

### Features

- ◆ High power density 65 W power supply (enclosed / open frame)
- ◆ 2 x MOPP Medical safety according to AAMI/ANSI ES 60601-1:2005(R) and IEC/EN 60601-1 3rd edition
- ◆ Ready to meet ErP directive, < 0.3 W no load power consumption
- ◆ Highest efficiency across full load range
- ◆ Protection class II prepared
- ◆ Operating up to 5000m altitude
- ◆ Adjustable output voltage
- ◆ 3-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 (60601-3 3rd edition, 2 x MOPP).

The excellent efficiency of up to 93.5% 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). They come with an active power factor correction and 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

| Order code                 |                           | Output voltage |        |         | Output current max. |        |        | Efficiency max. |
|----------------------------|---------------------------|----------------|--------|---------|---------------------|--------|--------|-----------------|
| enclosed, screw terminal   | open frame, pin connector | Vout 1         | Vout 2 | Vout 3  | Vout 1              | Vout 2 | Vout 3 |                 |
| TPP 65-105                 | TPP 65-105A-J             | 5 VDC (±10%)   | —      | —       | 10.0 A              | —      | —      | 90 %            |
| TPP 65-112                 | TPP 65-112A-J             | 12 VDC (±10%)  | —      | —       | 5.42 A              | —      | —      | 92.5 %          |
| TPP 65-115                 |                           | 15 VDC (±10%)  | —      | —       | 4.34 A              | —      | —      | 93.5 %          |
| TPP 65-124                 | TPP 65-124A-J             | 24 VDC (±10%)  | —      | —       | 2.71 A              | —      | —      | 93.5 %          |
|                            | TPP 65-148A-J             | 48 VDC (±10%)  | —      | —       | 1.36 A              | —      | —      | 93 %            |
| TPP 65-221 <sup>1)</sup>   |                           | +12 VDC (±10%) | +5 VDC | —       | 5.42 A              | 6 A    | —      | 90 %            |
| TPP 65-231 <sup>1)</sup>   |                           | +15 VDC (±10%) | +5 VDC | —       | 4.34 A              | 6 A    | —      | 90.5 %          |
| TPP 65-251 <sup>1)</sup>   |                           | +24 VDC (±10%) | +5 VDC | —       | 2.71 A              | 6 A    | —      | 89 %            |
| TPP 65-321M2 <sup>1)</sup> |                           | +12 VDC (±10%) | +5 VDC | -12 VDC | 5.42 A              | 6 A    | 0.6 A  | 89 %            |
| TPP 65-331M3 <sup>1)</sup> |                           | +15 VDC (±10%) | +5 VDC | -15 VDC | 4.34 A              | 6 A    | 0.6 A  | 89.5 %          |
| TPP 65-3512 <sup>1)</sup>  |                           | +24 VDC (±10%) | +5 VDC | +12 VDC | 2.71 A              | 6 A    | 0.6 A  | 88.5 %          |

<sup>1)</sup> Total power should not exceed nominal power

## Input Specifications

|                             |                                            |                                                        |
|-----------------------------|--------------------------------------------|--------------------------------------------------------|
| Input voltage range         | – AC range (universal input)<br>– DC range | 85 – 264 VAC<br>120 – 370 VDC                          |
| Input frequency             |                                            | 47 – 63 Hz                                             |
| Input current at full load  | – at 115 VAC / 230 VAC                     | 1.65 A max. / 0.95 A max.                              |
| Input protection            |                                            | T3.15 A/250 VAC (internal fuse in both line & neutral) |
| Input inrush current        | – at 230 VAC                               | 60A max.                                               |
| Zero load power consumption |                                            | 0.15 W typ.(acc. ErP directive)                        |

## Output Specifications

|                                                       |                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------------------------------------|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Voltage set accuracy                                  |                                                                                         | single output: $\pm 1\%$<br>multi output: $\pm 1\%$ Vout1<br>$\pm 2\%$ Vout2, Vout3                                                                                                                                                                                                                                                                                                                                               |
| Regulation - single output                            | – Input variation<br>– Load variation (0 - 100%)                                        | 0.2% max.<br>5 VDC model: 0.7% max.<br>other models: 0.5% max.                                                                                                                                                                                                                                                                                                                                                                    |
| Regulation - multi output                             | – Input variation<br>– Load variation (0 - 100%)<br><br>– cross regulation (25% / 100%) | 0.2% max.<br>Vout1: 0.5% max.<br>Vout2: 1.5% max. (0.1W to full load 0.7% max.)<br>Vout3: 0.7% max.<br>1.5% max.                                                                                                                                                                                                                                                                                                                  |
| Minimum load                                          |                                                                                         | not required<br>(Vout3 requires 0.5 W over Vout1/Vout2 to be stabilized)                                                                                                                                                                                                                                                                                                                                                          |
| Temperature coefficient                               |                                                                                         | 0.02%/K                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Hold-up time                                          | – Vin = 115 VAC                                                                         | 16 ms typ.                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Start-up time                                         |                                                                                         | <1s                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Rise time                                             |                                                                                         | 20 ms typ.                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Ripple and noise - single output<br>(20Mhz Bandwidth) |                                                                                         | 5 – 15 VDC model: 75 mVp-p typ. with cap. 10 $\mu$ F/25V 1206 X7R MLCC<br>24 VDC models: 75 mVp-p typ. with cap. 1 $\mu$ F/50V 1206 X7R MLCC<br>48 VDC models: 150 mVp-p typ. with cap. 0.1 $\mu$ F/100V 1206 X7R MLCC                                                                                                                                                                                                            |
| Ripple and noise - multi output<br>(20Mhz Bandwidth)  | – Vout 1<br><br>– Vout 2<br>– Vout 3                                                    | 12 VDC model: 120 mVp-p typ. with cap. 1 $\mu$ F/50V 1206 X7R MLCC<br>15 VDC model: 150 mVp-p typ. with cap. 1 $\mu$ F/50V 1206 X7R MLCC<br>24 VDC model: 240 mVp-p typ. with cap. 1 $\mu$ F/50V 1206 X7R MLCC<br>all models: 100 mVp-p typ. with cap. 10 $\mu$ F/25V 1206 X7R MLCC<br>12 VDC model: 120 mVp-p typ. with cap. 10 $\mu$ F/25V 1206 X7R MLCC<br>15 VDC model: 150 mVp-p typ. with cap. 10 $\mu$ F/25V 1206 X7R MLCC |
| Overvoltage protection                                |                                                                                         | 125 – 140% of nominal Vout                                                                                                                                                                                                                                                                                                                                                                                                        |
| Overload protection by current limit                  |                                                                                         | single output: at 145% Iout typ.<br>multi output: at 145% typ. Pout1 + Pout2                                                                                                                                                                                                                                                                                                                                                      |
| Short circuit protection                              |                                                                                         | continuous (automatic recovery)                                                                                                                                                                                                                                                                                                                                                                                                   |
| Transiente response<br>(25% load step change)         | – Peak deviation<br>– Recovery time                                                     | Vout1: 3% of Vout max.<br>600 $\mu$ s typ.                                                                                                                                                                                                                                                                                                                                                                                        |

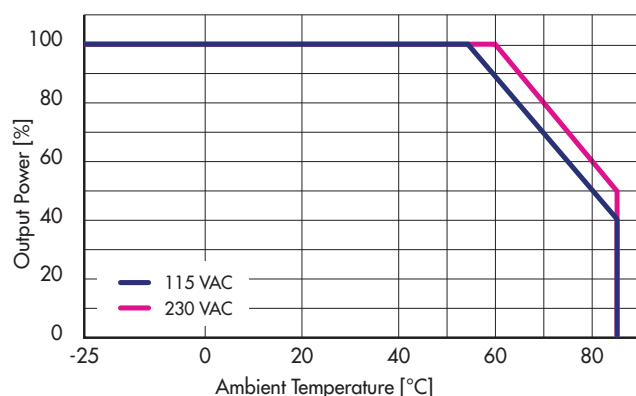
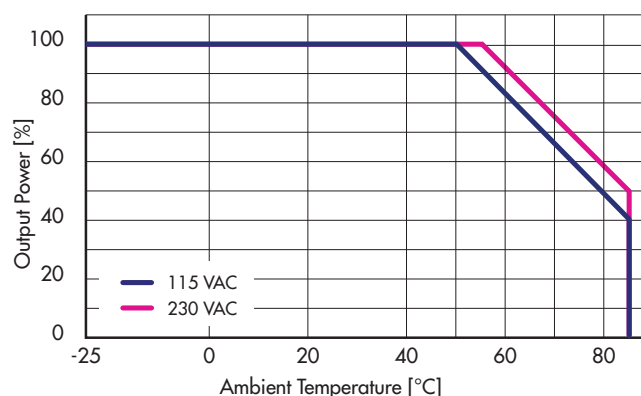
## General Specifications

|                       |                     |                                                                                                                                                                 |
|-----------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Operating temperature |                     | –40°C to +85°C with derating, see graph on p.3                                                                                                                  |
| Output power derating | – Temperature       | single output: 2 %/K above +60°C at 230 VAC<br>2 %/K above +55°C at 115 VAC<br>multi output: 1.67 %/K above +55°C at 230 VAC<br>1.71 %/K above +50°C at 115 VAC |
|                       | – Low input voltage | 1.33 %/V below 100 VAC                                                                                                                                          |

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

**General Specifications (continued)**

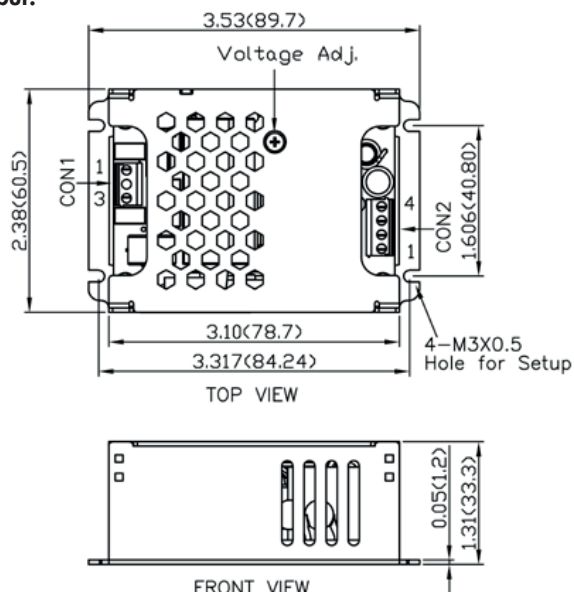
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|---------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Storage temperature                                                                                     |                                                                                                                                                                                      | -40°C to +85°C                                                                                                                                                                                                                                                                                                   |
| Humidity (non condensing)                                                                               |                                                                                                                                                                                      | 5 – 95 % rel. H max.                                                                                                                                                                                                                                                                                             |
| Altitude during operation                                                                               |                                                                                                                                                                                      | 5000 m                                                                                                                                                                                                                                                                                                           |
| Switching frequency - single output<br>(at 230 VAC)                                                     |                                                                                                                                                                                      | 5 VDC model: 60 kHz typ. (pulse frequency modulation)<br>other models: 120 kHz typ. (pulse frequency modulation)                                                                                                                                                                                                 |
| Switching frequency - multi output<br>(at 230 VAC)                                                      | - Vout 1<br>- Vout 2<br>- Vout 3                                                                                                                                                     | 5 VDC model: 60 kHz typ. (pulse frequency modulation)<br>other models: 115 kHz typ. (pulse frequency modulation)<br>750 kHz typ. (pulse frequency modulation)<br>510 kHz typ. (pulse frequency modulation)                                                                                                       |
| Isolation voltage 1min<br>(2 x MOPP insulation)                                                         | - Input / Output<br>- Input / Case                                                                                                                                                   | 4000 VAC<br>2500 VAC                                                                                                                                                                                                                                                                                             |
| Leakage current (at 264 VAC/60Hz)                                                                       |                                                                                                                                                                                      | 75 µA max.                                                                                                                                                                                                                                                                                                       |
| Isolation resistance (at 500 VDC)                                                                       |                                                                                                                                                                                      | 100 Mohm min.                                                                                                                                                                                                                                                                                                    |
| Reliability                                                                                             | - calculated MTBF at +25°C acc. to IEC 61709                                                                                                                                         | 1'494'000 h for single output models<br>1'059'000 h for multi output models                                                                                                                                                                                                                                      |
| Protection class                                                                                        |                                                                                                                                                                                      | class II prepared                                                                                                                                                                                                                                                                                                |
| Electromagnetic compatibility<br>(EMC), emissions                                                       | - Conducted input RI suppression<br>- Harmonic current emissions<br>- Voltage flicker<br>- Radiated input suppression                                                                | EN 55022, class B<br>IEC / EN 61000-3-2, class A<br>IEC / EN 61000-3-3, (class tba.)<br>EN 55011, class B<br>IEC / EN 60601-1-2 (for medical equipment)                                                                                                                                                          |
| Electromagnets compatibility (EMC), immunity                                                            | - Electrostatic discharge ESD<br>- RF field immunity<br>- Electrical fast transients/burst immunity<br>- Surge<br>- Conducted RF<br>- Magnetic field (only for single output models) | IEC / EN 60601-1-2<br>IEC / EN 61000-4-2, 8kV/6kV perf. criteria A<br>IEC / EN 61000-4-3, 20V/m perf. criteria A<br>IEC / EN 61000-4-4, ± 2kV perf. criteria A<br>IEC / EN 61000-4-5, ± 1kV/± 2kV perf. criteria A<br>IEC / EN 61000-4-6, 20 Vrms perf. criteria A<br>IEC / EN 61000-4-8, 10A/m perf. criteria A |
| Voltage dip and interruptions according to EN 60601-1-2<br>reference: 100 VAC / 50Hz                    |                                                                                                                                                                                      | 30%, 500ms perf. criteria A<br>60%, 100ms perf. criteria B<br>> 95%, 10ms perf. criteria A<br>> 95%, 5000ms perf. criteria B                                                                                                                                                                                     |
| Safety standards and certification<br><a href="http://www.ul.com">www.ul.com</a> File e188913 (pending) |                                                                                                                                                                                      | UL 60950-1, IEC/EN 60950-1,<br>IEC/EN 60601-1 3rd edition,<br>ANSI/AAMI ES60601-1:2005(R)2012                                                                                                                                                                                                                    |
| Environment                                                                                             | - Vibration acc. IEC 60068-2-6;<br>- Shock acc. IEC 60068-2-27                                                                                                                       | 3 axis, sine sweep, 10–55Hz, 1g, 1oct/min<br>3 axis, 10g half sine, 11msShock<br>20 G (3 directions each 3 times)                                                                                                                                                                                                |
| Environmental compliance                                                                                | - Reach<br>- RoHS                                                                                                                                                                    | <a href="http://www.tracopower.com/overview/tpp65">www.tracopower.com/overview/tpp65</a><br>RoHS directive 2011/65/EU                                                                                                                                                                                            |
| Connection                                                                                              |                                                                                                                                                                                      | screw terminal / pin connector                                                                                                                                                                                                                                                                                   |

**Single output models:**

**Multi output models:**


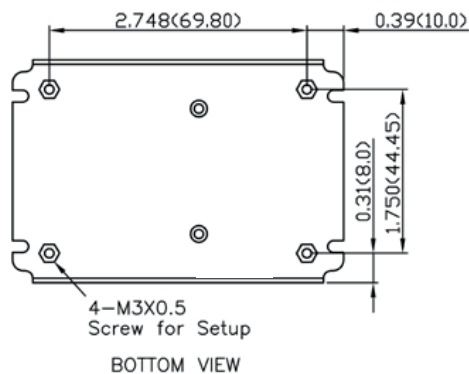
All specifications valid at nominal input voltage, full load and +25°C after warm-up time unless otherwise stated.

## Dimensions

### Single output:



Weight: 172g (6.07 oz)

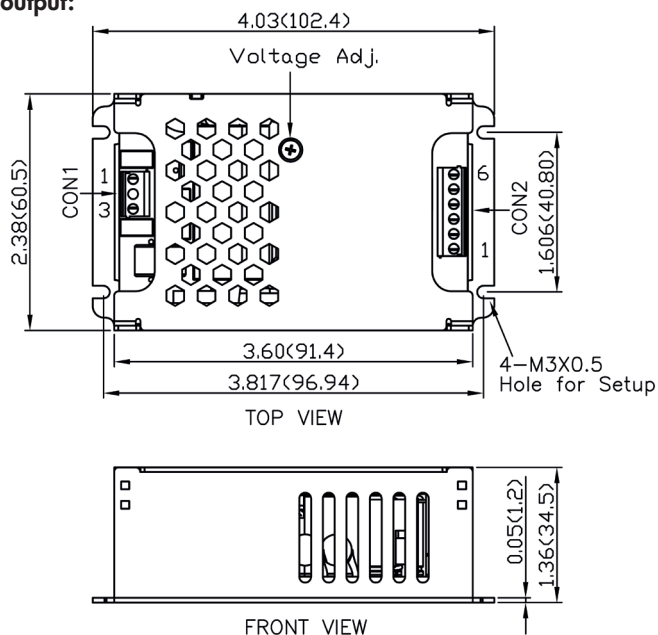


#### Screw Terminal

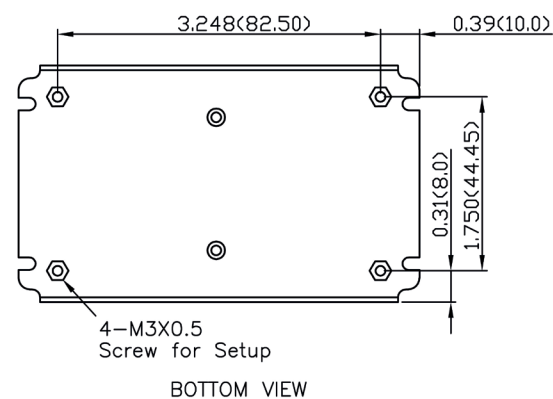
| Input |         | Output |        |
|-------|---------|--------|--------|
| Pin   | CON 1   | Pin*   | CON 2  |
| 1     | Line    | 1,2    | - Vout |
| 3     | Neutral | 3,4    | + Vout |

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

### Multi output:



Weight: 221g (7.90 oz)



#### Screw Terminal

| Input |         | Output |        |
|-------|---------|--------|--------|
| Pin   | CON 1   | Pin*   | CON 2  |
| 1     | Line    | 1      | Vout 3 |
| 3     | Neutral | 1,3    | Com    |
|       |         | 4,5    | Vout 2 |
|       |         | 6      | Vout 1 |

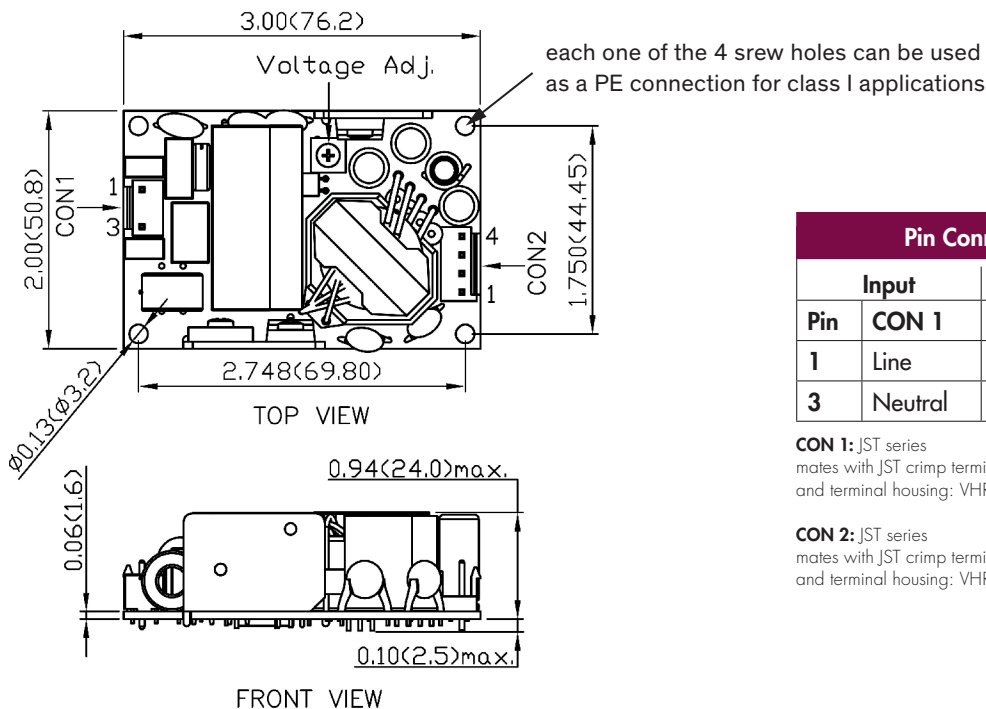
\*Terminal rated for 10 A max.  
(at higher current connection has to be splitted)

Dimensions in inch, ( ) = mm  
 Tolerances: x.xx±0.02 (x.x±0.5) x.xxx±0.01 (x.xx±0.25)  
 Wire dimensions range 26 - 16 AWG  
 M3x0.5 screw locked torque MAX 5Kgf.cm/0.49N.m  
 Terminal screw locked torque MAX 2Kgf.cm/0.2N.m

Customized versions on request !

Outline Dimensions

Single output:



| Pin Connector |         |        |        |
|---------------|---------|--------|--------|
| Input         |         | Output |        |
| Pin           | CON 1   | Pin    | CON 2  |
| 1             | Line    | 1,2    | - Vout |
| 3             | Neutral | 3,4    | + Vout |

**CON 1:** JST series  
mates with JST crimp terminal: BVH-21T-P1.1  
and terminal housing: VHR-3N

**CON 2:** JST series  
mates with JST crimp terminal: BVH-21T-P1.1  
and terminal housing: VHR-4N

Specifications can be changed without notice! Make sure you are using the latest documentation, downloadable at [www.tracopower.com](http://www.tracopower.com)