

Medical / Industrial AC-DC Power Supply

600W Convection Cooling / MEU-600C series



Highlights & Features

- Convection Cooled
- Up to 600 Watt in 5" x 8" x 1.57" Package
- Up to 9.5W/inch³ Power Density
- Full Power from 90V to 264V
- Full Power up to 50° C Ambient
- Up to 500KHrs MTBF
- 2MOPP Isolation
- Suited for Type BF Medical Products.
- 5V/1A Standby Output
- 12V/0.6A Fan Output for System
- Optional CV/CC Version
- 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
- Analog and Digital Voltage Adjustment
- PMBus Ver 1.3 Supported
- Optional RS485 Version

Input	
Input Voltage	85VAC ~ 264VAC
Input Frequency	47Hz ~ 63Hz
Input Current	<7.5A
Inrush Current	<55A
Power Factor	>0.95 @ rated load
Efficiency	Up to 94%
Patient Leakage Current	<100uA normal, <500uA SFC
Earth Leakage Current	<300uA normal, <1mA SFC
Output	
Output Voltage	24V 48V
Output Current	0-25.0A 0-12.5A
Ripple & Noise	<1% Vrated pk-pk
Auxiliary Power	5V / 1A (No minimum load required)
Fan Output	12V / 0.6A
Environmental	
MTBF	500KHrs
Operation Temperature	-20°C ~70°C ¹⁾
Operation Altitude	5000m or 54kPa

Safety Certifications

- IEC60601-1 2nd edition and IEC60601-1 3rd edition + A1 CB report
- TUV EN60601-1:2006/A11/A12
- UL60601-1+CAN/CSA 60601-1: (Ed.3.2005)
- IEC60950-1 CB report
- TUV EN60950-1
- UL60950-1+CAN/CSA60950-1
- GB4943.1-2011, GB9254-2008, GB17625.1-2012

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

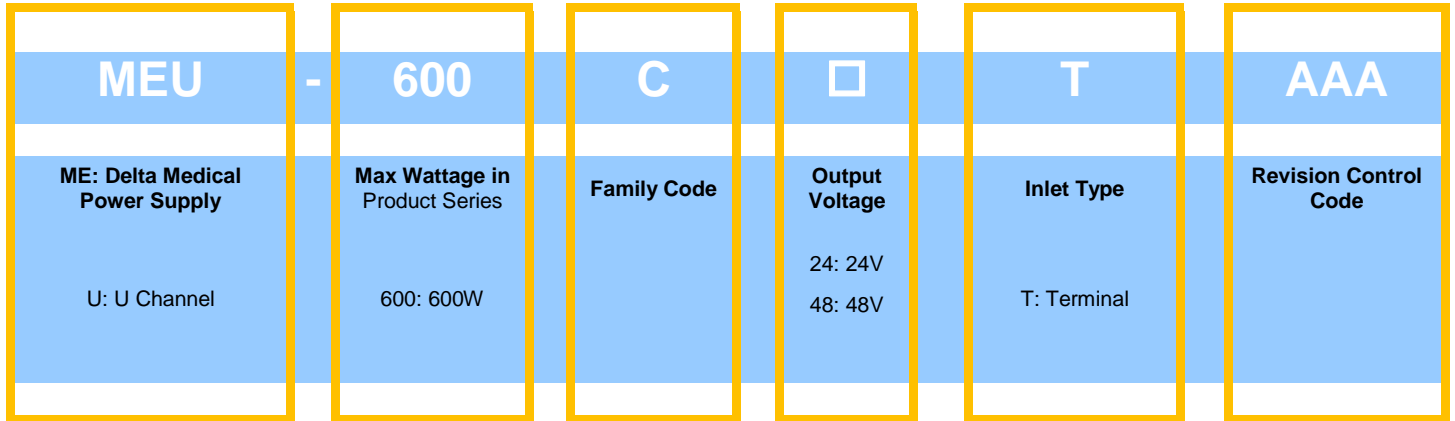
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Model Information

Model Number	Input Voltage	Output Voltage	Current Output
MEU-600C24T AAA	85-264Vac	24Vdc	0-25.0A
MEU-600C48T AAA	85-264Vac	48Vdc	0-12.5A

Model Numbering



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Specifications

Input Ratings / Characteristics

Nominal Input Voltage	100-240Vac
Input Voltage Range	85-264Vac
Nominal Input Frequency	50-60Hz
Input Frequency Range	47-63Hz
Input Current (max)	7.5A
Input Surge Voltage (max)	300Vac for 100ms
Full load Efficiency	(typ. For 24V output Model) 92.5% @ 115Vac/60Hz 94% @ 230Vac/50Hz, Reference Fig. 1 (typ. For 48V output Model) 94% @ 115Vac/60Hz 95% @ 230Vac/50Hz, Reference Fig. 1-1
Inrush Current (max)	55A @ 264Vac, cold/hot start
Input-PE(protective earth) leakage current (max)	0.3mA @ NC, 1mA @ 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		100Vac/60Hz (Typ)	264Vac/60Hz(Typ)	Delta Limit	IEC60601-1 Limit
Input-PE Leakage Current	Normal Condition	108	281	300uA max	5000uA max
	Single Fault Condition	213	550	1000uA max	10000uA max
Output-PE Leakage Current for Type BF application	Normal Condition	34	87	100uA max	100uA max
	Single Fault Condition	84	222	500uA max	500uA max

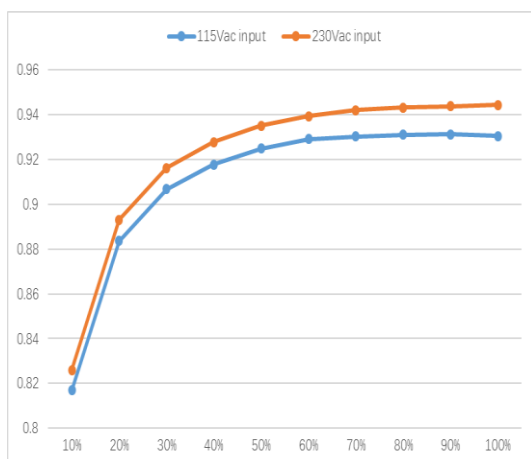


Figure 1. Typical efficiency Curve for 24V (600W max)

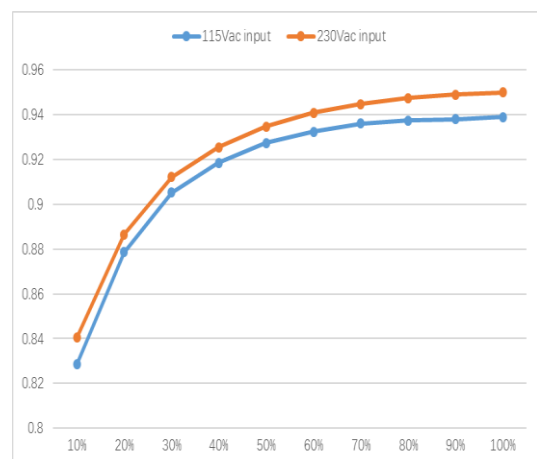


Figure 1-1. Typical efficiency Curve for 48V (600W max)

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Output Ratings / Characteristics

Total Regulation	± 3%
Output Power (max)	600W
Line Regulation (max)	1%
Load Regulation (max)	2%
Ripple & Noise (typ.)	1% pk-pk Vrated @ rated load, Reference Fig. 2
Voltage Trimming Range	± 10% Vrated
Dynamic Response (Overshoot & Undershoot O/P Voltage)	± 5% @ with 50-100% load change
Start-up Time (max)	2000ms @ 115Vac
Hold-up Time (min)	20ms @ 600W, with nominal input range
Capacitive load (max)	6000uF
Rise time (max)	<50ms
Remote Sense	Up to 500mV compensation for voltage drop across external wire connections to load. Short and reverse connection protected.



(a) 115V (measured value=190mV)



(b) 230V(measured value=187mV)

Figure 2. 24V output model Ripple & Noise example, 20MHz BW

Nominal Output Voltage of standby output (Vstby)	5V
Nominal Output Current of standby output	1A
Total Regulation of standby output	± 3%
Ripple & Noise of standby output	100mV max
Nominal Output Voltage of Fan Output (Vfan)	12V
Nominal Output Current of Fan Output	0.6A
Total Regulation of Fan Output	± 5%
Ripple & Noise of Fan Output	120mV max

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Ripple & Noise measurement circuit

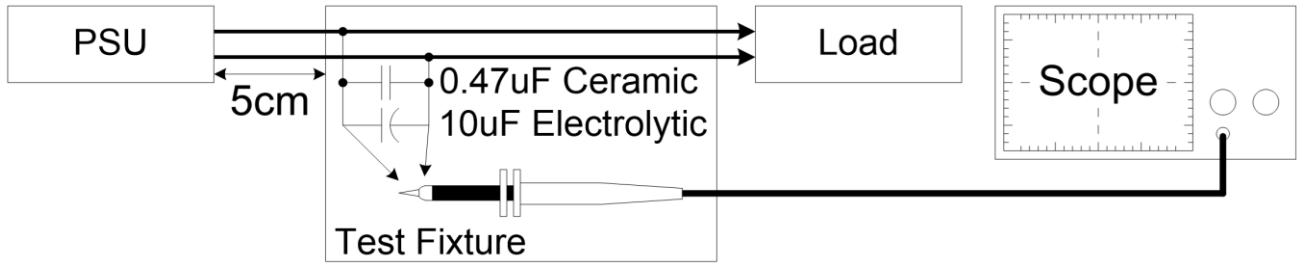


Figure 3. Ripple & Noise testing setup

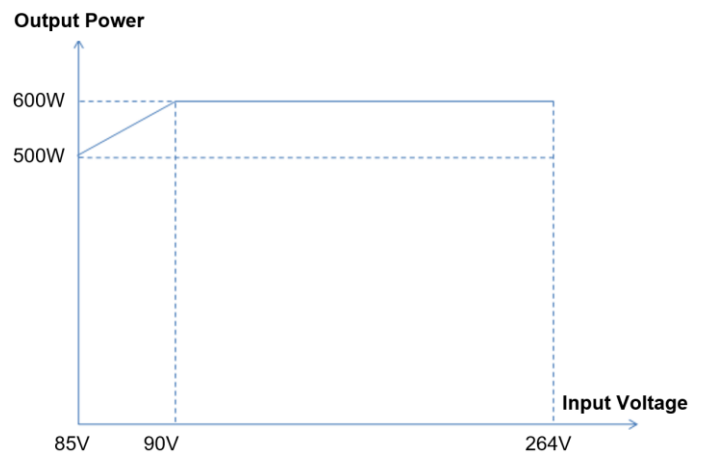
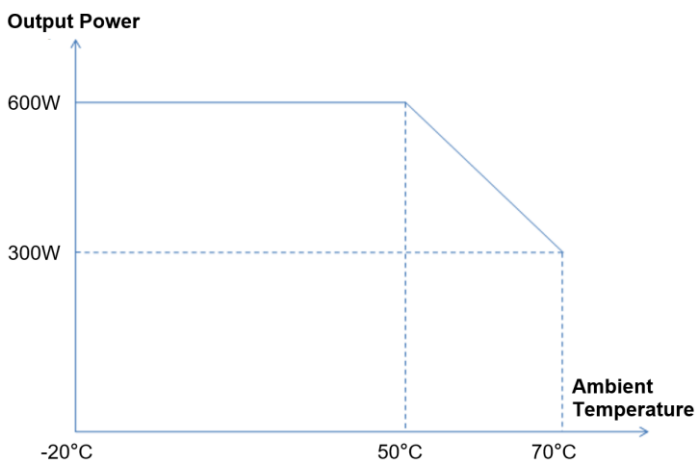
Mechanical

Package	U Channel
Dimensions (W x L x H)	127x203.2x40mm (5x8x1.57inch)
Unit Weight	1.3kg (2.87lb)

Environment

Surrounding Air Temperature	Operating	Absolute Maximum/Minimum Rating. -20°C to +70°C. Linear power derate from 100% load at 50°C, to 50% load at 70°C Note: see power de-rating curves below
	Storage	-40°C to +85°C
Operating Humidity	5-95% RH (Non-Condensing)	
Operating Altitude	Up to 5,000 meters (up to 16,400 feet or 106-54kPa)	
Non-Operating Altitude	Up to 5,575 meters (up to 18,290 feet or 106-50kPa)	
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 (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)	Main output 160% of rated current Standby 2A max Hiccup Mode(Non-Latching, Auto-Recovery) Fan Output 1.5A max with current limiting protection
Over Temperature	Latch Mode for Main output
Short Circuit	Hiccup Mode (Non-Latching, Auto-Recovery)

Reliability Data

MTBF (Minimum) at 115Vac, Full Load, 35 °C	500 Khrs based on Telecordia SR-332
Operating life (Minimum) at 115Vac, Full Load, 25°C	26,280 hrs

Safety Standards / Directives

Medical Safety	IEC60601-1 2 nd and 3 rd +A1 edition CB report TUV EN60601-1:2006 UL60601-1+CAN/CSA 60601-1: (Ed.3.2005)	
ITE Safety	IEC60950-1 CB report TUV EN60950-1 UL60950-1+CAN/CSA60950-1 GB4943.1-2011, GB9254-2008, GB17625.1-2012	
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
	Output to/Ground (1XMOPP)	1500 Vac (Type BF application rated)

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EMC

EMC / Emissions		EN55011/EN55032, 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 ¹⁾⁵⁾ Air Discharge: 15kV Contact Discharge: 8kV
Radiated Field	IEC61000-4-3	Criteria A ¹⁾ 80MHz-2700MHz, 10V/m AM modulation Level 2 Criteria A ¹⁾⁵⁾ 385MHz-5785MHz, 28V/m Pulse mode and other modulation
Electrical Fast Transient / Burst	IEC61000-4-4	Level 3 Criteria A ¹⁾ : 2kV
Surge	IEC61000-4-5	Level 3 Criteria A ¹⁾⁵⁾ Common Mode ³⁾ : 2kV Differential Mode ⁴⁾ : 1kV
Conducted	IEC61000-4-6	Level 2 Criteria A ¹⁾⁵⁾ 150kHz-80MHz, 3Vrms, 6Vrms at ISM bands and Amateur radio bands
Power Frequency Magnetic Fields	IEC61000-4-8	Criteria A ¹⁾⁵⁾ Magnetic field strength 30A/m
Voltage Dips	IEC61000-4-11	30% 10ms Criteria A ¹⁾ 60% 100ms Criteria B ²⁾ 100% 5000ms Criteria B ²⁾
Voltage Dips ⁵⁾	IEC60601-1-2	Criteria A ¹⁾ 0% U _T , 0.5 cycle (10ms) (0°, 45°, 90°, 135°, 180°, 225°, 270°, 315°, 360°) Criteria B ²⁾ , can meet Criteria A with 500W load or lower 0% U _T , 1 cycle (20ms), 0° Criteria B ²⁾ 70% U _T , 25 cycle (500ms), 0° Criteria B ²⁾ 70% U _T , 250 cycle (5000ms), 0°

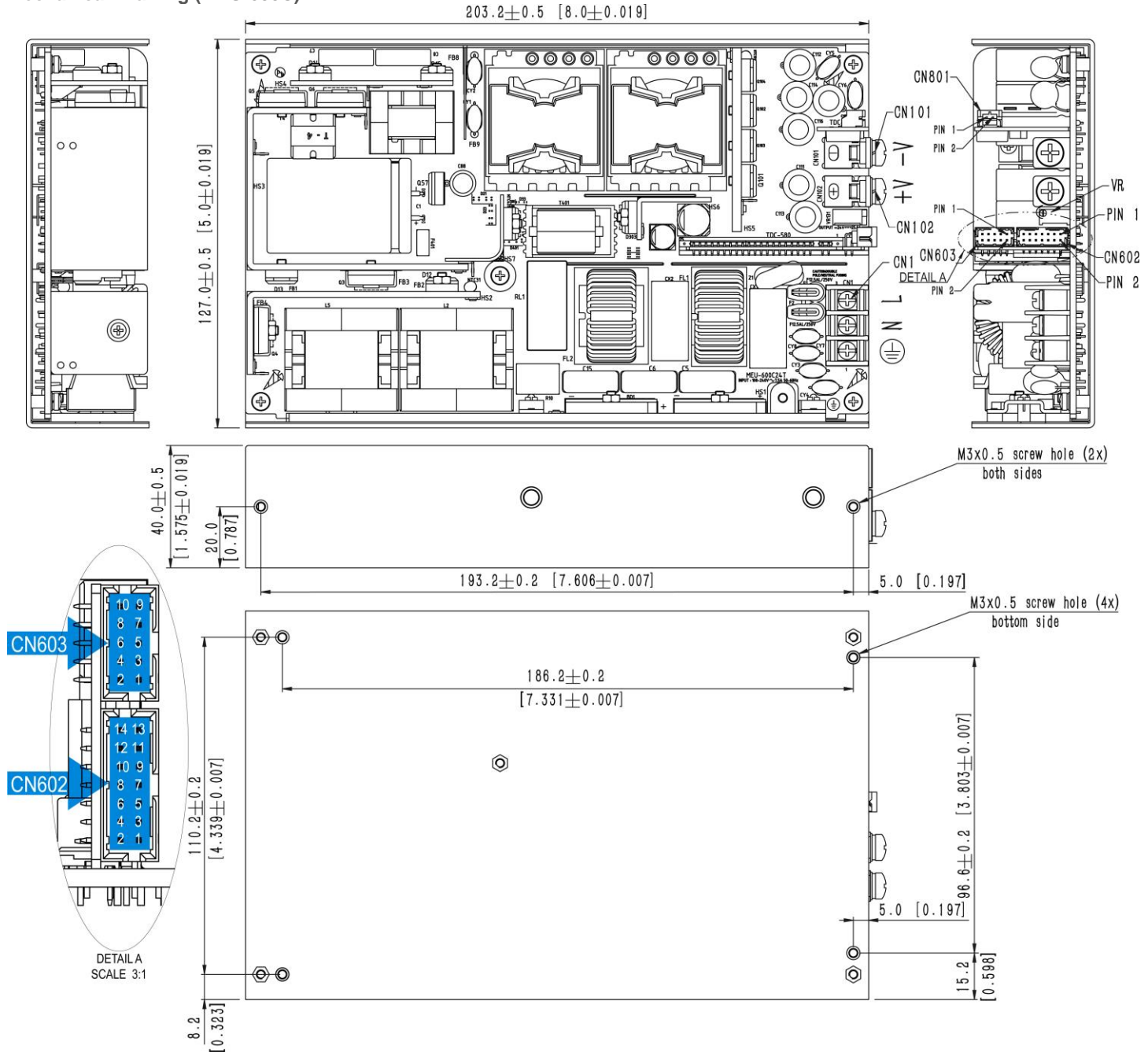
- 1) Criteria A: Normal performance within the specification limits
- 2) Criteria B: Output out of regulation, or shuts down during test. Automatically restored to normal operation after test.
- 3) Asymmetrical: Common mode (Line to earth)
- 4) Symmetrical: Differential mode (Line to line)
- 5) Compliant with IEC60601-1-2 4th Edition

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Dimensions

Mechanical Drawing (MEU-600C)



Notes:

1. Base plate mounting, M3 thread holes, maximum penetration 4.0mm (0.16 inch) from outside face of chassis, maximum torque 6.3kgf.cm (5.46 inch.lbs).
2. Side mounting, M3 thread holes, maximum penetration 4.0mm (0.16inch) from outside face of chassis, maximum torque 6.3kgf.cm (5.46 inch.lbs).
3. CN101/CN102, M5 screw, maximum torque 20kgf.cm (17.34 inch.lbs).
4. CN1, M3.5 screw, maximum torque 12kgf.cm (10.41 inch.lbs).
5. VR: clockwise is to increase the output voltage, anti-clockwise is to reduce the output voltage.

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Connector Definition and Pin Assignment

Input Connector CN1(DINKLE:DT-35-B01W-03)	
Pin 1	Line
Pin 2	Neutral
Pin 3	Ground
Output Connector	
CN101	DC RTN
CN102	Vo
Control Connector CN603(Molex:87833-1031) Mating With Molex:51110-1051 Terminal:0503948052	
Pin 1	5V bus for I ² C
Pin 2	DC RTN of 5V bus for I ² C
Pin 3	Serial data signal (SDA)
Pin 4	Serial clock signal (SCL)
Pin 5	NC
Pin 6	NC
Pin 7	Address bit 0 (A0)
Pin 8	Address bit 1 (A1)
Pin 9	Address bit 2 (A2)
Pin 10	NC
Control Connector CN602(Molex:87833-1420) Mating With Molex:51110-1451 Terminal:0503948052	
Pin 1	Remote On_Off/Inhibit +
Pin 2	Remote On_Off/Inhibit -
Pin 3	Power Good-
Pin 4	Power Good+
Pin 5	NC
Pin 6	NC
Pin 7	5V Standby Output +
Pin 8	5V Standby Output +
Pin 9	DC RTN
Pin 10	DC RTN
Pin 11	Remote Sense +
Pin 12	Remote Sense -
Pin 13	Current Share
Pin 14	DC RTN
CN801(JST: S2B-PH-SM4-TB) Mating With JST: PHR-2 Terminal: SPH-002T-P0.5S	
Pin 1	DC RTN
Pin 2	12V for Fan

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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.

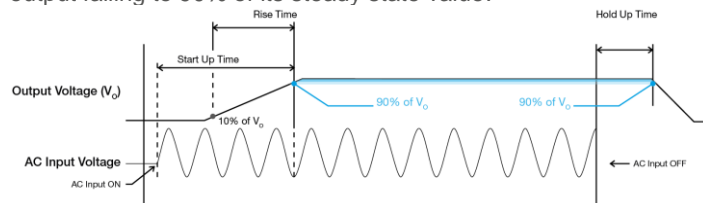


Figure 4. Time Sequence

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

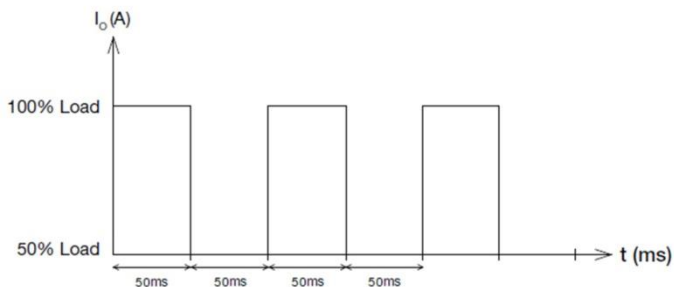


Figure 5. Dynamic Load

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.

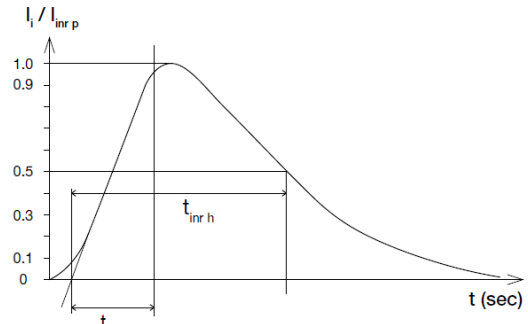


Figure 6. Inrush Current

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 6 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 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.

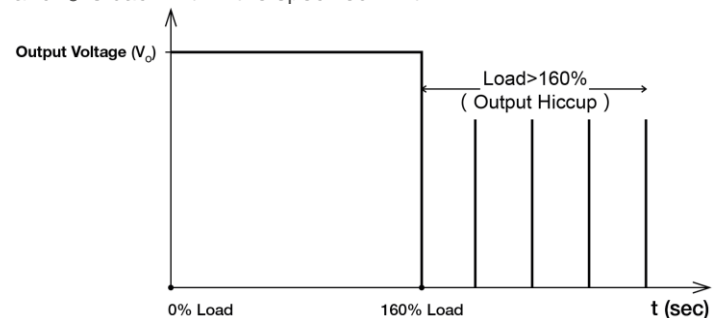


Figure 7. Hiccup at OLP/OCP

Additionally, if the load is $>100\%$; but $<160\%$ 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.

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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.

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 (80V/50mA rating). A resistor (suggested value 10Kohm, 1/8W) can be added between Power Good- pin and DC RTN, Power Good+ pin can be connected to 5V 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 between the time the Power Good Signal goes to low level, and the time when the output reaches 90% of its rated value.

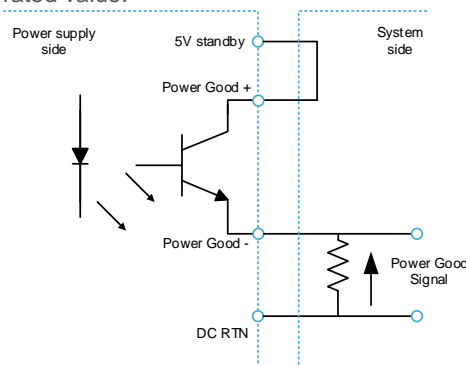


Figure 8. Power Good Connection

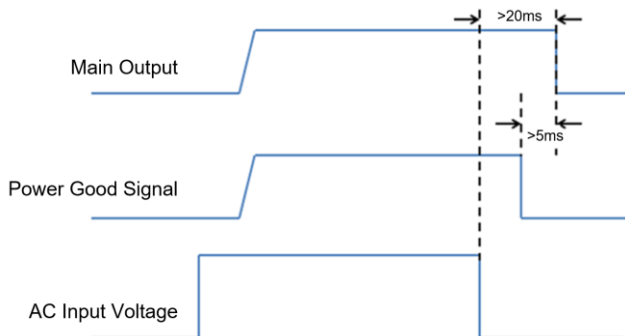


Figure 9. Power Good Time Sequence

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 +5V Standby output will continue to operate. System can use a switch to conduct through this diode (suggested pull up resistor to 5V standby with 1Kohm resistor) to disable the main out. The signal can be floated (no connection to the signal), in order to enable the main output

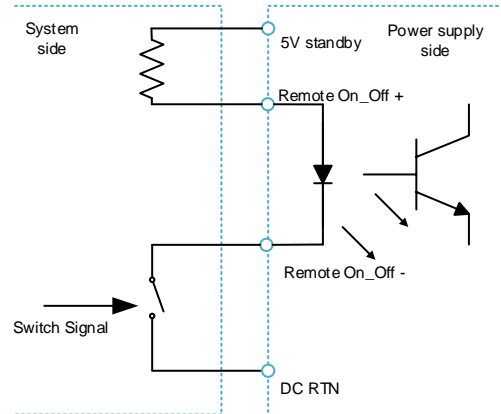


Figure 10. Remote On_Off Connection

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 500mV 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 ± 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).

PMBus

The power supply can communicate with the host product, using PMBus version 1.3 protocols. Multiple functions can be realized, such as monitoring the power supply operation status, and editing the power supply operating set-points. See user instruction for detailed control information.

Current Sharing

The power supply supports current sharing. Parallel the outputs as well as the current sharing bus to enable this feature.

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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

Attention

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