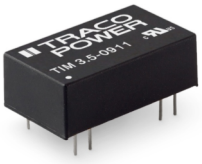
TRACO POWER

DC/DC Medical Converter

TIM 3.5 Series, 3.5 Watt

- **Compact DIP-16-package**
- **I/O isolation 5000 VACrms rated for 250 VACrms working voltage**
- **Certification according to IEC/EN/ES 60601-1 edition 3.2 for 2xMOPP and operation 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 3.5 series is a range of high performance, regulated 3.5 Watt DC/DC converters in a DIP-16 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 equipment, measurement equipment, and some IGBT driver applications.

Models

Order Code	Input Voltage Range	Output 1		Output 2		Efficiency
		Vnom	Imax	Vnom	Imax	typ.
TIM 3.5-0911	4.5 - 12 VDC (9 VDC nom.)	5 VDC	700 mA			77 %
TIM 3.5-0919		9 VDC	389 mA			78 %
TIM 3.5-0912		12 VDC	292 mA			82 %
TIM 3.5-0913		15 VDC	234 mA			82 %
TIM 3.5-0915		24 VDC	146 mA			82 %
TIM 3.5-0922		+12 VDC	146 mA	−12 VDC	146 mA	82 %
TIM 3.5-0923		+15 VDC	117 mA	−15 VDC	117 mA	81 %
TIM 3.5-1211	9 - 18 VDC (12 VDC nom.)	5 VDC	700 mA			79 %
TIM 3.5-1219		9 VDC	389 mA			79 %
TIM 3.5-1212		12 VDC	292 mA			82 %
TIM 3.5-1213		15 VDC	234 mA			82 %
TIM 3.5-1215		24 VDC	146 mA			82 %
TIM 3.5-1222		+12 VDC	146 mA	−12 VDC	146 mA	82 %
TIM 3.5-1223		+15 VDC	117 mA	−15 VDC	117 mA	82 %
TIM 3.5-2411	18 - 36 VDC (24 VDC nom.)	5 VDC	700 mA			79 %
TIM 3.5-2419		9 VDC	389 mA			80 %
TIM 3.5-2412		12 VDC	292 mA			83 %
TIM 3.5-2413		15 VDC	234 mA			83 %
TIM 3.5-2415		24 VDC	146 mA			82 %
TIM 3.5-2422		+12 VDC	146 mA	−12 VDC	146 mA	82 %
TIM 3.5-2423		+15 VDC	117 mA	−15 VDC	117 mA	82 %
TIM 3.5-4811	36 - 75 VDC (48 VDC nom.)	5 VDC	700 mA			79 %
TIM 3.5-4819		9 VDC	389 mA			80 %
TIM 3.5-4812		12 VDC	292 mA			82 %
TIM 3.5-4813		15 VDC	234 mA			82 %
TIM 3.5-4815		24 VDC	146 mA			82 %
TIM 3.5-4822		+12 VDC	146 mA	−12 VDC	146 mA	82 %
TIM 3.5-4823		+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) 6 - 8 VDC (5 VDC model) 10 - 14 VDC (9 VDC model) 13 - 19 VDC (12 VDC model) 16 - 22 VDC (15 VDC model) 25 - 35 VDC (24 VDC model)
Transient Response	- Response Time		500 µs typ. (25% Load Step)

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)
	- Certification Documents	www.tracopower.com/tim3-5-safety-cert/
Energy Source	- Output, acc. to 62368-1	ES1
Power Source	- Output, acc. to 62368-1	PS1
Pollution Degree		PD 2
Over Voltage Category		Not mains connected

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)
			FCC 47 Part 15 class A (with external filter)
			FCC 47 Part 18 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)
			FCC 47 Part 15 class A (internal filter)
			FCC 47 Part 18 class B (with external filter)
		External filter proposal:	www.tracopower.com/tim3-5-emc-filter/
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
			12 Vin models: KY 470 µF
			24 Vin models: KY 470 µF
			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
	- Approved Ambient Temp.	60601-1:	+75°C max.
	- 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/tim3-5-cc/
Cooling System			Natural convection (20 LFM)
Remote Control	- Current Controlled Remote (passive = on)		On: open circuit
			Off: 2 to 4 mA current (internal 1 kΩ resistor)
			Refers to 'Remote' and '-Vin' Pin
		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.
Regulator Topology			Flyback Converter, RCC Converter
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.
			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)

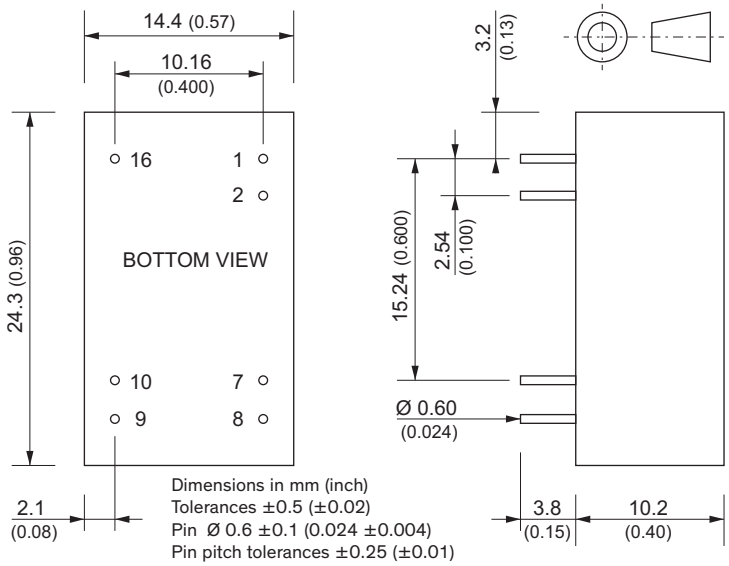
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Washing Process		According to Cleaning Guideline www.tracopower.com/info/cleaning.pdf
Environment	- Vibration	MIL-STD-810F
	- Mechanical Shock	MIL-STD-810F
	- Thermal Shock	MIL-STD-810F
Housing Material		Non-conductive Plastic (UL 94 V-0 rated)
Base 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		THD (Through-Hole Device)
Footprint Type		DIP16
Soldering Profile		Lead-Free Wave Soldering 260°C / 10 s max.
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: 7(a), 7(c)-I (RoHS exemptions refer to the component concentration only, not to the overall concentration in the product (O5A rule).)
	- SCIP Reference Number	0d290e44-e78c-4de4-aff6-70ee45b90620

Additional Information

Supporting Documents	www.tracopower.com/overview/tim3-5
Frequently Asked Questions	www.tracopower.com/glossary-faq
Glossary	www.tracopower.com/info/glossary.pdf
Service Portal	www.tracoserviceportal.com

Outline Dimensions



Dimensions in mm (inch)
Tolerances ±0.5 (±0.02)
Pin Ø 0.6 ±0.1 (0.024 ±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

Avoid routing PCB traces under the converter.

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