

- Compact SMD package
- Suitable for positive & negative output circuit
- Adjustable output voltage
- Wide input up to 42 VDC
- Remote On/Off input
- Built in filter capacitors
- Operation temp. range  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Excellent line/load regulation
- Low standby current
- 3-year product warranty



The new TSRN 1SM series are step-down non-isolated switching regulators in compact SMD package. They are an ideal solution to replace inefficient linear regulators. The high efficiency up to 95% allows full load operation up to  $+55^{\circ}\text{C}$  ( $+85^{\circ}\text{C}$  with derating) ambient temperature without the need of forced air cooling.

The TSRN-1SM switching regulators provide other significant features over linear regulators, i.e. better output accuracy ( $\pm 2\%$ ), lower standby current of  $\sim 4\text{ mA}$  and no requirement of external capacitors. They are suitable for positive or negative output circuits and offer a trim input for output voltage adjustment. The high efficiency, low standby power consumption and remote On/Off function make these regulators an ideal solution for energy sensitive applications.

### Models

| Order Code     | Output Current<br>max. | Input Voltage<br>Range      | Output Voltage<br>nom. (adjustable) | Efficiency<br>typ. |
|----------------|------------------------|-----------------------------|-------------------------------------|--------------------|
| TSRN 1-0525SM  | 1'000 mA               | 3 - 5.5 VDC (5 VDC nom.)    | 2.5 VDC (1.2 - 3.63 VDC)            | 96 %               |
| TSRN 1-2433SM  |                        | 4.6 - 42 VDC (12 VDC nom.)  | 3.3 VDC (1.5 - 5.5 VDC)             | 88 %               |
| TSRN 1-2450SM  |                        | 6.5 - 42 VDC (12 VDC nom.)  | 5 VDC (2.5 - 8.0 VDC)               | 92 %               |
| TSRN 1-2490SM  |                        | 10.5 - 42 VDC (12 VDC nom.) | 9 VDC (4.5 - 12.6 VDC)              | 95 %               |
| TSRN 1-24120SM |                        | 13.5 - 42 VDC (24 VDC nom.) | 12 VDC (4.5 - 13.5 VDC)             | 95 %               |
| TSRN 1-24150SM |                        | 16.5 - 42 VDC (24 VDC nom.) | 15 VDC (4.5 - 15.5 VDC)             | 96 %               |

Note - For external circuit proposal for negative output voltage, refer to application note: [www.tracopower.com/overview/tsrn1sm](http://www.tracopower.com/overview/tsrn1sm)

## Input Specifications

|                          |              |                                                                                                                                                                                                 |
|--------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Input Current            | - At no load | 5 Vin models: 6 mA typ.<br>12 Vin models: 3 mA typ.<br>24 Vin models: 4 mA typ.                                                                                                                 |
| Reflected Ripple Current |              | 100 mAp-p typ.                                                                                                                                                                                  |
| Recommended Input Fuse   |              | 5 Vin models: 2'000 mA (slow blow)<br>12 Vin models: 2'500 mA (slow blow)<br>24 Vin models: 1'600 mA (slow blow)<br>(The need of an external fuse has to be assessed in the final application.) |
| Input Filter             |              | Internal Capacitor                                                                                                                                                                              |

## Output Specifications

|                                        |                                                                                         |                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------------------|-----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Output Voltage Adjustment              |                                                                                         | 2.5 Vout models: 1.2 - 3.63 VDC<br>3.3 Vout models: 1.5 - 5.5 VDC<br>5 Vout models: 2.5 - 8.0 VDC<br>9 Vout models: 4.5 - 12.6 VDC<br>12 Vout models: 4.5 - 13.5 VDC<br>15 Vout models: 4.5 - 15.5 VDC<br>(By external trim resistor)<br>See application note: <a href="http://www.tracopower.com/tsrn1sm-adj">www.tracopower.com/tsrn1sm-adj</a> |
| Voltage Set Accuracy                   |                                                                                         | ±2% max.                                                                                                                                                                                                                                                                                                                                          |
| Regulation                             | - Input Variation (Vmin - Vmax)<br>- Load Variation (0 - 100%)                          | 0.2% max.<br>0.6% max.                                                                                                                                                                                                                                                                                                                            |
| Ripple and Noise<br>(20 MHz Bandwidth) | 5 Vin models:<br>24 Vin models:<br>3.3 Vout models:<br>5 Vout models:<br>9 Vout models: | 50 mVp-p max.<br>75 mVp-p max.<br>50 mVp-p max.<br>50 mVp-p max.<br>75 mVp-p max.                                                                                                                                                                                                                                                                 |
| Capacitive Load                        |                                                                                         | 470 µF max.                                                                                                                                                                                                                                                                                                                                       |
| Minimum Load                           |                                                                                         | Not required                                                                                                                                                                                                                                                                                                                                      |
| Temperature Coefficient                |                                                                                         | ±0.015 %/K max.                                                                                                                                                                                                                                                                                                                                   |
| Start-up Time                          |                                                                                         | 5 ms typ.                                                                                                                                                                                                                                                                                                                                         |
| Short Circuit Protection               |                                                                                         | Continuous, Automatic recovery                                                                                                                                                                                                                                                                                                                    |
| Transient Response                     | - Peak Variation<br>- Response Time                                                     | 150 mV typ. / 250 mV max. (50% Load Step)<br>250 µs typ. / 350 µs max. (50% Load Step)                                                                                                                                                                                                                                                            |

## Safety Specifications

|                       |                     |
|-----------------------|---------------------|
| Over Voltage Category | Not mains connected |
|-----------------------|---------------------|

## EMC Specifications

|                 |                                               |                                                                                                                                                                                                                                                                                                        |
|-----------------|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EMI (Emissions) | - Conducted Emissions<br>- Radiated Emissions | EN 55032 class A (with external filter)<br>EN 55032 class B (with external filter)<br>EN 55032 class A (with external filter)<br>EN 55032 class B (with external filter)<br>External filter proposal: <a href="http://www.tracopower.com/tsrn1sm-emc-filter">www.tracopower.com/tsrn1sm-emc-filter</a> |
|-----------------|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## General Specifications

|                    |                                                                        |                                                                                                                              |
|--------------------|------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Relative Humidity  |                                                                        | 95% max. (non condensing)                                                                                                    |
| Temperature Ranges | - Operating Temperature<br>- Case Temperature<br>- Storage Temperature | -40°C to +85°C<br>+105°C max.<br>-55°C to +125°C                                                                             |
| Power Derating     | - High Temperature                                                     | Depending on model<br>See application note: <a href="http://www.tracopower.com/tsrn1sm-cc">www.tracopower.com/tsrn1sm-cc</a> |

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

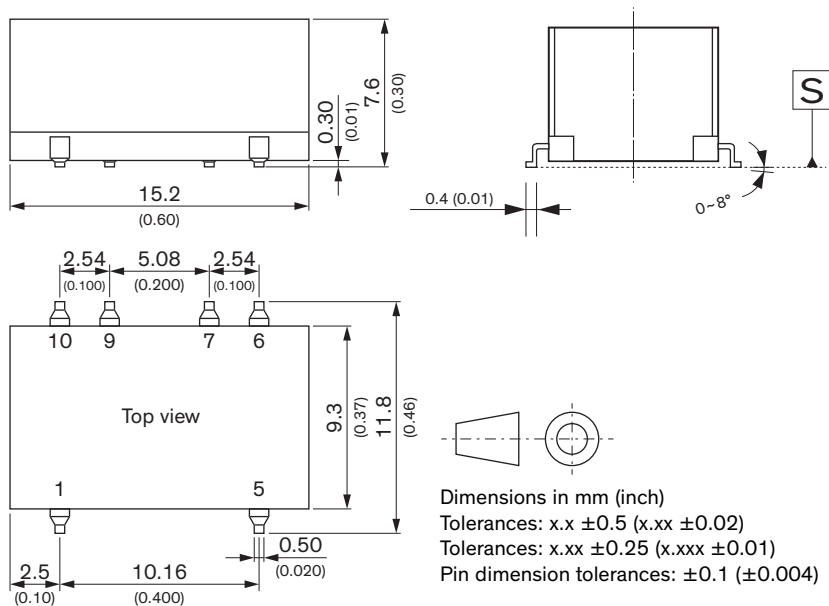
|                            |                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------------------|-------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Over Temperature           | - Protection Mode                                                             | 170°C typ. (Automatic recovery)                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Protection Switch Off      | - Measurement Point                                                           | Internal IC temperature                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Cooling System             |                                                                               | Natural convection (20 LFM)                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Remote Control             | - Voltage Controlled Remote<br>(passive = on)<br><br>- Off Idle Input Current | On: 2.0 to 5.0 VDC or open circuit<br>Off: 0 to 0.8 VDC or short circuit<br>Refers to 'Remote' and 'GND' Pin<br>1.2 mA typ.                                                                                                                                                                                                                                                                                                                                                                   |
| Regulator Topology         |                                                                               | Buck Converter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Switching Frequency        |                                                                               | 410 kHz typ. (PWM) (2.5 Vout models)<br>300 kHz typ. (PWM) (3.3 Vout models)<br>580 kHz typ. (PWM) (other models))                                                                                                                                                                                                                                                                                                                                                                            |
| Insulation System          |                                                                               | Non-isolated                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Reliability                | - Calculated MTBF                                                             | 14'000'000 h (MIL-HDBK-217F, ground benign)                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Moisture Sensitivity (MSL) |                                                                               | Level 1 (J-STD-033C)                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Washing Process            |                                                                               | According to Cleaning Guideline<br><a href="http://www.tracopower.com/info/cleaning.pdf">www.tracopower.com/info/cleaning.pdf</a>                                                                                                                                                                                                                                                                                                                                                             |
| Environment                | - Vibration<br><br>- Thermal Shock                                            | MIL-STD-810F<br>EN 61373<br>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 µm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Pin Surface Plating        |                                                                               | Tin (3 - 5 µm), matte                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Housing Type               |                                                                               | Plastic Case                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Mounting Type              |                                                                               | PCB Mount                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Connection Type            |                                                                               | SMD (Surface-Mount Device)                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Footprint Type             |                                                                               | SMD10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Soldering Profile          |                                                                               | Lead-Free Reflow Soldering (acc. J-STD-020E)<br>245°C max. (Tc)<br>30 s max. (tp, at Tp - 5°C)<br>65 s max. (tL, time above 217°C )                                                                                                                                                                                                                                                                                                                                                           |
|                            |                                                                               | See application note: <a href="http://www.tracopower.com/info/reflow-soldering.pdf">www.tracopower.com/info/reflow-soldering.pdf</a>                                                                                                                                                                                                                                                                                                                                                          |
| Weight                     |                                                                               | 1.7 g                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Environmental Compliance   | - REACH Declaration<br><br>- RoHS Declaration<br><br>- SCIP Reference Number  | <a href="http://www.tracopower.com/info/reach-declaration.pdf">www.tracopower.com/info/reach-declaration.pdf</a><br>REACH SVHC list compliant<br>REACH Annex XVII compliant<br><a href="http://www.tracopower.com/info/rohs-declaration.pdf">www.tracopower.com/info/rohs-declaration.pdf</a><br>Exemptions: 7(a), 7(c)-I<br>(RoHS exemptions refer to the component concentration only, not to the overall concentration in the product (O5A rule).)<br>c414b2ac-dba5-47f6-8505-84a60254272a |

## Additional Information

|                            |                                                                                                |
|----------------------------|------------------------------------------------------------------------------------------------|
| Supporting Documents       | <a href="http://www.tracopower.com/overview/tsrn1sm">www.tracopower.com/overview/tsrn1sm</a>   |
| Frequently Asked Questions | <a href="http://www.tracopower.com/glossary-faq">www.tracopower.com/glossary-faq</a>           |
| Glossary                   | <a href="http://www.tracopower.com/info/glossary.pdf">www.tracopower.com/info/glossary.pdf</a> |
| Service Portal             | <a href="http://www.tracoserviceportal.com">www.tracoserviceportal.com</a>                     |

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### Outline Dimensions



| Pinout |               |
|--------|---------------|
| Pin    | Function      |
| 1      | +Vin          |
| 5      | +Vout         |
| 6      | Trim          |
| 7      | GND           |
| 9      | GND           |
| 10     | Remote On/Off |

### Recommended Solder Pad Layout

