

### Medical Grade AC/DC Power Supply With PFC

<b>85-264Vrms</b> Input Voltage	<b>12/15/24/28/48V</b> Semi-Regulated Output	<b>1400W</b> Output Continuous	<b>1800W</b> Output Transient	<b>92%</b> Full Load Efficiency
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**ACuQor®**

#### Product Features

- High efficiency (92% for 48 VOUT Model at 1400W)
- Universal input voltage range
- Semi-regulated output for bus stability
- Integral fan cooling with speed control
- Active PFC; EN61000-3-2 compliant
- Low leakage; EN60601-1 compliant
- Low noise; EN55011 / EN55022 Class B compliant
- Over-current, over-voltage, and over-temp protection
- DC Power Good / AC Power Good signals
- Remote enable input
- Fan status output
- Small size: 4.75" x 7" x 1.625" (encased)
- RoHS 6/6 compliant
- 5 V (500 mW) standby output



**AC Input:** 85-264Vrms  
**DC Output:** 12/15/24/28/48V  
**Power:** 1400W  
**Grade:** Medical

## ACuQor 1400W Series Electrical Characteristics

All specifications typical with TA = 25 °C, unless otherwise specified.

MAIN OUTPUT SPECIFICATIONS			GENERAL SPECIFICATIONS		
Output power (continuous) (5 s transient)	85-132/170-264 Vrms	1400W	Fundamental ripple freq.	Input	500 kHz
	85-132/170-264 Vrms	1800W		Output	250 kHz
		132-170 Vrms	See Figure 12	Audible noise	Fan speed varies with temp.
Nominal DC output voltage (at 800W) (Semi-regulated)	12 Vout	12.4 V	Weight	( AQ0800xxxxGC ) 998 g (35.2 oz)	
	15 Vout	15.6 V		( AQ1100xxxxGC ) 1179 g (41.6 oz)	
	24 Vout	25 V		( AQ1400xxxxGC ) 1179 g (41.6 oz)	
	28 Vout	29 V		MTBF	MIL-217 533 kHours
	48 Vout	50 V	Demonstrated TBD kHours		
Efficiency (see figs. 1 - 10)	12 Vout, 115 Vrms, 1400W	87% typ.	ISOLATION SPECIFICATIONS		
	24 Vout, 115 Vrms, 1400W	89% typ.	Isolation voltage	Input to output	4000 Vrms
	48 Vout, 115 Vrms, 1400W	90% typ.		Input to ground	1500 Vrms
	12 Vout, 230 Vrms, 1400W	89.5% typ.		Output to ground (B)	500 Vrms
	24 Vout, 230 Vrms, 1400W	90.5% typ.		Output to ground (BF & CF)	1500 Vrms
	48 Vout, 230 Vrms, 1400W	91.5% typ.		Output to ground (CFD)	5000 Vpulse
Hold-up time (to -20%)	12 / 15 Vout	10 ms @ 1400W	Insulation resistance	Output to ground	10 MΩ min.
	24 / 28 / 48 Vout	12 ms @ 1400W	Leakage currents	See Note 2	
Maximum load capacitance	12 Vout	48,000 µF	ENVIRONMENTAL CHARACTERISTICS		
	15 Vout	40,500 µF	Thermal performance	Operating ambient (see Figure 11) 0 °C to +70 °C	
	24 Vout	24,000 µF		Non-operating ambient -40 °C to +85 °C	
	28 Vout	19,200 µF	Relative humidity	Non-condensing 5-95% RH	
	48 Vout	6,000 µF	Altitude	Operating 10,000 ft max. Non-operating 30,000 ft max.	
Output ripple voltage	Switching frequency (20 MHz BW)	0.5% p-p	Random vibration	5-500 Hz 0.03 g2/Hz	
	Twice line frequency (at 800W)	5.0% p-p		Shock	Half-sine, 10 ms, 3 axes 20 g peak
Turn-on delay		2 s max.	EMC CHARACTERISTICS		
Transient response	Iout steps from 50-75%	3% typ / 6% max. dev.	Conducted emissions	EN55011 and EN55022, FCC Level B	
	At 0.2 A/µs	100 ms recovery		part15	
Overvoltage protection	Cyclic restart	110-120%	Line frequency harmonics	EN61000-3-2 Class A	
Short circuit protection	Cyclic operation	115% rated Iout	Voltage fluctuations	EN61000-3-3 Clause 5b	
Total regulation	Over line, load and temperature	±6.0%	ESD air	EN61000-4-2 Level 3	
Auxiliary Output	Always on (See Note 1)	5 V @ 100 mA	ESD contact	EN61000-4-2 Level 3	
Thermal protection	Automatic recovery	+125 °C (PCB Temp)	Radiated immunity	EN61000-4-3 Level 3	
REMOTE_ENABLE	Input Low Voltage	0.45 V (max)	Fast transients	EN61000-4-4 Level 3	
	Input High Voltage	4.15 V (min)	Line surge immunity	EN61000-4-5 Level 3	
INPUT SPECIFICATIONS			Conducted immunity	EN61000-4-6 Level 3	
AC input voltage	Universal range	85-264 Vrms	Power freq. mag. field	EN61000-4-8 3 A/m	
				Voltage dip immunity	EN61000-4-11 Perf Criteria B, A, B
Input frequency		47-63 Hz			
Input current	115 Vrms @ 1400W	14 Arms			
	230 Vrms @ 1400W	7 Arms			
Power factor		>0.98			
Input surge current	264 Vrms (cold start)	50 A max.			
Internal input fuses	Both AC lines	20 A			

### NOTES:

- Derate 2 mA per °C above 50 °C ambient temperature.
- Leakage currents see page 4.

### SAFETY AGENCY CERTIFICATIONS

UL60601-1:2003  
CAN/CSA-22.2 No. 601.1-M90  
EN 60601-1/A2:1995  
IEC 60601-1/A2:1995  
CAN/CSA-C22.2 No. 60601-1-08  
ANSI/AAMI ES60601-1:2005  
EN 60601-1:2006  
IEC 60601-1:2005  
CE Marked  
Meets NFPA 99 2005 300 µA earth leakage



## EFFICIENCY, DERATING, AND $V_{OUT}$ DROOP CURVES

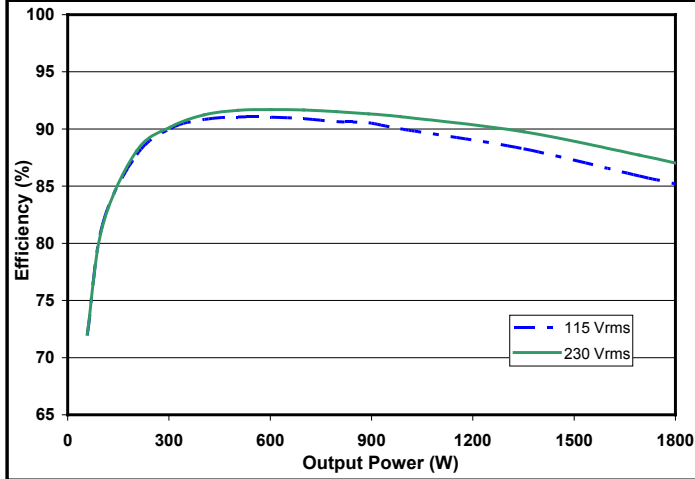


Figure 1: 12 VOUT efficiency curves.

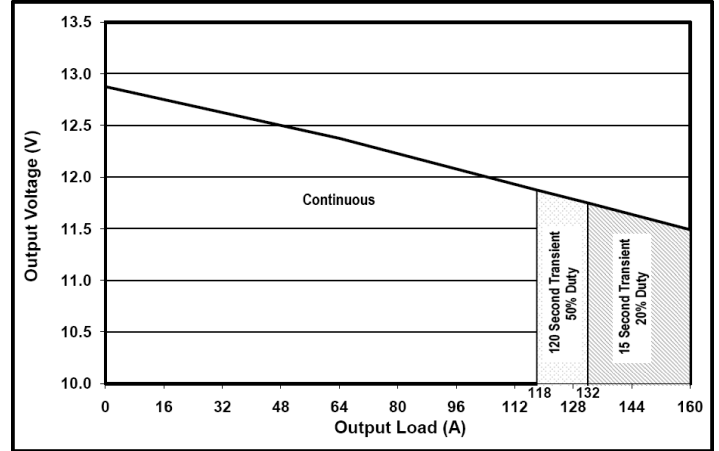


Figure 2: 12 VOUT droop characteristic.

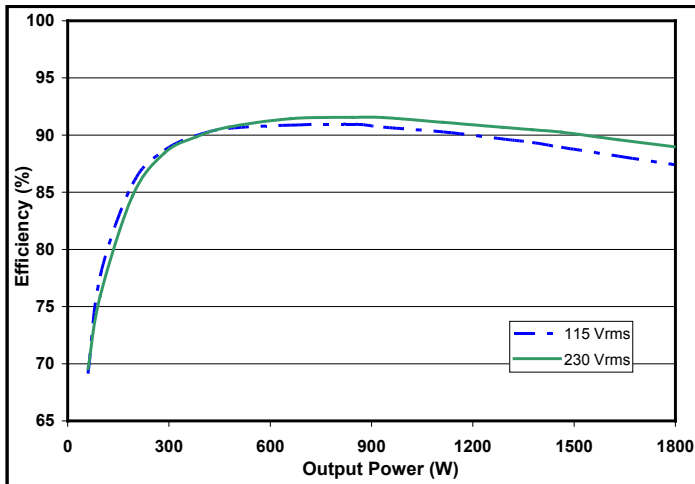


Figure 3: 15 VOUT efficiency curves.

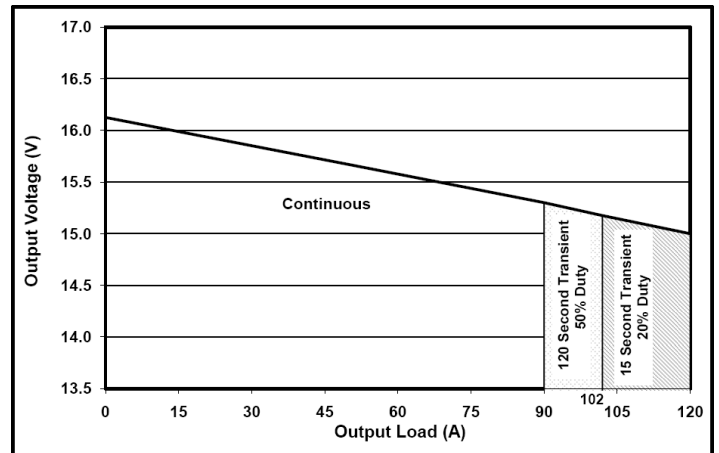


Figure 4: 15 VOUT droop characteristic.

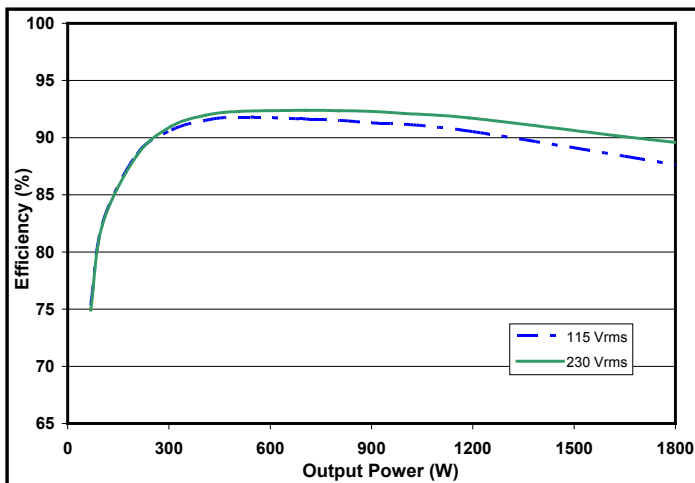


Figure 5: 24 VOUT efficiency curves.

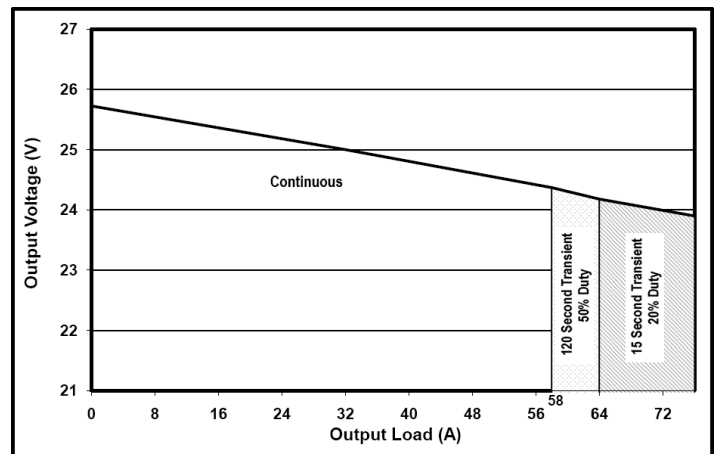


Figure 6: 24 VOUT droop characteristic.



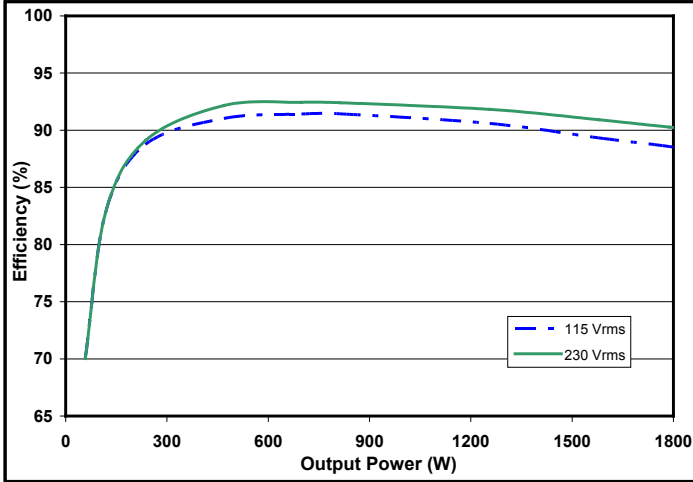


Figure 7: 28 VOUT efficiency curves.

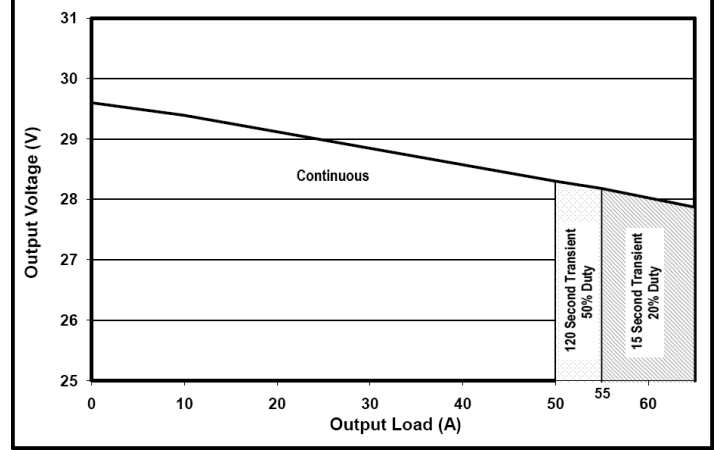


Figure 8: 28 VOUT droop characteristics.

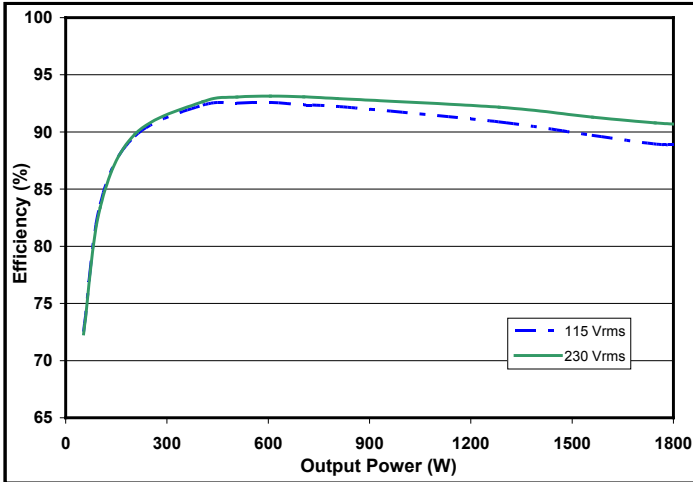


Figure 9: 48 VOUT efficiency curves.

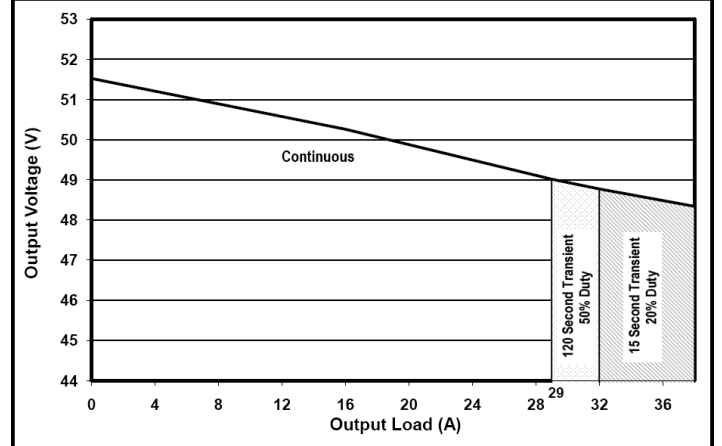


Figure 10: 48 VOUT droop characteristics.

AC Leakage Current from Input to Earth	AC Line Connection	Normal Condition	Open Neutral Fault
ACuQor Typical at 110% nominal input voltage 60 Hz	240 V L-N, 1 phase	220 $\mu$ A	440 $\mu$ A
	208 V L-L, 120 V L-N, 1 of 3 phases	120 $\mu$ A	240 $\mu$ A
	240 V L-N-L, 120 V L-N, split phase	120 $\mu$ A	240 $\mu$ A

For convenience, the following tables show limits allowed by various standards:

AC Leakage Current from Input to Earth	Standard	Normal Condition	Open Neutral Fault
Maximum Allowed per Standard	IEC60601-1	500 $\mu$ A	1000 $\mu$ A
	NFPA 99 2005	300 $\mu$ A	—
	IEC60950	3500 $\mu$ A	—

AC Leakage Current from Output to Earth	Model	Normal Condition	Open Earth Fault	AC Backdrive Fault
ACuQor Typical at 264 Vac 60 Hz input	AQ . . B . .	4 $\mu$ A	65 $\mu$ A	—
	AQ . . BF . .	4 $\mu$ A	40 $\mu$ A	78 $\mu$ A
	AQ . . CF . .	4 $\mu$ A	20 $\mu$ A	39 $\mu$ A

AC Leakage Current from Output to Earth	Contact Type	Normal Condition	Open Earth Fault	AC Backdrive Fault
Maximum Allowed per IEC60601-1	B	100 $\mu$ A	500 $\mu$ A	—
	BF	100 $\mu$ A	500 $\mu$ A	5000 $\mu$ A
	CF	10 $\mu$ A	50 $\mu$ A	50 $\mu$ A

Table 1: Leakage Currents

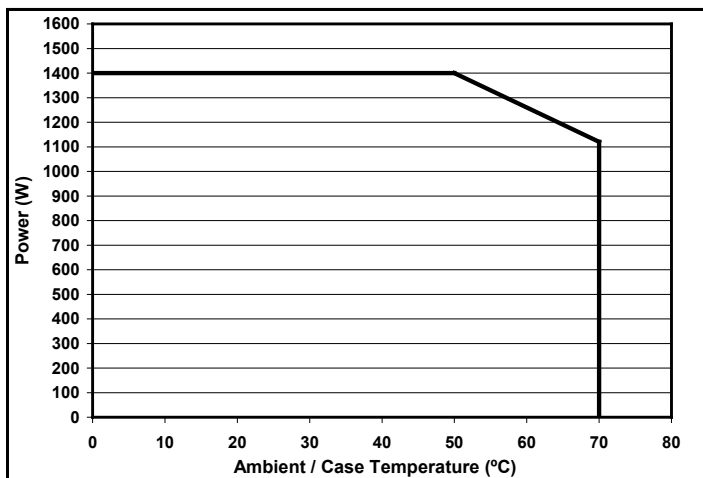


Figure 11: Continuous power derating curve in natural convection.

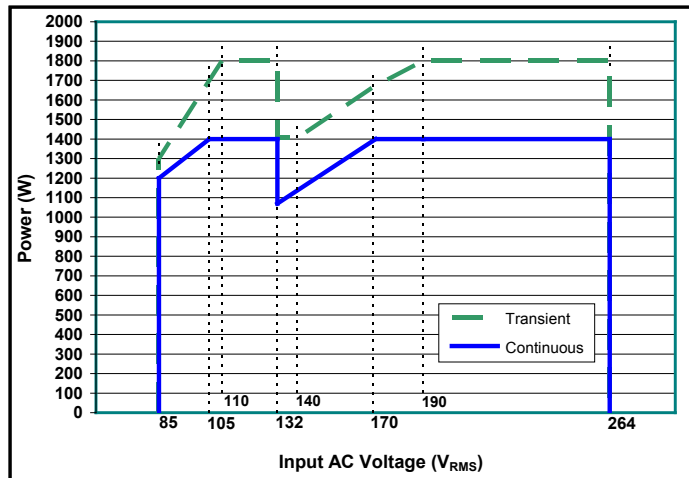
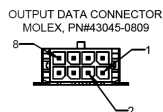
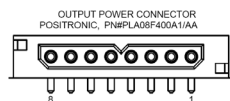


Figure 12: Rated output power vs Input AC Voltage.



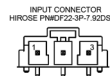
#### OUTPUT DATA CONNECTOR PINOUT

Pin 1	Reserved	Reserved for future use.
Pin 2	Reserved	Reserved for future use.
Pin 3	VOUT(-)	Negative Output Voltage
Pin 4	REMOTE_ENABLE	Logic input. See Figure B. Pull high to enable main output.
Pin 5	FAN_GOOD	Open collector with internal 5 V pullup. See Figure A. Pulsed low on fan failure, 100 ms, 50% duty.
Pin 6	AC_POWER_GOOD	Open collector with internal 5 V pullup. See Figure A. Pulled low on AC power dropout.
Pin 7	DC_POWER_GOOD	Open collector with internal 5 V pullup. See Figure A. Pulled low during startup ramp and within 5°C of temperature shutdown threshold.
Pin 8	5V_STANDBY	5 V @ 100 mA available whenever AC power is applied.



#### OUTPUT POWER CONNECTOR PINOUT

Pin 1	VOUT(+)	Positive Output Voltage
Pin 2	VOUT(-)	Negative Output Voltage
Pin 3	VOUT(+)	Positive Output Voltage
Pin 4	VOUT(-)	Negative Output Voltage
Pin 5	VOUT(+)	Positive Output Voltage
Pin 6	VOUT(-)	Negative Output Voltage
Pin 7	VOUT(+)	Positive Output Voltage
Pin 8	VOUT(-)	Negative Output Voltage



#### INPUT CONNECTOR PINOUT

Pin 1	Ground
Pin 2	AC Neutral
Pin 3	AC Line

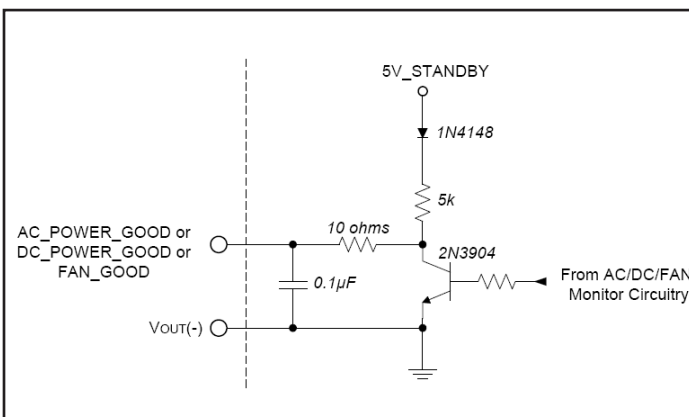


Figure A: Power good and fan good interface circuitry.

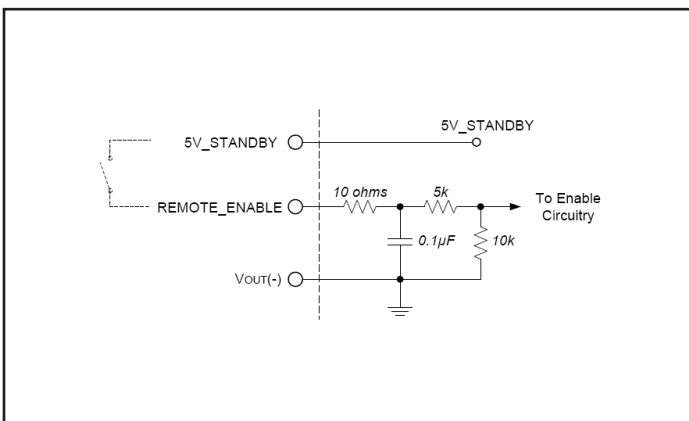
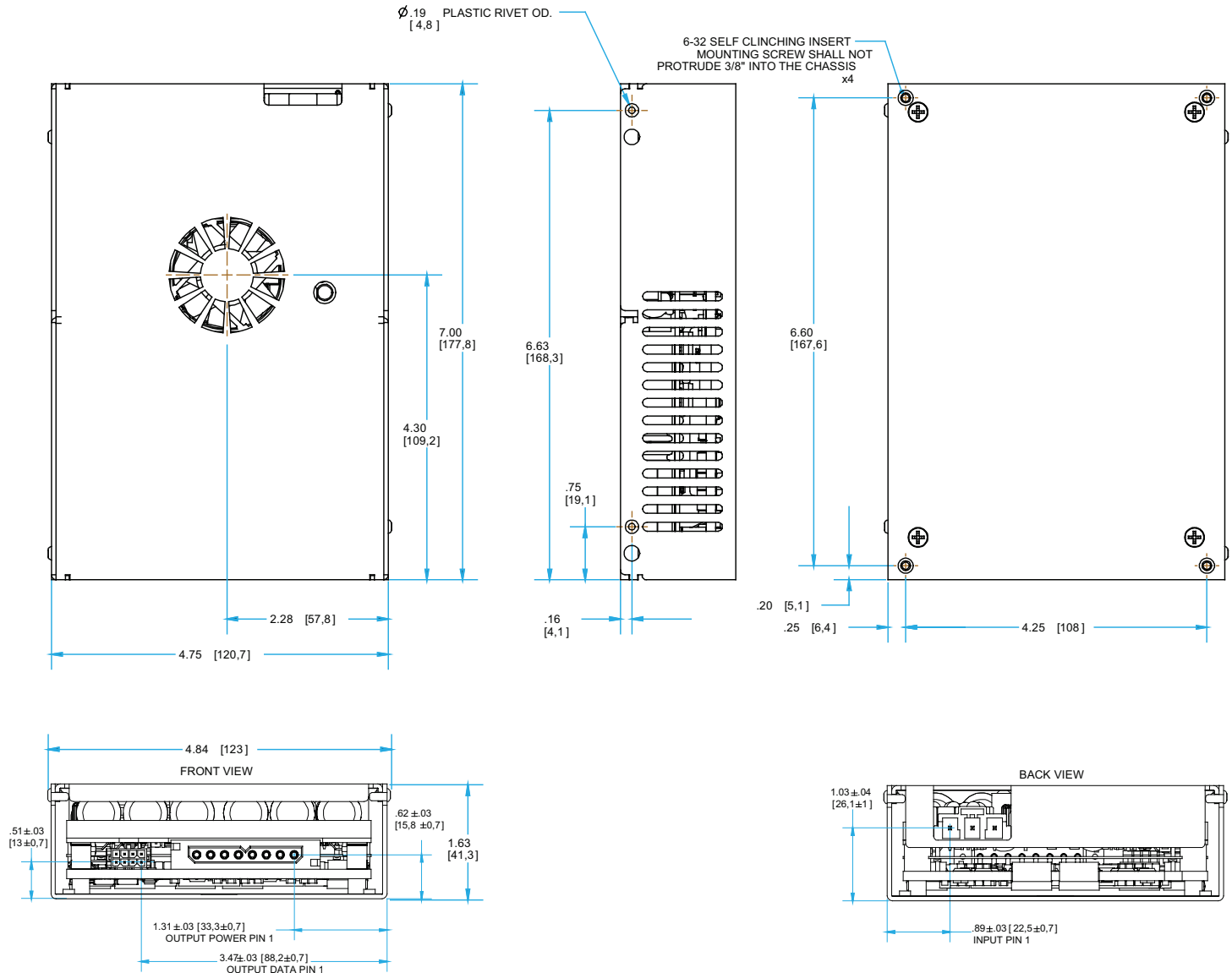


Figure B: Remote enable interface circuitry.

#### MATING CONNECTORS

Connector	Type	Contact
OUTPUT (Power)	Positronic PLA08M7	Positronic MS112N
OUTPUT (Data)	Molex 43025-0800	Molex 43030-0008
INPUT	Hirose DF22B-3S-7.92C	Hirose DF22A-1012SC

## MECHANICAL DRAWINGS



## NOTES

1. Recommended screw tightening torque of 6in.. lbs.
2. Undimensioned components are shown for visual reference only
3. All dimensions in inches [mm]  
Tolerances: x.xx in  $\pm 0.02$   
x.xxx in  $\pm 0.010$



**AC Input:** 85-264Vrms  
**DC Output:** 12/15/24/28/48V  
**Power:** 1400W  
**Grade:** Medical

## INSTALLATION INSTRUCTIONS

**GENERAL:** ACuQor power supplies are intended for use as components in medical and industrial equipment. ACuQor units must be properly installed within end use equipment before they can be safely applied as described in this document. The suitability of the ACuQor/equipment combination must be verified through end product investigation.

**MOUNTING:** Refer to the Mechanical Drawings section. ACuQor units are provided with threaded stainless-steel stand-offs or inserts for mounting. This mounting hardware is internally connected to the input connector protective-earth terminal for functional-earth EMC control. Any orientation (vertical, horizontal, etc.) may be used. Adequate air space should be provided over the fan intake (top) and exhaust (sides) to allow for exchange of cooling air. ACuQor is designed for a pollution degree 2 environment. A minimum of 5 mm electrical clearance should be allowed from the connector ends of encased models.

**INPUT:** Refer to the Connector Details section for input connector wiring. ACuQor products require a single phase AC power source of 100-240V 50/60Hz nominal. Refer to nameplate label for input current ratings. A protective-earth connection is also required. Minimum wire size of 14 AWG (2.5mm<sup>2</sup>) is recommended. Both sides of the AC line are internally fused (see table for specific models). These fuses are not user replaceable.

**OUTPUT:** Refer to the Connector Details section for output connector wiring and signal I/O functionality. Refer to nameplate label for output current ratings. Main DC output (Vout+, Vout-) pins should use 12 AWG (4.0mm<sup>2</sup>) wire size. Individual main output pins should not be loaded to more than 30 A. For currents greater than 30 A, multiple main output pins/wires must be used in parallel. All signal I/O pins are referenced to Vout-.

**EMC:** ACuQor products have been tested to the EMC specifications listed in the section of this datasheet titled Electrical Characteristics, on page two. However, end use equipment must be tested to verify EMC compliance.

**PATIENT CONTACT:** ACuQor models include versions designed for B, BF and CF patient contact application per IEC60601-1. The BF and CF ACuQor models provide reinforced insulation at the DC output voltage level and basic insulation at the 240 Vac level from output to protective-earth. Note that equipment and wiring may add to system leakage currents so that the end product must be tested for compliance. Refer to the Electrical Characteristics section for typical ACuQor input and output leakage currents. In addition, ACuQor defibrillation rated models comply with the minimum output to protective-earth creepage/clearance requirement and defibrillator pulse test of IEC60601-1.

**HIPOT TESTING:** ACuQor products are rated for Hipot testing levels of 1500 Vac input to protective-earth, 1500 Vac output to protective-earth, and 4000 Vac input to output. When performing the 4000 Vac input to output test, the test voltage must be balanced evenly 2000 Vac input and output to protective-earth. Two oppositely phased test voltage sources or a single test voltage source with external balancing impedances (capacitors) may be used to prevent overstressing input or output to protective-earth insulation per IEC60601-1 2005 sub clause 8.8.1 and IEC60601-1 1990 sub clause 20.4.

**CONDUCTIVE COOLING:** This product requires supplemental conductive cooling through its case to maintain the rated output power. The case should be mounted to a system chassis or heat sink with a thermally conductive interface material and kept at 50°C maximum to maintain full power rating of the product. For detailed applications assistance, consult Applications Engineering through the sales channel.

MODEL	Input Fuses (in Both AC Lines)	Fuses Total
AQ0800	Cooper Bussmann 20A 250V GBB-20	2
AQ1100	Cooper Bussmann 20A 250V GBB-20	2
AQ1400	Cooper Bussmann 20A 250V GBB-20	2

Table 2: AC line fuses for specific ACuQor Medical Models





**AC Input:** 85-264Vrms  
**DC Output:** 12/15/24/28/48V  
**Power:** 1400W  
**Grade:** Medical

## PART NUMBERING SYSTEM

The part numbering system for SynQor's ACuQor AC/DC power supplies follows the format shown in the table below. Not all combinations make valid part numbers, please contact SynQor for availability.

Family	Output Power	Grade	Range	Output Voltage	Package Type	Thermal Design	Options
<b>AQ:</b> ACuQor series of AC-DC semi-regulated output power supplies	<b>0800:</b> 800W <b>1100:</b> 1100W <b>1400:</b> 1400W	<b>M:</b> (Medical) <b>I:</b> (Industrial)	<b>U:</b> Universal (85-264 VRMS)	<b>12:</b> 12V <b>15:</b> 15V <b>24:</b> 24V <b>28:</b> 28V <b>48:</b> 48V	<b>G:</b> 1 unit (5"x7")	<b>C:</b> Encased	<b>Medical Grade</b> <b>B:</b> B isolation rating <b>BF:</b> BF isolation rating <b>CF:</b> CF isolation rating <b>CFD:</b> CF isolation rating defibrillator proof  <b>IND:</b> Industrial Grade

Example: **AQ1400MU24GCCFD**

## ACCESSORIES

SynQor offers a series of assemblies that can be ordered according to the table below. Mechanical drawings for these accessories are available for download in pdf format from the SynQor website.

Part Number	Description
<b>AQ-CBL-INPUT1CG</b>	Input mating cable with pre-stripped wire ends (36" long)
<b>AQ-CBL-OUT1CDG</b>	Output mating cables (Signal and Power) with pre-stripped wire ends (18" long)

## APPLICATION NOTES

A variety of application notes and technical white papers can be downloaded in pdf format from the SynQor website.

[Online Application Notes](#)

[Online Library of Technical White Papers](#)

[SynQor website.](#)

## PATENTS

SynQor holds the following U.S. patents, one or more of which apply to each product listed in this document. Additional patent applications may be pending or filed in the future.

5,999,417	6,222,742	6,545,890	6,577,109	6,594,159	6,731,520
6,894,468	6,896,526	6,927,987	7,050,309	7,072,190	7,085,146
7,119,524	7,269,034	7,272,021	7,272,023	7,558,083	7,564,702
7,765,687	7,787,261	8,023,290	8,149,597		

### Warranty

SynQor offers a three (3) year limited warranty. Complete warranty information is listed on our website or is available upon request from SynQor.

Information furnished by SynQor is believed to be accurate and reliable. However, no responsibility is assumed by SynQor for its use, nor for any infringements of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of SynQor.

## Contact SynQor for further information:

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