### DC/DC Railway Converter

**TEP 160WIR Series, 160 Watt**

- Compact metal 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 91%
- No minimum load
- Soft start
- Adjustable output voltage +10 / -20%
- Sense line
- Remote On/Off input
- Under voltage lock-out circuit

The TEP 160WIR 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 25°C. This temperature can be increased to 40°C with optional mounted heatsink or up to 60°C when mounted on an iron base plate. The very wide input voltage range and reverse input voltage protection make these converters interesting solution for battery operated systems. Typical applications are in telecom/datacom, industry control and railway systems for on board power distribution. These series is available in many optional designs on demand — see options.

### Models

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>TEP 160-2412WIR</td>
<td>9 - 36 VDC (24 VDC nom.)</td>
<td>12 VDC</td>
<td>12'000 mA</td>
<td>90 %</td>
</tr>
<tr>
<td>TEP 160-2413WIR</td>
<td></td>
<td>15 VDC</td>
<td>9'500 mA</td>
<td>91 %</td>
</tr>
<tr>
<td>TEP 160-2415WIR</td>
<td></td>
<td>24 VDC</td>
<td>6'000 mA</td>
<td>90 %</td>
</tr>
<tr>
<td>TEP 160-2416WIR</td>
<td></td>
<td>28 VDC</td>
<td>5'000 mA</td>
<td>90 %</td>
</tr>
<tr>
<td>TEP 160-2418WIR</td>
<td></td>
<td>48 VDC</td>
<td>3'000 mA</td>
<td>90 %</td>
</tr>
<tr>
<td>TEP 160-4812WIR</td>
<td>18 - 75 VDC (48 VDC nom.)</td>
<td>12 VDC</td>
<td>13'000 mA</td>
<td>91 %</td>
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<tr>
<td>TEP 160-4813WIR</td>
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<td>15 VDC</td>
<td>10'000 mA</td>
<td>91 %</td>
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<tr>
<td>TEP 160-4815WIR</td>
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<td>24 VDC</td>
<td>6'500 mA</td>
<td>91 %</td>
</tr>
<tr>
<td>TEP 160-4816WIR</td>
<td></td>
<td>28 VDC</td>
<td>5'500 mA</td>
<td>91 %</td>
</tr>
<tr>
<td>TEP 160-4818WIR</td>
<td></td>
<td>48 VDC</td>
<td>3'200 mA</td>
<td>91 %</td>
</tr>
<tr>
<td>TEP 160-7212WIR</td>
<td>43 - 160 VDC (110 VDC nom.)</td>
<td>12 VDC</td>
<td>15'000 mA</td>
<td>90 %</td>
</tr>
<tr>
<td>TEP 160-7213WIR</td>
<td></td>
<td>15 VDC</td>
<td>12'000 mA</td>
<td>90 %</td>
</tr>
<tr>
<td>TEP 160-7215WIR</td>
<td></td>
<td>24 VDC</td>
<td>7'500 mA</td>
<td>90 %</td>
</tr>
<tr>
<td>TEP 160-7216WIR</td>
<td></td>
<td>28 VDC</td>
<td>6'500 mA</td>
<td>90 %</td>
</tr>
<tr>
<td>TEP 160-7218WIR</td>
<td></td>
<td>48 VDC</td>
<td>3'800 mA</td>
<td>90 %</td>
</tr>
</tbody>
</table>
## Options

### TEP-HS1
- Optional model with 3.3 VDC / 40'000 mA Output and 9 - 36 VDC Input
- Optional model with 5 VDC / 28'000 mA Output and 9 - 36 VDC Input
- Optional model with 3.3 VDC / 40'000 mA Output and 18 - 75 VDC Input
- Optional model with 5 VDC / 30'000 mA Output and 18 - 75 VDC Input
- Optional model with 3.3 VDC / 43'000 mA Output and 43 - 160 VDC Input
- Optional model with 5 VDC / 32'000 mA Output and 43 - 160 VDC Input
- Sync pin to synchronize switching frequency of up to 3 units (EMC reason)
- Chassis mount models with EN 55032 class A filter: www.tracopower.com/products/tep160wircmf.pdf
- Negative (passive = Off) Remote On/Off function

### Input Specifications

<table>
<thead>
<tr>
<th>Input Current</th>
<th>- At no load</th>
<th>24 Vin models: 25 mA typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>48 Vin models: 20 mA typ.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>110 Vin models: 10 mA typ.</td>
<td></td>
</tr>
<tr>
<td>Surge Voltage</td>
<td>24 Vin models: 50 VDC max. (1 s max)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>48 Vin models: 100 VDC max. (1 s max)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>110 Vin models: 185 VDC max. (1 s max)</td>
<td></td>
</tr>
<tr>
<td>Under Voltage Lockout</td>
<td>24 Vin models: 7.3 VDC min. / 7.7 VDC typ. / 8.1 VDC max.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>48 Vin models: 15.5 VDC min. / 16 VDC typ. / 16.3 VDC max.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>110 Vin models: 33 VDC min. / 34.5 VDC typ. / 36 VDC max.</td>
<td></td>
</tr>
<tr>
<td>Recommended Input Fuse</td>
<td>24 Vin models: 25'000 mA (fast acting)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>48 Vin models: 15'000 mA (fast acting)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>110 Vin models: 8'000 mA (fast acting)</td>
<td></td>
</tr>
<tr>
<td>(The need of an external fuse has to be assessed in the final application.)</td>
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<td></td>
</tr>
</tbody>
</table>

### Output Specifications

#### Output Voltage Adjustment

-20% to +10% (By external trim resistor)

See application note: www.tracopower.com/overview/tep160wir

Output power must not exceed rated power!

<table>
<thead>
<tr>
<th>Voltage Set Accuracy</th>
<th>±1% max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulation</td>
<td>- Input Variation (Vmin - Vmax) 0.1% max.</td>
</tr>
<tr>
<td></td>
<td>- Load Variation (0 - 100%) 0.1% max.</td>
</tr>
</tbody>
</table>

#### Ripple and Noise (20 MHz Bandwidth)

| 3.3 Vout models: 75 mVp-p max. (w/ 1 µF X7R // 25 µF poscap) |
| 5 Vout models: 75 mVp-p max. (w/ 1 µF X7R // 25 µF poscap) |
| 12 Vout models: 100 mVp-p max. (w/ 1 µF X7R // 25 µF poscap) |
| 15 Vout models: 100 mVp-p max. (w/ 1 µF X7R // 25 µF poscap) |
| 24 Vout models: 200 mVp-p max. (w/ 4.7 µF X7R) |
| 28 Vout models: 200 mVp-p max. (w/ 4.7 µF X7R) |
| 48 Vout models: 300 mVp-p max. (w/ 22 µF X7R) |

All specifications valid at nominal voltage, full load and +25°C after warm-up time unless otherwise stated.
Capacitive Load
- 24 Vin input
  3.3 Vout models: 121'000 µF max.
  5 Vout models: 56'000 µF max.
  12 Vout models: 10'000 µF max.
  15 Vout models: 6'300 µF max.
  24 Vout models: 2'500 µF max.
  28 Vout models: 1'700 µF max.
  48 Vout models: 820 µF max.

- 48 Vin input
  3.3 Vout models: 121'000 µF max.
  5 Vout models: 60'000 µF max.
  12 Vout models: 10'800 µF max.
  15 Vout models: 6'600 µF max.
  24 Vout models: 2'700 µF max.
  28 Vout models: 1'900 µF max.
  48 Vout models: 860 µF max.

- 110 Vin input
  3.3 Vout models: 130'000 µF max.
  5 Vout models: 64'000 µF max.
  12 Vout models: 12'500 µF max.
  15 Vout models: 8'000 µF max.
  24 Vout models: 3'100 µF max.
  28 Vout models: 2'300 µF max.
  48 Vout models: 790 µF max.

Minimum Load
Not required

Temperature Coefficient
±0.02 %/K max.

Start-up Time
75 ms typ.

Short Circuit Protection
Continuous, Automatic recovery

Output Current Limitation
120 - 150% of Iout max.

Overvoltage Protection
115 - 130% of Vout nom.

Transient Response
- Response Time
  200 µs typ. / 250 µs max. (25% Load Step)

Safety Specifications

Safety Standards
- IT / Multimedia Equipment
  EN 60950-1
  EN 62368-1
  IEC 60950-1
  IEC 62368-1
  UL 60950-1
  UL 62368-1

- Railway Applications
  EN 50155

- Certification Documents
  www.tracopower.com/overview/tep160wir

Pollution Degree
PD 2

Over Voltage Category
OVC II

EMC Specifications

EMI Emissions
- Conducted Emissions
  EN 55011 class B (with external filter)
  EN 55032 class B (with external filter)

- Radiated Emissions
  EN 55011 class B (with external filter)
  EN 55032 class B (with external filter)

External filter proposal: www.tracopower.com/overview/tep160wir

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

- Electrostatic Discharge
  - Air: EN 61000-4-2, ±8 kV, perf. criteria A
  - Contact: EN 61000-4-2, ±6 kV, perf. criteria A
- RF Electromagnetic Field
- EFT (Burst) / Surge
- Conducted RF Disturbances
- PF Magnetic Field

Extended input component: 24 & 48 Vin models: 2x KY 220 µF
Continuous: 10 Vin models: 2x KYJ 150 µF

General Specifications

Relative Humidity: 95% max. (non condensing)

Temperature Ranges
- Operating Temperature: -40°C to +75°C
- Case Temperature: +105°C max.
- Storage Temperature: -55°C to +125°C

Power Derating
- High Temperature: See application note: www.tracopower.com/overview/tep160wir

Over Temperature Protection Switch Off
- Protection Mode: 115°C typ. (Automatic recovery at 105°C typ.)
- Measurement Point: Base-Plate

Cooling System: Natural convection (20 LFM)

Sense Function: 10% max. of Vout nom.
(Sense line to be connected to the output either at the module or at the load under regard of polarity.)

Remote Control
- Voltage Controlled Remote: On: 3.0 to 12 VDC or open circuit
  Off: 0 to 1.2 VDC or short circuit
  Refers to ‘Remote’ and ‘-Vin’ Pin
- Off Idle Input Current: 3 mA typ.
- Remote Pin Input Current: -0.5 to 1.0 mA

Altitude During Operation: 2'000 m max. (for reinforced insulation)
5'000 m max. (for functional insulation)

Switching Frequency: 225 - 275 kHz (PWM)
250 kHz typ. (PWM)

Insulation System
- Reinforced Insulation (110 Vin models)
- Functional Insulation (other models)

Working Voltage (rated): 145 VAC (3.3 and 5 Vout models)
185 VAC (48 Vout models)
172 VAC (other output models)

Isolation Test Voltage
- Input to Output, 60 s: 3'000 VAC (110 Vin models)
2'250 VDC (other models)
- Input to Case, 60 s: 1'500 VAC (110 Vin models)
1'600 VDC (other models)
- Output to Case, 60 s: 1'500 VAC

Isolation Resistance: 1'000 MΩ min.

Isolation Capacitance: 2'500 pF max.

Reliability
- Calculated MTBF: 350'000 h (MIL-HDBK-217F, ground benign)

Environment
- Vibration: MIL-STD-810F
  EN 61373
- Mechanical Shock: MIL-STD-810F
  EN 61373
- Thermal Shock: MIL-STD-810F
  EN 50155

Housing Material
- Alu base-plate w. plastic case (110 Vin models)
- Alu base-plate w. metal case (other models)

All specifications valid at nominal voltage, full load and +25°C after warm-up time unless otherwise stated.
**Base Material**
Non-conductive FR4 (UL 94 V-0 rated) (24 Vin & 48 Vin models only)

**Potting Material**
Silicone (UL 94 V-0 rated)

**Pin Material**
Copper

**Pin Foundation Plating**
Nickel (2 - 3 µm), matte

**Pin Surface Plating**
Tin (3 - 5 µm), matte

**Connection Type**
THD (Through-Hole Device)

**Weight**
105 g

**Thermal Impedance**
6.1 K/W
4.6 K/W (with Heat Sink)

**Environmental Compliance**
- REACH Declaration
  
  www.tracopower.com/info/reach-declaration.pdf

  - RoHS Declaration
    
    REACH SVHC list compliant
    REACH Annex XVII compliant
    
    www.tracopower.com/info/rohs-declaration.pdf

  - Flammability (EN 45545-2)
    
    Exemptions: 7a, 7c-I
    

**Supporting Documents**
Overview Link (for additional Documents)
  
  www.tracopower.com/overview/tep160wir

**Outline Dimensions**

*Dimensions in mm (inch)*

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
<th>Pin Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>–Vin (GND)</td>
<td>1 mm</td>
</tr>
<tr>
<td>2</td>
<td>Case</td>
<td>1 mm</td>
</tr>
<tr>
<td>3</td>
<td>Remote</td>
<td>1 mm</td>
</tr>
<tr>
<td>4</td>
<td>+Vin (Vcc)</td>
<td>1 mm</td>
</tr>
<tr>
<td>5</td>
<td>–Vout</td>
<td>2 mm</td>
</tr>
<tr>
<td>6</td>
<td>–Sense</td>
<td>1 mm</td>
</tr>
<tr>
<td>7</td>
<td>Trim</td>
<td>1 mm</td>
</tr>
<tr>
<td>8</td>
<td>+Sense</td>
<td>1 mm</td>
</tr>
<tr>
<td>9</td>
<td>+Vout</td>
<td>2 mm</td>
</tr>
<tr>
<td>10</td>
<td>Sync (on demand)</td>
<td>1 mm</td>
</tr>
</tbody>
</table>

The screw1 locked torque
24 & 48 Vout models
MAX 5.0kgf-cm/0.49N-m
72 Vout models
MAX 3.5kgf-cm/0.34N-m