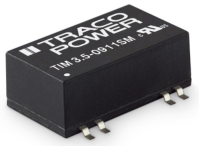
# TRACO POWER

## DC/DC Medical Converter

## TIM 3.5SM Series, 3.5 Watt

- **Compact SMD-16-package**
- **I/O isolation 5000 VACrms rated for 250 VACrms working voltage**
- **Certification according to IEC/EN/ES 60601-1 3rd edition for 2xMOPP and opperation to 5000 m altitude**
- **Low leakage current < 2 µA for BF-applications**
- **Extended operating temperature range –40°C to 90°C**
- **5-year product warranty**



2MOPP cULus CB Scheme

ES 60601-1 IEC 60601-1
UL 62368-1 IEC 62368-1

The TIM 3.5SM series is a range of high performance, regulated 3.5 Watt DC/DC converters in a SMD plastic package. The reinforced I/O-isolation system complies with the medical safety requirements for 2 × MOPP (Means Of Patient Protection). The converters constitute also a reliable solution for many demanding applications such as transportation systems, industrial control equipments, measurement equipments, and some IGBT driver applications.

## Models

| Order Code | Input Voltage Range | Output 1 | | Output 2 | | Efficiency |
|---|---|---|---|---|---|---|
| | | Vnom | Imax | Vnom | Imax | typ. |
| **TIM 3.5-0911SM** | 4.5 - 12 VDC (9 VDC nom.) | 5 VDC | 700 mA | | | 77 % |
| **TIM 3.5-0919SM** | | 9 VDC | 389 mA | | | 78 % |
| **TIM 3.5-0912SM** | | 12 VDC | 292 mA | | | 82 % |
| **TIM 3.5-0913SM** | | 15 VDC | 234 mA | | | 82 % |
| **TIM 3.5-0915SM** | | 24 VDC | 146 mA | | | 82 % |
| **TIM 3.5-0922SM** | | +12 VDC | 146 mA | –12 VDC | 146 mA | 82 % |
| **TIM 3.5-0923SM** | | +15 VDC | 117 mA | –15 VDC | 117 mA | 81 % |
| **TIM 3.5-1211SM** | 9 - 18 VDC (12 VDC nom.) | 5 VDC | 700 mA | | | 79 % |
| **TIM 3.5-1219SM** | | 9 VDC | 389 mA | | | 79 % |
| **TIM 3.5-1212SM** | | 12 VDC | 292 mA | | | 82 % |
| **TIM 3.5-1213SM** | | 15 VDC | 234 mA | | | 82 % |
| **TIM 3.5-1215SM** | | 24 VDC | 146 mA | | | 82 % |
| **TIM 3.5-1222SM** | | +12 VDC | 146 mA | –12 VDC | 146 mA | 82 % |
| **TIM 3.5-1223SM** | | +15 VDC | 117 mA | –15 VDC | 117 mA | 82 % |
| **TIM 3.5-2411SM** | 18 - 36 VDC (24 VDC nom.) | 5 VDC | 700 mA | | | 79 % |
| **TIM 3.5-2419SM** | | 9 VDC | 389 mA | | | 80 % |
| **TIM 3.5-2412SM** | | 12 VDC | 292 mA | | | 83 % |
| **TIM 3.5-2413SM** | | 15 VDC | 234 mA | | | 83 % |
| **TIM 3.5-2415SM** | | 24 VDC | 146 mA | | | 82 % |
| **TIM 3.5-2422SM** | | +12 VDC | 146 mA | –12 VDC | 146 mA | 82 % |
| **TIM 3.5-2423SM** | | +15 VDC | 117 mA | –15 VDC | 117 mA | 82 % |
| **TIM 3.5-4811SM** | 36 - 75 VDC (48 VDC nom.) | 5 VDC | 700 mA | | | 79 % |
| **TIM 3.5-4819SM** | | 9 VDC | 389 mA | | | 80 % |
| **TIM 3.5-4812SM** | | 12 VDC | 292 mA | | | 82 % |
| **TIM 3.5-4813SM** | | 15 VDC | 234 mA | | | 82 % |
| **TIM 3.5-4815SM** | | 24 VDC | 146 mA | | | 82 % |
| **TIM 3.5-4822SM** | | +12 VDC | 146 mA | –12 VDC | 146 mA | 82 % |
| **TIM 3.5-4823SM** | | +15 VDC | 117 mA | –15 VDC | 117 mA | 82 % |

## Input Specifications

| | | | |
|---|---|---|---|
| Input Current | - At no load | 9 Vin models: | 80 mA typ. |
| | | 12 Vin models: | 45 mA typ. |
| | | 24 Vin models: | 27 mA typ. |
| | | 48 Vin models: | 13 mA typ. |
| | - At full load | 9 Vin models: | 927 mA max. (5 Vout model) |
| | | | 917 mA max. (9 Vout model) |
| | | | 872 mA max. (12 Vout model) |
| | | | 872 mA max. (15 Vout model) |
| | | | 872 mA max. (24 Vout model) |
| | | | 872 mA max. (12 / -12 Vout model) |
| | | | 883 mA max. (15 / -15 Vout model) |
| | | 12 Vin models: | 376 mA max. (5 Vout model) |
| | | | 377 mA max. (9 Vout model) |
| | | | 360 mA max. (12 Vout model) |
| | | | 361 mA max. (15 Vout model) |
| | | | 364 mA max. (24 Vout model) |
| | | | 364 mA max. (12 / -12 Vout model) |
| | | | 362 mA max. (15 / -15 Vout model) |
| | | 24 Vin models: | 186 mA max. (5 Vout model) |
| | | | 186 mA max. (9 Vout model) |
| | | | 179 mA max. (12 Vout model) |
| | | | 179 mA max. (15 Vout model) |
| | | | 182 mA max. (24 Vout model) |
| | | | 182 mA max. (12 / -12 Vout model) |
| | | | 182 mA max. (15 / -15 Vout model) |
| | | 48 Vin models: | 93 mA max. (5 Vout model) |
| | | | 93 mA max. (9 Vout model) |
| | | | 90 mA max. (12 Vout model) |
| | | | 90 mA max. (15 Vout model) |
| | | | 91 mA max. (24 Vout model) |
| | | | 91 mA max. (12 / -12 Vout model) |
| | | | 90 mA max. (15 / -15 Vout model) |
| Surge Voltage | | 9 Vin models: | 15 VDC max. (1 s max.) |
| | | 12 Vin models: | 25 VDC max. (1 s max.) |
| | | 24 Vin models: | 50 VDC max. (1 s max.) |
| | | 48 Vin models: | 100 VDC max. (1 s max.) |
| Under Voltage Lockout | | 9 Vin models: | 2 VDC min. / 3 VDC typ. / 4 VDC max. |
| | | 12 Vin models: | 6 VDC min. / 7 VDC typ. / 8 VDC max. |
| | | 24 Vin models: | 13 VDC min. / 15 VDC typ. / 17 VDC max. |
| | | 48 Vin models: | 29 VDC min. / 32 VDC typ. / 35 VDC max. |
| Recommended Input Fuse | | 9 Vin models: | 1'600 mA (slow blow) |
| | | 12 Vin models: | 800 mA (slow blow) |
| | | 24 Vin models: | 500 mA (slow blow) |
| | | 48 Vin models: | 315 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. |

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

| | | | |
|---|---|---|---|
| Regulation | - Input Variation (Vmin - Vmax) | single output models: | 0.2% max. |
| | | dual output models: | 0.2% max. |
| | - Load Variation (10 - 90%) | single output models: | 0.5% max. |
| | | dual output models: | 0.8% max. (Output 1) |
| | | | 0.8% max. (Output 2) |
| | - Cross Regulation (25% / 100% asym. load) | dual output models: | 5% max. |
| Ripple and Noise (20 MHz Bandwidth) | - single output | 5 Vout models: | 50 mVp-p typ. |
| | | 9 Vout models: | 50 mVp-p typ. |
| | | 12 Vout models: | 50 mVp-p typ. |
| | | 15 Vout models: | 50 mVp-p typ. |
| | | 24 Vout models: | 75 mVp-p typ. |
| | - dual output | 12 / -12 Vout models: | 75 / 75 mVp-p typ. |
| | | 15 / -15 Vout models: | 75 / 75 mVp-p typ. |
| Capacitive Load | - single output | 5 Vout models: | 1'470 µF max. |
| | | 9 Vout models: | 680 µF max. |
| | | 12 Vout models: | 470 µF max. |
| | | 15 Vout models: | 330 µF max. |
| | | 24 Vout models: | 170 µF max. |
| | - dual output | 12 / -12 Vout models: | 220 / 220 µF max. |
| | | 15 / -15 Vout models: | 160 / 160 µF max. |
| Minimum Load | | | Not required |
| Temperature Coefficient | | | ±0.02 %/K max. |
| Start-up Time | | | 10 ms typ. / 20 ms max. |
| Short Circuit Protection | | | Continuous, Automatic recovery |
| Overvoltage Protection | | | 104 - 160% of Vout nom. (depending on model)<br>6 - 8 VDC (5 VDC model)<br>10 - 14 VDC (9 VDC model)<br>13 - 19 VDC (12 VDC model)<br>16 - 22 VDC (15 VDC model)<br>25 - 35 VDC (24 VDC model) |
| Transient Response | - Response Time | | 500 µs typ. (25% Load Step) |

## Safety Specifications

| | | |
|---|---|---|
| Safety Standards | - IT / Multimedia Equipment | EN 62368-1<br>IEC 62368-1<br>UL 62368-1 |
| | - Medical Equipment | EN 60601-1<br>IEC 60601-1<br>ANSI/AAMI ES 60601-1<br>2 x MOPP (Means Of Patient Protection) |
| | - Certification Documents | www.tracopower.com/overview/tim3-5sm |
| Pollution Degree | | PD 2 |

## EMC Specifications

| | | | |
|---|---|---|---|
| EMI Emissions | | | EN 60601-1-2 edition 4 (Medical Devices) |
| | - Conducted Emissions | | EN 55011 class B (with external filter)<br>EN 55032 class B (with external filter)<br>FCC Part 18 class B (with external filter) |
| | - Radiated Emissions | | EN 55011 class B (with external filter)<br>EN 55032 class B (with external filter)<br>FCC Part 18 class B (with external filter) |
| | | External filter proposal: | www.tracopower.com/overview/tim3-5sm |

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

| | | | |
|---|---|---|---|
| EMS Immunity | | | EN 60601-1-2 edition 4 (Medical Devices) |
| | - Electrostatic Discharge | Air: | EN 61000-4-2, ±15 kV, perf. criteria A |
| | | Contact: | EN 61000-4-2, ±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, ±2 kV, perf. criteria A |
| | | | EN 61000-4-5, ±1 kV, perf. criteria A |
| | | Ext. input component: | 9 Vin models: KY 1000 µF \|\| TVS SMDJ18A<br>12 Vin models: KY 470 µF<br>24 Vin models: KY 470 µF<br>48 Vin models: KY 220 µF |
| | - 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 |
| | | 1 s: | 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 |
| | - Case Temperature | | +105°C max. |
| | - Storage Temperature | | –55°C to +125°C |
| Power Derating | - High Temperature | | 3.3 %/K above 75°C |
| | | See application note: | www.tracopower.com/overview/tim3-5sm |
| Cooling System | | | Natural convection (20 LFM) |
| Remote Control | - Current Controlled Remote | | On: open circuit<br>Off: 2 to 4 mA current (internal 1 kΩ resistor) |
| | | External circuit proposal: | www.tracopower.com/info/current-remote.pdf |
| | - Off Idle Input Current | | 2.5 mA typ. |
| Altitude During Operation | | | 5'000 m max. |
| Switching Frequency | | | 100 kHz min. (RCC) |
| Insulation System | | | Reinforced Insulation |
| Working Voltage (rated) | | | 250 VAC |
| Isolation Test Voltage | - Input to Output, 60 s | | 5'000 VAC |
| Creepage | - Input to Output | | 8 mm min. |
| Clearance | - Input to Output | | 8 mm min. |
| Isolation Resistance | - Input to Output, 500 VDC | | 10'000 MΩ min. |
| Isolation Capacitance | - Input to Output, 100 kHz, 1 V | | 16 pF typ.<br>20 pF max. |
| Leakage Current | - Touch Current | | 2 µA max. (at 240 VAC / 60 Hz) |
| Reliability | - Calculated MTBF | | 5'041'000 h (MIL-HDBK-217F, ground benign) |
| Moisture Sensitivity (MSL) | | | Level 2 (J-STD-033C) |
| Washing Process | | | According to Cleaning Guideline<br>www.tracopower.com/info/cleaning.pdf |
| Environment | - Vibration | | MIL-STD-810F |
| | - Mechanical Shock | | MIL-STD-810F |
| | - Thermal Shock | | MIL-STD-810F |
| Housing Material | | | Non-conductive Plastic (UL 94 V-0 rated) |
| Base Material | | | Non-conductive Plastic (UL 94 V-0 rated) |
| Potting Material | | | Silicone (UL 94 V-0 rated) |
| Pin Material | | | Copper |
| Pin Foundation Plating | | | Nickel (1 - 3 µm) |
| Pin Surface Plating | | | Tin (7 - 12 µm), matte |
| Housing Type | | | Plastic Case |
| Mounting Type | | | PCB Mount |
| Connection Type | | | SMD (Surface-Mount Device) |
| Footprint Type | | | SMD16 |
| Soldering Profile | | | Lead-Free Reflow Soldering (acc. J-STD-020E) |
| | | See application note: | www.tracopower.com/info/reflow-soldering.pdf |

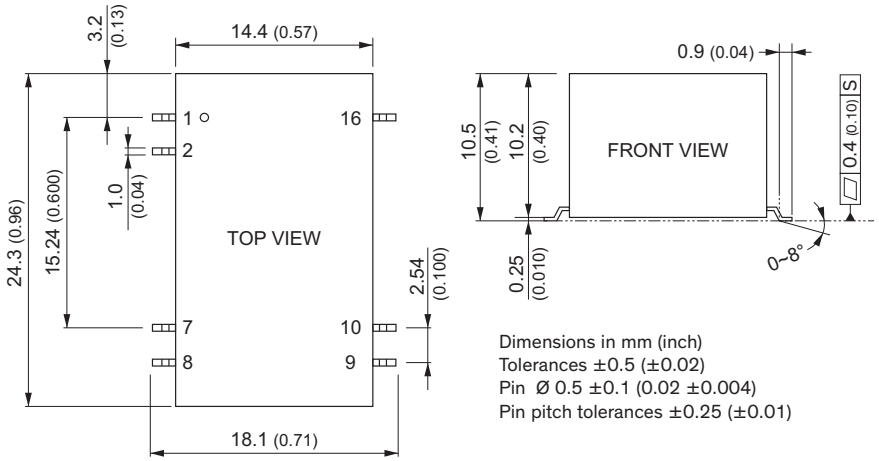
All specifications valid at nominal voltage, resistive full load and +25°C after warm-up time, unless otherwise stated.

| | | |
|---|---|---|
| Weight | | 7 g |
| Environmental Compliance | - REACH Declaration | www.tracopower.com/info/reach-declaration.pdf |
| | | REACH SVHC list compliant |
| | | REACH Annex XVII compliant |
| | - RoHS Declaration | www.tracopower.com/info/rohs-declaration.pdf |
| | | Exemptions: 7a, 7c-I |
| | | (RoHS exemptions refer to the component concentration only, not to the overall concentration in the product (O5A rule).) |
| | - SCIP Reference Number | 37df0294-b078-4c7a-97f0-3a6b42691f25 |

## Supporting Documents

| | |
|---|---|
| Overview Link (for additional Documents) | www.tracopower.com/overview/tim3-5sm |

## Outline Dimensions



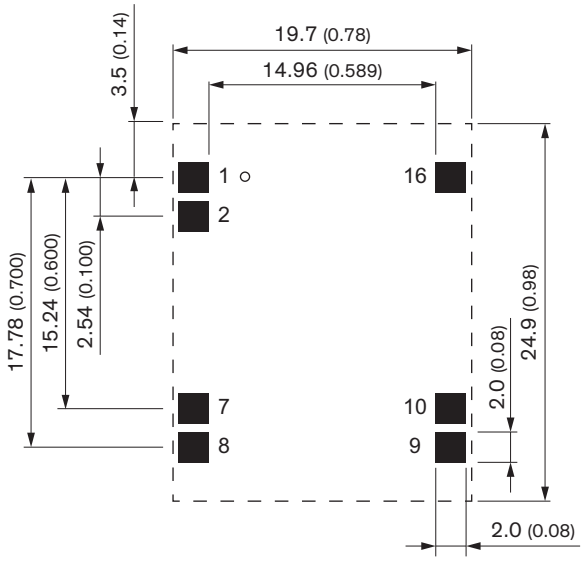

Dimensions in mm (inch)
Tolerances ±0.5 (±0.02)
Pin Ø 0.5 ±0.1 (0.02 ±0.004)
Pin pitch tolerances ±0.25 (±0.01)

**Pinout**

| Pin | Single Output | Dual Output |
|---|---|---|
| 1 | –Vin (GND) | –Vin (GND) |
| 2 | Remote | Remote |
| 7 | NC | NC |
| 8 | NC | Common |
| 9 | +Vout | +Vout |
| 10 | –Vout | –Vout |
| 16 | +Vin (Vcc) | +Vin (Vcc) |

NC: Not connected

**Recommended Solder Pad Layout**

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