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 3rd edition 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

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 3rd edition, 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.

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<tbody>
<tr>
<td>TPP 450-112-M</td>
<td>12 VDC (11.0 - 13.0 VDC)</td>
<td>37’500 mA</td>
<td>91 %</td>
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<tr>
<td>TPP 450-115-M</td>
<td>15 VDC (13.8 - 16.2 VDC)</td>
<td>30’000 mA</td>
<td>92 %</td>
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<tr>
<td>TPP 450-124-M</td>
<td>24 VDC (22.1 - 25.9 VDC)</td>
<td>18’750 mA</td>
<td>93 %</td>
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<tr>
<td>TPP 450-128-M</td>
<td>28 VDC (25.8 - 30.2 VDC)</td>
<td>16’100 mA</td>
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<td>TPP 450-136-M</td>
<td>36 VDC (33.1 - 38.9 VDC)</td>
<td>12’500 mA</td>
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<tr>
<td>TPP 450-148-M</td>
<td>48 VDC (44.2 - 51.8 VDC)</td>
<td>9’400 mA</td>
<td>94 %</td>
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<tr>
<td>TPP 450-153-M</td>
<td>53 VDC (48.8 - 57.2 VDC)</td>
<td>8’550 mA</td>
<td>94 %</td>
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<tr>
<td>TPP 450-AUX1</td>
<td>- Optional Cable for auxiliary connection (2 x 4 pin):</td>
<td>Optional version with fan on top</td>
<td></td>
</tr>
</tbody>
</table>

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### Input Specifications

| Input Voltage | - AC Range | Operational Range: 85 - 264 VAC (Full Range)  
|               | - DC Range | Rated Range: 100 - 240 VAC (Full Range)  
|               |           | Operational Range: 120 - 370 VDC (Designed for, no certification)  
|               |           | Polarity: +DC: L / −DC: N  
| Input Frequency |           | Operational Range: 47 - 440 Hz  
|               |           | Certified: 50/60 Hz  
| Input Current | - Full Load & Vin = 230 VAC | 2'400 mA max.  
|               | - Full Load & Vin = 115 VAC | 5'800 mA max.  
| Power Consumption | - No load & Vin = 230 VAC | 1'050 mW max.  
|               | - No load & Vin = 115 VAC | 1'450 mW max.  
| Input Inrush Current | - At 230 VAC | 100 A max.  
|               | - At 115 VAC | 55 A max.  
| Power Factor | - At 230 VAC | 0.95 min. (Active Power Factor Correction)  
|               | - At 115 VAC | 0.95 min. (Active Power Factor Correction)  
| Input Protection | T 6.3 A / 250 VAC (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 | ±8% (By trim potentiometer)  
| Voltage Set Accuracy | ±1% max.  
| Regulation | - Input Variation (Vmin - Vmax)  
|               | 0.2% max.  
|               | 0.5% max.  
| Ripple and Noise | 12 VDC model: 250 mVp-p typ. (w/ 1 µF X7R)  
| (20 MHz Bandwidth) | 15 VDC model: 300 mVp-p typ. (w/ 1 µF X7R)  
|               | 24 VDC model: 240 mVp-p typ. (w/ 1 µF X7R)  
|               | 28 VDC model: 280 mVp-p typ. (w/ 1 µF X7R)  
|               | 36 VDC model: 360 mVp-p typ. (w/ 1 µF X7R)  
|               | 48 VDC model: 480 mVp-p typ. (w/ 1 µF X7R)  
|               | 53 VDC model: 530 mVp-p typ. (w/ 0.1 µF X7R)  
| Capacitive Load | 12 VDC model: 31.250 µF max.  
|               | 15 VDC model: 20’000 µF max.  
|               | 24 VDC model: 7’820 µF max.  
|               | 28 VDC model: 5’750 µF max.  
|               | 36 VDC model: 3’500 µF max.  
|               | 48 VDC model: 1’960 µF max.  
|               | 53 VDC model: 1’800 µF max.  
| Minimum Load | Not required  
| Temperature Coefficient | ±0.02 %/K max.  
| Hold-up Time | - At 230 VAC | 12 ms min.  
|               | - At 115 VAC | 12 ms min.  
| Start-up Time | - At 230 VAC | 2’000 ms max.  
|               | - At 115 VAC | 2’000 ms max.  
| Short Circuit Protection | Continuous, Automatic recovery (Level 1, nom.)  
|               | Latch (Level 2, instantaneous high current)  
| Output Current Limitation | 115 - 155% of Iout max.  
| Overvoltage Protection | 110 - 135% of Vout nom.  
| (Latch off, Standby Power Source always present)  
| Transient Response | - Response Deviation | 3% max. (50% to 75% Load Step)  
|               | - Response Time | 600 µs typ. (50% to 75% Load Step)  

All specifications valid at nominal voltage, resistive full load and +25°C after warm-up time, unless otherwise stated.
# Safety Specifications

## Safety Standards
- IT / Multimedia Equipment: EN 62368-1
- IEC 62368-1
- UL 62368-1
- Railway Fire Protection: EN 45545-2
- Medical Equipment: EN 60601-1
- IEC 60601-1
- ANSI/AAMI ES 60601-1
- 2 x MOPP (Means Of Patient Protection)

## Protection Class
Class I (Prepared); Connection to PE

## 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 B (internal filter)
  - EN 55032 class B (internal filter)
- Radiated Emissions: EN 55011 class A (internal filter)
- Harmonic Current Emissions: EN 61000-3-2, class A
- EN 61000-3-2, class D
- Voltage Fluctuations & Flicker: 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
- Electrostatic Discharge
  - Air: EN 61000-4-2, ±15 kV, perf. criteria A
  - Contact: EN 61000-4-2, ±8 kV, perf. criteria A
- RF Electromagnetic Field
  - EFT (Burst) / Surge: EN 61000-4-3, 3 V/m, perf. criteria A
- EN 61000-4-4, ±2 kV, perf. criteria A
- L to PE: EN 61000-4-5, ±1 kV, perf. criteria A
- EN 61000-4-5, ±2 kV, perf. criteria A
- Conducted RF Disturbances
  - EN 61000-4-6, 20 Vrms, perf. criteria A
- PF Magnetic Field
- Voltage Dips & Interruptions
  - 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
  - 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

# 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: See application note: www.tracopower.com/overview/tpp450
- Low Input Voltage: 1.33 %/V below 100 VAC

All specifications valid at nominal voltage, resistive full load and +25°C after warm-up time, unless otherwise stated.
### Over Temperature Protection Switch Off
- Protection Mode: See application note: [www.tracopower.com/overview/tpp450](www.tracopower.com/overview/tpp450)  
  (Standby Power Source always present)
- Measurement Point: 110°C to 125°C (Latch off)

### 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: On: 3.0 to 12 VDC or open circuit
  - Output Voltage: Off: 0 to 1.2 VDC or short circuit
  - Output Current: Refers to ‘+Remote’ and ‘-Remote’ Pin
  - Remote Pin Input Current: -0.5 to 1.0 mA
  (Standby power source is always present)

### Altitude During Operation
- 5'000 m max.

### Switching Frequency
- 55 - 85 kHz (PFM)

### Insulation System
- Reinforced Insulation

### Working Voltage (rated)
- 312 VAC

### Isolation Test Voltage
- Input to Output: 60 s
  - Input to Case or PE, 60 s: 4'000 VAC
  - Output to Case or PE, 60 s: 2'500 VAC

### Isolation Resistance
- Input to Output: 500 VDC
  - Touch Current: 100 MΩ min.
  - Leakage Current (at 254 VAC): 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

### Housing Material
- Stainless Steel (Cover)

### Housing Type
- Metal Case

### Mounting Type
- Chassis Mount

### Connection Type
- Pin Connector

### Weight
- 552 g

### Power OK Signal
- Trigger Threshold: Open collector output
  - 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.

### Sense Function
- 8% max. of Vout nom.
  (see application note)

### Environmental Compliance
- REACH Declaration: [www.tracopower.com/info/reach-declaration.pdf](www.tracopower.com/info/reach-declaration.pdf)
  REACH SVHC list compliant
  REACH Annex XVII compliant
  Exemptions: 7a, 7c-l
  (RoHS exemptions refer to the component concentration only, not to the overall concentration in the product (O5A rule). The SCIP number is provided on request)

All specifications valid at nominal voltage, resistive full load and +25°C after warm-up time, unless otherwise stated.
Max. screw penetration: 1.3 (0.05)  
FAN dimension: 40×40×10mm  
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. 5.2 kgfcm / 0.51 Nm

**Internally connected with –Vout

*Terminal rated for 13 A max. (at higher current connection has to be split)

Input

<table>
<thead>
<tr>
<th>CON1</th>
<th>Pin</th>
<th>Function</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>AC (L)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>AC (N)</td>
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Output

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<tr>
<th>CON2</th>
<th>Pin*</th>
<th>Function</th>
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<tbody>
<tr>
<td>1-5</td>
<td>–Vout</td>
<td></td>
</tr>
<tr>
<td>6-10</td>
<td>+Vout</td>
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Auxiliary

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<th>CON3</th>
<th>Pin</th>
<th>Function</th>
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<tbody>
<tr>
<td>1</td>
<td>+Fan</td>
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<tr>
<td>2</td>
<td>+Sense</td>
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</tr>
<tr>
<td>3</td>
<td>+Remote</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>PG</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>+StandBy</td>
<td></td>
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<tr>
<td>6</td>
<td>–Fan**</td>
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</tr>
<tr>
<td>7</td>
<td>–Sense</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>–Remote**</td>
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<tr>
<td>9</td>
<td>No Pin</td>
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<tr>
<td>10</td>
<td>–StandBy**</td>
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Optional version with fan on top

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Internally connected with –Vout

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