

# Medical / Industrial AC-DC Power Supply

## 450 W Convection / 650 W Force Air MEU-650A□T



### Highlights & Features

- Convection / Force Air Cooled
- Up to 650 Watt in 4 " x 6 " x 1.575 " Package
- Up to 17.2 W/inch<sup>3</sup> Power Density
- Full Power up to 50°C Ambient
- Very High Efficiency up to 96%
- Up to 500 KHrs MTBF
- 2 x MOPP Isolation
- Suited for Type BF Medical Products.
- 5 V / 2 A Standby Output
- 12 V / 0.6 A Fan Output (24 V & 48 V model)
- Current Sharing
- Conformal coating
- Class B Conducted and Radiated EMI
- IEC60601-1-2 4th Edition Immunity Compliance
- Normal and Reversed Option for Remote On/Off and Power Good Signal
- Voltage Trimming

### Safety Certifications

- IEC60601-1 2<sup>nd</sup> edition
- IEC60601-1 3.1 edition CB report
- TUV EN60601-1:2006/A11/A12
- CAN/CSA-C22.2 NO.60601-1 + ANSI/AAMI
- ES 60601-1
- IEC60950-1 CB report
- IEC62368-1 CB report
- TUV EN62368-1
- UL62368-1 and CAN/CSA C22.2
- No. 62368-1
- IEC60335-1 CB report (12 V & 24 V Model)
- TUV EN60335-1 (12 V & 24 V Model)
- IEC61558-1 CB report (12 V & 24 V Model)
- TUV EN61558-1/-2-16 (12 V & 24 V Model)

Input				
Input Voltage Range		90-264 Vac		
Input Frequency		47-63 Hz		
Input Current		< 8 A		
Inrush Current		< 40 A		
Power Factor		>0.95 @ rated load		
Efficiency		Up to 96%		
Patient Leakage Current		< 100 uA normal, < 500 uA SFC		
Earth Leakage Current		< 300 uA normal, < 1 mA SFC		
Output				
Output Voltage		12 V	24 V	48 V
Output Current @ Convection		0-33.4 A	0-18.75 A	0-9.375 A
Output power (max) @ Convection		400 W	450 W	450 W
Output Current @ Force Air	@ 100 Vac	0-50 A	0-25 A	0-12.5 A
	@ 230 Vac	0-50 A	0-27.1 A	0-13.6 A
Output power (max) @ Force Air	@ 100 Vac	600 W max		
	@ 230 Vac	600 W max	650 W max	650 W max
Ripple & Noise (max)		1% Vrated pk-pk (400 W for 12 V, 450 W for 24 V & 48 V) 1.5% Vrated pk-pk (600 W for 12 V, 650 W for 24 V & 48 V)		
Standby Power		5 V / 2 A (No minimum load required)		
Environmental				
MTBF		500 KHrs		
Operation Temperature		-20°C ~70°C )		
Operation Altitude		5000 m or 54 kPa		

1) Power de-rating with temperature above 50°C, refer to power de-rating curve for detail

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Model Information (With 5 V/2 A standby available)

Model Number	Input Voltage Range	Output Voltage	Current Output @ Convection	Current Output @ Force Air
MEU-650A12T	110-132 Vac	12 Vdc	0-33.4 A	0-50.0 A
	180-264 Vac			0-50.0 A
MEU-650A24T	90-132 Vac	24 Vdc	0-18.75 A	0-25.0 A
	180-264 Vac			0-27.1 A
MEU-650A48T	90-132 Vac	48 Vdc	0-9.38 A	0-12.5 A
	180-264 Vac			0-13.6 A

Model Numbering

MEU	-	650	A	□	T	□	XXX
ME: Delta Medical Power Supply		Max Wattage in Product Series	Family Code	Output Voltage	Inlet Type		Revision Control Code
U: U channel		650: 650W		12:12V 24:24V 48:48V	T: Terminal		See below Table

Revision Control Code

Revision Control Code	Package
AAA	Delta Standard



# Medical / Industrial AC-DC Power Supply

## 450 W Convection / 650 W Force Air MEU-650A□T

### Specifications

#### Input Ratings / Characteristics

Model Number	MEU-650A12T	MEU-650A24T	MEU-650A48T
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)	8.0 A		
Input Surge Voltage (max)	300 Vac for 100 ms		
Full load Efficiency (typ) @ full load	92.0% @ 115 Vac 93.0% @ 230 Vac Reference Fig.1	94.5% @ 115 Vac 95.5% @ 230 Vac Reference Fig.2	95.0% @ 115 Vac 96.0% @ 230 Vac Reference Fig.3
Inrush Current (max)	40 A @ 264 Vac, cold start		
Input-PE(protective earth) leakage current (max)	0.3 mA @ NC, 1 mA @ SFC <sup>1)</sup>		
Output-PE(protective earth) leakage current for Type BF application (max)	0.1 mA @ NC, 0.5 mA @ SFC <sup>1)</sup>		
Power Factor (min)	0.95 @ 115 Vac / 50 Hz, 230 Vac / 50 Hz, full load		

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

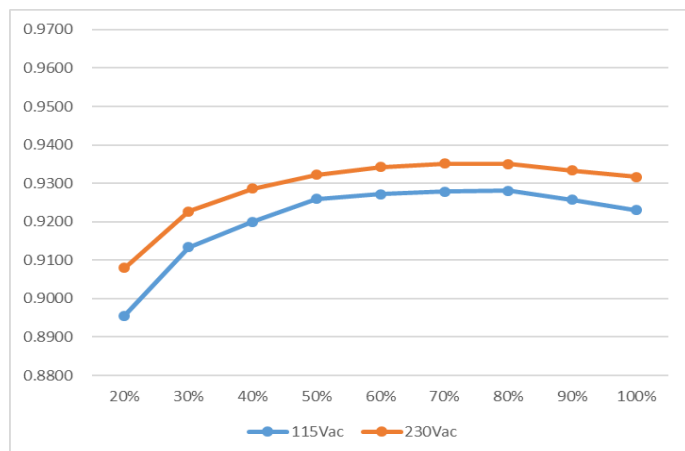


Figure 1. Typical efficiency Curve for MEU-650A12T

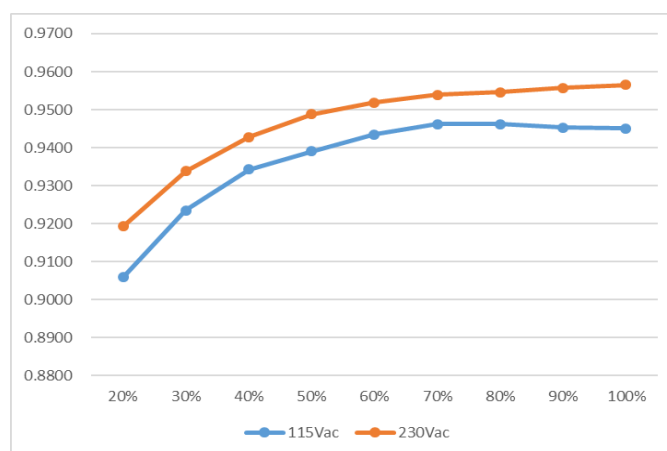


Figure 2. Typical efficiency Curve for MEU-650A24T

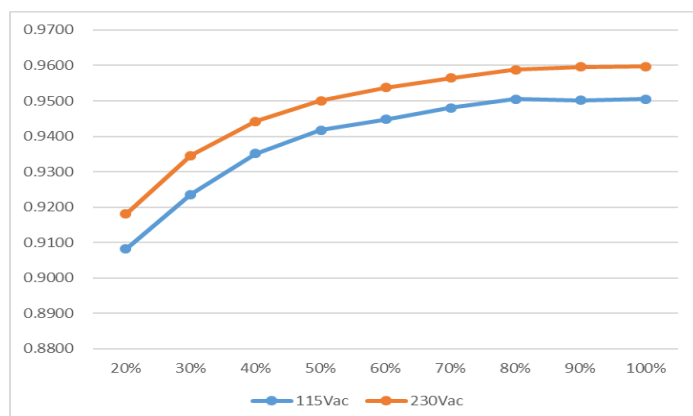


Figure 3. Typical efficiency Curve for MEU-650A48T

# Medical / Industrial AC-DC Power Supply

## 450 W Convection / 650 W Force Air MEU-650A□T

### Output Ratings / Characteristics

Model Number	MEU-650A12T	MEU-650A24T	MEU-650A48T
Total Regulation	$\pm 3\%$		
Output Power (max) @ convection	400 W	450 W	450 W
Output Power (max) @ force air cooling	600 W with 11.8 CFM	650 W with 6.9 CFM	650 W with 6.9 CFM
Line Regulation (max)	1%		
Load Regulation (max)	2%		
Ripple & Noise (max)	1% Vrated pk-pk @ rated load (400 W) 1.5% Vrated pk-pk @ rated load (600 W)	1.0% Vrated pk-pk @ rated load (450 W) 1.5% Vrated pk-pk @ rated load (650 W)	
Voltage Trimming Range	12-14 V	21.6-26.4 V	48-54 V
Dynamic Response (Overshoot & Undershoot O/P Voltage)	$\pm 5\%$ @ with 0-50% & 50-100% load change		
Start-up Time (max)	2000 ms with AC turn on		
Hold-up Time (min)	20 ms @ with nominal input range, 400W load (For MEU-650A12), 450 W load (For MEU-650A24 & 48),		
Capacitive load (max)	6000 $\mu$ F		
Rise time (max)	<50 ms		
Remote Sense	Up to 500 mV compensation for voltage drop across external wire connections to load. Short and reverse connection protected.		

### Output Ratings / Characteristics – Standby Output

Nominal Output Voltage of standby output (Vrated)	5 V
Nominal Output Current of standby output	2 A Note: 1 A @ convection cooling ; 2 A @ forced air cooling
Total Regulation of standby output	$\pm 3\%$
Ripple & Noise of standby output	100 mV max
Nominal Output Voltage of Fan output (Vrated)	12 V (For MEU-650A24 & MEU-650A48 only)
Nominal Output Current of Fan output	0.6 A
Total Regulation of Fan output	$\pm 5\%$
Ripple & Noise of Fan output	120 mV max

### Ripple & Noise measurement circuit

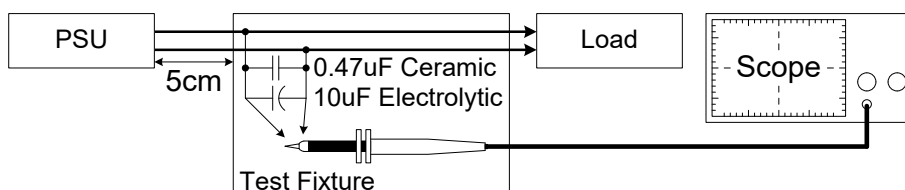


Figure 5. Ripple & Noise testing set up

# Medical / Industrial AC-DC Power Supply

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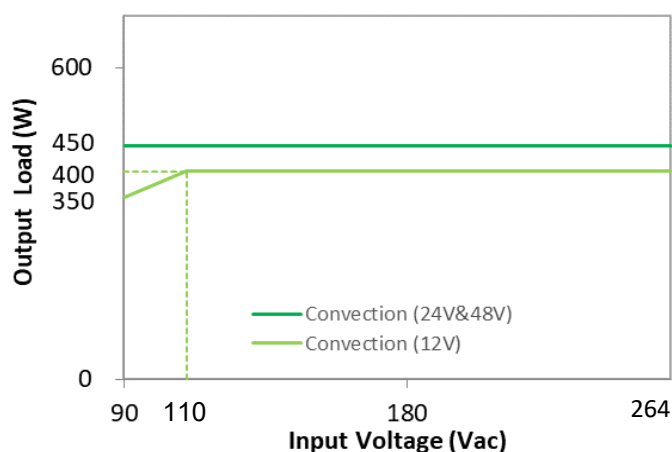
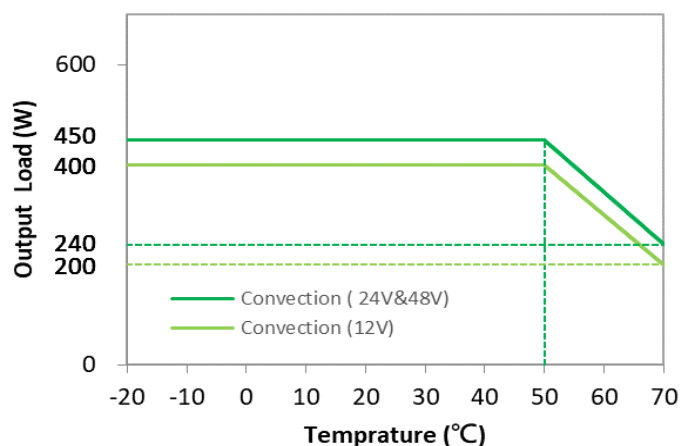
### Mechanical

Package	U channel
Dimensions (L x W x H)	152.4 x 101.6 x 40 mm (6 x 4 x 1.575 inch)
Unit Weight	0.80 kg

### Environment

Surrounding Air Temperature	Operating	-20°C to +70°C.
	Storage	-40°C to +85°C
Power De-rating Note: see power de-rating curves below	Convection	Linear power de-rate from 100% load at 50°C, to 50% load at 70°C (MEU-650A12T ) Linear power de-rate from 100% load at 50°C, to 53.3% load at 70°C (MEU-650A24&48T )
	Force Air	Linear power de-rate from 100% load at 50°C, to 50% load at 70°C
Operating Humidity	5-95% RH (Non-Condensing)	
Operating Altitude	Up to 5,000 meters (up to 16,400 feet or 106-54 kPa)	
Non-Operating Altitude	Up to 5,575 meters (up to 18,290 feet or 106-50 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	

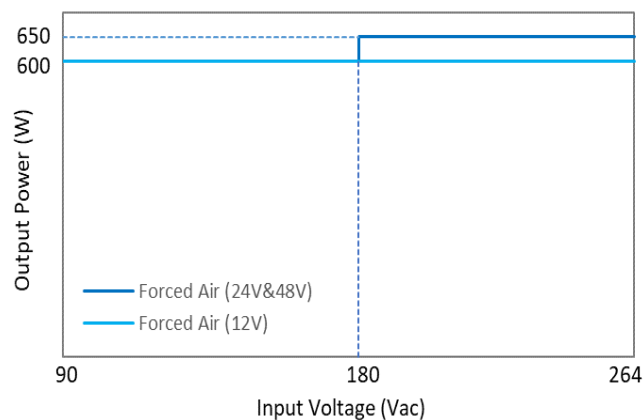
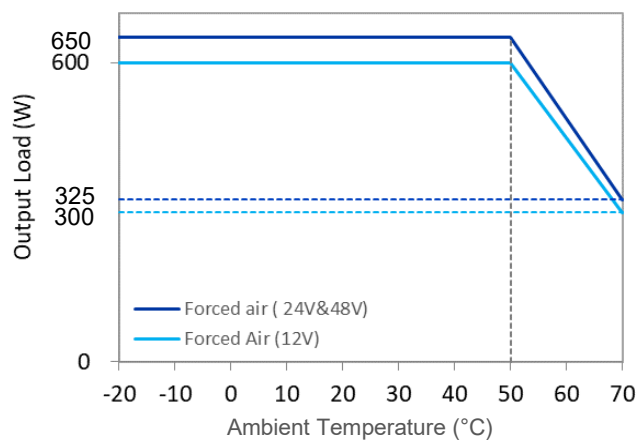
### Power De-rating curve (Convection)



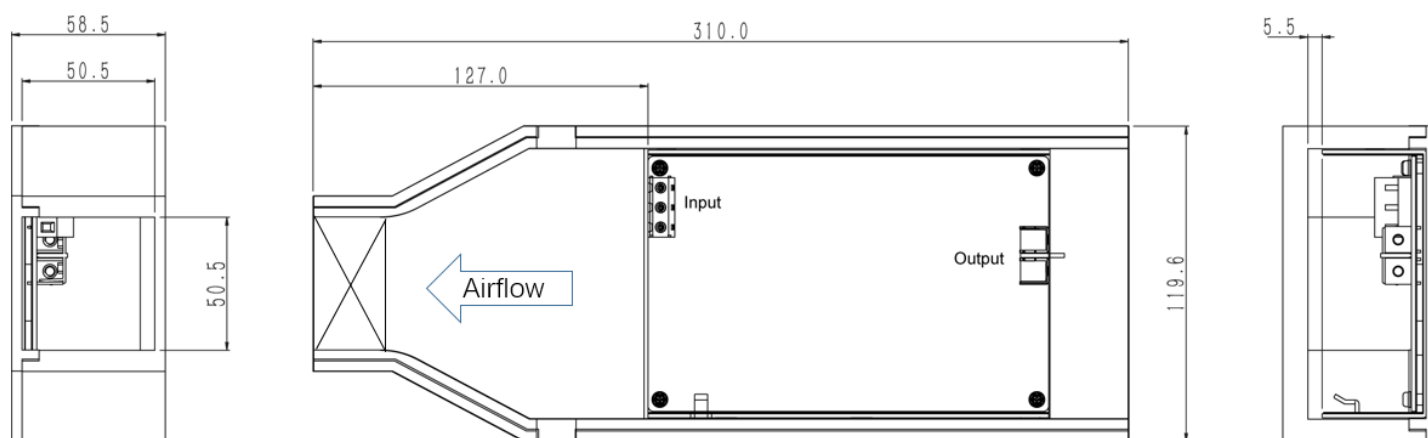
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Power De-rating curve (Force Air cooling)



Thermal Fixture Setup. With Fan P/N: DELTA AFB0512HHD



Notes 1 (For MEU-650A24T AAA AND MEU-650A48T AAA) :

1. Fan source and Box dimensions could be changed or modified to meet air speed:140 LFM
2. Airflow:6.9 CFM (Just for reference. Air speed should meet 140 LFM)
3. Used Fan voltage:7.0 V (Just for reference. The voltage should be adjusted for every Fan to meet air speed: 140 LFM)
4. Unit: mm

Notes 2 (For MEU-650A12T AAA) :

1. Fan source and Box dimensions could be changed or modified to meet air speed:230 LFM
2. Airflow:11.8 CFM (Just for reference. Air speed should meet 230 LFM)
3. Used Fan voltage:10.5 V (Just for reference. The voltage should be adjusted for every Fan to meet air speed: 230 LFM)
4. Unit: mm

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Protections (for both main output and 5Volt Standby outputs, unless otherwise indicated)

Overvoltage (max)	Main output 140% of rated normal voltage, Latch Mode Standby 125% of rated voltage, Latch Mode
Over load / Over current (max)	750 W for over 750 ms max Standby 3.2 A max with Hiccup Mode(Non-Latching, Auto-Recovery)
Over Temperature	Latch Mode for Main output
Short Circuit	Hiccup Mode for Main output and Standby (Non-Latching, Auto-Recovery)

### Reliability Data

MTBF(Minimum) at 115 Vac, 35 °C , 400 W for 12 V, 450 W for 24 V & 48 V	500 Khrs based on Telecordia SR-332
Operating life(Minimum) at 115 Vac, 25°C , 400 W for 12 V, 450 W for 24 V & 48V	26,280 hrs

### Safety Standards / Directives

Medical Safety	IEC60601-1 2 <sup>nd</sup> and 3.1 edition CB report TUV EN60601-1:2006 CAN/CSA-C22.2 NO.60601-1 + ANSI/AAMI ES 60601-1
ITE Safety	IEC60950-1 CB report IEC62368-1 CB report TUV EN62368-1 UL62368-1 and CAN/CSA C22.2 No. 62368-1
Household ( for MEU-650A12&24T )	IEC 60335-1 CB report TUV EN 60335-1 IEC 61558-1/ -2-16 CB report EN 61558-1 / -2-16
CE	In conformance with EN 60601-1: 2006 + A11: 2011 + A1: 2013 + A12: 2014& EN 60601-1-2: 2015
UKCA	In conformance with Electromagnetic Compatibility Regulations 2016 and Medical Devices Regulations 2002 (UK MDR 2002)
Galvanic Isolation	Input to/Output (2 X MOPP) 4000 Vac Input to/Ground (1 X MOPP) 1500 Vac Output to/Ground(1 X MOPP) 1500 Vac ( Type BF application rated)

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### EMC

EMC / Emissions		EN 55011 / EN 55032, 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 <sup>1)5)</sup> Air Discharge: 15 kV Contact Discharge: 8 kV
Radiated Field	IEC61000-4-3	Criteria A <sup>1)</sup> 80 MHz-2700 MHz, 10 V/m AM modulation  Level 2 Criteria A <sup>1)5)</sup> 385 MHz-5785 MHz, 28 V/m Pulse mode and other modulation
Electrical Fast Transient / Burst	IEC61000-4-4	Level 3 Criteria A <sup>1)</sup> :2 kV
Surge	IEC61000-4-5	Level 3 Criteria A <sup>1)5)</sup> Common Mode <sup>3)</sup> : 2 kV Differential Mode <sup>4)</sup> : 1 kV
Conducted	IEC61000-4-6	Level 2 Criteria A <sup>1)5)</sup> 150 kHz-80 MHz, 3 Vrms, 6 Vrms at ISM bands and Amateur radio bands
Power Frequency Magnetic Fields	IEC61000-4-8	Criteria A <sup>1)5)</sup> Magnetic field strength 30 A/m
Voltage Dips	IEC61000-4-11	30% 10 ms Criteria A <sup>1)</sup> 60% 100 ms Criteria B <sup>2)</sup> 100% 5000 ms Criteria B <sup>2)</sup>
Voltage Dips <sup>5)</sup>	IEC60601-1-2	Criteria A <sup>1)</sup> @ 550 W 0% U <sub>T</sub> , 0.5 cycle (10 ms) (0°, 45°, 90°, 135°, 180°, 225°, 270°, 315°, 360°) Criteria B <sup>2)</sup> , can meet Criteria A with 380 W or lower load 0% U <sub>T</sub> , 1 cycle (20 ms), 0° Criteria B <sup>2)</sup> 70% U <sub>T</sub> , 25 cycle (500 ms), 0° Criteria B <sup>2)</sup> 0% U <sub>T</sub> , 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 restored to normal operation after test.

3) Asymmetrical: Common mode (Line to earth)

4) Symmetrical: Differential mode (Line to line)

5) Compliant with IEC60601-1-2 4<sup>th</sup> Edition

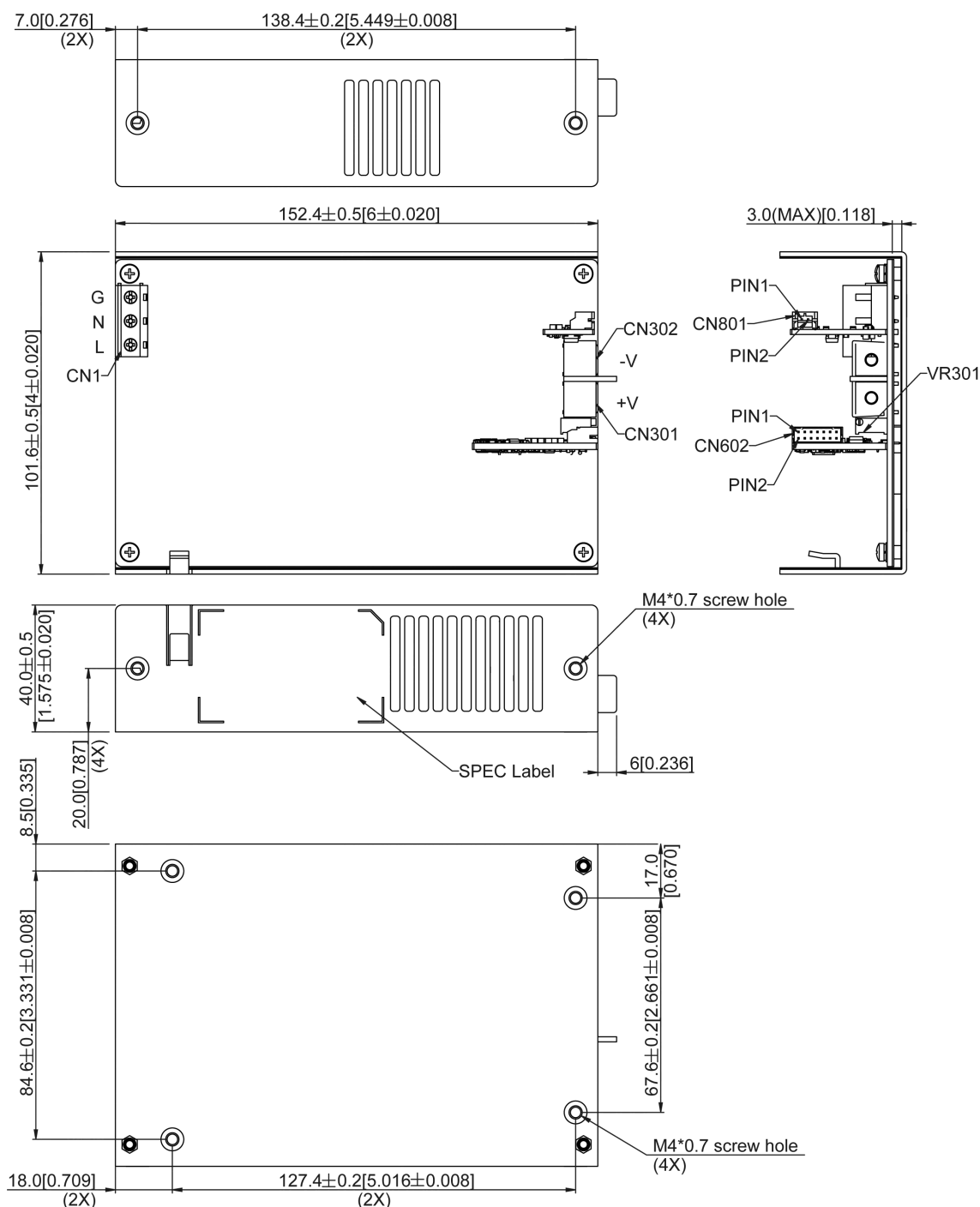


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### Dimensions

L x W x H: 152.4 x 101.6 x 40 mm (6.0 x 4.0 x 1.575 inch)



### Notes:

1. Base plate mounting, M4 thread holes, maximum penetration 3.0 mm (0.118 inch) from outside face of chassis, maximum torque 4.5 kgf.cm (3.91 lbf.in).
2. Side mounting, M4 thread holes, maximum penetration 3.0 mm (0.118 inch) from outside face of chassis, maximum torque 4.5 kgf.cm (3.91 lbf.in).
3. CN301/CN302, M4 screw in two positions, maximum torque 9.7 kgf.cm (8.41 inch.lbs).
4. All dimensions are in millimeters and inches

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### Connector Definition and Pin Assignment

Input Connector CN1(DEGSON: DG128-7.5-03P-1Y)	
L	AC Line(Phase)
N	AC Neutral
G	Ground
Output Connector	
CN301	Vo
CN302	DC RTN
<b>CN801(JST:S2B-PH-SM4-TB)Mating With JST:PHR-2 Terminal:SPH-002T-P0.5S (FOR MEU-650A24T AAA and MEU-650A48T AAA ONLY)</b>	
Pin 1	DC RTN
Pin 2	12 V for Fan
Control Connector CN602(CviLux:CI0114P1HDY-R0-NH) Mating With CviLux: CI0114SD000 Terminal:CI01TD21PE0	
Pin 1	Current Share
Pin 2	DC RTN
Pin 3	Remote Sense +
Pin 4	Remote Sense -
Pin 5	DC RTN
Pin 6	DC RTN
Pin 7	5V Standby Output +
Pin 8	5V Standby Output +
Pin 9	NC
Pin 10	NC
Pin 11	Power Good-
Pin 12	Power Good+
Pin 13	Remote On_Off/Inhibit +
Pin 14	Remote On_Off/Inhibit -

# Medical / Industrial AC-DC Power Supply

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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

Time between the collapse of the AC input voltage, and the output falling to 90% of its steady state value

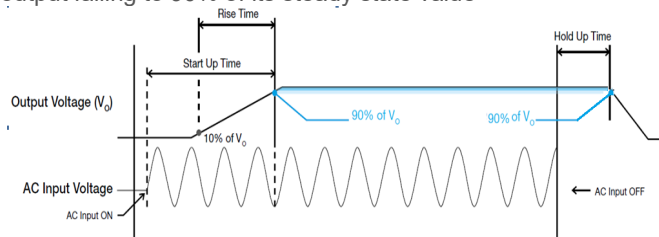


Figure 4 Time sequence

#### Dynamic Response (Main Output)

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

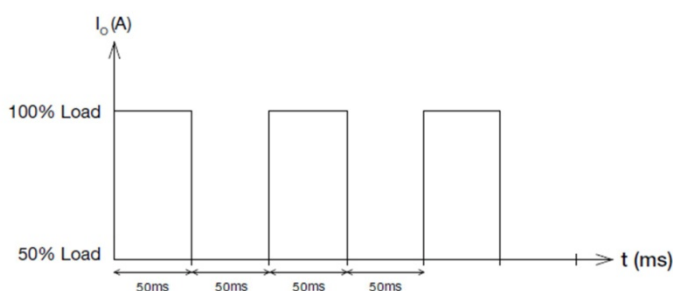


Figure 5 Dynamic Load

#### 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.

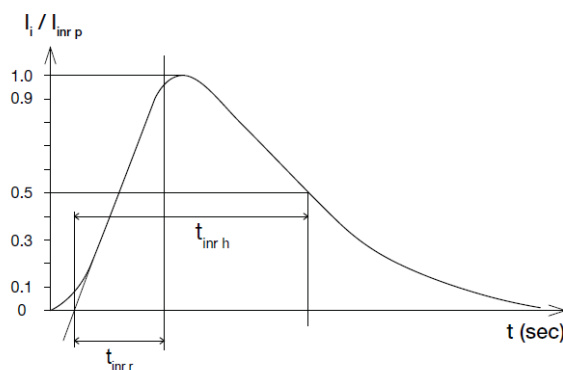


Figure 6 Inrush Current

#### 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 5 under "Protections". Power supply will latch off, and require removal/re-application of input AC voltage in order to restart.

#### Overload & Over current Protections

The power supply's Overload (OLP) and Over current (OCP) Protections will be activated before output power under 750 W for over 750 ms. 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.

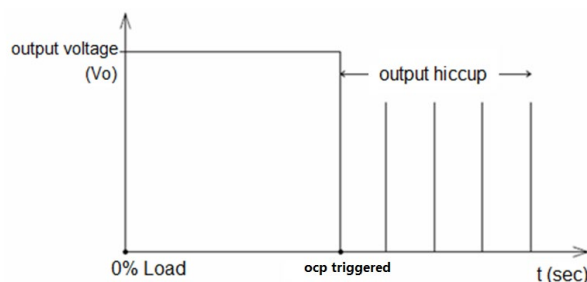


Figure 7. Hiccup at OLP/OCP

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

#### Short Circuit Protection

Output OLP/OCP function also provides protection against short circuits. When a short circuit is applied, the output current will operate in "Hiccup mode". The power supply will return to normal operation after the short circuit is removed.

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### 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 isolated open collector transistor (80 V/ 50 mA rating). A resistor (suggested value 10 K ohm, 1/8 W) can be added between Power Good- pin and DC RTN, Power Good+ pin can be connected to 5 V standby (or, other available pull-up voltage that is no greater than the transistor rating). Value of 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 Signal (Shown in below figure) generated will be high. When AC input is off, Power Good Signal generated will be low. There will be a minimum of 5 milliseconds (at 450 W load) between the time the Power Good Signal goes to low level, and the time when the output reaches 90% of its rated value.

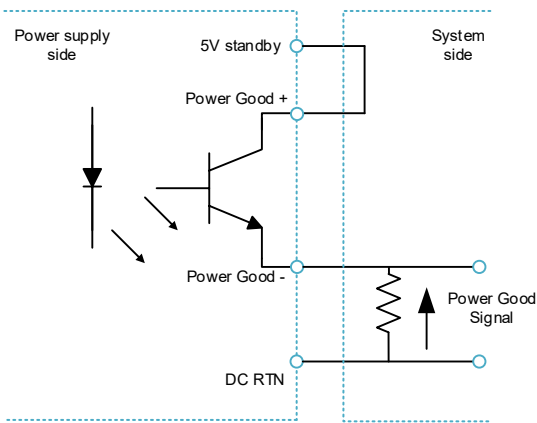


Figure 8 Power Good Connection

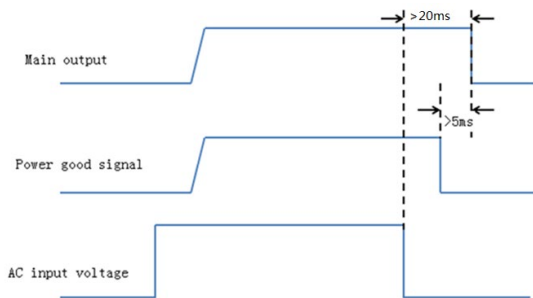


Figure 9 Power Good Time Sequence

### Remote On\_Off/Inhibit

Remote ON\_OFF/INHIBIT uses an isolated diode located within the power supply. This signal can be used to enable or disable only the main output. When the main output is disabled, the +5 V Standby output will continue to operate. System can use a switch to conduct through this diode (suggested pull up resistor to 5 V standby with 1 K ohm resistor) to disable the main out. The signal can be floated (no connection to the signal), in order to enable the main output

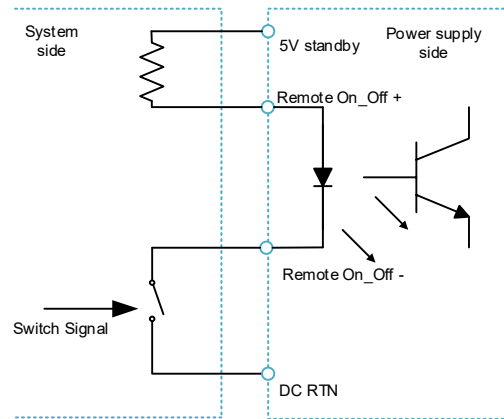


Figure 10 Remote On\_Off Connection

### Remote Sense

Remote sense feature can be used to compensate for the extra voltage drop on output wires that are connected from the main output terminals, to the load. With wires connected from the remote sense pins, at the same locations as the wires from the main output, the remote sense function can compensate up to 500 mV voltage drop. The power supply will not be damaged if the remote sense pins are shorted, or if a reverse/inverted polarity connection is made to the load

### Voltage Adjustment

The power supply provides a potentiometer for user to adjust the output voltage. The output voltage is designed to be able to adjust up to  $\pm 10\%$  of rated voltage, when the output is adjusted below nominal value, the maximum output current is the same as the nominal output, when the output is adjusted above nominal value, the output power cannot exceed the nominal maximum power (the maximum output current will be reduced accordingly).

### Current Sharing

The power supply supports current sharing. Parallel the outputs as well as the current sharing bus to enable this feature. To ensure better current sharing performance, use VR to trim output voltage as close as possible before put two power supplies in parallel.

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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 60950 and IEC 60065. 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](http://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.

### Manufacturer and Authorized Representatives Information

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