

- Compact SMD-16-package
- I/O isolation 5000 VACrms rated for 250 VACrms working voltage
- Certification according to IEC/EN/ES 60601-1 3rd edition for 2xMOPP and operation to 5000 m altitude
- Low leakage current < 2  $\mu$ A for BF-applications
- Extended operating temperature range -40°C to 90°C
- 5-year product warranty



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

The TIM 3.5SM series is a range of high performance, regulated 3.5 Watt DC/DC converters in a SMD plastic package. The reinforced I/O-isolation system complies with the medical safety requirements for 2 x MOPP (Means Of Patient Protection). The converters constitute also a reliable solution for many demanding applications such as transportation systems, industrial control equipments, measurement equipments, and some IGBT driver applications.

### Models

Order Code	Input Voltage Range	Output 1		Output 2		Efficiency typ.
		Vnom	I <sub>max</sub>	Vnom	I <sub>max</sub>	
TIM 3.5-0911SM	4.5 - 12 VDC (9 VDC nom.)	5 VDC	700 mA			77 %
TIM 3.5-0919SM		9 VDC	389 mA			78 %
TIM 3.5-0912SM		12 VDC	292 mA			82 %
TIM 3.5-0913SM		15 VDC	234 mA			82 %
TIM 3.5-0915SM		24 VDC	146 mA			82 %
TIM 3.5-0922SM		+12 VDC	146 mA	-12 VDC	146 mA	82 %
TIM 3.5-0923SM		+15 VDC	117 mA	-15 VDC	117 mA	81 %
TIM 3.5-1211SM	9 - 18 VDC (12 VDC nom.)	5 VDC	700 mA			79 %
TIM 3.5-1219SM		9 VDC	389 mA			79 %
TIM 3.5-1212SM		12 VDC	292 mA			82 %
TIM 3.5-1213SM		15 VDC	234 mA			82 %
TIM 3.5-1215SM		24 VDC	146 mA			82 %
TIM 3.5-1222SM		+12 VDC	146 mA	-12 VDC	146 mA	82 %
TIM 3.5-1223SM		+15 VDC	117 mA	-15 VDC	117 mA	82 %
TIM 3.5-2411SM	18 - 36 VDC (24 VDC nom.)	5 VDC	700 mA			79 %
TIM 3.5-2419SM		9 VDC	389 mA			80 %
TIM 3.5-2412SM		12 VDC	292 mA			83 %
TIM 3.5-2413SM		15 VDC	234 mA			83 %
TIM 3.5-2415SM		24 VDC	146 mA			82 %
TIM 3.5-2422SM		+12 VDC	146 mA	-12 VDC	146 mA	82 %
TIM 3.5-2423SM		+15 VDC	117 mA	-15 VDC	117 mA	82 %
TIM 3.5-4811SM	36 - 75 VDC (48 VDC nom.)	5 VDC	700 mA			79 %
TIM 3.5-4819SM		9 VDC	389 mA			80 %
TIM 3.5-4812SM		12 VDC	292 mA			82 %
TIM 3.5-4813SM		15 VDC	234 mA			82 %
TIM 3.5-4815SM		24 VDC	146 mA			82 %
TIM 3.5-4822SM		+12 VDC	146 mA	-12 VDC	146 mA	82 %
TIM 3.5-4823SM		+15 VDC	117 mA	-15 VDC	117 mA	82 %

## Input Specifications

Input Current	- At no load	9 Vin models: <b>80 mA typ.</b> 12 Vin models: <b>45 mA typ.</b> 24 Vin models: <b>27 mA typ.</b> 48 Vin models: <b>13 mA typ.</b>
	- At full load	9 Vin models: <b>927 mA max.</b> (5 Vout model) <b>917 mA max.</b> (9 Vout model) <b>872 mA max.</b> (12 Vout model) <b>872 mA max.</b> (15 Vout model) <b>872 mA max.</b> (24 Vout model) <b>872 mA max.</b> (12 / -12 Vout model) <b>883 mA max.</b> (15 / -15 Vout model) 12 Vin models: <b>376 mA max.</b> (5 Vout model) <b>377 mA max.</b> (9 Vout model) <b>360 mA max.</b> (12 Vout model) <b>361 mA max.</b> (15 Vout model) <b>364 mA max.</b> (24 Vout model) <b>364 mA max.</b> (12 / -12 Vout model) <b>362 mA max.</b> (15 / -15 Vout model) 24 Vin models: <b>186 mA max.</b> (5 Vout model) <b>186 mA max.</b> (9 Vout model) <b>179 mA max.</b> (12 Vout model) <b>179 mA max.</b> (15 Vout model) <b>182 mA max.</b> (24 Vout model) <b>182 mA max.</b> (12 / -12 Vout model) <b>182 mA max.</b> (15 / -15 Vout model) 48 Vin models: <b>93 mA max.</b> (5 Vout model) <b>93 mA max.</b> (9 Vout model) <b>90 mA max.</b> (12 Vout model) <b>90 mA max.</b> (15 Vout model) <b>91 mA max.</b> (24 Vout model) <b>91 mA max.</b> (12 / -12 Vout model) <b>90 mA max.</b> (15 / -15 Vout model)
Surge Voltage		9 Vin models: <b>15 VDC max.</b> (1 s max.) 12 Vin models: <b>25 VDC max.</b> (1 s max.) 24 Vin models: <b>50 VDC max.</b> (1 s max.) 48 Vin models: <b>100 VDC max.</b> (1 s max.)
Under Voltage Lockout		9 Vin models: <b>2 VDC min. / 3 VDC typ. / 4 VDC max.</b> 12 Vin models: <b>6 VDC min. / 7 VDC typ. / 8 VDC max.</b> 24 Vin models: <b>13 VDC min. / 15 VDC typ. / 17 VDC max.</b> 48 Vin models: <b>29 VDC min. / 32 VDC typ. / 35 VDC max.</b>
Recommended Input Fuse		9 Vin models: <b>1'600 mA</b> (slow blow) 12 Vin models: <b>800 mA</b> (slow blow) 24 Vin models: <b>500 mA</b> (slow blow) 48 Vin models: <b>315 mA</b> (slow blow)  (The need of an external fuse has to be assessed in the final application.)
Input Filter		<b>Internal Capacitor</b>

## Output Specifications

Voltage Set Accuracy	<b>±1% max.</b>
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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: <b>0.2% max.</b> dual output models: <b>0.2% max.</b>
	- Load Variation (10 - 90%)	single output models: <b>0.5% max.</b> dual output models: <b>0.8% max. (Output 1)</b> <b>0.8% max. (Output 2)</b>
	- Cross Regulation (25% / 100% asym. load)	dual output models: <b>5% max.</b>
Ripple and Noise (20 MHz Bandwidth)	- single output	5 Vout models: <b>50 mVp-p typ.</b> 9 Vout models: <b>50 mVp-p typ.</b> 12 Vout models: <b>50 mVp-p typ.</b> 15 Vout models: <b>50 mVp-p typ.</b> 24 Vout models: <b>75 mVp-p typ.</b>
	- dual output	12 / -12 Vout models: <b>75 / 75 mVp-p typ.</b> 15 / -15 Vout models: <b>75 / 75 mVp-p typ.</b>
Capacitive Load	- single output	5 Vout models: <b>1'470 µF max.</b> 9 Vout models: <b>680 µF max.</b> 12 Vout models: <b>470 µF max.</b> 15 Vout models: <b>330 µF max.</b> 24 Vout models: <b>170 µF max.</b>
	- dual output	12 / -12 Vout models: <b>220 / 220 µF max.</b> 15 / -15 Vout models: <b>160 / 160 µF max.</b>
Minimum Load		<b>Not required</b>
Temperature Coefficient		<b>±0.02 %/K max.</b>
Start-up Time		<b>10 ms typ. / 20 ms max.</b>
Short Circuit Protection		<b>Continuous, Automatic recovery</b>
Overvoltage Protection		<b>104 - 160% of Vout nom.</b> (depending on model) <b>6 - 8 VDC (5 VDC model)</b> <b>10 - 14 VDC (9 VDC model)</b> <b>13 - 19 VDC (12 VDC model)</b> <b>16 - 22 VDC (15 VDC model)</b> <b>25 - 35 VDC (24 VDC model)</b>
Transient Response	- Response Time	<b>500 µs typ. (25% Load Step)</b>

### Safety Specifications

Standards	- IT / Multimedia Equipment	<b>EN 62368-1</b> <b>IEC 62368-1</b> <b>UL 62368-1</b>
	- Medical Equipment	<b>EN 60601-1</b> <b>IEC 60601-1</b> <b>ANSI/AAMI ES 60601-1</b> <b>2 x MOPP (Means Of Patient Protection)</b>
	- Certification Documents	<a href="http://www.tracopower.com/overview/tim3-5sm">www.tracopower.com/overview/tim3-5sm</a>
Pollution Degree		<b>PD 2</b>

### EMC Specifications

EMI (Emissions)	- Conducted Emissions	<b>EN 60601-1-2 edition 4 (Medical Devices)</b> <b>EN 55011 class B (with external filter)</b> <b>EN 55032 class B (with external filter)</b> <b>FCC 47 Part 18 class B (with external filter)</b>
	- Radiated Emissions	<b>EN 55011 class B (with external filter)</b> <b>EN 55032 class B (with external filter)</b> <b>FCC 47 Part 18 class B (with external filter)</b>
		External filter proposal: <a href="http://www.tracopower.com/overview/tim3-5sm">www.tracopower.com/overview/tim3-5sm</a>

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

EMS (Immunity)	<ul style="list-style-type: none"> <li>- Electrostatic Discharge</li> <li>- RF Electromagnetic Field</li> <li>- EFT (Burst) / Surge</li> <li>- Conducted RF Disturbances</li> <li>- PF Magnetic Field</li> </ul>	<p>EN 60601-1-2 edition 4 (Medical Devices)</p> <p>Air: EN 61000-4-2, <math>\pm 15</math> kV, perf. criteria A</p> <p>Contact: EN 61000-4-2, <math>\pm 8</math> kV, perf. criteria A</p> <p>EN 61000-4-3, 10 V/m, perf. criteria A</p> <p>EN 61000-4-4, <math>\pm 2</math> kV, perf. criteria A</p> <p>EN 61000-4-5, <math>\pm 1</math> kV, perf. criteria A</p> <p>Ext. input component: 9 Vin models: KY 1000 <math>\mu</math>F    TVS SMDJ18A</p> <p>12 Vin models: KY 470 <math>\mu</math>F</p> <p>24 Vin models: KY 470 <math>\mu</math>F</p> <p>48 Vin models: KY 220 <math>\mu</math>F</p> <p>EN 61000-4-6, 10 Vrms, perf. criteria A</p> <p>Continuous: EN 61000-4-8, 100 A/m, perf. criteria A</p> <p>1 s: EN 61000-4-8, 1000 A/m, perf. criteria A</p>
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### General Specifications

Relative Humidity		95% max. (non condensing)
Temperature Ranges	<ul style="list-style-type: none"> <li>- Operating Temperature</li> <li>- Case Temperature</li> <li>- Storage Temperature</li> </ul>	<p>-40°C to +90°C</p> <p>+105°C max.</p> <p>-55°C to +125°C</p>
Power Derating	<ul style="list-style-type: none"> <li>- High Temperature</li> </ul>	<p>3.3 %/K above 75°C</p> <p>See application note: <a href="http://www.tracopower.com/overview/tim3-5sm">www.tracopower.com/overview/tim3-5sm</a></p>
Cooling System		Natural convection (20 LFM)
Remote Control	<ul style="list-style-type: none"> <li>- Current Controlled Remote (passive = on)</li> <li>- Off Idle Input Current</li> </ul>	<p>On: open circuit</p> <p>Off: 2 to 4 mA current (internal 1 k<math>\Omega</math> resistor)</p> <p>Refers to 'Remote' and '-Vin' Pin</p> <p>External circuit proposal: <a href="http://www.tracopower.com/info/current-remote.pdf">www.tracopower.com/info/current-remote.pdf</a></p> <p>2.5 mA typ.</p>
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 M $\Omega$ min.
Isolation Capacitance	- Input to Output, 100 kHz, 1 V	16 pF typ.
		20 pF max.
Leakage Current	- Touch Current	2 $\mu$ A max. (at 240 VAC / 60 Hz)
Reliability	- Calculated MTBF	5'041'000 h (MIL-HDBK-217F, ground benign)
Moisture Sensitivity (MSL)		Level 2 (J-STD-033C)
Washing Process		According to Cleaning Guideline
		<a href="http://www.tracopower.com/info/cleaning.pdf">www.tracopower.com/info/cleaning.pdf</a>
Environment	<ul style="list-style-type: none"> <li>- Vibration</li> <li>- Mechanical Shock</li> <li>- Thermal Shock</li> </ul>	<p>MIL-STD-810F</p> <p>MIL-STD-810F</p> <p>MIL-STD-810F</p>
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 $\mu$ m)
Pin Surface Plating		Tin (7 - 12 $\mu$ m), matte
Housing Type		Plastic Case
Mounting Type		PCB Mount
Connection Type		SMD (Surface-Mount Device)
Footprint Type		SMD16

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

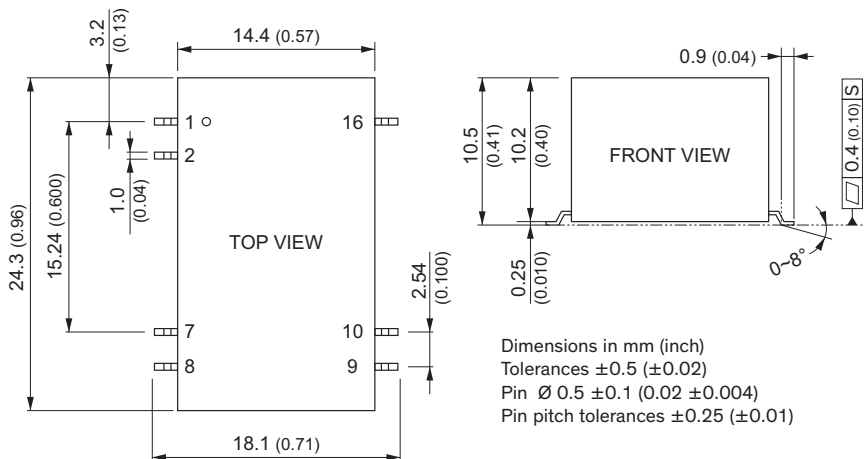
Soldering Profile	Lead-Free Reflow Soldering (acc. J-STD-020E) 245°C max. (Tp) 10 s max. (tp, at Tp - 5°C) 85 s max. (tL, time above 217°C)
Weight	7 g
Environmental Compliance	- REACH Declaration <a href="http://www.tracopower.com/info/reach-declaration.pdf">www.tracopower.com/info/reach-declaration.pdf</a> REACH SVHC list compliant REACH Annex XVII compliant - RoHS Declaration <a href="http://www.tracopower.com/info/rohs-declaration.pdf">www.tracopower.com/info/rohs-declaration.pdf</a> Exemptions: 7a, 7c-I (RoHS exemptions refer to the component concentration only, not to the overall concentration in the product (O5A rule.)) - SCIP Reference Number <a href="https://www.tracopower.com/info/scip-reference-number.pdf">www.tracopower.com/info/scip-reference-number.pdf</a>

### Supporting Documents

Overview Link (for additional Documents)

[www.tracopower.com/overview/tim3-5sm](http://www.tracopower.com/overview/tim3-5sm)

### Outline Dimensions



Pin	Pinout	
	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

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### Recommended Solder Pad Layout

