

- I/O isolation 5000 VAC (reinforced)
- Short circuit protection
- Semi-regulated outputs
- Input voltage ranges ( $\pm 10\%$ ):  
5, 12, 15, 24 VDC
- Operating temperature range  
-40 to +85 °C without derating
- Certification according to IEC/EN/ES  
60601-1 3rd edition for 2xMOPP and  
IEC/EN/UL 62368-1
- Low leakage current  $< 2 \mu\text{A}$
- Efficiency up to 85%
- Operation up to 5000 m altitude
- 5-year product warranty



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

The TRV 1M is a series of 1 Watt DC/DC converters in a compact SIP-9 package with reinforced isolation of 5000 VAC for medical and industrial applications. The series offers models with different input voltages ( $\pm 10\%$ ) between 5 and 24 VDC. With a continuous short circuit protection and a low leakage current of less than  $2 \mu\text{A}$ , this converter series is especially suited to protect any connected interfaces or applied parts to patients. Featuring semi-regulated outputs this series provides a good level of regulation without affecting the cost efficiency. It is an ideal solution for applications where a completely unregulated DC/DC converter would not meet your regulation requirements and therefore opens up the overall application range of this series. Together with an operating temperature range from -40 to +85°C without derating and certifications according to IEC/EN/ES 60601-1 3rd ed. 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 <sub>max</sub>	Vnom	I <sub>max</sub>	
TRV 1-0510M	4.5 - 5.5 VDC (5 VDC nom.)	3.3 VDC	303 mA			80 %
TRV 1-0511M		5 VDC	200 mA			82 %
TRV 1-0512M		12 VDC	83 mA			85 %
TRV 1-0513M		15 VDC	67 mA			84 %
TRV 1-0521M		+5 VDC	100 mA	-5 VDC	100 mA	85 %
TRV 1-0522M		+12 VDC	42 mA	-12 VDC	42 mA	85 %
TRV 1-0523M		+15 VDC	34 mA	-15 VDC	34 mA	84 %
TRV 1-1210M	9.6 - 14.4 VDC (12 VDC nom.)	3.3 VDC	303 mA			80 %
TRV 1-1211M		5 VDC	200 mA			82 %
TRV 1-1212M		12 VDC	83 mA			84 %
TRV 1-1213M		15 VDC	67 mA			83 %
TRV 1-1221M		+5 VDC	100 mA	-5 VDC	100 mA	82 %
TRV 1-1222M		+12 VDC	42 mA	-12 VDC	42 mA	83 %
TRV 1-1223M		+15 VDC	34 mA	-15 VDC	34 mA	83 %
TRV 1-1510M	12 - 18 VDC (15 VDC nom.)	3.3 VDC	303 mA			79 %
TRV 1-1511M		5 VDC	200 mA			83 %
TRV 1-1512M		12 VDC	83 mA			84 %
TRV 1-1513M		15 VDC	67 mA			84 %
TRV 1-1521M		+5 VDC	100 mA	-5 VDC	100 mA	82 %
TRV 1-1522M		+12 VDC	42 mA	-12 VDC	42 mA	83 %
TRV 1-1523M		+15 VDC	34 mA	-15 VDC	34 mA	83 %
TRV 1-2410M	19.2 - 28.8 VDC (24 VDC nom.)	3.3 VDC	303 mA			78 %
TRV 1-2411M		5 VDC	200 mA			82 %
TRV 1-2412M		12 VDC	83 mA			83 %
TRV 1-2413M		15 VDC	67 mA			83 %
TRV 1-2421M		+5 VDC	100 mA	-5 VDC	100 mA	80 %
TRV 1-2422M		+12 VDC	42 mA	-12 VDC	42 mA	81 %
TRV 1-2423M		+15 VDC	34 mA	-15 VDC	34 mA	81 %

Note - 5 Vin models: If the input will be switched electromechanically, use an external 100  $\mu\text{F}/10 \text{ V E/C}$ . to avoid voltage transient.

## Input Specifications

Input Current	- At no load	5 Vin models: <b>30 mA typ.</b> 12 Vin models: <b>30 mA typ.</b> 15 Vin models: <b>15 mA typ.</b> 24 Vin models: <b>10 mA typ.</b>
Surge Voltage		5 Vin models: <b>6 VDC max.</b> (1 s max.) 12 Vin models: <b>25 VDC max.</b> (1 s max.) 15 Vin models: <b>25 VDC max.</b> (1 s max.) 24 Vin models: <b>40 VDC max.</b> (1 s max.)
Recommended Input Fuse		5 Vin models: <b>500 mA</b> (slow blow) 12 Vin models: <b>315 mA</b> (slow blow) 15 Vin models: <b>315 mA</b> (slow blow) 24 Vin models: <b>160 mA</b> (slow blow)  (The need of an external fuse has to be assessed in the final application.)

## Output Specifications

Voltage Set Accuracy		<b>±3.5% max.</b> (60% load: 3.3, 5, ±5 Vout models) <b>±3.5% max.</b> (90% load: other models)
Regulation	- Input Variation (1% Vin step)  - Load Variation (10 - 100%)  - Cross Regulation (25% / 100% asym. load)	single output models: <b>0.2% max.</b> dual output models: <b>0.2% max.</b> single output models: <b>10% max.</b> (3.3, 5 Vout models) <b>7% max.</b> (other models) dual output models: <b>7% max.</b> (Output 1) <b>7% max.</b> (Output 2) (10% max. for ±5 Vout model) dual output models: <b>6% max.</b>
Ripple and Noise	- 20 MHz Bandwidth	<b>75 mVp-p typ.</b> <b>100 mVp-p max.</b>
Capacitive Load	- single output  - dual output	3.3 Vout models: <b>2'000 µF max.</b> 5 Vout models: <b>820 µF max.</b> 12 Vout models: <b>470 µF max.</b> 15 Vout models: <b>470 µF max.</b> 5 / -5 Vout models: <b>470 / 470 µF max.</b> 12 / -12 Vout models: <b>220 / 220 µF max.</b> 15 / -15 Vout models: <b>220 / 220 µF max.</b>
Minimum Load		<b>Not required</b>
Temperature Coefficient		<b>±0.03 %/K max.</b>
Short Circuit Protection		<b>Continuous, Automatic recovery</b>

## Safety Specifications

Safety 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
	- Certification Documents	<a href="http://www.tracopower.com/overview/trv1m">www.tracopower.com/overview/trv1m</a>

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

## EMC Specifications

EMI Emissions	- Conducted 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)
	- 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: <a href="http://www.tracopower.com/overview/trv1m">www.tracopower.com/overview/trv1m</a>		
EMS Immunity	- Electrostatic Discharge	Air: EN 61000-4-2, ±15 kV, perf. criteria A Contact: EN 61000-4-2, ±8 kV, perf. criteria A

## General Specifications

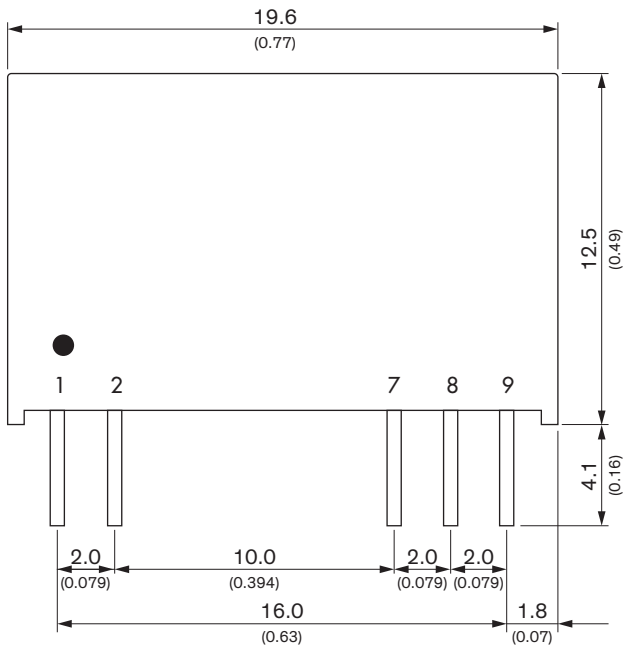
Relative Humidity		95% max. (non condensing)
Temperature Ranges	- Operating Temperature	-40°C to +85°C (without derating)
	- Case Temperature	+105°C max.
	- Storage Temperature	-55°C to +125°C
Cooling System		Natural convection (20 LFM)
Altitude During Operation		5'000 m max.
Switching Frequency		220 - 380 kHz (PWM)
Insulation System		Reinforced Insulation
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	15 pF typ.
		20 pF max.
Leakage Current	- Touch Current	2 µA max.
Reliability	- Calculated MTBF	19'360'000 h (MIL-HDBK-217F, ground benign)
Environment	- Vibration	MIL-STD-810F
	- Mechanical Shock	MIL-STD-810F
	- Thermal Shock	MIL-STD-810F
Housing Material		Non-conductive Plastic (UL94 V-0 rated)
Potting Material		Silicone (UL 94 V-0 rated)
Pin Material		Brass
Pin Foundation Plating		Nickel (1 - 2 µm)
Pin Surface Plating		Tin (3 - 5 µm), matte
Connection Type		THD (Through-Hole Device)
Weight		4.8 g
Environmental Compliance	- Reach	<a href="http://www.tracopower.com/info/reach-declaration.pdf">www.tracopower.com/info/reach-declaration.pdf</a>
	- RoHS	<a href="http://www.tracopower.com/info/rohs-declaration.pdf">www.tracopower.com/info/rohs-declaration.pdf</a>

## Supporting Documents

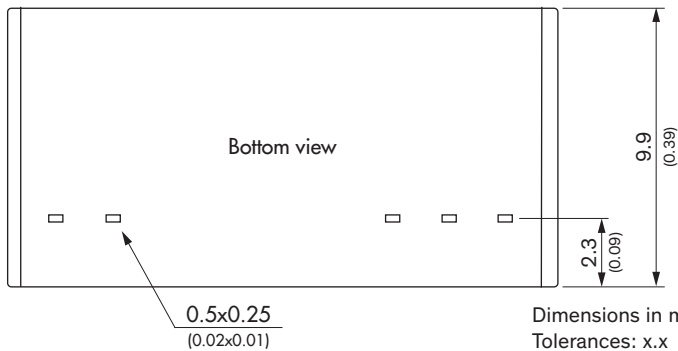
Overview Link (for additional Documents)	<a href="http://www.tracopower.com/overview/trv1m">www.tracopower.com/overview/trv1m</a>
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**Outline Dimensions**



Pinout		
Pin	Single	Dual
1	+Vin (Vcc)	+Vin (Vcc)
2	-Vin (GND)	-Vin (GND)
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)