

Unregulated DC/DC Medical Converter

TRV 1M Series, 1 Watt

- I/O isolation 5000 VAC (reinforced)
- Short circuit protection
- Unregulated outputs
- Input voltage ranges ($\pm 10\%$):
5, 12, 15, 24 VDC
- Operating temperature range
-40 to +95 °C without derating
- Certification according to IEC/EN/ES 60601-1 edition 3.2 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. Together with an operating temperature range from -40 to +95°C without derating and certifications according to 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 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 model: If the input is switched electromechanically, use an external 100 $\mu\text{F}/25 \text{ V E/C.}$ to reduce voltage transient.
 - Other models: If the input is switched electromechanically, use an external 47 $\mu\text{F}/100 \text{ V E/C.}$ to reduce 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		$\pm 3.5\%$ max. (60% load: 3.3, 5, ± 5 Vout models) $\pm 3.5\%$ max. (90% load: other models)
Regulation (Unregulated)	- Input Variation (1% Vin step) - Load Variation - Cross Regulation (25% / 100% asym. load)	single output models: 0.2% max. dual output models: 0.2% max. See application note: www.tracopower.com/overview/trv1m dual output models: 6% max.
Ripple and Noise	- 20 MHz Bandwidth	100 mVp-p max. 75 mVp-p typ.
Capacitive Load	- single output - dual output	3.3 Vout models: 2'000 μ F max. 5 Vout models: 820 μ F max. 12 Vout models: 470 μ F max. 15 Vout models: 470 μ F max. 5 / -5 Vout models: 470 / 470 μ F max. 12 / -12 Vout models: 220 / 220 μ F max. 15 / -15 Vout models: 220 / 220 μ F max.
Minimum Load		See application note: www.tracopower.com/overview/trv1m
Temperature Coefficient		± 0.03 %/K max.
Short Circuit Protection		Continuous, Automatic recovery

Safety Specifications

Standards	- IT / Multimedia Equipment - Medical Equipment - Certification Documents	EN 62368-1 IEC 62368-1 UL 62368-1 EN 60601-1 IEC 60601-1 ANSI/AAMI ES 60601-1 2 x MOPP (Means Of Patient Protection) www.tracopower.com/overview/trv1m
Pollution Degree		PD 2

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

EMC Specifications

EMI (Emissions)		EN 60601-1-2 edition 4 (Medical Devices)
- 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: www.tracopower.com/overview/trv1m
EMS (Immunity)		EN 60601-1-2 edition 4 (Medical Devices)
		EN 55024 (IT Equipment)
		EN 55035 (Multimedia)
- 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, ± 2 kV, perf. criteria A
	External filter proposal:	www.tracopower.com/overview/trv1m
- 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
EMC / Environmental		www.tracopower.com/overview/trv1m
- Certification Documents		

General Specifications

Relative Humidity		95% max. (non condensing)
Temperature Ranges	- Operating Temperature	-40°C to +95°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.
Regulator Topology		Flyback Converter
Switching Frequency		220 - 380 kHz (PWM)
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 M Ω min.
Isolation Capacitance	- Input to Output, 100 kHz, 1 V	15 pF typ. 20 pF max.
Leakage Current	- Touch Current	2 μ A max.
Reliability	- Calculated MTBF	19'360'000 h (MIL-HDBK-217F, ground benign)
Washing Process		According to Cleaning Guideline 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)
Potting Material		Silicone (UL 94 V-0 rated)
Pin Material		Brass
Pin Foundation Plating		Nickel (1 - 2 μ m)
Pin Surface Plating		Tin (3 - 5 μ m), matte
Housing Type		Plastic Case
Mounting Type		PCB Mount

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

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 www.tracopower.com/info/reach-declaration.pdf REACH SVHC list compliant REACH Annex XVII compliant www.tracopower.com/info/rohs-declaration.pdf Exemptions: 7(a), 7(c)-I (RoHS exemptions refer to the component concentration only, not to the overall concentration in the product (O5A rule).) - RoHS Declaration - SCIP Reference Number 804cccb4-e301-4dbb-9ef4-8516768826e7

Additional Information

Supporting Documents	www.tracopower.com/overview/trv1m
Frequently Asked Questions	www.tracopower.com/glossary-faq
Glossary	www.tracopower.com/info/glossary.pdf

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Pinout		
Pin	Single	Dual
1	+Vin (Vcc)	+Vin (Vcc)
2	−Vin (GND)	−Vin (GND)
7	−Vout	−Vout
8	No pin	Common
9	+Vout	+Vout

