

## DC/DC Railway Converter

## TMR 10WIR Series, 10 Watt

- Compact SIP-8 metal case
- EN 50155 and EN 61373 approval for railway applications
- Qualification for fire behavior according to EN 45545-2
- Wide 4:1 input voltage: 9-36, 18-75, 36-160 VDC
- Operating temperature range -40 to +75 °C without derating
- High efficiency up to 89%
- 3000 VDC I/O-isolation
- Protection against overload, and short circuit
- Remote On/Off function
- 3-year product warranty



The TMR 10WIR series is a family of ruggedized 10 Watt DC/DC converters for highest reliability in harsh environments. The converters have a wide 4:1 input range and increased resistance against electromagnetic interference, shock/vibration and thermal shock and come in a SIP-8 metal package. The innovative design provides high efficiencies up to 89% and thus enable an operating temperature range from -40 up to +75°C without derating. The approvals according to standards EN 50155 and EN 61373 qualify them for railway and transportation systems. Additional qualification for the fire behavior of components according to EN 45545-2 and the safety approval according IEC/- EN62368-1, UL62368-1 support a potential compliance test of the application. Built-in features like input under-voltage-lockout, short circuit protection and remote On/Off make this series suitable for almost any application demands and thus facilitate the design-in process.

| Models         |                                |          |                  |          |                  |                 |
|----------------|--------------------------------|----------|------------------|----------|------------------|-----------------|
| Order Code     | Input Voltage Range            | Output 1 |                  | Output 2 |                  | Efficiency typ. |
|                |                                | Vnom     | I <sub>max</sub> | Vnom     | I <sub>max</sub> |                 |
| TMR 10-2410WIR | 9 - 36 VDC<br>(24 VDC nom.)    | 3.3 VDC  | 2'500 mA         |          |                  | 87 %            |
| TMR 10-2411WIR |                                | 5 VDC    | 2'000 mA         |          |                  | 88 %            |
| TMR 10-2412WIR |                                | 12 VDC   | 840 mA           |          |                  | 89 %            |
| TMR 10-2413WIR |                                | 15 VDC   | 670 mA           |          |                  | 89 %            |
| TMR 10-2415WIR |                                | 24 VDC   | 420 mA           |          |                  | 89 %            |
| TMR 10-2421WIR |                                | +5 VDC   | 1'000 mA         | -5 VDC   | 1'000 mA         | 86 %            |
| TMR 10-2422WIR |                                | +12 VDC  | 420 mA           | -12 VDC  | 420 mA           | 89 %            |
| TMR 10-2423WIR |                                | +15 VDC  | 336 mA           | -15 VDC  | 336 mA           | 89 %            |
| TMR 10-4810WIR | 18 - 75 VDC<br>(48 VDC nom.)   | 3.3 VDC  | 2'500 mA         |          |                  | 87 %            |
| TMR 10-4811WIR |                                | 5 VDC    | 2'000 mA         |          |                  | 88 %            |
| TMR 10-4812WIR |                                | 12 VDC   | 840 mA           |          |                  | 89 %            |
| TMR 10-4813WIR |                                | 15 VDC   | 670 mA           |          |                  | 89 %            |
| TMR 10-4815WIR |                                | 24 VDC   | 420 mA           |          |                  | 89 %            |
| TMR 10-4821WIR |                                | +5 VDC   | 1'000 mA         | -5 VDC   | 1'000 mA         | 86 %            |
| TMR 10-4822WIR |                                | +12 VDC  | 420 mA           | -12 VDC  | 420 mA           | 89 %            |
| TMR 10-4823WIR |                                | +15 VDC  | 336 mA           | -15 VDC  | 336 mA           | 89 %            |
| TMR 10-7210WIR | 40 - 160 VDC<br>(110 VDC nom.) | 3.3 VDC  | 2'500 mA         |          |                  | 86 %            |
| TMR 10-7211WIR |                                | 5 VDC    | 2'000 mA         |          |                  | 87 %            |
| TMR 10-7212WIR |                                | 12 VDC   | 840 mA           |          |                  | 88 %            |
| TMR 10-7213WIR |                                | 15 VDC   | 670 mA           |          |                  | 88 %            |
| TMR 10-7215WIR |                                | 24 VDC   | 420 mA           |          |                  | 88 %            |
| TMR 10-7221WIR |                                | +5 VDC   | 1'000 mA         | -5 VDC   | 1'000 mA         | 85 %            |
| TMR 10-7222WIR |                                | +12 VDC  | 420 mA           | -12 VDC  | 420 mA           | 88 %            |
| TMR 10-7223WIR |                                | +15 VDC  | 336 mA           | -15 VDC  | 336 mA           | 88 %            |

## Input Specifications

|                        |              |                                 |                                                                             |
|------------------------|--------------|---------------------------------|-----------------------------------------------------------------------------|
| Input Current          | - At no load | 24 Vin models:                  | 8 mA typ.                                                                   |
|                        |              | 48 Vin models:                  | 4 mA typ.                                                                   |
|                        |              | 110 Vin models:                 | 4 mA typ. (3.3 Vout model)                                                  |
|                        |              |                                 | 3 mA typ. (5 Vout model)                                                    |
|                        |              |                                 | 3 mA typ. (12 Vout model)                                                   |
|                        |              |                                 | 3 mA typ. (15 Vout model)                                                   |
|                        |              |                                 | 3 mA typ. (24 Vout model)                                                   |
|                        |              |                                 | 3 mA typ. (5 / -5 Vout model)                                               |
|                        |              | 3 mA typ. (12 / -12 Vout model) |                                                                             |
|                        |              | 3 mA typ. (15 / -15 Vout model) |                                                                             |
| Surge Voltage          |              | 24 Vin models:                  | 50 VDC max. (1 s max.)                                                      |
|                        |              | 48 Vin models:                  | 100 VDC max. (1 s max.)                                                     |
|                        |              | 110 Vin models:                 | 200 VDC max. (1 s max.)                                                     |
| Under Voltage Lockout  |              | 24 Vin models:                  | 6.2 VDC min. / 7.2 VDC typ. / 8.2 VDC max.                                  |
|                        |              | 48 Vin models:                  | 12.5 VDC min. / 14.5 VDC typ. / 16.4 VDC max.                               |
|                        |              | 110 Vin models:                 | 31.8 VDC min. / 33.8 VDC typ. / 35.6 VDC max.                               |
| Recommended Input Fuse |              | 24 Vin models:                  | 2'000 mA (slow blow)                                                        |
|                        |              | 48 Vin models:                  | 1'250 mA (slow blow)                                                        |
|                        |              | 110 Vin models:                 | 630 mA (slow blow)                                                          |
|                        |              |                                 | (The need of an external fuse has to be assessed in the final application.) |
| Input Filter           |              |                                 | Internal Capacitor                                                          |

## Output Specifications

|                                        |                                      |                       |                                |
|----------------------------------------|--------------------------------------|-----------------------|--------------------------------|
| Voltage Set Accuracy                   |                                      |                       | ±1% max.                       |
| Regulation                             | - Input Variation (Vmin - Vmax)      | single output models: | 0.2% max.                      |
|                                        |                                      | dual output models:   | 0.5% max.                      |
|                                        | - Load Variation (0 - 100%)          | single output models: | 0.5% max.                      |
|                                        |                                      | dual output models:   | 1% max. (Output 1)             |
|                                        |                                      |                       | 1% max. (Output 2)             |
|                                        | - Voltage Balance (symmetrical load) | dual output models:   | 5% max.                        |
| Ripple and Noise<br>(20 MHz Bandwidth) | - single output                      | 3.3 Vout models:      | 75 mVp-p max. (w/ 1 µF)        |
|                                        |                                      | 5 Vout models:        | 75 mVp-p max. (w/ 1 µF)        |
|                                        |                                      | 12 Vout models:       | 100 mVp-p max. (w/ 1 µF)       |
|                                        |                                      | 15 Vout models:       | 100 mVp-p max. (w/ 1 µF)       |
|                                        |                                      | 24 Vout models:       | 100 mVp-p max. (w/ 1 µF)       |
|                                        | - dual output                        | 5 / -5 Vout models:   | 75 / 75 mVp-p max. (w/ 1 µF)   |
|                                        |                                      | 12 / -12 Vout models: | 100 / 100 mVp-p max. (w/ 1 µF) |
|                                        |                                      | 15 / -15 Vout models: | 100 / 100 mVp-p max. (w/ 1 µF) |
|                                        | - single output                      | 3.3 Vout models:      | 45 mVp-p typ. (w/ 1 µF)        |
|                                        |                                      | 5 Vout models:        | 45 mVp-p typ. (w/ 1 µF)        |
|                                        |                                      | 12 Vout models:       | 70 mVp-p typ. (w/ 1 µF)        |
|                                        |                                      | 15 Vout models:       | 70 mVp-p typ. (w/ 1 µF)        |
|                                        |                                      | 24 Vout models:       | 70 mVp-p typ. (w/ 1 µF)        |
|                                        | - dual output                        | 5 / -5 Vout models:   | 45 / 45 mVp-p typ. (w/ 1 µF)   |
|                                        |                                      | 12 / -12 Vout models: | 70 / 70 mVp-p typ. (w/ 1 µF)   |
|                                        |                                      | 15 / -15 Vout models: | 70 / 70 mVp-p typ. (w/ 1 µF)   |

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

|                           |                 |                                                                                                                                                                                                             |
|---------------------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Capacitive Load           | - single output | 3.3 Vout models: 3'700 $\mu$ F max.<br>5 Vout models: 1'800 $\mu$ F max.<br>12 Vout models: 700 $\mu$ F max.<br>15 Vout models: 680 $\mu$ F max.<br>24 Vout models: 330 $\mu$ F max.                        |
|                           | - dual output   | 5 / -5 Vout models: 1'100 / 1'100 $\mu$ F max.<br>12 / -12 Vout models: 580 / 580 $\mu$ F max.<br>15 / -15 Vout models: 300 / 300 $\mu$ F max.                                                              |
| 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             |                 | 45 ms typ. / 75 ms max.                                                                                                                                                                                     |
| Short Circuit Protection  |                 | Continuous, Automatic recovery                                                                                                                                                                              |
| Output Current Limitation |                 | 160% typ. of Iout max.                                                                                                                                                                                      |
| Transient Response        | - Response Time | 250 $\mu$ s typ. (25% Load Step)                                                                                                                                                                            |

## Safety Specifications

|                       |                                                     |                                                                                                            |
|-----------------------|-----------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| Standards             | - IT / Multimedia Equipment                         | EN 62368-1<br>IEC 62368-1<br>UL 62368-1                                                                    |
|                       | - Railway Applications<br>- Certification Documents | EN 50155<br><a href="http://www.tracopower.com/overview/tmr10wir">www.tracopower.com/overview/tmr10wir</a> |
| Pollution Degree      |                                                     | PD 2                                                                                                       |
| Over Voltage Category |                                                     | Not mains connected                                                                                        |

## EMC Specifications

|                     |                                                     |                                                                                                                                                                                                                                                                |
|---------------------|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EMI (Emissions)     | - Conducted Emissions                               | EN 50121-3-2 (EMC for Rolling Stock)<br>EN 55032 class A (with external filter)<br>EN 55032 class B (with external filter)                                                                                                                                     |
|                     | - Radiated Emissions                                | EN 55032 class A (with external filter)<br>EN 55032 class B (with external filter)<br>External filter proposal: <a href="http://www.tracopower.com/overview/tmr10wir">www.tracopower.com/overview/tmr10wir</a>                                                 |
| EMS (Immunity)      | - Electrostatic Discharge                           | EN 50121-3-2 (EMC for Rolling Stock)<br>EN 55035 (Multimedia)<br>Air: EN 61000-4-2, $\pm 8$ kV, perf. criteria A<br>Contact: EN 61000-4-2, $\pm 6$ kV, perf. criteria A                                                                                        |
|                     | - RF Electromagnetic Field<br>- EFT (Burst) / Surge | 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<br>External filter proposal: <a href="http://www.tracopower.com/overview/tmr10wir">www.tracopower.com/overview/tmr10wir</a> |
|                     | - Conducted RF Disturbances                         | EN 61000-4-6, 10 Vrms, perf. criteria A                                                                                                                                                                                                                        |
|                     | - PF Magnetic Field                                 | Continuous: 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/tmr10wir">www.tracopower.com/overview/tmr10wir</a>                                                                                                                                                                 |

## 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      | Depending on model<br>(For ideal temperature behaviour, use suggested PCB layout from application note.)<br>See application note: <a href="http://www.tracopower.com/overview/tmr10wir">www.tracopower.com/overview/tmr10wir</a> |

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

|                           |                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cooling System            |                                                                                                                                                                    | Natural convection (20 LFM)                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Remote Control            | <ul style="list-style-type: none"> <li>- Voltage Controlled Remote (passive = on)</li> <li>- Off Idle Input Current</li> <li>- Remote Pin Input Current</li> </ul> | Off: 3 to 12 VDC<br>Refers to 'Remote' and '-Vin' Pin<br>On: 0 to 0.8 VDC or open circuit<br>2.5 mA typ.<br>0.5 to 2.5 mA                                                                                                                                                                                                                                                                                                                                                                     |
| Altitude During Operation |                                                                                                                                                                    | 5'000 m max.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Regulator Topology        |                                                                                                                                                                    | Flyback Converter                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Switching Frequency       |                                                                                                                                                                    | 250 - 520 kHz (PWM)<br>365 kHz typ. (PWM)                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Insulation System         |                                                                                                                                                                    | Functional Insulation                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Isolation Test Voltage    | <ul style="list-style-type: none"> <li>- Input to Output, 60 s</li> <li>- Input to Case, 60 s</li> <li>- Output to Case, 60 s</li> </ul>                           | 3'000 VDC (110 Vin models)<br>2'250 VDC (other models)<br>1'500 VDC<br>1'500 VDC                                                                                                                                                                                                                                                                                                                                                                                                              |
| Isolation Resistance      | - Input to Output, 500 VDC                                                                                                                                         | 1'000 MΩ min.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Isolation Capacitance     | - Input to Output, 100 kHz, 1 V                                                                                                                                    | 600 pF max.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Reliability               | - Calculated MTBF                                                                                                                                                  | 2'605'000 h (MIL-HDBK-217F, ground benign)                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Washing Process           |                                                                                                                                                                    | Not allowed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Environment               | <ul style="list-style-type: none"> <li>- Vibration</li> <li>- Mechanical Shock</li> <li>- Thermal Shock</li> <li>- Flammability</li> </ul>                         | MIL-STD-810F<br>EN 61373<br>MIL-STD-810F<br>EN 61373<br>MIL-STD-810F<br>EN 45545-2<br><a href="http://www.tracopower.com/info/en45545-declaration.pdf">www.tracopower.com/info/en45545-declaration.pdf</a>                                                                                                                                                                                                                                                                                    |
| Housing Material          |                                                                                                                                                                    | Copper                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Potting Material          |                                                                                                                                                                    | Silicone (UL 94 V-0 rated)                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Pin Material              |                                                                                                                                                                    | Brass (C2680-H)                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Pin Foundation Plating    |                                                                                                                                                                    | Nickel (1 - 2 μm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Foundation Plating        |                                                                                                                                                                    | Nickel (2.5 - 3 μm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Pin Surface Plating       |                                                                                                                                                                    | Tin (3 - 5 μm), matte                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Housing Type              |                                                                                                                                                                    | Metal Case                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Mounting Type             |                                                                                                                                                                    | PCB Mount                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Connection Type           |                                                                                                                                                                    | THD (Through-Hole Device)                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Footprint Type            |                                                                                                                                                                    | SIP8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Soldering Profile         |                                                                                                                                                                    | Lead-Free Wave Soldering<br>260°C / 6 s max.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Weight                    |                                                                                                                                                                    | 7.7 g                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Thermal Impedance         | - Case to Ambient                                                                                                                                                  | 25 K/W typ.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Environmental Compliance  | <ul style="list-style-type: none"> <li>- REACH Declaration</li> <li>- RoHS Declaration</li> <li>- SCIP Reference Number</li> </ul>                                 | <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<br><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).)<br>ded6012d-3761-48fe-9631-a4fd4bfaafea |

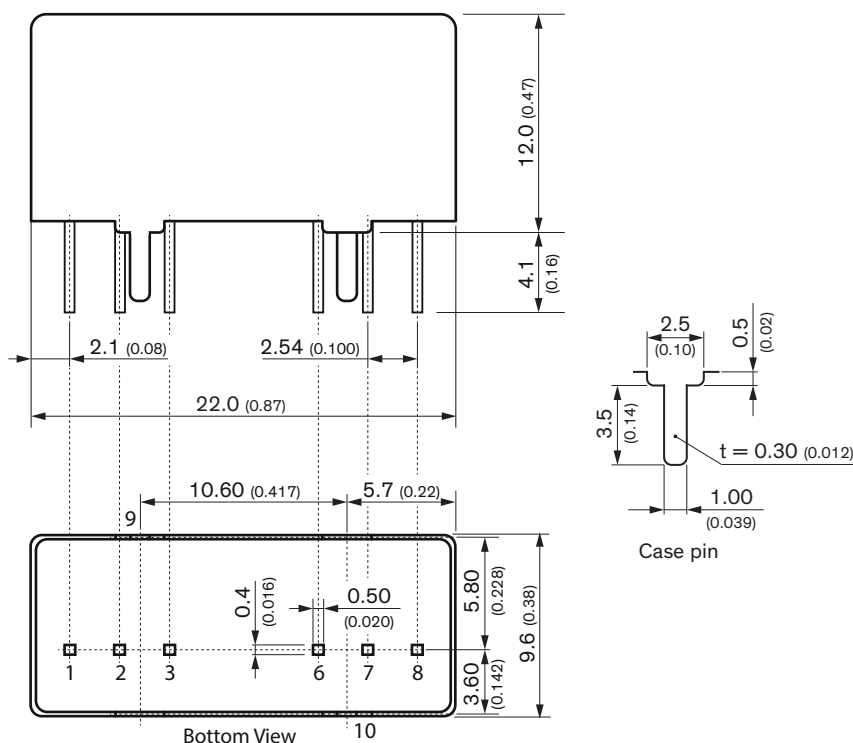
## Supporting Documents

Overview Link (for additional Documents)

[www.tracopower.com/overview/tmr10wir](http://www.tracopower.com/overview/tmr10wir)

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

### Outline Dimensions

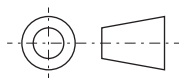


Dimensions in mm (inch)

Tolerances: x.x  $\pm 0.5$  (x.xx  $\pm 0.02$ )

x.xx  $\pm 0.25$  (x.xxx  $\pm 0.01$ )

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



| Pinout |               |             |
|--------|---------------|-------------|
| Pin    | Single Output | Dual Output |
| 1      | -Vin          |             |
| 2      | +Vin          |             |
| 3      | Remote On/Off |             |
| 6      | +Vout         |             |
| 7      | -Vout         | Common      |
| 8      | NC            | -Vout       |
| 9      | Case*         |             |
| 10     | Case*         |             |

NC: Not connected

\*Case pins must not be connected to any circuit.