

#### Features

- ◆ SMD-package
- ◆ Up to 96 % efficiency
- ◆ No thermal layer required
- ◆ Built in filter capacitors
- ◆ Operation temp. range -40°C to +85°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°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<br>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 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)                | $V_{out} < 8$ VDC: 50 mV max.<br>$V_{out} > 8$ VDC: 75 mV max.                                                                                                       |
| Temperature coefficient                            | $\pm 0.015\%$ / °C max.                                                                                                                                              |
| Dynamic load response 50% load change (upper half) | 200 mV max. peak variation<br>250 $\mu$ S max. response time                                                                                                         |
| Startup rise time 10 % to 90 % $V_{out}$           | 5 mS                                                                                                                                                                 |
| Short circuit protection                           | continuous, automatic recovery                                                                                                                                       |
| Current limitation                                 | TSR 1-05xxSM models: at 4.8 A typ.<br>other models: at 2.5 A typ.                                                                                                    |
| 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                                                                          | acc. MIL-STD-810F                                                                                                                                                                                                                                                                                  |
| Humidity (non condensing)                                                              | 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)                                           | TSR 1-05xxSM models: 1200 kHz<br>other models: 500 kHz                                                                                                                                                                                                                                             |
| 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>                                                                                                   |

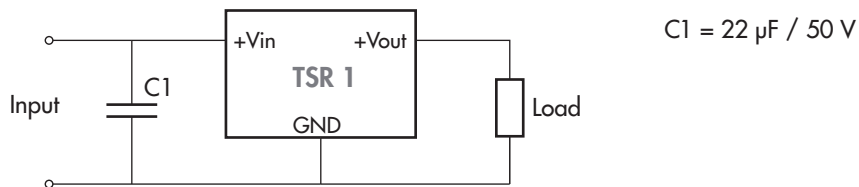
## Physical Specifications

|                                  |                                                                                                                                                              |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Casing material                  | non-conductive plastic                                                                                                                                       |
| Package weight                   | 1.7 g (0.07 oz)                                                                                                                                              |
| Lead-free reflow solder process  | as per J-STD-020D.01 (to find at:<br><a href="http://www.jedec.org">www.jedec.org</a> - free registration required)<br>245°C<br>– max. peak body temperature |
| Moisture sensitivity level (MSL) | level 1 as per IPC J-STD-033B.1 (to find at:<br><a href="http://www.jedec.org">www.jedec.org</a> - free registration required)                               |
| Washing                          | baking after washing: $100^{\circ}\text{C}$ for 30 min.                                                                                                      |

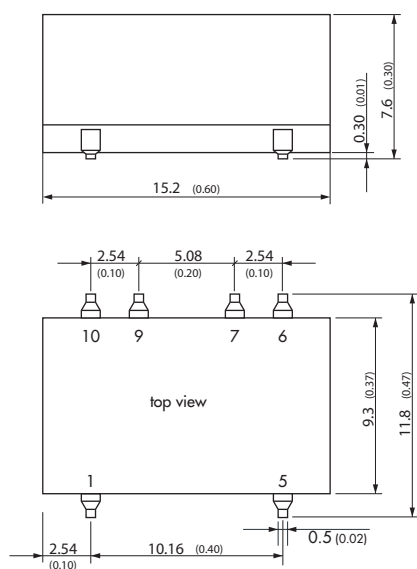
All specifications valid at nominal input voltage, full load and  $+25^{\circ}\text{C}$  after warm-up time unless otherwise stated.

## Applications notes

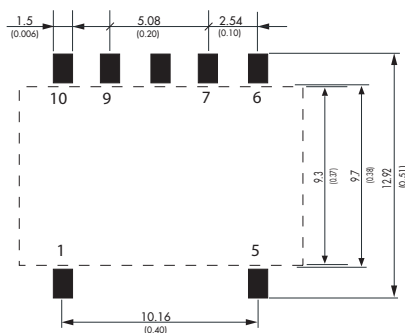
For input voltage higher than 32 VDC (max. 36 VDC)



## 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:  $\pm 0.5$  ( $\pm 0.02$ )