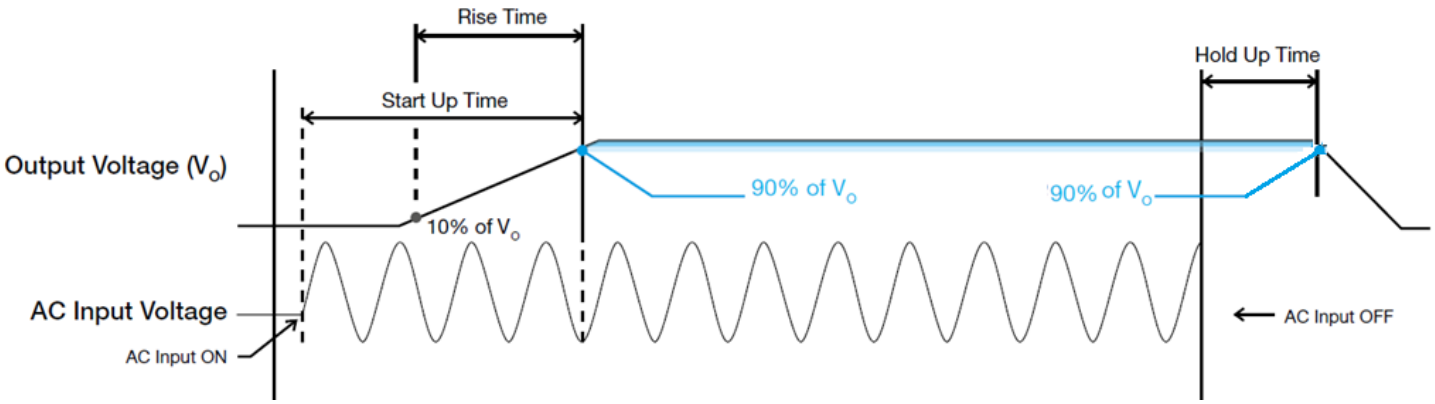
Rise Time

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.

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



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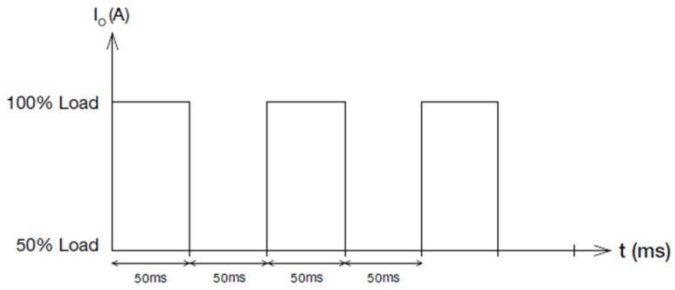
Dynamic Response

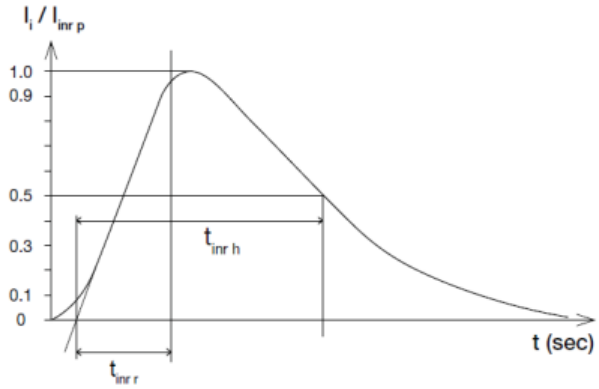
The power supply output voltage will remain within ±5% of its steady state value, when subjected to a dynamic load 50 to 100% of its rated current.

- **50 to 100% Load**



Inrush Current

Inrush current is the input current that 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.

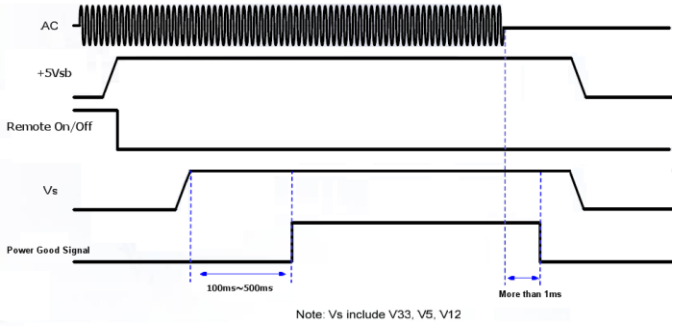
Over Temperature Protection

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, +5 Vsb will start first, then Remote On/Off will be pulled low by computer, +12 V1/+12 V2/+5 V/+3.3 V 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, +5 Vsb, Remote On/Off, +12 V1/12 V2/5/3.3 V, 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 +5 V Standby output will continue to operate.

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Certificate

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 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 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.

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

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