AC/DC Medical Power Supply

TPP 65 Series, 65 Watt

- Enclosed power supply with screw terminal connection
- Certification according to IEC/EN/ES 60601-1-2 ed. 4
- 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 2.44" x 3.0" 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</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vnom</td>
<td>Imax</td>
<td>Vnom</td>
<td>Imax</td>
<td>typ.</td>
</tr>
<tr>
<td>TPP 65-105</td>
<td>50 W</td>
<td>5 VDC</td>
<td>10'000 mA</td>
<td></td>
<td>90 %</td>
</tr>
<tr>
<td>TPP 65-112</td>
<td>12 VDC</td>
<td></td>
<td></td>
<td></td>
<td>93 %</td>
</tr>
<tr>
<td>TPP 65-115</td>
<td>15 VDC</td>
<td></td>
<td></td>
<td></td>
<td>94 %</td>
</tr>
<tr>
<td>TPP 65-124</td>
<td>24 VDC</td>
<td></td>
<td></td>
<td></td>
<td>94 %</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></td>
<td>+15 VDC</td>
<td>4'340 mA</td>
<td>+5 VDC</td>
<td>8'000 mA</td>
</tr>
<tr>
<td>TPP 65-251</td>
<td></td>
<td>+24 VDC</td>
<td>2'710 mA</td>
<td>+5 VDC</td>
<td>8'000 mA</td>
</tr>
<tr>
<td>TPP 65-321M2</td>
<td>+12 VDC</td>
<td>5'420 mA</td>
<td></td>
<td>+5 VDC</td>
<td>8'000 mA</td>
</tr>
<tr>
<td>TPP 65-331M3</td>
<td>+15 VDC</td>
<td>4'340 mA</td>
<td></td>
<td>+5 VDC</td>
<td>8'000 mA</td>
</tr>
<tr>
<td>TPP 65-3512</td>
<td>+24 VDC</td>
<td>2'710 mA</td>
<td></td>
<td>+5 VDC</td>
<td>8'000 mA</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Input Voltage</th>
<th>AC Range</th>
<th>85 - 264 VAC (Full Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DC Range</td>
<td>120 - 370 VDC (Designed for, no certification)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(DC+: N / DC−: L)</td>
</tr>
</tbody>
</table>

| Input Frequency | 47 - 63 Hz |
| Input Current   | - Full Load & Vin = 930 VAC |
|                 | - Full Load & Vin = 115 VAC |
| Power Consumption| - At no load |
|                 | - At 230 VAC |

## Output Specifications

| Output Voltage Adjustment | ±10% (only Output 1) (By trim potentiometer) |
|                          | Output power must not exceed rated power! |

| Voltage Set Accuracy | ±1% max. (Output 1) |
|                     | ±2% max. (Output 2 and 3) |

### Regulation

| - Input Variation (Vmin - Vmax) | 0.2% max. |
| - Load Variation (0 - 100%)     | 0.2% max. (5 VDC model) |
|                                 | 0.7% max. (other output models) |
|                                 | 0.5% max. (Output 1) |
|                                 | 1.5% max. (Output 2) |
|                                 | 0.5% max. (Output 3) |
| - Cross Regulation              | 1.5% max. |

### Ripple and Noise

(20 MHz Bandwidth)

| - single output | 5 VDC model: 75 mVpp typ. (w/ 10 µF X7R) |
|                 | 12 VDC model: 75 mVpp typ. (w/ 10 µF X7R) |
|                 | 15 VDC model: 75 mVpp typ. (w/ 10 µF X7R) |
|                 | 24 VDC model: 75 mVpp typ. (w/ 1 µF X7R) |
| - dual output   | 12 / 5 VDC model: 120 / 100 mVpp typ. (w/ 10 µF X7R) |
|                 | 15 / 5 VDC model: 150 / 100 mVpp typ. (w/ 10 µF X7R) |
|                 | 24 / 5 VDC model: 240 / 100 mVpp typ. (w/ 10 µF X7R) |
| - triple output | 12 / 5 / 12 VDC model: 120 / 100 / 120 mVpp typ. (w/ 10 µF X7R) |
|                 | 15 / 5 / 15 VDC model: 150 / 100 / 150 mVpp typ. (w/ 10 µF X7R) |
|                 | 24 / 5 / 12 VDC model: 240 / 100 / 120 mVpp typ. (w/ 10 µF X7R) |

### Capacitive Load

| - single output | 5 VDC model: 20'000 µF max. |
|                 | 12 VDC model: 4’520 µF max. |
|                 | 15 VDC model: 2’900 µF max. |
|                 | 24 VDC model: 1’130 µF max. |
| - dual output   | 12 / 5 VDC model: 2’500 / 3’000 µF max. |
|                 | 15 / 5 VDC model: 1’200 / 3’000 µF max. |
|                 | 24 / 5 VDC model: 625 / 3’000 µF max. |
| - triple output | 12 / 5 / 12 VDC model: 2’500 / 3’000 / 500 µF max. |
|                 | 15 / 5 / 15 VDC model: 1’200 / 3’000 / 500 µF max. |
|                 | 24 / 5 / 12 VDC model: 625 / 3’000 / 500 µF max. |

### Minimum Load

Not required (0.5 W for Vout1 and Vout2 if Vout3 = Full Load)

### Temperature Coefficient

±0.02 %/K max.

### Hold-up Time

- At 115 VAC: 16 ms min.

### Start-up Time

- At 230 VAC: 1’000 ms max.

All specifications valid at nominal voltage, full load and +25°C after warm-up time unless otherwise stated.
## Short Circuit Protection
- Continuous, Automatic recovery

## Output Current Limitation
- 120 - 160% of I_{out} max.
- 145% typ. of I_{out} max. (P_{out 1} + P_{out 2})

## Overvoltage Protection
- 125 - 140% of V_{out} nom. (only Output 1)

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

## Safety Specifications
### Safety Standards
- Medical Equipment
  - EN 60601-1
  - IEC 60601-1
  - ANSI/AAMI ES 60601-1
  - 2 x MOPP (Means Of Patient Protection)
- Certification Documents:
  - www.tracopower.com/overview/tpp65

### Protection Class
- Class I (Unshielded): Connection to PE
- Class II (Prepared): Reinforced Insulation

### Pollution Degree
- PD 2

### Over Voltage Category
- OVC II

## EMC Specifications
### EMI Emissions
- Conducted Emissions
  - 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
  - EN 61000-2-2, class A
  - EN 61000-3-3

### 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
  - 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
- EFT (Burst) / Surge
  - EN 61000-4-6, 20 Vrms, perf. criteria A
- Conducted RF Disturbances
  - EN 61000-4-8, 30 A/m, perf. criteria A
- PF Magnetic Field
  - EN 61000-4-11, Continuous: 230 VAC / 50 Hz
  - 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
  - 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 +85°C
- Storage Temperature
  - -40°C to +85°C

### Power Derating
- High Temperature
  - See application note: www.tracopower.com/overview/tpp65
  - 4 %/V below 90 VAC
- Low Input Voltage

All specifications valid at nominal voltage, full load and +25°C after warm-up time unless otherwise stated.
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
- Input to Output, 500 VDC, 60 s: 100 MΩ min.

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 (at 264 VAC)
- 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

Connection Type
Screw Terminal

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

Environmental Compliance
- Reach
www.tracopower.com/info/reach-declaration.pdf
- RoHS
www.tracopower.com/info/rohs-declaration.pdf

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

Outline Dimensions

Single Output Models

Screw Terminal

<table>
<thead>
<tr>
<th>Input (CON1)</th>
<th>Output (CON2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin</td>
<td>Function</td>
</tr>
<tr>
<td>1</td>
<td>Line</td>
</tr>
<tr>
<td>3</td>
<td>Neutral</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

Each one of the 4 screw holes can be used as a PE connection for CLASS I application.

Dimensions in inch, ( ) = mm
Outside dimension tolerance: ±0.02 inch (±0.5 mm)
Hole spacing tolerance: ±0.01 inch (±0.25 mm)

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

Each one of the 4 screw holes can be used as a PE connection for CLASS I application.

Dimensions in inch, ( ) = mm
Outside dimension tolerance: ±0.02 inch (±0.5 mm)
Hole spacing tolerance: ±0.01 inch (±0.25 mm)

**Screw Terminal**

<table>
<thead>
<tr>
<th>Input (CON1)</th>
<th>Output (CON2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pin</strong></td>
<td><strong>Pin</strong></td>
</tr>
<tr>
<td>1 Line</td>
<td>1 NC</td>
</tr>
<tr>
<td>3 Neutral</td>
<td>2,3 COM</td>
</tr>
<tr>
<td>4,5 Vout 2</td>
<td></td>
</tr>
<tr>
<td>6 Vout 1</td>
<td>Vout 1</td>
</tr>
</tbody>
</table>

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Wire dimension range: 26 - 16 AWG