

## DC/DC Railway Converter

## TEP 100WIR Series, 100 Watt

- Compact half-brick package
- Ultra wide 4:1 input voltage ranges  
9–36, 18–75, 43–160 VDC
- EN 50155 approval for railway applications
- Very high efficiency up to 93%
- No minimum load
- Soft start
- Adjustable output voltage +10/-20%
- Sense line
- Remote On/Off input
- Under voltage lock-out circuit
- 3-year product warranty



The TEP 100WIR Series is a family of isolated high performance DC/DC converter modules with ultra-wide 4:1 input voltage ranges which come in a rugged, sealed industry standard half brick package. A very high efficiency allows full power operation without forced air cooling at 60°C. This temperature can be increased to 70°C with optional mounted heatsink or up to 85°C when mounted on an iron base plate. The very wide input voltage range makes these converters an interesting solution for battery operated systems. Typical applications are in telecom/datacom, industry control and railway systems for on board power distribution. This series is available in many optional designs on demand.

| Models          |                                |                                  |                     |                 |
|-----------------|--------------------------------|----------------------------------|---------------------|-----------------|
| Order Code      | Input Voltage Range            | Output Voltage nom. (adjustable) | Output Current max. | Efficiency typ. |
| TEP 100-2411WIR | 9 - 36 VDC<br>(24 VDC nom.)    | 5 VDC (4.0 - 5.5 VDC)            | 20'000 mA           | 93 %            |
| TEP 100-2412WIR |                                | 12 VDC (9.6 - 13.2 VDC)          | 8'400 mA            | 90 %            |
| TEP 100-2415WIR |                                | 24 VDC (19.2 - 26.4 VDC)         | 4'200 mA            | 90 %            |
| TEP 100-2416WIR |                                | 28 VDC (22.4 - 30.8 VDC)         | 3'600 mA            | 90 %            |
| TEP 100-2418WIR |                                | 48 VDC (38.4 - 52.8 VDC)         | 2'100 mA            | 90 %            |
| TEP 100-4812WIR | 18 - 75 VDC<br>(48 VDC nom.)   | 12 VDC (9.6 - 13.2 VDC)          | 8'400 mA            | 90 %            |
| TEP 100-4815WIR |                                | 24 VDC (19.2 - 26.4 VDC)         | 4'200 mA            | 90 %            |
| TEP 100-4816WIR |                                | 28 VDC (22.4 - 30.8 VDC)         | 3'600 mA            | 92 %            |
| TEP 100-4818WIR |                                | 48 VDC (38.4 - 52.8 VDC)         | 2'100 mA            | 91 %            |
| TEP 100-7212WIR | 43 - 160 VDC<br>(110 VDC nom.) | 12 VDC (9.6 - 13.2 VDC)          | 8'400 mA            | 90 %            |
| TEP 100-7215WIR |                                | 24 VDC (19.2 - 26.4 VDC)         | 4'200 mA            | 90 %            |
| TEP 100-7216WIR |                                | 28 VDC (22.4 - 30.8 VDC)         | 3'600 mA            | 90 %            |
| TEP 100-7218WIR |                                | 48 VDC (38.4 - 52.8 VDC)         | 2'100 mA            | 91 %            |

## Options

|                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>TEP-HS1</b>                                             | - Optional Heat Sink: <a href="http://www.tracopower.com/overview/tep-hs1">www.tracopower.com/overview/tep-hs1</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>on demand</b><br>(backorder with MOQ non stocking item) | <ul style="list-style-type: none"> <li>- Optional model with 3.3 VDC and 25'000 mA Output, and 9 - 36 VDC Input</li> <li>- Optional model with 15 VDC and 6'700 mA Output, and 9 - 36 VDC Input</li> <li>- Optional model with 3.3 VDC and 25'000 mA Output, and 18 - 75 VDC Input</li> <li>- Optional model with 5 VDC and 20'000 mA Output, and 18 - 75 VDC Input</li> <li>- Optional model with 15 VDC and 6'700 mA Output, and 18 - 75 VDC Input</li> <li>- Optional model with 3.3 VDC and 25'000 mA Output, and 43 - 160 VDC Input</li> <li>- Optional model with 5 VDC and 20'000 mA Output, and 43 - 160 VDC Input</li> <li>- Optional model with 15 VDC and 6'700 mA Output, and 43 - 160 VDC Input</li> <li>- Optional models with inverse Remote On/Off function (passive = off)</li> <li>- Chassis mount models w/o filter: <a href="http://www.tracopower.com/overview/tep100wircm">www.tracopower.com/overview/tep100wircm</a></li> <li>- Chassis mount models w/ filter to meet EN 55032 class A: <a href="http://www.tracopower.com/overview/tep100wircmf">www.tracopower.com/overview/tep100wircmf</a></li> </ul> |

## Input Specifications

|                        |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Input Current          | - At no load | 110 Vin models: <b>10 mA typ.</b><br>24 Vin models: <b>20 mA typ.</b> (3.3 Vout model)<br><b>25 mA typ.</b> (5 Vout model)<br><b>25 mA typ.</b> (12 Vout model)<br><b>25 mA typ.</b> (15 Vout model)<br><b>25 mA typ.</b> (24 Vout model)<br><b>25 mA typ.</b> (28 Vout model)<br><b>35 mA typ.</b> (48 Vout model)<br>48 Vin models: <b>15 mA typ.</b> (3.3 Vout model)<br><b>15 mA typ.</b> (5 Vout model)<br><b>20 mA typ.</b> (12 Vout model)<br><b>20 mA typ.</b> (15 Vout model)<br><b>20 mA typ.</b> (24 Vout model)<br><b>20 mA typ.</b> (28 Vout model)<br><b>25 mA typ.</b> (48 Vout model) |
| Surge Voltage          |              | 24 Vin models: <b>50 VDC max.</b> (1 s max.)<br>48 Vin models: <b>100 VDC max.</b> (1 s max.)<br>110 Vin models: <b>185 VDC max.</b> (1 s max.)                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Under Voltage Lockout  |              | 24 Vin models: <b>7.3 VDC min. / 7.5 VDC typ. / 8.1 VDC max.</b><br>48 Vin models: <b>15.5 VDC min. / 16 VDC typ. / 16.3 VDC max.</b><br>110 Vin models: <b>33 VDC min. / 34.5 VDC typ. / 36 VDC max.</b>                                                                                                                                                                                                                                                                                                                                                                                             |
| Recommended Input Fuse |              | 24 Vin models: <b>20'000 mA</b> (fast acting)<br>48 Vin models: <b>12'000 mA</b> (fast acting)<br>110 Vin models: <b>5'000 mA</b> (slow blow)<br>(The need of an external fuse has to be assessed in the final application.)                                                                                                                                                                                                                                                                                                                                                                          |
| Input Filter           |              | <b>Internal Pi-Type</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

## Output Specifications

|                           |                                                                |                                                                                                                                                                                                                        |
|---------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Output Voltage Adjustment |                                                                | <b>-20% to +10%</b> (By external trim resistor)<br>See application note: <a href="http://www.tracopower.com/overview/tep100wir">www.tracopower.com/overview/tep100wir</a><br>Output power must not exceed rated power! |
| Voltage Set Accuracy      |                                                                | <b>±1% max.</b>                                                                                                                                                                                                        |
| Regulation                | - Input Variation (Vmin - Vmax)<br>- Load Variation (0 - 100%) | <b>0.1% max.</b><br><b>0.1% max.</b>                                                                                                                                                                                   |

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

|                                        |                                                                                                                                                                                                             |                                                               |
|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Ripple and Noise<br>(20 MHz Bandwidth) | 3.3 Vout models:                                                                                                                                                                                            | <b>75 mVp-p max.</b> (w/ 1 $\mu$ F X7R    22 $\mu$ F poscap)  |
|                                        | 5 Vout models:                                                                                                                                                                                              | <b>75 mVp-p max.</b> (w/ 1 $\mu$ F X7R    22 $\mu$ F poscap)  |
|                                        | 12 Vout models:                                                                                                                                                                                             | <b>100 mVp-p max.</b> (w/ 1 $\mu$ F X7R    22 $\mu$ F poscap) |
|                                        | 15 Vout models:                                                                                                                                                                                             | <b>100 mVp-p max.</b> (w/ 1 $\mu$ F X7R    22 $\mu$ F poscap) |
|                                        | 24 Vout models:                                                                                                                                                                                             | <b>200 mVp-p max.</b> (w/ 4.7 $\mu$ F X7R)                    |
|                                        | 28 Vout models:                                                                                                                                                                                             | <b>200 mVp-p max.</b> (w/ 4.7 $\mu$ F X7R)                    |
|                                        | 48 Vout models:                                                                                                                                                                                             | <b>300 mVp-p max.</b> (w/ 2.2 $\mu$ F X7R)                    |
| Capacitive Load                        | 3.3 Vout models:                                                                                                                                                                                            | <b>75'700 <math>\mu</math>F max.</b>                          |
|                                        | 5 Vout models:                                                                                                                                                                                              | <b>40'000 <math>\mu</math>F max.</b>                          |
|                                        | 12 Vout models:                                                                                                                                                                                             | <b>7'000 <math>\mu</math>F max.</b>                           |
|                                        | 15 Vout models:                                                                                                                                                                                             | <b>4'460 <math>\mu</math>F max.</b>                           |
|                                        | 24 Vout models:                                                                                                                                                                                             | <b>1'750 <math>\mu</math>F max.</b>                           |
|                                        | 28 Vout models:                                                                                                                                                                                             | <b>1'280 <math>\mu</math>F max.</b>                           |
|                                        | 48 Vout models:                                                                                                                                                                                             | <b>430 <math>\mu</math>F max.</b>                             |
| Minimum Load                           | Not required                                                                                                                                                                                                |                                                               |
| Temperature Coefficient                | $\pm 0.02$ %/K max.                                                                                                                                                                                         |                                                               |
| Hold-up Time                           | 10 ms min. (acc. to EN 50155 Class S2, see application note for ext. capacitor calculation:<br><a href="http://www.tracopower.com/info/holdup_en50155.pdf">www.tracopower.com/info/holdup_en50155.pdf</a> ) |                                                               |
| Start-up Time                          | 75 ms typ.                                                                                                                                                                                                  |                                                               |
| Short Circuit Protection               | Continuous, Automatic recovery                                                                                                                                                                              |                                                               |
| Output Current Limitation              | 150% typ. of Iout max. (110 Vin models)<br>120 - 150% (other models)                                                                                                                                        |                                                               |
| Overvoltage Protection                 | 115 - 130% of Vout nom.                                                                                                                                                                                     |                                                               |
| Transient Response                     | - Response Time                                                                                                                                                                                             | 200 $\mu$ s typ. / 250 $\mu$ s max. (25% Load Step)           |

## Safety Specifications

|           |                                                     |                                                                                                              |
|-----------|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Standards | - IT / Multimedia Equipment                         | EN 60950-1<br>EN 62368-1<br>IEC 60950-1<br>IEC 62368-1<br>UL 60950-1<br>UL 62368-1                           |
|           | - Railway Applications<br>- Certification Documents | EN 50155<br><a href="http://www.tracopower.com/overview/tep100wir">www.tracopower.com/overview/tep100wir</a> |

## EMC Specifications

|                                                                                                                            |                       |                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------|
| EMI (Emissions)                                                                                                            | - Conducted Emissions | EN 50121-3-2 (EMC for Rolling Stock)<br>EN 55011 class B (with external filter)<br>EN 55032 class B (with external filter) |
|                                                                                                                            | - Radiated Emissions  | EN 55011 class B (with external filter)<br>EN 55032 class B (with external filter)                                         |
| External filter proposal: <a href="http://www.tracopower.com/overview/tep100wir">www.tracopower.com/overview/tep100wir</a> |                       |                                                                                                                            |

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

|                     |                                                     |                                                                                                                                                                                                                                                                                        |
|---------------------|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EMS (Immunity)      | - Electrostatic Discharge                           | Air: EN 50121-3-2 (EMC for Rolling Stock)<br>EN 55024 (IT Equipment)<br>EN 55035 (Multimedia)                                                                                                                                                                                          |
|                     | - RF Electromagnetic Field<br>- EFT (Burst) / Surge | Contact: EN 61000-4-2, $\pm 8$ kV, perf. criteria A<br>EN 61000-4-2, $\pm 6$ kV, perf. criteria A<br>EN 61000-4-3, 20 V/m, perf. criteria A<br>EN 61000-4-4, $\pm 2$ kV, perf. criteria A<br>EN 61000-4-5, $\pm 2$ kV, perf. criteria A                                                |
|                     | - Conducted RF Disturbances<br>- PF Magnetic Field  | Ext. input component: 24 Vin models: 2 x KY 220 $\mu$ F<br>48 Vin models: 2 x KY 220 $\mu$ F<br>110 Vin models: 2 x KXJ 150 $\mu$ F<br>Continuous: EN 61000-4-6, 10 Vrms, perf. criteria A<br>EN 61000-4-8, 100 A/m, perf. criteria A<br>1 s: EN 61000-4-8, 1000 A/m, perf. criteria A |
| EMC / Environmental | - Certification Documents                           | <a href="http://www.tracopower.com/overview/tep100wir">www.tracopower.com/overview/tep100wir</a>                                                                                                                                                                                       |

## General Specifications

|                                        |                                                                                                          |                                                                                                                                                                                                                      |
|----------------------------------------|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Relative Humidity                      |                                                                                                          | 95% max. (non condensing)                                                                                                                                                                                            |
| Temperature Ranges                     | - Operating Temperature<br>- Case Temperature<br>- Storage Temperature                                   | -40°C to +75°C<br>+105°C max.<br>-55°C to +125°C                                                                                                                                                                     |
| Power Derating                         | - High Temperature                                                                                       | Depending on model                                                                                                                                                                                                   |
|                                        | See application note:                                                                                    | <a href="http://www.tracopower.com/overview/tep100wir">www.tracopower.com/overview/tep100wir</a>                                                                                                                     |
| Over Temperature Protection Switch Off | - Protection Mode<br>- Measurement Point                                                                 | 115°C typ. (Automatic recovery at 105°C typ.)<br>Base-Plate                                                                                                                                                          |
| Cooling System                         |                                                                                                          | Natural convection (20 LFM)                                                                                                                                                                                          |
| Sense Function                         |                                                                                                          | 10% max. of Vout nom.<br>(If sense function is not used, sense pins must be connected to corresponding polarity output pins.)                                                                                        |
| Remote Control                         | - Voltage Controlled Remote (passive = on)<br><br>- Off Idle Input Current<br>- Remote Pin Input Current | On: 3.0 to 12 VDC or open circuit<br>Off: 0 to 1.2 VDC or short circuit<br>Refers to 'Remote' and '-Vin' Pin<br>3 mA typ.<br>-0.5 to 1.0 mA<br>(Optional models with inverse Remote On/Off function (passive = off)) |
| Altitude During Operation              |                                                                                                          | 2'000 m max. (for reinforced insulation)<br>5'000 m max. (for functional insulation)                                                                                                                                 |
| Switching Frequency                    |                                                                                                          | 300 kHz typ. (PWM) ( $\pm 10\%$ , 110 Vin models)<br>250 kHz typ. (PWM) ( $\pm 10\%$ , other models)                                                                                                                 |
| Insulation System                      |                                                                                                          | Reinforced Insulation                                                                                                                                                                                                |
| Working Voltage (rated)                |                                                                                                          | 177 VAC (110 Vin models)<br>145 VAC (24 and 48 Vin, 3.3 and 5 Vout models)<br>185 VAC (24 and 48 Vin, 48 Vout models)<br>172 VAC (24 and 48 Vin, other output models)                                                |
| Isolation Test Voltage                 | - Input to Output, 60 s<br>- Input to Case, 60 s<br>- Output to Case, 60 s                               | 3'000 VAC<br>1'500 VAC<br>1'500 VAC                                                                                                                                                                                  |
| Isolation Resistance                   | - Input to Output, 500 VDC                                                                               | 1'000 M $\Omega$ min.                                                                                                                                                                                                |
| Isolation Capacitance                  | - Input to Output, 100 kHz, 1 V                                                                          | 2'500 pF max.                                                                                                                                                                                                        |
| Reliability                            | - Calculated MTBF                                                                                        | 409'000 h (MIL-HDBK-217F, ground benign)                                                                                                                                                                             |
| Washing Process                        |                                                                                                          | According to Cleaning Guideline<br><a href="http://www.tracopower.com/info/cleaning.pdf">www.tracopower.com/info/cleaning.pdf</a>                                                                                    |

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|                          |                         |                                                                                                                                                                                                                                                                        |
|--------------------------|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Environment              | - Vibration             | MIL-STD-810F<br>EN 61373                                                                                                                                                                                                                                               |
|                          | - Mechanical Shock      | MIL-STD-810F<br>EN 61373                                                                                                                                                                                                                                               |
|                          | - Thermal Shock         | MIL-STD-810F                                                                                                                                                                                                                                                           |
|                          | - Flammability          | EN 45545-2<br><a href="http://www.tracopower.com/info/en45545-declaration.pdf">www.tracopower.com/info/en45545-declaration.pdf</a>                                                                                                                                     |
| Housing Material         |                         | Alu base-plate w. metal case (24 and 48 Vin models)<br>Alu base-plate w. plastic case (110 Vin models)                                                                                                                                                                 |
| Base Material            |                         | Non-conductive FR4 (UL 94 V-0 rated) (24 and 48 Vin models only)                                                                                                                                                                                                       |
| Potting Material         |                         | Silicone (UL 94 V-0 rated)                                                                                                                                                                                                                                             |
| Pin Material             |                         | Copper                                                                                                                                                                                                                                                                 |
| Pin Foundation Plating   |                         | Nickel (2 - 3 µm)                                                                                                                                                                                                                                                      |
| Pin Surface Plating      |                         | Tin (3 - 5 µm), matte                                                                                                                                                                                                                                                  |
| Housing Type             |                         | Metal Case (24 and 48 Vin models)<br>Plastic Case (110 Vin models)                                                                                                                                                                                                     |
| Mounting Type            |                         | PCB Mount                                                                                                                                                                                                                                                              |
| Connection Type          |                         | THD (Through-Hole Device)                                                                                                                                                                                                                                              |
| Footprint Type           |                         | Half-Brick                                                                                                                                                                                                                                                             |
| Soldering Profile        |                         | Lead-Free Wave Soldering<br>260°C / 6 s max.                                                                                                                                                                                                                           |
| Weight                   |                         | 105 g                                                                                                                                                                                                                                                                  |
| Thermal Impedance        | - Case to Ambient       | 6.7 K/W typ.<br>4.7 K/W typ. (with Heat Sink)                                                                                                                                                                                                                          |
|                          | - REACH Declaration     | <a href="http://www.tracopower.com/info/reach-declaration.pdf">www.tracopower.com/info/reach-declaration.pdf</a><br>REACH SVHC list compliant<br>REACH Annex XVII compliant                                                                                            |
| Environmental Compliance | - RoHS Declaration      | <a href="http://www.tracopower.com/info/rohs-declaration.pdf">www.tracopower.com/info/rohs-declaration.pdf</a><br>Exemptions: 7(a), 7(c)-I<br>(RoHS exemptions refer to the component concentration only, not to the overall concentration in the product (O5A rule).) |
|                          | - SCIP Reference Number | 4e8cc3a5-c3ec-44b0-9980-158ec468eab5                                                                                                                                                                                                                                   |

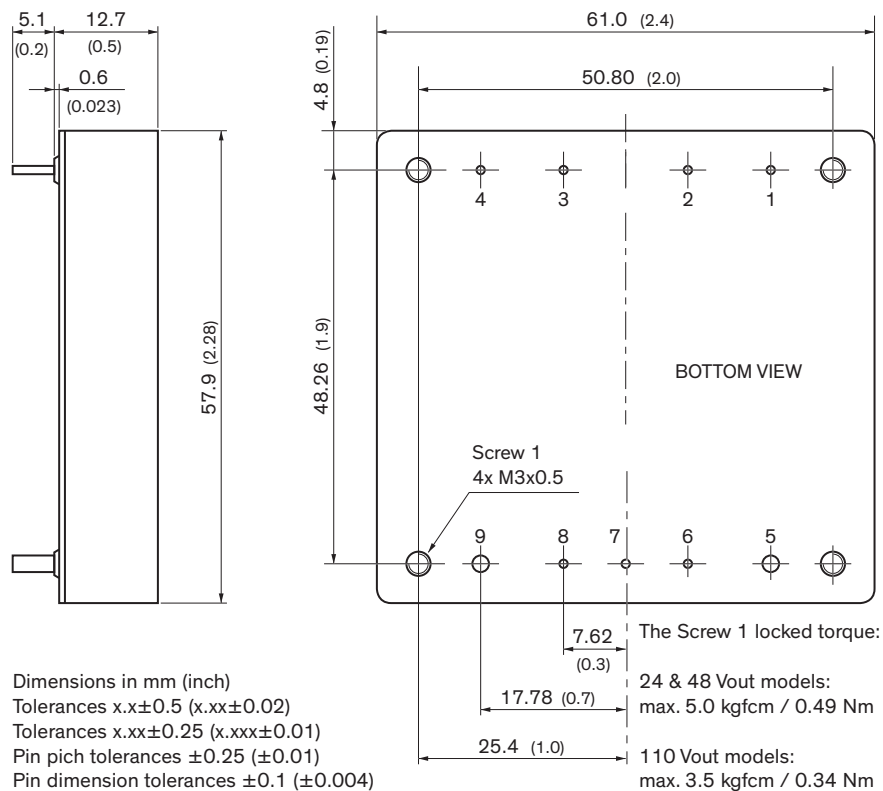
## Supporting Documents

Overview Link (for additional Documents)

[www.tracopower.com/overview/tep100wir](http://www.tracopower.com/overview/tep100wir)

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

### Outline Dimensions



| Pinout |               |                    |
|--------|---------------|--------------------|
| Pin    | Single        | Pin Diameter       |
| 1      | -Vin (GND)    | 1.0 mm (0.04 inch) |
| 2      | Case          | 1.0 mm (0.04 inch) |
| 3      | Remote On/Off | 1.0 mm (0.04 inch) |
| 4      | +Vin (Vcc)    | 1.0 mm (0.04 inch) |
| 5      | -Vout         | 2.0 mm (0.08 inch) |
| 6      | -Sense        | 1.0 mm (0.04 inch) |
| 7      | Trim          | 1.0 mm (0.04 inch) |
| 8      | +Sense        | 1.0 mm (0.04 inch) |
| 9      | +Vout         | 2.0 mm (0.08 inch) |