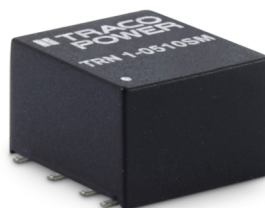


## DC/DC Converter

## TRN 1SM Series, 1 Watt

- Compact SMD package  
11,9 x 11,3 x 8,0 mm
- Fully regulated outputs
- Input Voltage range  
4.5-13.2, 9-18, 18-36, 36-75 VDC
- I/O-isolation 1'600 VDC
- Operating temperature range  
-40°C to +90°C without derating
- Short circuit protection
- Designed to meet IEC/EN/UL 62368-1  
(not certified)
- 3-year product warranty



The TRN 1SM Series comprises 1 Watt fully regulated, high performance DC/DC converters. They come in a compact cubical package of only 1.07 cm<sup>3</sup>. Full load operation is reliable up to 90°C environment temperature. With 1'600 VDC I/O isolation voltage, and short current protection they cover a wide range of application when space is limited. The input of the converters is designed for a wide voltage range (2:1) and minimum load is not required. The functional I/O-isolation system is designed to meet IEC/EN/UL 62368-1 (not certified) with a test voltage (60 s) of 1600 VDC.

### Models

| Order Code   | Input Voltage Range            | Output 1 |                  | Output 2 |                  | Efficiency typ. |
|--------------|--------------------------------|----------|------------------|----------|------------------|-----------------|
|              |                                | Vnom     | I <sub>max</sub> | Vnom     | I <sub>max</sub> |                 |
| TRN 1-0510SM | 4.5 - 13.2 VDC<br>(9 VDC nom.) | 3.3 VDC  | 300 mA           |          |                  | 77 %            |
| TRN 1-0511SM |                                | 5 VDC    | 200 mA           |          |                  | 79 %            |
| TRN 1-0512SM |                                | 12 VDC   | 90 mA            |          |                  | 81 %            |
| TRN 1-0513SM |                                | 15 VDC   | 70 mA            |          |                  | 82 %            |
| TRN 1-0515SM |                                | 24 VDC   | 45 mA            |          |                  | 83 %            |
| TRN 1-0521SM |                                | +5 VDC   | 100 mA           | -5 VDC   | 100 mA           | 79 %            |
| TRN 1-0522SM |                                | +12 VDC  | 45 mA            | -12 VDC  | 45 mA            | 83 %            |
| TRN 1-0523SM |                                | +15 VDC  | 35 mA            | -15 VDC  | 35 mA            | 80 %            |
| TRN 1-1210SM | 9 - 18 VDC<br>(12 VDC nom.)    | 3.3 VDC  | 300 mA           |          |                  | 77 %            |
| TRN 1-1211SM |                                | 5 VDC    | 200 mA           |          |                  | 80 %            |
| TRN 1-1212SM |                                | 12 VDC   | 90 mA            |          |                  | 81 %            |
| TRN 1-1213SM |                                | 15 VDC   | 70 mA            |          |                  | 83 %            |
| TRN 1-1215SM |                                | 24 VDC   | 45 mA            |          |                  | 83 %            |
| TRN 1-1221SM |                                | +5 VDC   | 100 mA           | -5 VDC   | 100 mA           | 79 %            |
| TRN 1-1222SM |                                | +12 VDC  | 45 mA            | -12 VDC  | 45 mA            | 83 %            |
| TRN 1-1223SM |                                | +15 VDC  | 35 mA            | -15 VDC  | 35 mA            | 80 %            |
| TRN 1-2410SM | 18 - 36 VDC<br>(24 VDC nom.)   | 3.3 VDC  | 300 mA           |          |                  | 77 %            |
| TRN 1-2411SM |                                | 5 VDC    | 200 mA           |          |                  | 81 %            |
| TRN 1-2412SM |                                | 12 VDC   | 90 mA            |          |                  | 82 %            |
| TRN 1-2413SM |                                | 15 VDC   | 70 mA            |          |                  | 83 %            |
| TRN 1-2415SM |                                | 24 VDC   | 45 mA            |          |                  | 82 %            |
| TRN 1-2421SM |                                | +5 VDC   | 100 mA           | -5 VDC   | 100 mA           | 79 %            |
| TRN 1-2422SM |                                | +12 VDC  | 45 mA            | -12 VDC  | 45 mA            | 82 %            |
| TRN 1-2423SM |                                | +15 VDC  | 35 mA            | -15 VDC  | 35 mA            | 80 %            |
| TRN 1-4810SM | 36 - 75 VDC<br>(48 VDC nom.)   | 3.3 VDC  | 300 mA           |          |                  | 77 %            |
| TRN 1-4811SM |                                | 5 VDC    | 200 mA           |          |                  | 78 %            |
| TRN 1-4812SM |                                | 12 VDC   | 90 mA            |          |                  | 80 %            |
| TRN 1-4813SM |                                | 15 VDC   | 70 mA            |          |                  | 81 %            |
| TRN 1-4815SM |                                | 24 VDC   | 45 mA            |          |                  | 81 %            |
| TRN 1-4821SM |                                | +5 VDC   | 100 mA           | -5 VDC   | 100 mA           | 78 %            |
| TRN 1-4822SM |                                | +12 VDC  | 45 mA            | -12 VDC  | 45 mA            | 81 %            |
| TRN 1-4823SM |                                | +15 VDC  | 35 mA            | -15 VDC  | 35 mA            | 79 %            |

## Input Specifications

|                          |              |                                                                                                                                                                                                                                                            |
|--------------------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Input Current            | - At no load | 9 Vin models: <b>35 mA typ.</b><br>12 Vin models: <b>20 mA typ.</b><br>24 Vin models: <b>10 mA typ.</b><br>48 Vin models: <b>5 mA typ.</b>                                                                                                                 |
| Surge Voltage            |              | 9 Vin models: <b>15 VDC max.</b> (1 s max.)<br>12 Vin models: <b>25 VDC max.</b> (1 s max.)<br>24 Vin models: <b>50 VDC max.</b> (1 s max.)<br>48 Vin models: <b>100 VDC max.</b> (1 s max.)                                                               |
| Reflected Ripple Current |              | <b>30 mAp-p typ.</b>                                                                                                                                                                                                                                       |
| Recommended Input Fuse   |              | 9 Vin models: <b>500 mA</b> (slow blow)<br>12 Vin models: <b>315 mA</b> (slow blow)<br>24 Vin models: <b>160 mA</b> (slow blow)<br>48 Vin models: <b>160 mA</b> (slow blow)<br>(The need of an external fuse has to be assessed in the final application.) |
| Input Filter             |              | <b>Internal Capacitor</b>                                                                                                                                                                                                                                  |

## Output Specifications

|                           |                                            |                                                                                                                                                                                              |
|---------------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Voltage Set Accuracy      |                                            | <b>±1% max.</b>                                                                                                                                                                              |
| Regulation                | - Input Variation (Vmin - Vmax)            | single output models: <b>0.2% max.</b><br>dual output models: <b>0.2% max.</b>                                                                                                               |
|                           | - Load Variation (0 - 100%)                | single output models: <b>1% max.</b><br>dual output models: <b>1% max.</b> (Output 1)<br><b>1% max.</b> (Output 2)                                                                           |
|                           | - Cross Regulation (25% / 100% asym. load) | dual output models: <b>5% max.</b>                                                                                                                                                           |
| Ripple and Noise          | - 20 MHz Bandwidth                         | <b>50 mVp-p typ.</b>                                                                                                                                                                         |
| Capacitive Load           | - single output                            | 3.3 Vout models: <b>1'680 µF max.</b><br>5 Vout models: <b>820 µF max.</b><br>12 Vout models: <b>470 µF max.</b><br>15 Vout models: <b>330 µF max.</b><br>24 Vout models: <b>160 µF max.</b> |
|                           | - dual output                              | 5 / -5 Vout models: <b>470 / 470 µF max.</b><br>12 / -12 Vout models: <b>330 / 330 µF max.</b><br>15 / -15 Vout models: <b>220 / 220 µF max.</b>                                             |
| Minimum Load              |                                            | <b>Not required</b>                                                                                                                                                                          |
| Temperature Coefficient   |                                            | <b>±0.02 %/K max.</b>                                                                                                                                                                        |
| Start-up Time             |                                            | <b>5 ms typ. / 15 ms max.</b>                                                                                                                                                                |
| Short Circuit Protection  |                                            | <b>Continuous, Automatic recovery</b>                                                                                                                                                        |
| Output Current Limitation |                                            | <b>200% typ. of Iout max.</b>                                                                                                                                                                |
| Transient Response        | - Response Deviation                       | <b>3% typ.</b> (25% Load Step)                                                                                                                                                               |
|                           | - Response Time                            | <b>500 µs typ.</b> (25% Load Step)                                                                                                                                                           |

## Safety Specifications

|                       |                             |                                                       |
|-----------------------|-----------------------------|-------------------------------------------------------|
| Standards             | - IT / Multimedia Equipment | <b>Designed for IEC/EN/UL 62368-1 (not certified)</b> |
| Over Voltage Category |                             | <b>Not mains connected</b>                            |

## EMC Specifications

|                           |                       |                                                                                                  |
|---------------------------|-----------------------|--------------------------------------------------------------------------------------------------|
| EMI (Emissions)           | - Conducted Emissions | <b>EN 55032 class A</b> (with external filter)<br><b>EN 55032 class B</b> (with external filter) |
|                           | - Radiated Emissions  | <b>EN 55032 class A</b> (with external filter)<br><b>EN 55032 class B</b> (with external filter) |
| External filter proposal: |                       | <a href="http://www.tracopower.com/trn1sm-emc-filter/">www.tracopower.com/trn1sm-emc-filter/</a> |

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

|                                                                                                                                                |                       |                                            |
|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------------------------|
| <b>EMS (Immunity)</b>                                                                                                                          |                       | EN 55024 (IT Equipment)                    |
|                                                                                                                                                |                       | EN 55035 (Multimedia)                      |
| <ul style="list-style-type: none"> <li>- Electrostatic Discharge</li> <li>- RF Electromagnetic Field</li> <li>- EFT (Burst) / Surge</li> </ul> | Air:                  | EN 61000-4-2, $\pm 8$ kV, perf. criteria A |
|                                                                                                                                                | Contact:              | EN 61000-4-2, $\pm 6$ kV, perf. criteria A |
|                                                                                                                                                |                       | EN 61000-4-3, 10 V/m, perf. criteria A     |
|                                                                                                                                                |                       | EN 61000-4-4, $\pm 2$ kV, perf. criteria A |
|                                                                                                                                                |                       | EN 61000-4-5, $\pm 1$ kV, perf. criteria A |
| <ul style="list-style-type: none"> <li>- Conducted RF Disturbances</li> <li>- PF Magnetic Field</li> </ul>                                     | Ext. input component: | Nippon chemi-con KY 220 $\mu$ F/100 V      |
|                                                                                                                                                | Continuous:           | EN 61000-4-6, 10 Vrms, perf. criteria A    |
|                                                                                                                                                | 1 s:                  | EN 61000-4-8, 100 A/m, perf. criteria A    |
|                                                                                                                                                |                       | EN 61000-4-8, 1000 A/m, perf. criteria A   |

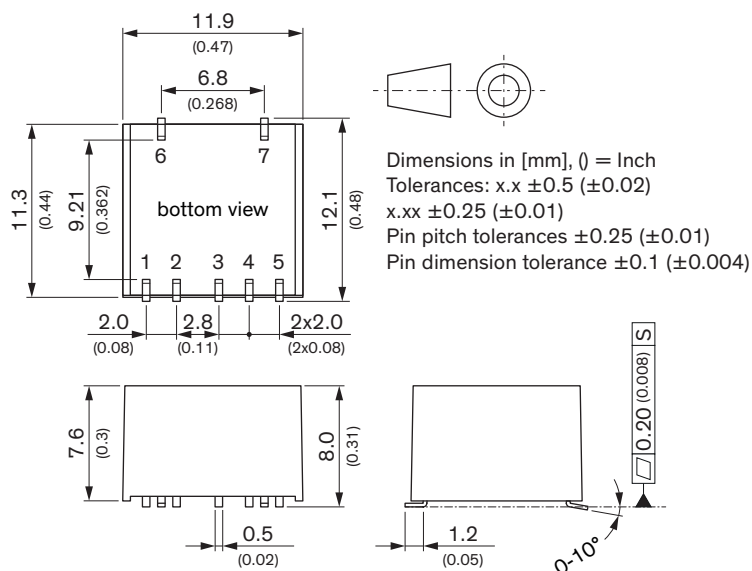
| General Specifications     |                                                                                                                                      |                                                                                                                                                      |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Relative Humidity          |                                                                                                                                      | 95% max. (non condensing)                                                                                                                            |
| Temperature Ranges         | - Operating Temperature                                                                                                              | -40°C to +90°C (without derating)                                                                                                                    |
|                            | - Case Temperature                                                                                                                   | +105°C max.                                                                                                                                          |
|                            | - Storage Temperature                                                                                                                | -55°C to +125°C                                                                                                                                      |
| Power Derating             | - High Temperature                                                                                                                   | 6.7 %/K above 90°C                                                                                                                                   |
|                            | See application note: <a href="http://www.tracopower.com/trn1sm-cc/">www.tracopower.com/trn1sm-cc/</a>                               |                                                                                                                                                      |
| Cooling System             |                                                                                                                                      | Natural convection (20 LFM)                                                                                                                          |
| Regulator Topology         |                                                                                                                                      | RCC Converter                                                                                                                                        |
| Switching Frequency        |                                                                                                                                      | 100 kHz min. (PFM)                                                                                                                                   |
| Insulation System          |                                                                                                                                      | Functional Insulation                                                                                                                                |
| Isolation Test Voltage     | - Input to Output, 60 s                                                                                                              | 1'600 VDC                                                                                                                                            |
| Isolation Resistance       | - Input to Output, 500 VDC                                                                                                           | 1'000 M $\Omega$ min.                                                                                                                                |
| Isolation Capacitance      | - Input to Output, 100 kHz, 1 V                                                                                                      | 75 pF max.                                                                                                                                           |
| Reliability                | - Calculated MTBF                                                                                                                    | 7'400'000 h (MIL-HDBK-217F, ground benign)                                                                                                           |
| Moisture Sensitivity (MSL) |                                                                                                                                      | Level 2 (J-STD-033C)                                                                                                                                 |
| Washing Process            |                                                                                                                                      | According to Cleaning Guideline<br><a href="http://www.tracopower.com/info/cleaning.pdf">www.tracopower.com/info/cleaning.pdf</a>                    |
| Environment                | - Vibration                                                                                                                          | MIL-STD-810F                                                                                                                                         |
|                            | - Thermal Shock                                                                                                                      | MIL-STD-810F                                                                                                                                         |
| Housing Material           |                                                                                                                                      | Non-conductive Plastic (UL 94 V-0 rated)                                                                                                             |
| Potting Material           |                                                                                                                                      | Epoxy (UL 94 V-0 rated)                                                                                                                              |
| Pin Material               |                                                                                                                                      | Copper                                                                                                                                               |
| Pin Foundation Plating     |                                                                                                                                      | Nickel (0.3 - 0.9 $\mu$ m)                                                                                                                           |
| Pin Surface Plating        |                                                                                                                                      | Tin (5 - 6 $\mu$ m), matte                                                                                                                           |
| Housing Type               |                                                                                                                                      | Plastic Case                                                                                                                                         |
| Mounting Type              |                                                                                                                                      | PCB Mount                                                                                                                                            |
| Connection Type            |                                                                                                                                      | SMD (Surface-Mount Device)                                                                                                                           |
| Footprint Type             |                                                                                                                                      | SMD10                                                                                                                                                |
| Soldering Profile          |                                                                                                                                      | Lead-Free Reflow Soldering (acc. J-STD-020E)                                                                                                         |
|                            |                                                                                                                                      | 245°C max. (Tc)                                                                                                                                      |
|                            |                                                                                                                                      | 30 s max. (tp, at Tp - 5°C)                                                                                                                          |
|                            |                                                                                                                                      | 90 s max. (tL, time above 217°C)                                                                                                                     |
|                            | See application note: <a href="http://www.tracopower.com/info/reflow-soldering.pdf">www.tracopower.com/info/reflow-soldering.pdf</a> |                                                                                                                                                      |
| Weight                     |                                                                                                                                      | 2.1 g                                                                                                                                                |
| Environmental Compliance   | - REACH Declaration                                                                                                                  | <a href="http://www.tracopower.com/info/reach-declaration.pdf">www.tracopower.com/info/reach-declaration.pdf</a>                                     |
|                            |                                                                                                                                      | REACH SVHC list compliant                                                                                                                            |
|                            |                                                                                                                                      | REACH Annex XVII compliant                                                                                                                           |
|                            | - RoHS Declaration                                                                                                                   | <a href="http://www.tracopower.com/info/rohs-declaration.pdf">www.tracopower.com/info/rohs-declaration.pdf</a>                                       |
|                            |                                                                                                                                      | 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                                                                                                              | a0e28475-72e6-4861-99e1-67f3154e0c90                                                                                                                 |

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

### Additional Information

|                            |                                                                                                |
|----------------------------|------------------------------------------------------------------------------------------------|
| Supporting Documents       | <a href="http://www.tracopower.com/overview/trn1sm">www.tracopower.com/overview/trn1sm</a>     |
| Frequently Asked Questions | <a href="http://www.tracopower.com/glossary-faq">www.tracopower.com/glossary-faq</a>           |
| Glossary                   | <a href="http://www.tracopower.com/info/glossary.pdf">www.tracopower.com/info/glossary.pdf</a> |
| Service Portal             | <a href="http://www.tracoserviceportal.com">www.tracoserviceportal.com</a>                     |

### Outline Dimensions



| Pinout |            |            |
|--------|------------|------------|
| Pin    | Single     | Dual       |
| 1      | -Vin (GND) | -Vin (GND) |
| 2      | +Vin (Vcc) | +Vin (Vcc) |
| 3      | +Vout      | +Vout      |
| 4      | No pin     | Common     |
| 5      | -Vout      | -Vout      |
| 6      | NC         | NC         |
| 7      | NC         | NC         |

NC: Not connected

Avoid routing PCB traces under the converter.

### Recommended Solder Pad Layout

