AC/DC Medical Power Supply

- Enclosed power supply with screw terminal connection
- Certification according to IEC/EN/ES 60601-1 3rd edition for 2 x MOPP
- Low leakage current <75 µA rated for BF applications
- Risk management process according to ISO 14971 incl. risk management file
- Acceptance criteria for electronic assemblies acc. to IPC-A-610 Level 3
- EMC compliance to IEC 60601-1-2 ed. 4
- Protection class I and II
- Operating up to 5000 m altitude
- Ready to meet ErP directive, <0.15 W no load power consumption
- 5-year product warranty

The TPP 65 Series of 65 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 leakage current is below 75 µA what makes the units suitable for BF (body floating) applications.

The excellent efficiency of up to 92% allows a high power density for the standard 2.38” x 3.53” packaging format. The full load operating temperature range is –40°C to +60°C while it goes up to 85°C with 50% load derating (for single output models). The EMC characteristic is dedicated for applications in industrial and domestic fields.

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

<table>
<thead>
<tr>
<th>Order Code</th>
<th>Output Power</th>
<th>Output 1</th>
<th>Output 2</th>
<th>Output 3</th>
<th>Efficiency typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vnom</td>
<td>Imax</td>
<td>Vnom</td>
<td>Imax</td>
<td>Vnom</td>
</tr>
<tr>
<td>TPP 65-105</td>
<td>50 W</td>
<td>5 VDC</td>
<td>10'000 mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPP 65-112</td>
<td>12 VDC</td>
<td>5'420 mA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPP 65-115</td>
<td>15 VDC</td>
<td>4'340 mA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPP 65-124</td>
<td>24 VDC</td>
<td>2'710 mA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPP 65-221</td>
<td>65 W</td>
<td>+12 VDC</td>
<td>5'420 mA</td>
<td>+5 VDC</td>
<td>8'000 mA</td>
</tr>
<tr>
<td>TPP 65-231</td>
<td>+15 VDC</td>
<td>4'340 mA</td>
<td>+5 VDC</td>
<td>8'000 mA</td>
<td></td>
</tr>
<tr>
<td>TPP 65-251</td>
<td>+24 VDC</td>
<td>2'710 mA</td>
<td>+5 VDC</td>
<td>8'000 mA</td>
<td></td>
</tr>
<tr>
<td>TPP 65-321M2</td>
<td>+12 VDC</td>
<td>5'420 mA</td>
<td>+5 VDC</td>
<td>8'000 mA</td>
<td>-12 VDC</td>
</tr>
<tr>
<td>TPP 65-331M3</td>
<td>+15 VDC</td>
<td>4'340 mA</td>
<td>+5 VDC</td>
<td>8'000 mA</td>
<td>-15 VDC</td>
</tr>
<tr>
<td>TPP 65-3512</td>
<td>+24 VDC</td>
<td>2'710 mA</td>
<td>+5 VDC</td>
<td>8'000 mA</td>
<td>+12 VDC</td>
</tr>
</tbody>
</table>

Note: - Total Power must not exceed 65 W.
- Other output models are available on request.
### Input Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>- AC Range 85 - 264 VAC (Full Range)</td>
</tr>
<tr>
<td></td>
<td>- DC Range 120 - 370 VDC (Designed for, no certification)</td>
</tr>
<tr>
<td>Input Frequency</td>
<td>47 - 63 Hz</td>
</tr>
<tr>
<td>Input Current</td>
<td>- Full Load &amp; Vin = 230 VAC</td>
</tr>
<tr>
<td></td>
<td>- Full Load &amp; Vin = 115 VAC</td>
</tr>
<tr>
<td>Power Consumption</td>
<td>- At no load 150 mW max. (Ready to meet ErP directive)</td>
</tr>
<tr>
<td>Input Inrush Current</td>
<td>- At 230 VAC 60 A max.</td>
</tr>
<tr>
<td>Input Protection</td>
<td>T 3.15 A / 250 VAC [Internal Fuse in L &amp; N]</td>
</tr>
<tr>
<td>Recommended Input Fuse</td>
<td>(The need of an external fuse has to be assessed in the final application.)</td>
</tr>
</tbody>
</table>

### Output Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Voltage Adjustment</td>
<td>±10% (only Output 1) (By trim potentiometer)</td>
</tr>
<tr>
<td>Voltage Set Accuracy</td>
<td>±1% max. (Output 1)</td>
</tr>
<tr>
<td></td>
<td>±2% max. (Output 2 and 3)</td>
</tr>
<tr>
<td>Regulation</td>
<td>- Input Variation (Vmin - Vmax)</td>
</tr>
<tr>
<td></td>
<td>single output models: 0.2% max.</td>
</tr>
<tr>
<td></td>
<td>dual output models: 0.2% max.</td>
</tr>
<tr>
<td></td>
<td>triple output models: 0.2% max.</td>
</tr>
<tr>
<td></td>
<td>- Load Variation (0 - 100%)</td>
</tr>
<tr>
<td></td>
<td>single output models: 0.7% max. (5 VDC model)</td>
</tr>
<tr>
<td></td>
<td>0.5% max. (other output models)</td>
</tr>
<tr>
<td></td>
<td>dual output models: 0.5% max. (Output 1)</td>
</tr>
<tr>
<td></td>
<td>1.5% max. (Output 2)</td>
</tr>
<tr>
<td></td>
<td>triple output models: 0.5% max. (Output 1)</td>
</tr>
<tr>
<td></td>
<td>1.5% max. (Output 2)</td>
</tr>
<tr>
<td></td>
<td>0.7% max. (Output 3)</td>
</tr>
<tr>
<td></td>
<td>- Cross Regulation (25% / 100% asym. load)</td>
</tr>
<tr>
<td></td>
<td>dual output models: 1.5% max.</td>
</tr>
<tr>
<td></td>
<td>triple output models: 1.5% max.</td>
</tr>
<tr>
<td>Ripple and Noise (20 MHz Bandwidth)</td>
<td>- single output 5 VDC model: 75 mVp-p typ. (w/ 10 µF X7R)</td>
</tr>
<tr>
<td></td>
<td>12 VDC model: 75 mVp-p typ. (w/ 10 µF X7R)</td>
</tr>
<tr>
<td></td>
<td>15 VDC model: 75 mVp-p typ. (w/ 10 µF X7R)</td>
</tr>
<tr>
<td></td>
<td>24 VDC model: 75 mVp-p typ. (w/ 1 µF X7R)</td>
</tr>
<tr>
<td></td>
<td>- dual output 12 / 5 VDC model: 120 / 100 mVp-p typ. (w/ 10 µF X7R)</td>
</tr>
<tr>
<td></td>
<td>15 / 5 VDC model: 150 / 100 mVp-p typ. (w/ 10 µF X7R)</td>
</tr>
<tr>
<td></td>
<td>24 / 5 VDC model: 240 / 100 mVp-p typ. (w/ 10 µF X7R)</td>
</tr>
<tr>
<td></td>
<td>- triple output 12 / 5 / -12 VDC model: 120 / 100 / 120 mVp-p typ. (w/ 10 µF X7R)</td>
</tr>
<tr>
<td></td>
<td>15 / 5 / -15 VDC model: 150 / 100 / 150 mVp-p typ. (w/ 10 µF X7R)</td>
</tr>
<tr>
<td></td>
<td>24 / 5 / -12 VDC model: 240 / 100 / 120 mVp-p typ. (w/ 10 µF X7R)</td>
</tr>
<tr>
<td>Capacitive Load</td>
<td>- single output 5 VDC model: 20'000 µF max.</td>
</tr>
<tr>
<td></td>
<td>12 VDC model: 4'520 µF max.</td>
</tr>
<tr>
<td></td>
<td>15 VDC model: 2'900 µF max.</td>
</tr>
<tr>
<td></td>
<td>24 VDC model: 1'130 µF max.</td>
</tr>
<tr>
<td></td>
<td>- dual output 12 / 5 VDC model: 2'500 / 3'000 µF max.</td>
</tr>
<tr>
<td></td>
<td>15 / 5 VDC model: 1'200 / 3'000 µF max.</td>
</tr>
<tr>
<td></td>
<td>24 / 5 VDC model: 625 / 3'000 µF max.</td>
</tr>
<tr>
<td></td>
<td>- triple output 12 / 5 / -12 VDC model: 2'500 / 3'000 / 500 µF max.</td>
</tr>
<tr>
<td></td>
<td>15 / 5 / -15 VDC model: 1'200 / 3'000 / 500 µF max.</td>
</tr>
<tr>
<td></td>
<td>24 / 5 / -12 VDC model: 625 / 3'000 / 500 µF max.</td>
</tr>
<tr>
<td>Minimum Load</td>
<td>Not required (0.5 W for Vout1 and Vout2 if Vout3 = Full Load)</td>
</tr>
<tr>
<td>Temperature Coefficient</td>
<td>±0.02 %/K max.</td>
</tr>
<tr>
<td>Hold-up Time</td>
<td>- At 115 VAC 16 ms min.</td>
</tr>
<tr>
<td>Start-up Time</td>
<td>- At 230 VAC 1’000 ms max.</td>
</tr>
<tr>
<td>Short Circuit Protection</td>
<td>Continuous, Automatic recovery</td>
</tr>
</tbody>
</table>

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

- 120 - 160% of Iout max.
- 145% typ. of Iout max.
- (Pout 1 + Pout 2)

### Overvoltage Protection

- 125 - 140% of Vout nom.
- (only Output 1)

### Transient Response

- Response Deviation: 3% max. (50% to 75% Load Step)
- Response Time: 600 μs typ. (50% to 75% Load Step)
- (Only Output 1)

### Safety Specifications

#### Safety 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)

#### Protection Class

- Class I & II (Prepared): Reinforced Insulation

#### 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)
- FCC Part 18 class B (internal filter)

- Radiated Emissions: EN 55011 class B (internal filter)
- EN 55032 class B (internal filter)
- FCC Part 18 class B (internal filter)

- Harmonic Current Emissions
- Voltage Fluctuations & Flicker

- Voltage Dips & Interruptions: EN 61000-3-2, class A
- EN 61000-3-3
- EN 61000-4-2, ±15 kV, perf. criteria A
- EN 61000-4-3, ±1 kV, perf. criteria A
- EN 61000-4-4, ±2 kV, perf. criteria A
- EN 61000-4-5, ±1 kV, perf. criteria A
- EN 61000-4-6, 20 Vrms, perf. criteria A
- EN 61000-4-11, 30%, 25 periods, perf. criteria A
- EN 61000-4-12, 50%, 25 periods, perf. criteria A

#### EMS Immunity

- Electrostatic Discharge: EN 60601-1-2 edition 4 (Medical Devices)
- Air: EN 61000-4-2, ±15 kV, perf. criteria A
- Contact: EN 61000-4-2, ±8 kV, perf. criteria A
- Continuous: EN 61000-4-3, 20 V/m, perf. criteria A
- EN 61000-4-4, ±2 kV, perf. criteria A
- EN 61000-4-5, ±1 kV, perf. criteria A
- EN 61000-4-6, 20 Vrms, perf. criteria A
- EN 61000-4-8, 30 A/m, perf. criteria A
- EN 61000-4-11

#### General Specifications

<table>
<thead>
<tr>
<th>Relative Humidity</th>
<th>95% max. (non condensing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Ranges</td>
<td>- Operating Temperature: -40°C to +85°C</td>
</tr>
<tr>
<td></td>
<td>- Storage Temperature: -40°C to +85°C</td>
</tr>
</tbody>
</table>

All specifications valid at nominal voltage, resistive full load and +25°C after warm-up time, unless otherwise stated.
Power Derating
- High Temperature
- Low Input Voltage

See application note: www.tracopower.com/overview/tpp65

4 \% /V below 90 VAC

Cooling System
Natural convection (20 LFM)

Altitude During Operation
5'000 m max.

Switching Frequency
- 50 - 140 kHz (PWM) (Output 1)
- 750 kHz typ. (PWM) (Output 2)
- 510 kHz typ. (PWM) (Output 3)

Insulation System
Reinforced Insulation

Working Voltage (rated)
258 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

Creepage
- Input to Output
  8 mm min.

Clearance
- Input to Output
  8 mm min.

Isolation Resistance
- Input to Output, 500 VDC
  100 MΩ min.

Leakage Current
- Touch Current
  75 µA max.

Reliability
- Calculated MTBF
  1'500'000 h (for single output models)
  1'000'000 h (for multi output models)

  (MIL-HDBK-217F, ground benign)

Environment
- Vibration
  IEC 60068-2-6
- Mechanical Shock
  IEC 60068-2-27

Housing Material
Aluminium

Housing Type
Metal Case

Mounting Type
Chassis Mount

Connection Type
Screw Terminal

Weight
- single output
  172 g
- dual output
  221 g
- triple output
  221 g

Environmental Compliance
- REACH Declaration
  www.tracopower.com/info/reach-declaration.pdf
  REACH SVHC list compliant
  REACH Annex XVII compliant

- RoHS Declaration
  www.tracopower.com/info/rohs-declaration.pdf
  Exemptions: 7a, 7c-I
  (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.)

Supporting Documents
Overview Link (for additional Documents)
www.tracopower.com/overview/tpp65

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

**Single Output Models**

Max. corner screw penetration: 2.3 (0.09)
Max. center screw penetration: 2.0 (0.08)
All dimensions in mm (inch)
Tolerance: X.X ±0.5 (X.XX ±0.02)
X.XX ±0.25 (X.XXX ±0.010)
The screw locked torque:
max. 5.0 kgfcm / 0.49 Nm
Terminal screw locked torque:
max. 4.0 kgfcm / 0.39 Nm

**Multi Output Models**

Max. corner screw penetration: 2.3 (0.09)
Max. center screw penetration: 2.0 (0.08)
All dimensions in mm (inch)
Tolerance: X.X ±0.5 (X.XX ±0.02)
X.XX ±0.25 (X.XXX ±0.010)
The screw locked torque:
max. 5.0 kgfcm / 0.49 Nm
Terminal screw locked torque:
max. 4.0 kgfcm / 0.39 Nm

**Screw Terminal**

**Input (CON1) Output (CON2)**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
<th>Pin*</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Line</td>
<td>1,2</td>
<td>–Vout</td>
</tr>
<tr>
<td>3</td>
<td>Neutral</td>
<td>3,4</td>
<td>+Vout</td>
</tr>
</tbody>
</table>

*Terminal rated for 10 A max. (at higher current connection has to be split)

**CON1:** Terminal Block
mates with Screw locked torque MAX 2Kgf.cm/0.2N.m
Wire dimension range: 26 - 16 AWG

**CON2:** Terminal Block
mates with Screw locked torque MAX 2Kgf.cm/0.2N.m
Wire dimension range: 26 - 16 AWG