

## AC/DC Medical Power Supply

## TPP 450 Series, 450 Watt

- **High power density 3" x 5.8" encased medical power supply**
- **450 Watt up to 65°C without derating, 320 Watt fanless operation without derating up to 50°C**
- **Medical certification to IEC/EN/ES 60601-1 edition 3.2 for 2 x MOPP**
- **EMC compliance to IEC/EN 60601-1-2 4th edition**
- **Risk management process according to ISO 14971 incl. risk management file**
- **Acceptance criteria for electronic assemblies acc. to IPC-A-610 class 3**
- **Isolation (4000 VAC) and leakage current (<100 µA) rated for BF applications**
- **Standard features: 5 V standby output 12 V fan output, Remote On/Off, Power Good Signal, variable fan speed**
- **Operating up to 5000 m altitude**
- **5-year product warranty**



ES 60601-1 IEC 60601-1  
UL 62368-1 IEC 62368-1

The TPP 450 Series of 450 Watt AC/DC power supplies feature a reinforced double I/O isolation system according to latest medical safety standards (60601-1 edition 3.2, 2 x MOPP). The earth leakage current is below 100 µA what makes the units suitable for BF (body floating) applications. The excellent efficiency of up to 94% allows a high power density for the standard 3" x 5" packaging format.

Fanless operation power is 320W up to +50°C and 450W at +65°C with fan. Thus you can power your medical device in a quiet and hygienic way as you don't need to run a fan to cool down the power supply. High reliability is provided by use of industrial quality grade components and an excellent thermal management. It makes the products an ideal solution for medical devices and for demanding safety and space critical applications.

### Models

Order Code	Output Power max.	Output Voltage nom. (adjustable)	Output Current max.	Efficiency typ.
TPP 450-112-M		12 VDC (11.0 - 13.0 VDC)	37'500 mA	91 %
TPP 450-115-M		15 VDC (13.8 - 16.2 VDC)	30'000 mA	92 %
TPP 450-124-M		24 VDC (22.1 - 25.9 VDC)	18'750 mA	93 %
TPP 450-128-M	450 W	28 VDC (25.8 - 30.2 VDC)	16'100 mA	93 %
TPP 450-136-M		36 VDC (33.1 - 38.9 VDC)	12'500 mA	93 %
TPP 450-148-M		48 VDC (44.2 - 51.8 VDC)	9'400 mA	94 %
TPP 450-153-M		53 VDC (48.8 - 57.2 VDC)	8'550 mA	94 %

### Options

TPP 450-AUX1	- Optional Cable for auxiliary connection (2 x 4 pin): <a href="http://www.tracopower.com/overview/tpp450-aux1">www.tracopower.com/overview/tpp450-aux1</a>
on demand (backorder with MOQ non stocking item)	- Optional version with fan on top

**Input Specifications**

Input Voltage	- AC Range	Operational Range: <b>85 - 264 VAC</b> (Full Range) Rated Range: <b>100 - 240 VAC</b> (Full Range)
	- DC Range	Operational Range: <b>120 - 370 VDC</b> (Designed for, no certification) Polarity: <b>+DC: L / -DC: N</b>
Input Frequency		Operational Range: <b>47 - 440 Hz</b> Certified: <b>50/60 Hz</b>
Power Consumption	- No load & Vin = 230 VAC - No load & Vin = 115 VAC	<b>1'050 mW</b> max. <b>1'450 mW</b> max.
Input Current	- Full load & Vin = 230 VAC - Full load & Vin = 115 VAC	<b>2'400 mA</b> max. <b>5'800 mA</b> max.
Input Inrush Current	- At 230 VAC - At 115 VAC	<b>100 A</b> max. <b>55 A</b> max.
Power Factor	- At 230 VAC - At 115 VAC	<b>0.95 min.</b> (Active Power Factor Correction) <b>0.95 min.</b> (Active Power Factor Correction)
Input Protection		<b>T 6.3 A / 250 VAC</b> (Internal Fuse in L & N)
Recommended Input Fuse		(The need of an external fuse has to be assessed in the final application.)

**Output Specifications**

Output Voltage Adjustment	<b>±8%</b> (By trim potentiometer) Output power must not exceed rated power!
Voltage Set Accuracy	<b>±1% max.</b>
Regulation	- Input Variation (Vmin - Vmax) <b>0.2% max.</b> - Load Variation (0 - 100%) <b>0.5% max.</b>
Ripple and Noise (20 MHz Bandwidth)	12 VDC model: <b>250 mVp-p typ.</b> (w/ 1 $\mu$ F X7R) 15 VDC model: <b>300 mVp-p typ.</b> (w/ 1 $\mu$ F X7R) 24 VDC model: <b>240 mVp-p typ.</b> (w/ 1 $\mu$ F X7R) 28 VDC model: <b>280 mVp-p typ.</b> (w/ 1 $\mu$ F X7R) 36 VDC model: <b>360 mVp-p typ.</b> (w/ 1 $\mu$ F X7R) 48 VDC model: <b>480 mVp-p typ.</b> (w/ 1 $\mu$ F X7R) 53 VDC model: <b>530 mVp-p typ.</b> (w/ 0.1 $\mu$ F X7R)
Capacitive Load	12 VDC model: <b>31'250 <math>\mu</math>F max.</b> 15 VDC model: <b>20'000 <math>\mu</math>F max.</b> 24 VDC model: <b>7'820 <math>\mu</math>F max.</b> 28 VDC model: <b>5'750 <math>\mu</math>F max.</b> 36 VDC model: <b>3'500 <math>\mu</math>F max.</b> 48 VDC model: <b>1'960 <math>\mu</math>F max.</b> 53 VDC model: <b>1'600 <math>\mu</math>F max.</b>
Minimum Load	<b>Not required</b>
Temperature Coefficient	<b>±0.02 %/K max.</b>
Hold-up Time	- At 230 VAC <b>12 ms min.</b> - At 115 VAC <b>12 ms min.</b>
Start-up Time	- At 230 VAC <b>2'000 ms max.</b> - At 115 VAC <b>2'000 ms max.</b>
Short Circuit Protection	<b>Continuous, Automatic recovery</b> (Level 1, nom.) <b>Latch</b> (Level 2, instantaneous high current)
Output Current Limitation	<b>115 - 155% of Iout max.</b>
Oversupply Protection	<b>110 - 135% of Vout nom.</b> (Latch off, Standby Power Source always present)
Transient Response	- Response Deviation <b>3% max.</b> (50% to 75% Load Step) - Response Time <b>600 <math>\mu</math>s typ.</b> (50% to 75% Load Step)

All specifications valid at 230 VAC, resistive full load and +25°C after warm-up time, unless otherwise stated.

## Safety Specifications

Standards	- IT / Multimedia Equipment	EN 62368-1 IEC 62368-1 UL 62368-1 EN 60601-1 IEC 60601-1 ANSI/AAMI ES 60601-1 2 x MOPP (Means Of Patient Protection) <a href="http://www.tracopower.com/overview/tpp450">www.tracopower.com/overview/tpp450</a>
	- Medical Equipment	
	- Certification Documents	
Protection Class		Class I (Prepared): Connection to PE  See application note: <a href="http://www.tracopower.com/info/protection-class.pdf">www.tracopower.com/info/protection-class.pdf</a> (Any one of the four mounting holes can be considered as PE connection for class I application)
Pollution Degree		PD 2
Over Voltage Category		OVC II

## EMC Specifications

EMI (Emissions)	- Conducted Emissions	EN 60601-1-2 edition 4 (Medical Devices) EN 55011 class A (internal filter) EN 55011 class B (internal filter) EN 55032 class A (internal filter) EN 55032 class B (internal filter) EN 55011 class A (internal filter) EN 55032 class A (internal filter) EN 61000-3-2, class A EN 61000-3-2, class D EN 61000-3-3  (For optimal EMI performance the power supply should be mounted to a grounded aluminium plate (480 x 248 x 12 mm) with electrical contact to the four PCB mounting holes. To comply with safety standards, this plate must be grounded.)
EMS (Immunity)	- Radiated Emissions	
	- Harmonic Current Emissions	
	- Voltage Fluctuations & Flicker	
EMC / Environmental	- Electrostatic Discharge	Air: EN 61000-4-2, ±15 kV, perf. criteria A Contact: EN 61000-4-2, ±8 kV, perf. criteria A EN 61000-4-3, 3 V/m, perf. criteria A EN 61000-4-4, ±2 kV, perf. criteria A
	- RF Electromagnetic Field	L to L: EN 61000-4-5, ±1 kV, perf. criteria A L to PE: EN 61000-4-5, ±2 kV, perf. criteria A EN 61000-4-6, 20 Vrms, perf. criteria A
	- EFT (Burst) / Surge	Continuous: EN 61000-4-8, 30 A/m, perf. criteria A 230 VAC / 50 Hz: EN 61000-4-11 30%, 25 periods, perf. criteria A >95%, 0.5 periods, perf. criteria A >95%, 1 period, perf. criteria A >95%, 250 periods, perf. criteria B
	- Conducted RF Disturbances	115 VAC / 60 Hz: EN 61000-4-11 30%, 25 periods, perf. criteria A >95%, 0.5 periods, perf. criteria A >95%, 1 period, perf. criteria A >95%, 250 periods, perf. criteria B
	- PF Magnetic Field	
	- Voltage Dips & Interruptions	
	- Certification Documents	<a href="http://www.tracopower.com/overview/tpp450">www.tracopower.com/overview/tpp450</a>

All specifications valid at 230 VAC, resistive full load and +25°C after warm-up time, unless otherwise stated.

### General Specifications

Relative Humidity	95% max. (non condensing)	
Temperature Ranges	- Operating Temperature	-40°C to +80°C
	- Storage Temperature	-40°C to +80°C
Power Derating	- High Temperature	Depending on model
	- Low Input Voltage	1.33 %/V below 100 VAC
		See application note: <a href="http://www.tracopower.com/overview/tpp450">www.tracopower.com/overview/tpp450</a>
Over Temperature Protection Switch Off	- Protection Mode	110°C to 125°C (Latch off)
	- Measurement Point	See application note: <a href="http://www.tracopower.com/overview/tpp450">www.tracopower.com/overview/tpp450</a> (Standby Power Source always present)
Cooling System	Forced air cooling (with internal fan)	
Fan Power Source	- Characteristic	Variable fan speed (temperature regulated)
	- Output Voltage	12 VDC
	- Output Current	500 mA max.
Standby Power Source	- Output Voltage	5 VDC
	- Output Current	2000 mA max.
Remote Control	- Voltage Controlled Remote (passive = on)	On: 3.0 to 12 VDC or open circuit Off: 0 to 1.2 VDC or short circuit Refers to '+Remote' and '-Remote' Pin -0.5 to 1.0 mA (Standby power source is always present)
Altitude During Operation	5'000 m max.	
Regulator Topology	LLC Converter	
Switching Frequency	55 - 85 kHz (PFM)	
Insulation System	Reinforced Insulation	
Working Voltage (rated)	312 VAC	
Isolation Test Voltage	- Input to Output, 60 s	4'000 VAC
	- Input to Case or PE, 60 s	2'500 VAC
	- Output to Case or PE, 60 s	2'500 VAC
Isolation Resistance	- Input to Output, 500 VDC	100 MΩ min.
Leakage Current (at 264 VAC)	- Touch Current	100 µA max.
Reliability	- Calculated MTBF	410'000 h (MIL-HDBK-217F, ground benign)
Environment	- Vibration	IEC 60068-2-6
	- Mechanical Shock	IEC 60068-2-27
	- Flammability	EN 45545-2 <a href="http://www.tracopower.com/info/en45545-declaration.pdf">www.tracopower.com/info/en45545-declaration.pdf</a>
Housing Material	Stainless Steel (Cover)	
Housing Type	Metal Case	
Mounting Type	Chassis Mount	
Connection Type	Pin Connector	
Weight	552 g	
Power OK Signal	Open collector output	
	- Trigger Threshold	12 VDC model: 9.8 - 11 VDC 15 VDC model: 12.3 - 13.8 VDC 24 VDC model: 19.7 - 22.1 VDC 28 VDC model: 23 - 25.8 VDC 36 VDC model: 29.5 - 33.1 VDC 48 VDC model: 39.4 - 44.2 VDC 53 VDC model: 43.5 - 48.8 VDC
	- Power OK	Low level
	- Power Off	High resistance (Refers to 'PG' and '-Vout' Pin)
	- Pin Specifications	50 VDC / 50 mA / 120 mW max.

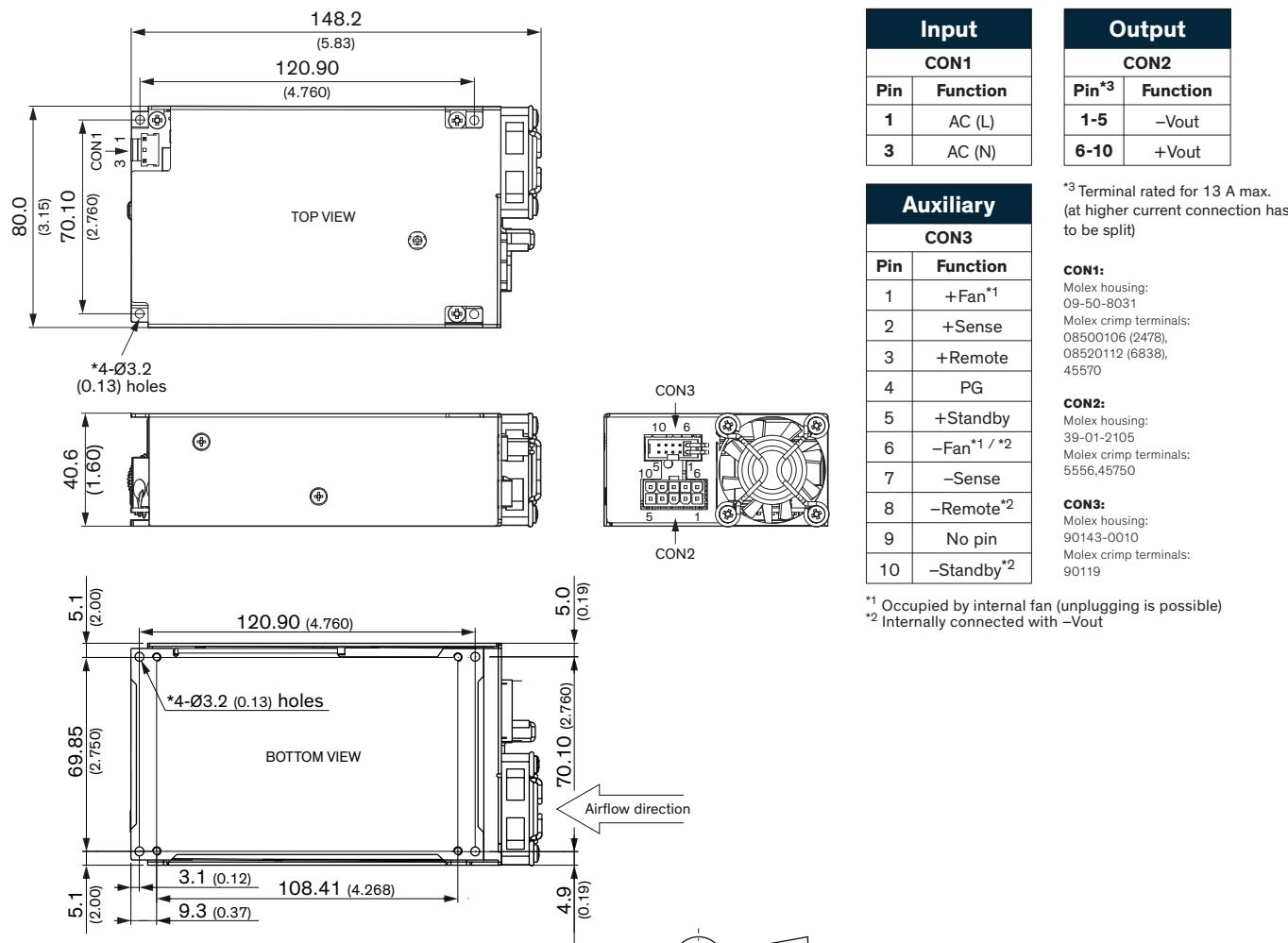
All specifications valid at 230 VAC, resistive full load and +25°C after warm-up time, unless otherwise stated.

Sense Function	8% max. of Vout nom. (see application note)
Environmental Compliance - REACH Declaration	REACH SVHC list compliant REACH Annex XVII compliant <a href="http://www.tracopower.com/info/reach-declaration.pdf">www.tracopower.com/info/reach-declaration.pdf</a>
- RoHS Declaration	Exemptions: 7(a), 7(c)-I (RoHS exemptions refer to the component concentration only, not to the overall concentration in the product (O5A rule).)
- SCIP Reference Number	<b>48f4e8fa-a51e-453d-a4d3-54d733464d7b</b>

## Additional Information

Supporting Documents	<a href="http://www.tracopower.com/overview/tpp450">www.tracopower.com/overview/tpp450</a>
Frequently Asked Questions	<a href="http://www.tracopower.com/glossary-faq">www.tracopower.com/glossary-faq</a>
Glossary	<a href="http://www.tracopower.com/info/glossary.pdf">www.tracopower.com/info/glossary.pdf</a>

## Outline Dimensions



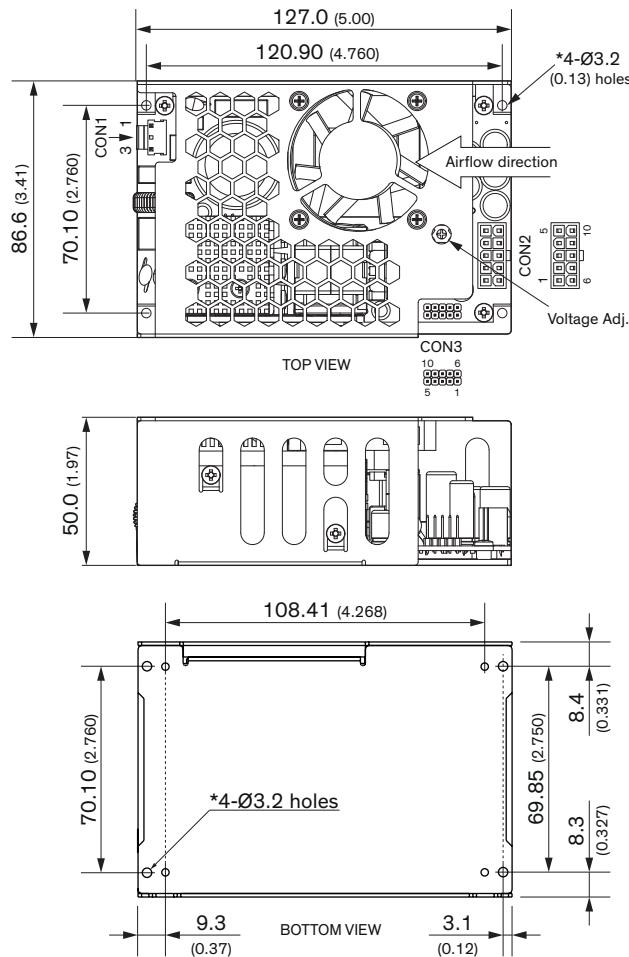
\*Any one of the four mounting holes can be considered as PE connection for class I application

FAN dimension: 40x40x10mm Air flow: 9.5 CFM  
The fan's durability is lower compared to the power supply and has only 2 years warranty.

All dimensions in mm (inch)  
Tolerance: X.X ± 0.5 (X.XX ± 0.02)  
X.XX ± 0.25 (X.XXX ± 0.01)  
Screw locked torque: max. 4.2 kgfcm / 0.41 Nm

All specifications valid at 230 VAC, resistive full load and +25°C after warm-up time, unless otherwise stated.

**Optional version with fan on top**



\*Any one of the four mounting holes can be considered as PE connection for class I application

All dimensions in mm (inch)

Tolerance:  $x.x \pm 0.5$  ( $x.xx \pm 0.02$ )

$x.xx \pm 0.25$  ( $x.xxx \pm 0.010$ )

Screw locked torque: max. 4.2 kgfcm / 0.41 Nm

FAN dimension: 50×50×10mm Air flow: 11.4 CFM  
The fan's durability is lower compared to the power supply and has only 2 years warranty.

Input	
CON1	
Pin	Function
1	AC (L)
3	AC (N)

Output	
CON2	
Pin <sup>*3</sup>	Function
1-5	+Vout
6-10	-Vout

<sup>\*3</sup> Terminal rated for 13 A max.  
(at higher current connection has to be split)

Auxiliary	
CON3	
Pin	Function
1	+Fan <sup>*1</sup>
2	+Sense
3	+Remote
4	PG
5	+Standby
6	-Fan <sup>*1 / *2</sup>
7	-Sense
8	-Remote <sup>*2</sup>
9	No pin
10	-Standby <sup>*2</sup>

**CON1:**  
Molex housing: 09-50-8031  
Molex crimp terminals: 08500106 (2478), 08520112 (6838), 45570

**CON2:**  
Molex housing: 39-01-2105  
Molex crimp terminals: 5556,45750

**CON3:**  
Molex housing: 90143-0010  
Molex crimp terminals: 90119

<sup>\*1</sup> Occupied by internal fan (unplugging is possible)

<sup>\*2</sup> Internally connected with -Vout