- **I/O isolation 5000 VAC (reinforced)**
- **Short circuit protection**
- **Semi-regulated outputs**
- **Input voltage ranges (±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 µA**
- **Efficiency up to 85%**
- **Operation up to 5000 m altitude**
- **5-year product warranty**

2MOPP c UL us CB Scheme

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 (±10%) between 5 and 24 VDC. With a continuous short circuit protection and a low leakage current of less than 2 µA, 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 you regulation requirements and therefore opens up the overall application range of this series. Together with an operating temperature range from -40 to +85C° 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
		Vnom	Imax	Vnom	Imax	typ.
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 µF/10 V E/C. to avoid voltage transient.

Input Specifications

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

Output Specifications

Voltage Set Accuracy			±3.5% max. (60% load: 3.3, 5, ±5 Vout models)
			±3.5% max. (90% load: other models)
Regulation	- Input Variation (1% Vin step)	single output models:	0.2% max.
		dual output models:	0.2% max.
	- Load Variation (10 - 100%)	single output models:	10% max. (3.3, 5 Vout models)
			7% max. (other models)
		dual output models:	7% max. (Output 1)
			7% max. (Output 2)
			(10% max. for ±5 Vout model)
	- Cross Regulation (25% / 100% asym. load)	dual output models:	6% max.
Ripple and Noise	- 20 MHz Bandwidth		75 mVp-p typ.
			100 mVp-p max.
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.
Short Circuit Protection			Continuous, Automatic recovery

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

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

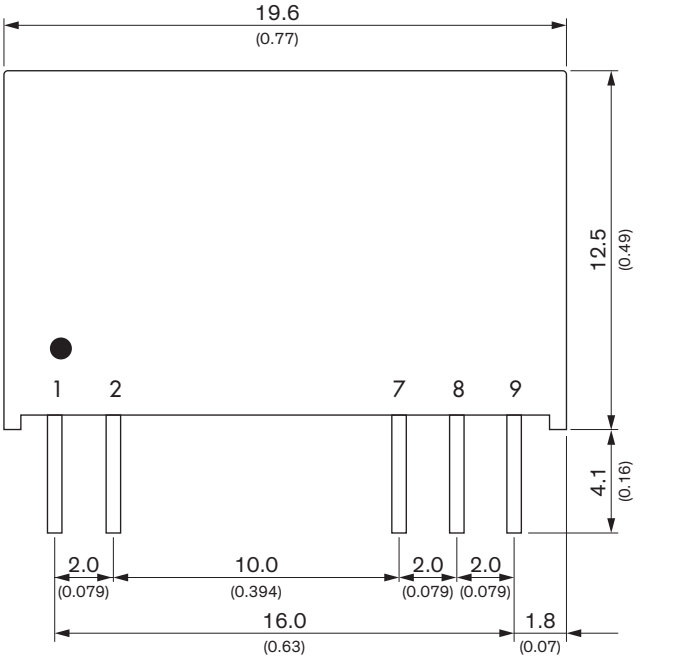
EMC Specifications

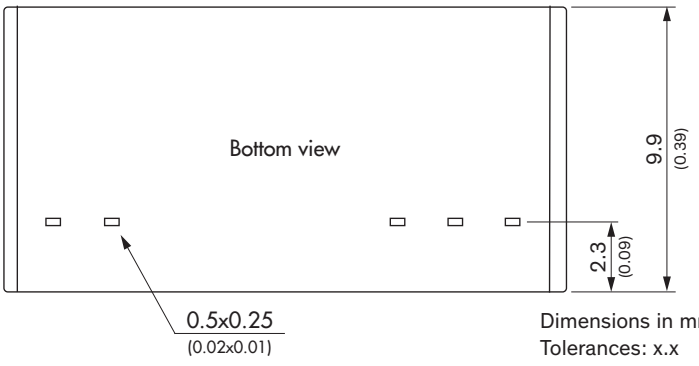
EMI Emissions	- Conducted Emissions		EN 55011 class A (with external filter)
			EN 55011 class B (with external filter)
			EN 55032 class A (with external filter)
			EN 55032 class B (with external filter)
	- Radiated Emissions		EN 55011 class A (with external filter)
			EN 55011 class B (with external filter)
			EN 55032 class A (with external filter)
			EN 55032 class B (with external filter)
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	
	- RoHS	

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)