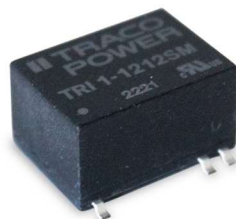


## Unregulated DC/DC Converter

## TRI 1SM Series, 1 Watt

- Reinforced I/O-isolation 3000 VAC rated for 480 VAC working voltage
- Ultra-high isolation peak voltage 8000 VDC (1s)
- Operating temperature range -40 to +85°C without derating
- High efficiency up to 84%
- Input voltage range ( $\pm 10\%$ ): 5, 12, 24 VDC
- Protection against overvoltage and short circuit
- 3-year product warranty



The new TRI 1SM is a high isolation, unregulated DC/DC converter series which comes in a compact SMD-14 package. The core characteristic of the TRI 1SM series is a sophisticated reinforced isolation system which is able to withstand high test voltages (8000 VDC for 1s and 3000 VAC for 60s) and working voltages (480 VACrms). Efficiencies up to 84% allow safe operation from -40°C to +85°C without derating. All models have a  $\pm 10\%$  input voltage range and precisely regulated, isolated output voltages. With the latest IT safety certifications (IEC/EN/UL 62368-1) the TRI 1SM series is the perfect choice for many demanding low power applications in the industrial, transportation and instrumentation sectors.

| Models       |                                  |          |                  |          |                  |                 |
|--------------|----------------------------------|----------|------------------|----------|------------------|-----------------|
| Order Code   | Input Voltage Range              | Output 1 |                  | Output 2 |                  | Efficiency typ. |
|              |                                  | Vnom     | I <sub>max</sub> | Vnom     | I <sub>max</sub> |                 |
| TRI 1-0511SM | 4.5 - 5.5 VDC<br>(5 VDC nom.)    | 5 VDC    | 200 mA           |          |                  | 76 %            |
| TRI 1-0512SM |                                  | 12 VDC   | 84 mA            |          |                  | 80 %            |
| TRI 1-0513SM |                                  | 15 VDC   | 68 mA            |          |                  | 83 %            |
| TRI 1-0522SM |                                  | +12 VDC  | 42 mA            | -12 VDC  | 42 mA            | 80 %            |
| TRI 1-0523SM |                                  | +15 VDC  | 33 mA            | -15 VDC  | 33 mA            | 84 %            |
| TRI 1-1211SM | 10.8 - 13.2 VDC<br>(12 VDC nom.) | 5 VDC    | 200 mA           |          |                  | 76 %            |
| TRI 1-1212SM |                                  | 12 VDC   | 84 mA            |          |                  | 79 %            |
| TRI 1-1213SM |                                  | 15 VDC   | 68 mA            |          |                  | 80 %            |
| TRI 1-1222SM |                                  | +12 VDC  | 42 mA            | -12 VDC  | 42 mA            | 79 %            |
| TRI 1-1223SM |                                  | +15 VDC  | 33 mA            | -15 VDC  | 33 mA            | 80 %            |
| TRI 1-2411SM | 21.6 - 26.4 VDC<br>(24 VDC nom.) | 5 VDC    | 200 mA           |          |                  | 76 %            |
| TRI 1-2412SM |                                  | 12 VDC   | 84 mA            |          |                  | 80 %            |
| TRI 1-2413SM |                                  | 15 VDC   | 68 mA            |          |                  | 80 %            |
| TRI 1-2422SM |                                  | +12 VDC  | 42 mA            | -12 VDC  | 42 mA            | 80 %            |
| TRI 1-2423SM |                                  | +15 VDC  | 33 mA            | -15 VDC  | 33 mA            | 80 %            |

## Input Specifications

|                        |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Input Current          | - At no load   | 5 Vin models: 50 mA typ. / 75 mA max.<br>12 Vin models: 35 mA typ. / 53 mA max.<br>24 Vin models: 20 mA typ. / 30 mA max.                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                        | - At full load | 5 Vin models: 267 mA max. (5 Vout model)<br>249 mA max. (12 Vout model)<br>246 mA max. (15 Vout model)<br>249 mA max. (12 / -12 Vout model)<br>239 mA max. (15 / -15 Vout model)<br>12 Vin models: 111 mA max. (5 Vout model)<br>108 mA max. (12 Vout model)<br>106 mA max. (15 Vout model)<br>108 mA max. (12 / -12 Vout model)<br>102 mA max. (15 / -15 Vout model)<br>24 Vin models: 56 mA max. (5 Vout model)<br>53 mA max. (12 Vout model)<br>54 mA max. (15 Vout model)<br>53 mA max. (12 / -12 Vout model)<br>52 mA max. (15 / -15 Vout model) |
| Surge Voltage          |                | 5 Vin models: 9 VDC max. (1 s max.)<br>12 Vin models: 18 VDC max. (1 s max.)<br>24 Vin models: 30 VDC max. (1 s max.)                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Recommended Input Fuse |                | 5 Vin models: 500 mA (slow blow)<br>12 Vin models: 200 mA (slow blow)<br>24 Vin models: 100 mA (slow blow)<br>(The need of an external fuse has to be assessed in the final application.)                                                                                                                                                                                                                                                                                                                                                             |
| Input Filter           |                | Internal Capacitor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

## Output Specifications

|                             |                                                                                                |                                                                                                                                                                                    |
|-----------------------------|------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Voltage Set Accuracy        |                                                                                                | ±3% max.                                                                                                                                                                           |
| Regulation<br>(Unregulated) | - Input Variation (1% Vin step)<br>- Load Variation<br>- Voltage Balance<br>(symmetrical load) | single output models: 1.5% max.<br>See application note: <a href="http://www.tracopower.com/overview/tri1sm">www.tracopower.com/overview/tri1sm</a><br>dual output models: 1% max. |
| Ripple and Noise            | - 20 MHz Bandwidth                                                                             | 100 mVp-p max.                                                                                                                                                                     |
| Capacitive Load             | - single output<br><br>- dual output                                                           | 5 Vout models: 220 µF max.<br>12 Vout models: 220 µF max.<br>15 Vout models: 220 µF max.<br>12 / -12 Vout models: 100 / 100 µF max.<br>15 / -15 Vout models: 100 / 100 µF max.     |
| Minimum Load                |                                                                                                | See application note: <a href="http://www.tracopower.com/overview/tri1sm">www.tracopower.com/overview/tri1sm</a><br>(Higher regulation tolerance below 2% load.)                   |
| Temperature Coefficient     |                                                                                                | ±0.02 %/K max.                                                                                                                                                                     |
| Short Circuit Protection    |                                                                                                | Continuous, Automatic recovery                                                                                                                                                     |

## Safety Specifications

|                       |                             |                                                                                            |
|-----------------------|-----------------------------|--------------------------------------------------------------------------------------------|
| Standards             | - IT / Multimedia Equipment | EN 62368-1<br>IEC 62368-1<br>UL 62368-1                                                    |
|                       | - Certification Documents   | <a href="http://www.tracopower.com/overview/tri1sm">www.tracopower.com/overview/tri1sm</a> |
| 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

|                           |                            |                                                                                                                                                                                                                              |
|---------------------------|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EMI (Emissions)           | - Conducted Emissions      | EN 55032 class A (with external filter)<br>EN 55032 class B (with external filter)                                                                                                                                           |
|                           | - Radiated Emissions       | EN 55032 class A (internal filter)<br>EN 55032 class B (internal filter)                                                                                                                                                     |
| External filter proposal: |                            | <a href="http://www.tracopower.com/overview/tri1sm">www.tracopower.com/overview/tri1sm</a>                                                                                                                                   |
| EMS (Immunity)            |                            | EN 55024 (IT Equipment)<br>EN 55035 (Multimedia)                                                                                                                                                                             |
|                           | - Electrostatic Discharge  | Air: EN 61000-4-2, $\pm 15$ kV, perf. criteria A<br>Contact: EN 61000-4-2, $\pm 8$ kV, perf. criteria A                                                                                                                      |
|                           | - RF Electromagnetic Field | EN 61000-4-3, 10 V/m, perf. criteria A                                                                                                                                                                                       |
|                           | - EFT (Burst) / Surge      | EN 61000-4-4, $\pm 2$ kV, perf. criteria A<br>EN 61000-4-5, $\pm 1$ kV, perf. criteria A                                                                                                                                     |
|                           | - PF Magnetic Field        | External filter proposal: <a href="http://www.tracopower.com/overview/tri1sm">www.tracopower.com/overview/tri1sm</a><br>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/tri1sm">www.tracopower.com/overview/tri1sm</a>                                                                                                                                   |

### General Specifications

|                            |                                 |                                                                                                                                   |
|----------------------------|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Relative Humidity          |                                 | 95% max. (non condensing)                                                                                                         |
| Temperature Ranges         | - Operating Temperature         | -40°C to +95°C                                                                                                                    |
|                            | - Case Temperature              | +105°C max.                                                                                                                       |
|                            | - Storage Temperature           | -50°C to +125°C                                                                                                                   |
| Power Derating             | - High Temperature              | 5 %/K above 85°C                                                                                                                  |
| See application note:      |                                 | <a href="http://www.tracopower.com/overview/tri1sm">www.tracopower.com/overview/tri1sm</a>                                        |
| Cooling System             |                                 | Natural convection (20 LFM)                                                                                                       |
| Altitude During Operation  |                                 | 5'000 m max.                                                                                                                      |
| Regulator Topology         |                                 | Push-Pull Converter                                                                                                               |
| Switching Frequency        |                                 | 30 - 100 kHz (Royer)                                                                                                              |
|                            |                                 | 55 kHz typ. (Royer)                                                                                                               |
| Insulation System          |                                 | Reinforced Insulation                                                                                                             |
| Working Voltage (rated)    |                                 | 480 VAC (679 VDC)                                                                                                                 |
| Isolation Test Voltage     | - Input to Output, 60 s         | 3'000 VAC (4242 VDC)                                                                                                              |
|                            | - Input to Output, 1 s          | 8'000 VDC                                                                                                                         |
| Creepage                   | - Input to Output               | 8 mm min.                                                                                                                         |
| Clearance                  | - Input to Output               | 8 mm min.                                                                                                                         |
| Isolation Resistance       | - Input to Output, 500 VDC      | 10'000 M $\Omega$ min.                                                                                                            |
| Isolation Capacitance      | - Input to Output, 100 kHz, 1 V | 20 pF typ.                                                                                                                        |
| Reliability                | - Calculated MTBF               | 4'700'000 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                     | IPC-9592B                                                                                                                         |
|                            | - Mechanical Shock              | IPC-9592B                                                                                                                         |
|                            | - Thermal Shock                 | IPC-9592B                                                                                                                         |
| Housing Material           |                                 | Plastic resin (UL 94 V-0 rated)                                                                                                   |
| Base Material              |                                 | Non-conductive Plastic (UL 94 V-0 rated)                                                                                          |
| Pin Material               |                                 | Phosphor Bronze (C5191)                                                                                                           |
| Pin Foundation Plating     |                                 | Copper (1 - 3 $\mu$ m)                                                                                                            |
| Pin Surface Plating        |                                 | Tin (7.5 $\mu$ m min.), matte                                                                                                     |
| Housing Type               |                                 | Plastic Case                                                                                                                      |
| Mounting Type              |                                 | PCB Mount                                                                                                                         |
| Connection Type            |                                 | SMD (Surface-Mount Device)                                                                                                        |
| Footprint Type             |                                 | SMD14                                                                                                                             |

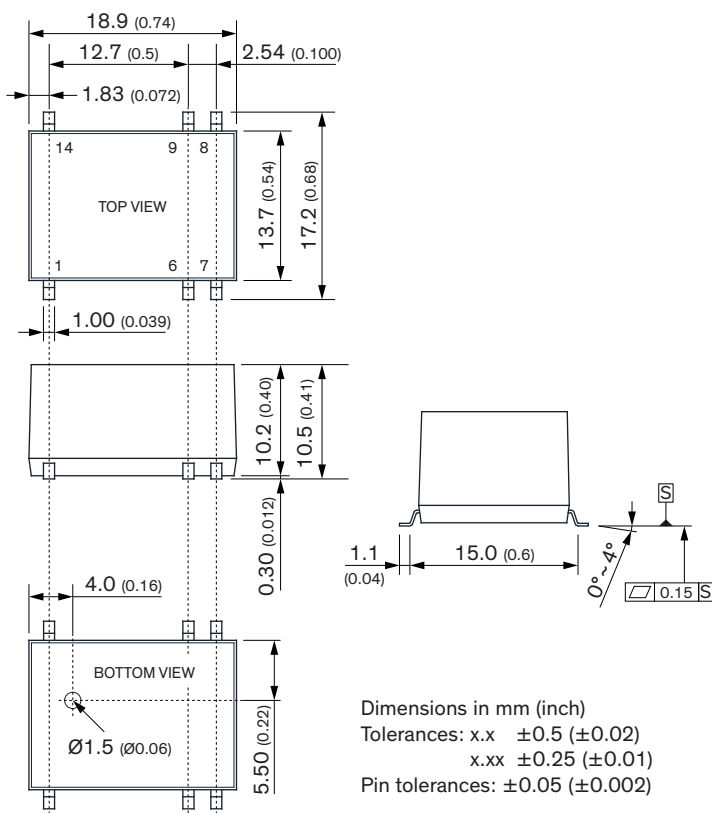
All specifications valid at nominal voltage, resistive full load and +25°C after warm-up time, unless otherwise stated.

|                          |                                                                                                                                                                                                                                                                                                                                                                         |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Soldering Profile        | Lead-Free Reflow Soldering (acc. J-STD-020E)<br>245°C max. (Tp)<br>10 s max. (tp, at Tp - 5°C)<br>See application note: <a href="http://www.tracopower.com/info/reflow-soldering.pdf">www.tracopower.com/info/reflow-soldering.pdf</a>                                                                                                                                  |
| Weight                   | 4.1 g                                                                                                                                                                                                                                                                                                                                                                   |
| Environmental Compliance | - REACH Declaration<br><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>- RoHS Declaration<br><a href="http://www.tracopower.com/info/rohs-declaration.pdf">www.tracopower.com/info/rohs-declaration.pdf</a><br>Exemptions: No Exemptions |

### Additional Information

|                            |                                                                                                |
|----------------------------|------------------------------------------------------------------------------------------------|
| Supporting Documents       | <a href="http://www.tracopower.com/overview/tri1sm">www.tracopower.com/overview/tri1sm</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> |

### Outline Dimensions



| Pinout |        |        |
|--------|--------|--------|
| Pin    | Single | Dual   |
| 1      | -Vin   |        |
| 6      | NC     | Common |
| 7      | NC     | -Vout  |
| 8      | +Vout  | +Vout  |
| 9      | -Vout  | Common |
| 14     | +Vin   | +Vin   |

NC: Not connected

### Recommended Solder Pad Layout

