DC/DC Railway Converter

- Compact half-brick housing
- Ultra-wide 12:1 input: 14–160 VDC
- −40°C to +105°C operating temperature
- Fully encapsulated
- Dedicated holdup capacitor connection
- EN 50155, EN 45545-2 and EN 61373 certified
- Reinforced 3000VAC I/O isolation
- Remote on/off and trim function
- Protection against short-circuit (SCP), overvoltage (OVP), overtemperature (OTP)
- 3-year product warranty

The TEP 200UIR is a series of railway-certified DC/DC converters designed for highest reliability in demanding applications. Its ultra-wide 12:1 input voltage range allows the application engineer to target an array of nominal system voltages with a single power supply design. Thanks to its dedicated holdup capacitor connection, the TEP 200UIR meets extended holdup-time requirements without the need for bulky input capacitors. The TEP 200UIR series is EN 50155 certified for applications on rolling stock. Additional certifications include EN 61373 for mechanical shock and vibration, EN 45545-2 for fire behavior and IEC/EN/UL 62368-1 for IT and general-purpose industrial applications.

### Models

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>TEP 200-7211UIR</td>
<td>14 - 160 VDC (72 VDC nom.)</td>
<td>5 VDC (4.0 - 5.5 VDC)</td>
<td>40'000 mA</td>
<td>91 %</td>
</tr>
<tr>
<td>TEP 200-7212UIR</td>
<td></td>
<td>12 VDC (9.6 - 13.2 VDC)</td>
<td>16'800 mA</td>
<td>93 %</td>
</tr>
<tr>
<td>TEP 200-7213UIR</td>
<td></td>
<td>15 VDC (12.0 - 16.5 VDC)</td>
<td>13'400 mA</td>
<td>92 %</td>
</tr>
<tr>
<td>TEP 200-7215UIR</td>
<td></td>
<td>24 VDC (19.2 - 26.4 VDC)</td>
<td>8'400 mA</td>
<td>89 %</td>
</tr>
<tr>
<td>TEP 200-7218UIR</td>
<td></td>
<td>48 VDC (38.4 - 52.8 VDC)</td>
<td>4'200 mA</td>
<td>93 %</td>
</tr>
</tbody>
</table>

### Options


- Optional model with 28 VDC / 7’200 mA Output and 14 - 160 VDC Input
- Optional model with 53 VDC / 3’900 mA Output and 14 - 160 VDC Input
- Optional models with inverse Remote On/Off function (passive = off)

**Note:** A capacitor 150 µF / 200 V must be connected between BUS pin and -Vin
## Input Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Current</td>
<td>- At no load 30 mA typ.</td>
</tr>
<tr>
<td></td>
<td>- At full load 3'000 mA typ.</td>
</tr>
<tr>
<td>Surge Voltage</td>
<td>185 VDC max. (1 s max.)</td>
</tr>
<tr>
<td>Under Voltage Lockout</td>
<td>10 VDC min. / 11 VDC typ. / 12 VDC max.</td>
</tr>
<tr>
<td></td>
<td>(Adjustable w/ external resistor; see application note)</td>
</tr>
<tr>
<td>Recommended Input Fuse</td>
<td>20 A (fast acting)</td>
</tr>
<tr>
<td></td>
<td>(The need of an external fuse has to be assessed in the final application.)</td>
</tr>
<tr>
<td>Input Filter</td>
<td>Internal Capacitor</td>
</tr>
</tbody>
</table>

## Output Specifications

### Output Voltage Adjustment

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

See application note: [www.tracopower.com/overview/tep200uir](http://www.tracopower.com/overview/tep200uir)

Output power must not exceed rated power!

### Voltage Set Accuracy

±1% max.

### Regulation

- Input Variation (Vmin - Vmax) 0.2% max.
- Load Variation (0 - 100%) 0.1% max.

### Ripple and Noise

(20 MHz Bandwidth)

- 5 Vout models: 75 mVP-p typ. (w/ 22 µF/25 V X7R MLCC || 22 µF/25 V POSCAP)
- 12 Vout models: 150 mVP-p typ. (w/ 22 µF/25 V X7R MLCC || 22 µF/25 V POSCAP)
- 15 Vout models: 150 mVP-p typ. (w/ 22 µF/25 V X7R MLCC || 22 µF/25 V POSCAP)
- 24 Vout models: 200 mVP-p typ. (w/ 22 µF/50 V X7R MLCC)
- 28 Vout models: 200 mVP-p typ. (w/ 22 µF/50 V X7R MLCC)
- 48 Vout models: 300 mVP-p typ. (w/ 1 µF/100 V X7R MLCC)
- 53 Vout models: 300 mVP-p typ. (w/ 1 µF/100 V X7R MLCC)

### Capacitive Load

- 5 Vout models: 60'000 µF max.
- 12 Vout models: 10'300 µF max.
- 15 Vout models: 6'600 µF max.
- 24 Vout models: 2'600 µF max.
- 28 Vout models: 1'800 µF max.
- 48 Vout models: 620 µF max.
- 53 Vout models: 470 µF max.

### Minimum Load

Not required

### Temperature Coefficient

±0.02 %/K max.

### Hold-up Time

10 ms min. (acc. to EN 50155 Class S2, see application note for BUS connection: [www.tracopower.com/overview/tep200uir](http://www.tracopower.com/overview/tep200uir))

### Start-up Time

350 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 250 µs typ. (25% Load Step)

## Safety Specifications

### Standards

- IT / Multimedia Equipment EN 62368-1
- IEC 62368-1
- UL 62368-1
- Railway Applications
- Certification Documents EN 50155

[www.tracopower.com/overview/tep200uir](http://www.tracopower.com/overview/tep200uir)

### Pollution Degree

PD 2

### Over Voltage Category

Not mains connected

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

<table>
<thead>
<tr>
<th>EMI Emissions</th>
<th>EN 50121-3-4 (EMC for Rolling Stock)</th>
<th>EN 55032 class A (with external filter)</th>
<th>EN 55032 class B (with external filter)</th>
<th>EN 55032 class A (with external filter)</th>
<th>EN 55032 class B (with external filter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conducted Emissions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiated Emissions</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

External filter proposal: [www.tracopower.com/overview/tep200uir](http://www.tracopower.com/overview/tep200uir)

<table>
<thead>
<tr>
<th>EMS Immunity</th>
<th>EN 50121-3-4 (EMC for Rolling Stock)</th>
<th>EN 55024 IT Equipment</th>
<th>EN 55035 Multimedia</th>
<th>EN 55032 class A (with external filter)</th>
<th>EN 55032 class B (with external filter)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrostatic Discharge Air</td>
<td>EN 61000-4-2, ±8 kV, perf. criteria A</td>
<td>EN 61000-4-2, ±6 kV, perf. criteria A</td>
<td>EN 61000-4-3, 20 V/m, perf. criteria A</td>
<td>EN 61000-4-4, ±2 kV, perf. criteria A</td>
<td>EN 61000-4-5, ±2 kV, perf. criteria A</td>
</tr>
<tr>
<td>RF Electromagnetic Field Contact</td>
<td>EN 61000-4-2, +8 kV, perf. criteria A</td>
<td>EN 61000-4-2, +6 kV, perf. criteria A</td>
<td>EN 61000-4-3, 20 V/m, perf. criteria A</td>
<td>EN 61000-4-4, +2 kV, perf. criteria A</td>
<td>EN 61000-4-5, +2 kV, perf. criteria A</td>
</tr>
</tbody>
</table>

External filter proposal: [www.tracopower.com/overview/tep200uir](http://www.tracopower.com/overview/tep200uir)

<table>
<thead>
<tr>
<th>Conducted RF Disturbances Continuous</th>
<th>EN 61000-4-6, 10 Vrms, perf. criteria A</th>
<th>EN 61000-4-8, 100 A/m, perf. criteria A</th>
<th>1 s: EN 61000-4-8, 1000 A/m, perf. criteria A</th>
</tr>
</thead>
</table>

## General Specifications

<table>
<thead>
<tr>
<th>Relative Humidity</th>
<th>95% max. (non condensing)</th>
</tr>
</thead>
</table>

### Temperature Ranges

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

### Power Derating

- High Temperature: Depending on model

See application note: [www.tracopower.com/overview/tep200uir](http://www.tracopower.com/overview/tep200uir)

### Over Temperature Protection Switch Off

- Protection Mode: 115°C typ. (Automatic: recovery at 100°C typ.)
- Measurement Point: Base-Plate

### Cooling System

- Natural convection (20 LFM)

### Sense Function

- 10% max. of Vout nom. (If sense function is not used, sense pins must be connected to corresponding polarity output pins.)

### Remote Control

- Voltage Controlled Remote (passive = on)
- Off Idle Input Current
- Remote Pin Input Current

- On: 3.0 to 12 VDC or open circuit
- Off: 0 to 1.2 VDC or short circuit
- Refers to 'Remote' and 'Vin' Pin
  - 15 mA typ.
  - 0.5 to 1.0 mA
  - Optional models with inverse Remote On/Off function (passive = off)

### Altitude During Operation

- 5'000 m max.

### Regulator Topology

- Soft switch half bridge Converter

### Switching Frequency

- 189 - 231 kHz (PWM)
- 210 kHz typ. (PWM)

### Insulation System

- Reinforced Insulation

### Working Voltage (rated)

- 166 VAC

### Isolation Test Voltage

- Input to Output, 60 s: 3'000 VAC
- Input to Case, 60 s: 1'500 VAC (where case is the baseplate)
- Output to Case, 60 s: 1'500 VAC (where case is the baseplate)

### Isolation Resistance

- Input to Output, 500 VDC: 1'000 MΩ min.

### Isolation Capacitance

- Input to Output, 100 kHz, 1 V: 1'000 pF typ.

### Distance Through Isolation

- 0.4 mm

### Reliability

- Calculated MTBF: 230'000 h [MIL-HDBK-217F, ground benign]

### Washing Process


All specifications valid at nominal voltage, resistive full load and +25°C after warm-up time, unless otherwise stated.
**Environment**
- **Vibration**
  - MIL-STD-810F
  - EN 61373
  - 7.6 g, 3 axis, 60 min, 20-2000 Hz
  - 7.7 g, 3 axis, random waveform, 60 min
- **Mechanical Shock**
  - MIL-STD-810F
  - EN 61373
  - 50 g, 3 axis, terminal peak sawtooth, 11 ms
- **Thermal Shock**
  - MIL-STD-810F
  - -55°C to +125°C, 72 cycles, 30 min each
- **Flammability**
  - EN 61373
  - 7.7 g, 3 axis, random waveform, 60 min

**Housing Material**
- Alu base-plate w. plastic case

**Isolation Frame Material**
- Non-conductive Plastic (UL 94 V-0 rated)

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

**Pin Material**
- Tinned Copper

**Pin Foundation Plating**
- Nickel (3 - 5 µm)

**Pin Surface Plating**
- Tin (5 - 7 µm), matte

**Housing Type**
- Plastic Case

**Mounting Type**
- PCB Mount

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

**Footprint Type**
- Half-Brick

**Soldering Profile**
- Lead-Free Wave Soldering
- 260°C / 4 s max.

**Weight**
- 113 g

**Thermal Impedance**
- Case to Ambient
  - 6.1 K/W typ. (without heatsink)
  - 4.6 K/W (with heatsink TEP-HS6)
  - 3.7 K/W (with heatsink TEP-HS7)

**Environmental Compliance**
- **REACH Declaration**
  - www.tracopower.com/info/reach-declaration.pdf
  - REACH SVHC list compliant
  - REACH Annex XVII compliant
- **RoHS Declaration**
  - www.tracopower.com/info/rohs-declaration.pdf
  - Exemptions: 7a, 7c-I
  - (RoHS exemptions refer to the component concentration only, not to the overall concentration in the product (O5A rule))
- **SCIP Reference Number**
  - 593e408b-5a6d-4a90-8906-9ca2ff3fac8c

### Supporting Documents

**Overview Link**
- for additional Documents
  - www.tracopower.com/overview/tep200uir

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

**Pinout**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Function</th>
<th>Pin Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(-\text{Vin (GND)})</td>
<td>1.0 (0.04)</td>
</tr>
<tr>
<td>2</td>
<td>Bus</td>
<td>1.0 (0.04)</td>
</tr>
<tr>
<td>3</td>
<td>Remote On/Off (Ctrl)</td>
<td>1.0 (0.04)</td>
</tr>
<tr>
<td>4</td>
<td>(+\text{Vin (Vcc)})</td>
<td>1.0 (0.04)</td>
</tr>
<tr>
<td>5</td>
<td>(-\text{Vout})</td>
<td>2.0 (0.08)</td>
</tr>
<tr>
<td>6</td>
<td>(-\text{Sense})</td>
<td>1.0 (0.04)</td>
</tr>
<tr>
<td>7</td>
<td>Trim</td>
<td>1.0 (0.04)</td>
</tr>
<tr>
<td>8</td>
<td>(+\text{Sense})</td>
<td>1.0 (0.04)</td>
</tr>
<tr>
<td>9</td>
<td>(+\text{Vout})</td>
<td>2.0 (0.08)</td>
</tr>
<tr>
<td>10</td>
<td>UVLO</td>
<td>1.0 (0.04)</td>
</tr>
<tr>
<td>11</td>
<td>Pulse Out</td>
<td>1.0 (0.04)</td>
</tr>
</tbody>
</table>

Important: A capacitor 150 \(\mu\)F / 200 V must be connected between BUS pin and \(-\text{Vin}\).

For more details regarding BUS Pin, Under Voltage Lockout (UVLO) and Pulse Out see application notes on [www.tracopower.com](http://www.tracopower.com).

Dimensions in mm (inch)

<table>
<thead>
<tr>
<th>Tolerances</th>
<th>Pin</th>
<th>Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\pm 0.50)</td>
<td>(x.xx)</td>
<td>0.25</td>
</tr>
<tr>
<td>(\pm 0.25)</td>
<td>(x.xx)</td>
<td>0.10</td>
</tr>
</tbody>
</table>

Pin dimension tolerance: \(\pm 0.10\) (\(\pm 0.004\))

Screw lock torque: Max. 0.34 Nm (3.5 kgfcm)