

- SMD-package
- Up to 96% efficiency
- No thermal layer required
- Built in filter capacitors
- Operation temp. range  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Short circuit protection
- Wide input operating range
- Excellent line / load regulation
- Low standby current
- 3-year product warranty



The new TSR-1SM series models of step-down switching regulators have a high efficiency up to 96% which allows full load operation up to  $+65^{\circ}\text{C}$  ambient temperature without the need of any heat transmission layer. Excellent output voltage accuracy ( $\pm 2\%$ ) and low standby current ( $\sim 1 \mu\text{A}$ ) are features that distinguish these switching regulators from linear regulators.

Models					
Order Code	Output Current max.	Input Voltage Range	Output Voltage nom.	Efficiency typ.	
TSR 1-0512SM	1'000 mA	3 - 5.5 VDC (5 VDC nom.)	1.2 VDC	91 % (at Vin min.)	
TSR 1-0515SM			1.5 VDC	92 % (at Vin min.)	
TSR 1-0518SM			1.8 VDC	93 % (at Vin min.)	
TSR 1-0525SM			2.5 VDC	95 % (at Vin min.)	
TSR 1-2412SM		4.6 - 36 VDC (12 VDC nom.)	4.6 - 36 VDC (12 VDC nom.)	1.2 VDC	74 % (at Vin min.)
TSR 1-2415SM				1.5 VDC	79 % (at Vin min.)
TSR 1-2418SM				1.8 VDC	82 % (at Vin min.)
TSR 1-2425SM				2.5 VDC	87 % (at Vin min.)
TSR 1-2433SM				3.3 VDC	91 % (at Vin min.)
TSR 1-2450SM				5 VDC	94 % (at Vin min.)
TSR 1-2465SM				6.5 VDC	94 % (at Vin min.)
TSR 1-2490SM				9 VDC	95 % (at Vin min.)
TSR 1-24120SM		12 VDC	95 % (at Vin min.)		
TSR 1-24150SM		15 VDC	96 % (at Vin min.)		

## Input Specifications

Input Current	- At no load	5 Vin models: <b>1 mA typ.</b> 12 Vin models: <b>1 mA typ.</b> 24 Vin models: <b>1 mA typ.</b>
	- At full load	5 Vin models: <b>1'000 mA max.</b> 12 Vin models: <b>1'000 mA max.</b> 24 Vin models: <b>1'000 mA max.</b> (at Vin min.)
Reflected Ripple Current		<b>150 mAp-p typ.</b>
Recommended Input Fuse	- 12 Vin input	5 Vin models: <b>1'000 mA</b> (slow blow) 24 Vin models: <b>1'600 mA</b> (slow blow) 1.2 Vout models: <b>800 mA</b> (slow blow) 1.5 Vout models: <b>800 mA</b> (slow blow) 1.8 Vout models: <b>800 mA</b> (slow blow) 2.5 Vout models: <b>1'250 mA</b> (slow blow) 3.3 Vout models: <b>1'250 mA</b> (slow blow) 5 Vout models: <b>1'250 mA</b> (slow blow) 6.5 Vout models: <b>1'250 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>±2% max.</b>
Regulation	- Input Variation (Vmin - Vmax)	<b>0.2% max.</b>
	- Load Variation (0 - 100%)	<b>0.6% max.</b>
Ripple and Noise (20 MHz Bandwidth)		5 Vin models: <b>50 mVp-p typ.</b> 12 Vin models: <b>50 mVp-p typ.</b> 24 Vin models: <b>75 mVp-p typ.</b>
Capacitive Load		<b>470 µF max.</b>
Minimum Load		<b>Not required</b>
Temperature Coefficient		<b>±0.015 %/K max.</b>
Start-up Time		<b>5 ms typ.</b>
Short Circuit Protection		<b>Continuous, Automatic recovery</b>
Output Current Limitation		<b>480% typ. of Iout max.</b>
		(5 Vin models) <b>250% typ. (other models)</b>
Transient Response	- Peak Variation	<b>200 mV typ. / 400 mV max. (50% Load Step)</b>
	- Response Time	<b>250 µs typ. / 350 µs max. (50% Load Step)</b>

## General Specifications

Relative Humidity		<b>95% max. (non condensing)</b>
Temperature Ranges	- Operating Temperature	<b>-40°C to +85°C</b>
	- Case Temperature	<b>+105°C max.</b>
	- Storage Temperature	<b>-55°C to +125°C</b>
Power Derating	- High Temperature	<b>2.5 %/K above 65°C</b>
Over Temperature	- Protection Mode	<b>150°C typ. (Automatic recovery)</b>
Protection Switch Off	- Measurement Point	<b>Internal IC temperature</b>
Cooling System		<b>Natural convection (20 LFM)</b>
Switching Frequency		<b>1200 kHz typ. (PWM) (5 Vin models)</b>
		<b>500 kHz typ. (PWM) (other models)</b>
Insulation System		<b>Non-isolated</b>
Reliability	- Calculated MTBF	<b>12'000'000 h (MIL-HDBK-217F, ground benign)</b>
Moisture Sensitivity (MSL)		<b>Level 1 (J-STD-033C)</b>

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

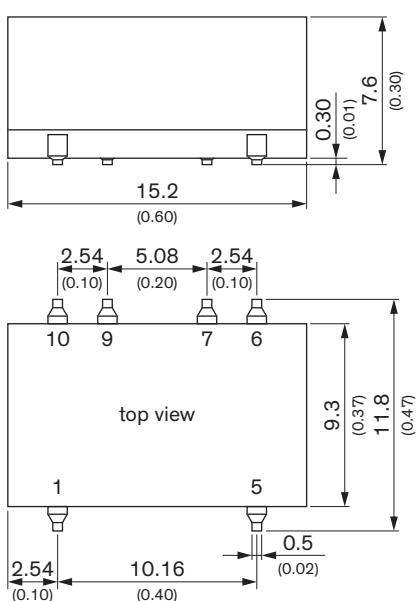
Washing Process		Allowed (open product) See Cleaning Guideline: <a href="http://www.tracopower.com/info/cleaning.pdf">www.tracopower.com/info/cleaning.pdf</a>
Environment	- Vibration - Thermal Shock	MIL-STD-810F MIL-STD-810F
Housing Material		Non-conductive Plastic (UL 94 V-0 rated)
Base Material		Non-conductive Plastic (UL 94 V-0 rated)
Potting Material		Epoxy (UL 94 V-0 rated) (Converter halfway potted on top of the PCB, not visible through vent hole)
Pin Material		Copper
Pin Foundation Plating		Nickel (2 - 3 $\mu\text{m}$ )
Pin Surface Plating		Tin (3 - 5 $\mu\text{m}$ ), matte
Housing Type		Plastic Case
Mounting Type		PCB Mount
Connection Type		SMD (Surface-Mount Device)
Footprint Type		SMD 10 Pin
Soldering Profile		Reflow Soldering (J-STD-020E) 245°C max.
Weight		1.7 g
Environmental Compliance	- REACH Declaration  - RoHS 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 <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). The SCIP number is provided on request.)

### Supporting Documents

Overview Link (for additional Documents)

[www.tracopower.com/overview/tsr1sm](http://www.tracopower.com/overview/tsr1sm)

### Outline Dimensions



Pinout	
Pin	Function
1	+Vin
5	+Vout
6	NC
7	GND
9	GND
10	NC

NC: Not connected

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

## Recommended Solder Pad Layout

