

### Features

- ◆ 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	Input voltage range	Output voltage	Output current max.	Efficiency typ.	
				@ Vin min.	@ Vin max.
TSR 1-0512SM	3.0 – 5.5 VDC	1.2 VDC	1 A	90.5 %	90.0 %
TSR 1-0515SM	3.0 – 5.5 VDC	1.5 VDC		92.0 %	91.5 %
TSR 1-0518SM	3.0 – 5.5 VDC	1.8 VDC		92.5 %	92.0 %
TSR 1-0525SM	3.8 – 5.5 VDC	2.5 VDC		94.5 %	94.0 %
TSR 1-2412SM	4.6 – 36 VDC*	1.2 VDC		74 %	62 %
TSR 1-2415SM	4.6 – 36 VDC*	1.5 VDC		79 %	67 %
TSR 1-2418SM	4.6 – 36 VDC*	1.8 VDC		82 %	70 %
TSR 1-2425SM	4.6 – 36 VDC*	2.5 VDC		87 %	75 %
TSR 1-2433SM	4.75 – 36 VDC*	3.3 VDC		91 %	80 %
TSR 1-2450SM	6.5 – 36 VDC*	5.0 VDC		94 %	84 %
TSR 1-2465SM	9.0 – 36 VDC*	6.5 VDC		94 %	89 %
TSR 1-2490SM	12 – 36 VDC*	9.0 VDC		95 %	90 %
TSR 1-24120SM	15 – 36 VDC*	12 VDC		95 %	92 %
TSR 1-24150SM	18 – 36 VDC*	15 VDC		96 %	94 %

\* For input voltage higher than 32 VDC an input capacitor  $22 \mu\text{F} / 50 \text{V}$  is required. See application notes (page 3)

### Input Specifications

Maximum input current (at $V_{in}$ min. and 1 A output current)	1 A
No load input current	1 mA typ.
Reflected ripple current	150 mA
Input filter	internal capacitor

### Output Specifications

Voltage set accuracy	$\pm 2\%$
Regulation	<ul style="list-style-type: none"> <li>- Input variation                      0.2 %</li> <li>- Load variation (0 – 100 %)        0.6 %</li> <li>- Load variation (10 – 90 %)        0.3 %</li> </ul>
Minimum load	not required
Ripple and noise (20 MHz Bandwidth)	<ul style="list-style-type: none"> <li><math>V_{out} &lt; 8</math> VDC: 50 mV max.</li> <li><math>V_{out} &gt; 8</math> VDC: 75 mV max.</li> </ul>
Temperature coefficient	$\pm 0.015\%$ / °C max.
Dynamic load response 50% load change (upper half)	<ul style="list-style-type: none"> <li>200 mV max. peak variation</li> <li>250 <math>\mu</math>s max. response time</li> </ul>
Startup rise time 10 % to 90 % $V_{out}$	5 ms
Short circuit protection	continuous, automatic recovery
Current limitation	<ul style="list-style-type: none"> <li>TSR 1-05xxSM models: at 4.8 A typ.</li> <li>other models: at 2.5 A typ.</li> </ul>
Capacitive load	470 $\mu$ F max.

### General Specifications

Temperature ranges	<ul style="list-style-type: none"> <li>- Operating                                <math>-40^{\circ}\text{C}</math> to <math>+85^{\circ}\text{C}</math></li> <li>- Max. casing temperature            <math>105^{\circ}\text{C}</math></li> <li>- Storage                                    <math>-55^{\circ}\text{C}</math> to <math>+125^{\circ}\text{C}</math></li> </ul>
Derating	2.5 %/K above $65^{\circ}\text{C}$
Thermal shock & vibration	acc. MIL-STD-810F
Humidity (non condensing)	5 – 95 % rel H max.
Reliability, calculated MTBF (MIL-HDBK-217F, at $+25^{\circ}\text{C}$ , ground benign)	$>12$ Mio. h
Isolation voltage	none
Switching frequency (pulse width modulation)	<ul style="list-style-type: none"> <li>TSR 1-05xxSM models: 1200 kHz</li> <li>other models: 500 kHz</li> </ul>
Environmental compliance	<ul style="list-style-type: none"> <li>- Reach                                      <a href="http://www.tracopower.com/overview/tsr1sm">www.tracopower.com/overview/tsr1sm</a></li> <li>- RoHS                                        RoHS directive 2011/65/EU</li> </ul>

### Physical Specifications

Casing material	non-conductive plastic
Package weight	1.7 g (0.06 oz)
Lead-free reflow solder process	<ul style="list-style-type: none"> <li>as per J-STD-020D.01 (to find at: <a href="http://www.jedec.org">www.jedec.org</a> - free registration required)</li> <li>245°C</li> <li>- max. peak body temperature</li> </ul>
Moisture sensitivity level (MSL)	level 1 as per IPC J-STD-033B.1 (to find at: <a href="http://www.jedec.org">www.jedec.org</a> - free registration required)
Washing	baking after washing: $100^{\circ}\text{C}$ for 30 min.

All specifications valid at nominal input voltage, full load and  $+25^{\circ}\text{C}$  after warm-up time unless otherwise stated.

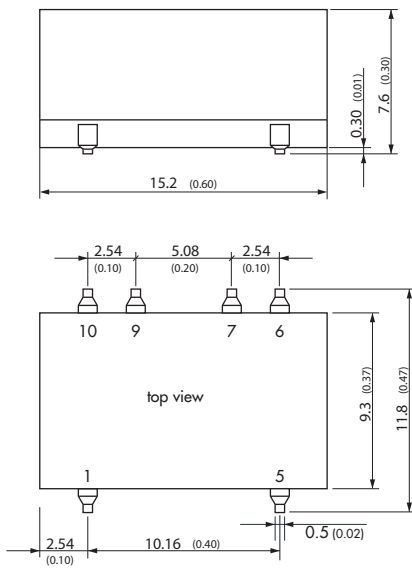
**Applications notes**

For input voltage higher than 32 VDC (max. 36 VDC)



C1 = 22  $\mu$ F / 50 V

**Outline Dimensions**



Solder Pad Dimension



Pin-Out	
1	-Vin
5	+Vout
6	nc
7	GND
9	GND
10	nc

nc = no internal connection

Dimensions in [mm], ( ) = Inch  
Pin pitch tolerances:  $\pm 0.25$  ( $\pm 0.01$ )  
Pin profile tolerance:  $\pm 0.1$  ( $\pm 0.004$ )  
Other tolerances:  $\pm 0.5$  ( $\pm 0.02$ )