

- I/O isolation 5000 VAC (reinforced)
- Wide 1.5:1 input voltage range
- Operating temperature range -40 to +80 °C without derating
- Certification according to IEC/EN/ES 60601-1 edition 3.2 for 2xMOPP and IEC/EN/UL 62368-1
- Short circuit protection
- Regulated outputs
- Low leakage current < 2 µA
- Efficiency up to 84 %
- Operation up to 5000 m altitude
- 5-year product warranty



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

The TRV 2M is a series of 2 Watt DC/DC converters in a compact SIP-9 package with reinforced isolation of 5000 VAC for medical and industrial applications. The series offers a 1.5:1 input voltage range with a nominal input ranging between 5 and 24 VDC. With a continuous short circuit protection and a low leakage current of less than 2 µA, this converter is especially suited to protect any connected interfaces or applied parts to patients. Featuring almost fully regulated outputs this series provides great level of regulation without affecting the cost efficiency. It is an ideal solution for applications where an unregulated DC/DC converter would not meet your regulation requirements but cost still is a critical factor. With an operating temperature range from -40 to +80°C without derating and certifications acc. IEC/EN/ES 60601-1 ed. 3.2 for 2xMOPP and IEC/EN/UL 62368-1 this series is suitable for many different applications where a medical isolation system and short circuit protection is needed.

Models

| Order Code | Input Voltage Range | Output 1 | | Output 2 | | Efficiency typ. |
|-------------|----------------------------------|----------|------------------|----------|------------------|-----------------|
| | | Vnom | I _{max} | Vnom | I _{max} | |
| TRV 2-0510M | 4.5 - 7 VDC (5 VDC nom.) | 3.3 VDC | 600 mA | | | 78 % |
| TRV 2-0511M | | 5 VDC | 400 mA | | | 81 % |
| TRV 2-0512M | | 12 VDC | 167 mA | | | 83 % |
| TRV 2-0513M | | 15 VDC | 134 mA | | | 83 % |
| TRV 2-0521M | | +5 VDC | 200 mA | -5 VDC | 200 mA | 82 % |
| TRV 2-0522M | | +12 VDC | 83 mA | -12 VDC | 83 mA | 83 % |
| TRV 2-0523M | | +15 VDC | 67 mA | -15 VDC | 67 mA | 81 % |
| TRV 2-1210M | 9.6 - 14.4 VDC (12 VDC nom.) | 3.3 VDC | 600 mA | | | 79 % |
| TRV 2-1211M | | 5 VDC | 400 mA | | | 81 % |
| TRV 2-1212M | | 12 VDC | 167 mA | | | 84 % |
| TRV 2-1213M | | 15 VDC | 134 mA | | | 83 % |
| TRV 2-1221M | | +5 VDC | 200 mA | -5 VDC | 200 mA | 81 % |
| TRV 2-1222M | | +12 VDC | 83 mA | -12 VDC | 83 mA | 83 % |
| TRV 2-1223M | | +15 VDC | 67 mA | -15 VDC | 67 mA | 82 % |
| TRV 2-1510M | 12 - 18 VDC (15 VDC nom.) | 3.3 VDC | 600 mA | | | 79 % |
| TRV 2-1511M | | 5 VDC | 400 mA | | | 81 % |
| TRV 2-1512M | | 12 VDC | 167 mA | | | 84 % |
| TRV 2-1513M | | 15 VDC | 134 mA | | | 83 % |
| TRV 2-1521M | | +5 VDC | 200 mA | -5 VDC | 200 mA | 81 % |
| TRV 2-1522M | | +12 VDC | 83 mA | -12 VDC | 83 mA | 83 % |
| TRV 2-1523M | | +15 VDC | 67 mA | -15 VDC | 67 mA | 80 % |
| TRV 2-2410M | 19.2 - 28.8 VDC (24 VDC nom.) | 3.3 VDC | 600 mA | | | 78 % |
| TRV 2-2411M | | 5 VDC | 400 mA | | | 80 % |
| TRV 2-2412M | | 12 VDC | 167 mA | | | 82 % |
| TRV 2-2413M | | 15 VDC | 134 mA | | | 82 % |
| TRV 2-2421M | | +5 VDC | 200 mA | -5 VDC | 200 mA | 81 % |
| TRV 2-2422M | | +12 VDC | 83 mA | -12 VDC | 83 mA | 81 % |
| TRV 2-2423M | | +15 VDC | 67 mA | -15 VDC | 67 mA | 80 % |

Note - 5 Vin model: If the input is switched electromechanically, use an external 100 µF/25 V E/C. to reduce voltage transient.

- Other models: If the input is switched electromechanically, use an external 47 μ F/100 V E/C. to reduce voltage transient.

Input Specifications

| | | |
|------------------------|----------------|---|
| Input Current | - At no load | 5 Vin models: 5 mA typ. (3.3 Vout model) 5 mA typ. (5 Vout model) 20 mA typ. (12 Vout model) 20 mA typ. (15 Vout model) 5 mA typ. (5 / -5 Vout model) 20 mA typ. (12 / -12 Vout model) 25 mA typ. (15 / -15 Vout model) |
| | | 12 Vin models: 4 mA typ. (3.3 Vout model) 4 mA typ. (5 Vout model) 10 mA typ. (12 Vout model) 10 mA typ. (15 Vout model) 4 mA typ. (5 / -5 Vout model) 10 mA typ. (12 / -12 Vout model) 10 mA typ. (15 / -15 Vout model) |
| | | 15 Vin models: 4 mA typ. (3.3 Vout model) 4 mA typ. (5 Vout model) 8 mA typ. (12 Vout model) 8 mA typ. (15 Vout model) 4 mA typ. (5 / -5 Vout model) 8 mA typ. (12 / -12 Vout model) 8 mA typ. (15 / -15 Vout model) |
| | | 24 Vin models: 3 mA typ. (3.3 Vout model) 3 mA typ. (5 Vout model) 6 mA typ. (12 Vout model) 6 mA typ. (15 Vout model) 3 mA typ. (5 / -5 Vout model) 6 mA typ. (12 / -12 Vout model) 6 mA typ. (15 / -15 Vout model) |
| | - At full load | 5 Vin models: 510 mA typ. 12 Vin models: 210 mA typ. 15 Vin models: 170 mA typ. 24 Vin models: 105 mA typ. |
| Surge Voltage | | 5 Vin models: 15 VDC max. (1 s max.) 12 Vin models: 25 VDC max. (1 s max.) 15 Vin models: 25 VDC max. (1 s max.) 24 Vin models: 35 VDC max. (1 s max.) |
| Recommended Input Fuse | | 5 Vin models: 1'000 mA (slow blow) 12 Vin models: 500 mA (slow blow) 15 Vin models: 500 mA (slow blow) 24 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 | | $\pm 3\%$ max. (60% load: 3.3, 5, ± 5 Vout models) $\pm 3\%$ max. (90% load: other models) |
| Regulation (Unregulated) | - Input Variation (Vmin - Vmax) | single output models: 2% max. dual output models: 2% max. |
| | - Load Variation | See application note: www.tracopower.com/overview/trv2m |
| | - Voltage Balance (symmetrical load) | dual output models: 4% max. |
| | - Cross Regulation (25% / 100% asym. load) | dual output models: 4% max. |

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

| | | |
|--|-----------------|--|
| Ripple and Noise (20 MHz Bandwidth) | - single output | 3.3 Vout models: 100 mVp-p typ. 5 Vout models: 100 mVp-p typ. 12 Vout models: 125 mVp-p typ. 15 Vout models: 125 mVp-p typ. |
| | - dual output | 5 / -5 Vout models: 100 / 100 mVp-p typ. 12 / -12 Vout models: 125 / 125 mVp-p typ. 15 / -15 Vout models: 125 / 125 mVp-p typ. |
| Capacitive Load | - single output | 3.3 Vout models: 2'000 µF max. 5 Vout models: 820 µF max. 12 Vout models: 470 µF max. 15 Vout models: 470 µF max. |
| | - dual output | 5 / -5 Vout models: 470 / 470 µF max. 12 / -12 Vout models: 220 / 220 µF max. 15 / -15 Vout models: 220 / 220 µF max. |
| Minimum Load | | Not required |
| Temperature Coefficient | | ±0.03 %/K max. |
| Start-up Time | | 20 ms max. |
| Short Circuit Protection | | Continuous, Automatic recovery |

Safety Specifications

| | | |
|-----------------------|-----------------------------|---|
| Standards | - IT / Multimedia Equipment | EN 62368-1 IEC 62368-1 UL 62368-1 |
| | - Medical Equipment | EN 60601-1 IEC 60601-1 ANSI/AAMI ES 60601-1 2 x MOPP (Means Of Patient Protection) www.tracopower.com/overview/trv2m |
| | - Certification Documents | |
| Pollution Degree | | PD 2 |
| Over Voltage Category | | OVC II (not mains connected) |

EMC Specifications

| | | |
|-----------------|-----------------------------|--|
| EMI (Emissions) | - Conducted Emissions | EN 60601-1-2 edition 4 (Medical Devices) EN 55011 class A (with external filter) EN 55011 class B (with external filter) EN 55032 class A (with external filter) EN 55032 class B (with external filter) |
| | - Radiated Emissions | EN 55011 class A (with external filter) EN 55011 class B (with external filter) EN 55032 class A (with external filter) EN 55032 class B (with external filter) External filter proposal: www.tracopower.com/overview/trv2m |
| EMS (Immunity) | - Electrostatic Discharge | EN 60601-1-2 edition 4 (Medical Devices) EN 55024 (IT Equipment) EN 55035 (Multimedia) 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, ±2 kV, perf. criteria A |
| | - Conducted RF Disturbances | External filter proposal: www.tracopower.com/overview/trv2m 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) |
|-------------------|---------------------------|

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

| | | |
|---------------------------|--|--|
| Temperature Ranges | - Operating Temperature - Case Temperature - Storage Temperature | -40°C to +95°C +105°C max. -55°C to +125°C |
| Power Derating | - High Temperature | Depending on model See application note: www.tracopower.com/overview/trv2m |
| Cooling System | | Natural convection (20 LFM) |
| Altitude During Operation | | 5'000 m max. |
| Regulator Topology | | Flyback Converter |
| Switching Frequency | | 180 - 400 kHz (PFM) |
| Insulation System | | Reinforced Insulation |
| Working Voltage (rated) | | 250 VAC |
| Isolation Test Voltage | - Input to Output, 60 s - Input to Output, 1 s | 5'000 VAC 7'000 VDC |
| Creepage | - Input to Output | 8 mm min. |
| Clearance | - Input to Output | 8 mm min. |
| Isolation Resistance | - Input to Output, 500 VDC | 10'000 MΩ min. |
| Isolation Capacitance | - Input to Output, 100 kHz, 1 V | 10 pF typ. 20 pF max. |
| Leakage Current | - Touch Current | 2 μA max. (264 VAC, 60 Hz) |
| Reliability | - Calculated MTBF | 10'410'000 h (MIL-HDBK-217F, ground benign) |
| Washing Process | | According to Cleaning Guideline www.tracopower.com/info/cleaning.pdf |
| Environment | - Vibration - Mechanical Shock - Thermal Shock | MIL-STD-810F 7.6 g, 3 axis, 60 min, 20-2000 Hz MIL-STD-810F 50 g, 3 axis, 11 ms MIL-STD-810F -55°C to +125°C, 72 cycles, 30 min each |
| Housing Material | | Non-conductive Plastic (UL 94 V-0 rated) |
| Potting Material | | Silicone (UL 94 V-0 rated) |
| Pin Material | | Tinned Copper |
| Pin Foundation Plating | | Nickel (2 - 3 μm) |
| Pin Surface Plating | | Tin (3 - 5 μm), matte |
| Housing Type | | Plastic Case |
| Mounting Type | | PCB Mount |
| Connection Type | | THD (Through-Hole Device) |
| Footprint Type | | SIP9 |
| Soldering Profile | | Lead-Free Wave Soldering 260°C / 6 s max. |
| Weight | | 4.8 g |
| Environmental Compliance | - REACH Declaration - RoHS Declaration - SCIP Reference Number | www.tracopower.com/info/reach-declaration.pdf REACH SVHC list compliant REACH Annex XVII compliant www.tracopower.com/info/rohs-declaration.pdf Exemptions: 7a, 7c-I (RoHS exemptions refer to the component concentration only, not to the overall concentration in the product (O5A rule)) 2dda669e-cfb2-4463-b721-ad8acc4e0fbd |

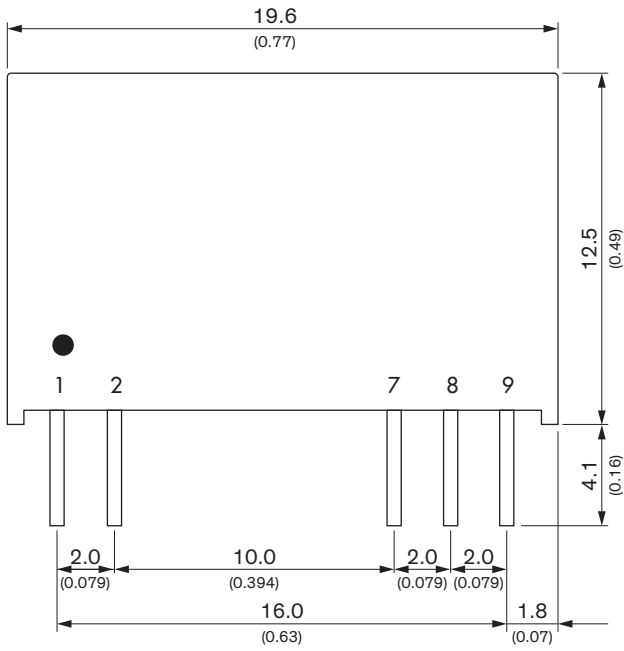
Supporting Documents

Overview Link (for additional Documents)

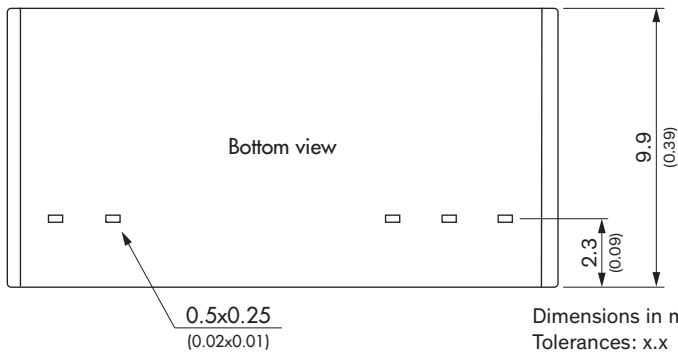
www.tracopower.com/overview/trv2m

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

Outline Dimensions



| Pinout | | |
|--------|--------|--------|
| Pin | Single | Dual |
| 1 | +Vin | +Vin |
| 2 | -Vin | -Vin |
| 7 | -Vout | -Vout |
| 8 | No pin | Common |
| 9 | +Vout | +Vout |



Dimensions in mm (inch)
 Tolerances: x.x ±0.5 (±0.02)
 x.xx ±0.25 (±0.01)
 Pin diameter ±0.1 (±0.004)