

- 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 $V_{in}$ min.)	
TSR 1-0515SM			1.5 VDC	92 % (at $V_{in}$ min.)	
TSR 1-0518SM		3.8 - 5.5 VDC (5 VDC nom.)	1.8 VDC	93 % (at $V_{in}$ min.)	
TSR 1-0525SM			2.5 VDC	95 % (at $V_{in}$ min.)	
TSR 1-2412SM		4.6 - 36 VDC (12 VDC nom.)	1.2 VDC	74 % (at $V_{in}$ min.)	
TSR 1-2415SM			1.5 VDC	79 % (at $V_{in}$ min.)	
TSR 1-2418SM			1.8 VDC	82 % (at $V_{in}$ min.)	
TSR 1-2425SM			2.5 VDC	87 % (at $V_{in}$ min.)	
TSR 1-2433SM			4.75 - 36 VDC (12 VDC nom.)	3.3 VDC	91 % (at $V_{in}$ min.)
TSR 1-2450SM			6.5 - 36 VDC (12 VDC nom.)	5 VDC	94 % (at $V_{in}$ min.)
TSR 1-2465SM			9 - 36 VDC (12 VDC nom.)	6.5 VDC	94 % (at $V_{in}$ min.)
TSR 1-2490SM			12 - 36 VDC (24 VDC nom.)	9 VDC	95 % (at $V_{in}$ min.)
TSR 1-24120SM		15 - 36 VDC (24 VDC nom.)	12 VDC	95 % (at $V_{in}$ min.)	
TSR 1-24150SM		18 - 36 VDC (24 VDC nom.)	15 VDC	96 % (at $V_{in}$ 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.</b> (other models)
Transient Response	- Peak Variation	<b>200 mV typ. / 400 mV max.</b> (50% Load Step)
	- Response Time	<b>250 µs typ. / 350 µs max.</b> (50% Load Step)

## General Specifications

Relative Humidity		<b>95% max.</b> (non condensing)
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> See application note: <a href="http://www.tracopower.com/overview/tsr1sm">www.tracopower.com/overview/tsr1sm</a>
Over Temperature Protection Switch Off	- Protection Mode - Measurement Point	<b>150°C typ.</b> (Automatic recovery) <b>Internal IC temperature</b>
Cooling System		<b>Natural convection</b> (20 LFM)
Switching Frequency		<b>1200 kHz typ.</b> (PWM) (5 Vin models)
		<b>500 kHz typ.</b> (PWM) (other models)
Insulation System		<b>Non-isolated</b>
Reliability	- Calculated MTBF	<b>12'000'000 h</b> (MIL-HDBK-217F, ground benign)
Moisture Sensitivity (MSL)		<b>Level 1</b> (J-STD-033C)

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

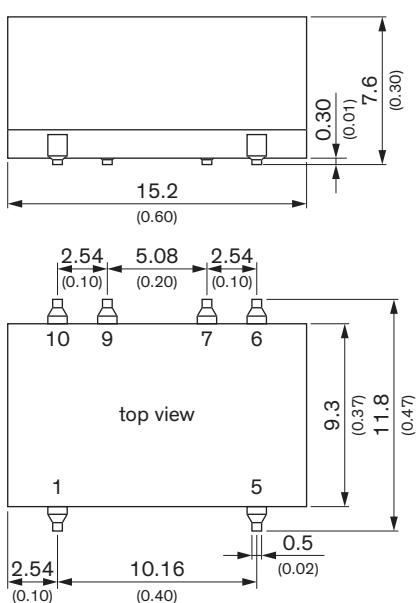
Washing Process		Allowed (open product) See Cleaning Guideline: <a href="http://www.tracopower.com/info/cleaning.pdf">www.tracopower.com/info/cleaning.pdf</a>
Environment	- Vibration - Thermal Shock	MIL-STD-810F MIL-STD-810F
Housing Material		Non-conductive Plastic (UL 94 V-0 rated)
Base Material		Non-conductive 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		SMD10
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



Dimensions in mm (inch)  
 Tolerances: x.xx  $\pm 0.5$  (x.x  $\pm 0.02$ )  
 Tolerances: x.xxx  $\pm 0.25$  (x.xx  $\pm 0.01$ )  
 Pin pitch tolerances:  $\pm 0.25$  ( $\pm 0.01$ )  
 Pin dimension tolerances:  $\pm 0.1$  ( $\pm 0.004$ )

### Pinout

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

NC: Not connected

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## Recommended Solder Pad Layout

