DC/DC Railway Converter

TEN 20WIRH Series, 20 Watt

- Fully encapsulated 1”x1.6” package
- 3000 VAC I/O isolation (reinforced)
- 4:1 input voltage range: 36 – 160 VDC
- EN 50155 and EN 61373 certified
- Internal class A EMI filter
- -40°C up to +75°C without derating
- EN 45545-2 fire behavior
- Remote on/off function
- Undervoltage lockout (UVLO), short-circuit protection (SCP), overtemperature protection (OTP), and overvoltage protection (OVP)
- 3-year product warranty

The TEN 20WIRH is a series of 20 watt railway-certified DC/DC converters with reinforced I/O isolation for highest reliability in harsh environments. The proven and certified design guarantees highest resistance against thermal shocks, moisture, mechanical shocks, and vibration. The TEN 20WIRH comes with additional EN 62368-1 safety approvals for IT equipment and EN 45545-2 certification for fire behavior. Thanks to its favorable operating temperature range of -40°C to +75°C without derating (depending on the model), the TEN 20WIRH presents a first choice for demanding applications.

<table>
<thead>
<tr>
<th>Models</th>
<th>Input Voltage Range</th>
<th>Output 1</th>
<th>Output 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vnom</td>
<td>Imax</td>
<td>Vnom</td>
</tr>
<tr>
<td>TEN 20-11011WIRH</td>
<td>5.1 VDC</td>
<td>4'000 mA</td>
<td></td>
</tr>
<tr>
<td>TEN 20-11012WIRH</td>
<td>12 VDC</td>
<td>1'670 mA</td>
<td></td>
</tr>
<tr>
<td>TEN 20-11013WIRH</td>
<td>15 VDC</td>
<td>1'330 mA</td>
<td></td>
</tr>
<tr>
<td>TEN 20-11015WIRH</td>
<td>24 VDC</td>
<td>833 mA</td>
<td></td>
</tr>
<tr>
<td>TEN 20-11021WIRH</td>
<td>+5 VDC</td>
<td>2'000 mA</td>
<td>–5 VDC</td>
</tr>
<tr>
<td>TEN 20-11022WIRH</td>
<td>+12 VDC</td>
<td>833 mA</td>
<td>–12 VDC</td>
</tr>
<tr>
<td>TEN 20-11023WIRH</td>
<td>+15 VDC</td>
<td>667 mA</td>
<td>–15 VDC</td>
</tr>
</tbody>
</table>

Options

- Optional models with inverse remote on/off function (passiv = off)

www.tracopower.com

October 19, 2021
### Input Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Current - At no load</td>
<td>10 mA typ.</td>
</tr>
<tr>
<td>Surge Voltage</td>
<td>200 VDC max. (1 s max.)</td>
</tr>
<tr>
<td>Input Inrush Current</td>
<td>50 A typ.</td>
</tr>
<tr>
<td>Start-up Voltage</td>
<td>36 VDC</td>
</tr>
<tr>
<td>Under Voltage Lockout</td>
<td>32 VDC min. / 34 VDC typ. / 35.8 VDC max.</td>
</tr>
<tr>
<td>Recommended Input Fuse</td>
<td>1'000 mA (Slow blow)</td>
</tr>
<tr>
<td>(The need of an external fuse has to be assessed in the final application)</td>
<td></td>
</tr>
<tr>
<td>Input Filter</td>
<td>Internal Pt-Type</td>
</tr>
</tbody>
</table>

### Output Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output Voltage Adjustment</strong></td>
<td>±10% (1.1, 12 Vout single models)</td>
</tr>
<tr>
<td>- Input Variation (Vmin - Vmax)</td>
<td>single output models: 0.2% max.</td>
</tr>
<tr>
<td></td>
<td>dual output models: 0.2% max.</td>
</tr>
<tr>
<td>- Load Variation (0 - 100%)</td>
<td>single output models: 0.5% max.</td>
</tr>
<tr>
<td></td>
<td>dual output models: 1% max. (Output 1)</td>
</tr>
<tr>
<td></td>
<td>dual output models: 1% max. (Output 2)</td>
</tr>
<tr>
<td>- Voltage Balance (symmetrical load)</td>
<td>dual output models: 2% max.</td>
</tr>
<tr>
<td>- Cross Regulation (25% / 100% asym. load)</td>
<td>dual output models: 5% max.</td>
</tr>
<tr>
<td><strong>Ripple and Noise</strong></td>
<td></td>
</tr>
<tr>
<td>(20 MHz Bandwidth)</td>
<td></td>
</tr>
<tr>
<td>- single output:</td>
<td>5.1 Vout models: 75 mVp-p typ. (w/ 1 µF, 50 V, X7R)</td>
</tr>
<tr>
<td></td>
<td>12 Vout models: 100 mVp-p typ. (w/ 1 µF, 50 V, X7R)</td>
</tr>
<tr>
<td></td>
<td>15 Vout models: 100 mVp-p typ. (w/ 1 µF, 50 V, X7R)</td>
</tr>
<tr>
<td></td>
<td>24 Vout models: 150 mVp-p typ. (w/ 1 µF, 50 V, X7R)</td>
</tr>
<tr>
<td>- dual output:</td>
<td>5 / -5 Vout models: 75 / 75 mVp-p typ. (w/ 1 µF, 50 V, X7R)</td>
</tr>
<tr>
<td></td>
<td>12 / -12 Vout models: 100 / 100 mVp-p typ. (w/ 1 µF, 50 V, X7R)</td>
</tr>
<tr>
<td></td>
<td>15 / -15 Vout models: 100 / 100 mVp-p typ. (w/ 1 µF, 50 V, X7R)</td>
</tr>
<tr>
<td><strong>Capacitive Load</strong></td>
<td></td>
</tr>
<tr>
<td>- single output:</td>
<td>5.1 Vout models: 5'000 µF max.</td>
</tr>
<tr>
<td></td>
<td>12 Vout models: 850 µF max.</td>
</tr>
<tr>
<td></td>
<td>15 Vout models: 700 µF max.</td>
</tr>
<tr>
<td></td>
<td>24 Vout models: 220 µF max.</td>
</tr>
<tr>
<td>- dual output:</td>
<td>5 / -5 Vout models: 2'500 / 2'500 µF max.</td>
</tr>
<tr>
<td></td>
<td>12 / -12 Vout models: 500 / 500 µF max.</td>
</tr>
<tr>
<td></td>
<td>15 / -15 Vout models: 350 / 350 µF max.</td>
</tr>
<tr>
<td><strong>Minimum Load</strong></td>
<td>Not required</td>
</tr>
<tr>
<td><strong>Temperature Coefficient</strong></td>
<td>±0.02 %/K max.</td>
</tr>
<tr>
<td><strong>Start-up Time</strong></td>
<td>30 ms typ. / 60 ms max.</td>
</tr>
<tr>
<td><strong>Short Circuit Protection</strong></td>
<td>Continuous, Automatic recovery</td>
</tr>
<tr>
<td><strong>Output Current Limitation</strong></td>
<td>150% typ. of Iout max.</td>
</tr>
<tr>
<td><strong>Overvoltage Protection</strong></td>
<td>126% typ. of Vout nom. (depending on model)</td>
</tr>
<tr>
<td>6.2 VDC typ. (5.1 Vout model)</td>
<td>15 VDC typ. (12 Vout model)</td>
</tr>
<tr>
<td>20 VDC typ. (15 Vout model)</td>
<td>30 VDC typ. (24 Vout model) (by Zener diode)</td>
</tr>
</tbody>
</table>

All specifications valid at nominal voltage, resistive full load and +25°C after warm-up time, unless otherwise stated.
## Transient Response
- Peak Variation: 320 mV typ. / 400 mV max. (75% to 100% Load Step)
- Response Time: 250 µs typ. / 300 µs max. (75% to 100% Load Step)

## Safety Specifications
### Safety Standards
- IT / Multimedia Equipment: EN 62368-1
- IEC 62368-1
- UL 62368-1
- Railway Applications: EN 50155
- Certification Documents: www.tracopower.com/overview/ten20wirh

### Pollution Degree
PD 2

### Over Voltage Category
OVC II

## EMC Specifications
### EMI Emissions
- Conducted Emissions: EN 55032 class A (internal filter), EN 55032 class B (with external filter)
- Radiated Emissions: EN 55032 class A (internal filter), EN 55032 class B (with external filter)

### 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
  - 20 V/m, perf. criteria A
- EFT (Burst) / Surge
  - ±2 kV, perf. criteria A
- Conducted RF Disturbances
  - Ext. input component: 2x 220 µF, 200 V, KXJ \( \times \) SMDJ170A
- PF Magnetic Field
  - Continuous: EN 61000-4-6, 10 Vrms, perf. criteria A
  - 1 s: EN 61000-4-6, 100 A/m, perf. criteria A

### General Specifications
#### Relative Humidity
95% max. (non condensing)

#### Temperature Ranges
- Operating Temperature: \(-40^\circ\text{C}\) to \(+85^\circ\text{C}\)
- Case Temperature: \(+105^\circ\text{C}\) max.
- Storage Temperature: \(-55^\circ\text{C}\) to \(+125^\circ\text{C}\)

#### Power Derating
- High Temperature
  - See application note: www.tracopower.com/overview/ten20wirh

#### Over Temperature Protection Switch Off
- Protection Mode: 115°C typ. (Automatic recovery)
- Measurement Point: Case

#### Cooling System
Natural convection (20 LFM)

#### 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
  - 3 mA typ. / 3.5 mA max. (Optional models with inverse logic (passiv = off) available)

#### Altitude During Operation
5’000 m max.

#### Switching Frequency
- 250 - 310 kHz (PWM)
- 275 kHz typ. (PWM)

#### Insulation System
Reinforced Insulation

#### Working Voltage (rated)
182 VAC

All specifications valid at nominal voltage, resistive full load and +25°C after warm-up time, unless otherwise stated.
### Isolation Test Voltage
- Input to Output, 60 s: 3'000 VAC
- Input to Case, 60 s: 3'000 VAC
- Output to Case, 60 s: 2'000 VAC

### Creepage
- Input to Output: 4.5 mm min.

### Clearance
- Input to Output: 4.5 mm min.

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

### Creepage
- Input to Output: 4.5 mm min.

### Isolation Capacitance
- Input to Output, 100 kHz, 1 V:
  - 650 pF typ.
  - 1'000 pF max.

### Reliability
- Calculated MTBF: 1'558'000 h (MIL-HDBK-217F, ground benign)

### Washing Process
- Allowed (hermetical product)
- Baking after washing: 100°C for 45 min

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

### Housing Material
- Non-conductive Plastic (UL 94 V-0 rated)

### Base 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 [2 - 3 µm]

### Pin Surface Plating
- Tin [3 - 5 µm], matte

### Soldering Profile
- Wave Soldering
  - 260°C / 6 s max.

### Connection Type
- THD

### Weight
- 24 g

### Thermal Impedance
- 11.5 K/W

### Environmental Compliance
- **REACH Declaration**
  - www.tracopower.com/info/reach-declaration.pdf
  - REACH SVHC list compliant
  - REACH Annex XVII compliant
  - 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). The SCIP number is provided on request.)

- **Flammability (EN 45545-2)**

### Supporting Documents

**Overview Link** (for additional Documents)

www.tracopower.com/overview/ten20wirh

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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

All dimension in mm (inch)
Tolerance: X.X ±0.5 (X.XX ±0.02)
X.XX ±0.25 (X.XXX ±0.010)
Pin dimension tolerance ±0.10 (±0.004)

Pinout

<table>
<thead>
<tr>
<th>Pin</th>
<th>Single</th>
<th>Dual</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+ Vin</td>
<td>+ Vin</td>
</tr>
<tr>
<td>2</td>
<td>- Vin</td>
<td>- Vin</td>
</tr>
<tr>
<td>3</td>
<td>Ctrl</td>
<td>Ctrl</td>
</tr>
<tr>
<td>4</td>
<td>+ Vout</td>
<td>+ Vout</td>
</tr>
<tr>
<td>5</td>
<td>- Vout</td>
<td>Common</td>
</tr>
<tr>
<td>6</td>
<td>Trim</td>
<td>- Vout</td>
</tr>
</tbody>
</table>

NC = not connected