

#### Features

- ◆ 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°C to +85°C
- ◆ No heat-sink required
- ◆ Over-temperature protection
- ◆ Short circuit protection
- ◆ Excellent line / load regulation
- ◆ Low standby current
- ◆ Moisture sensitivity level (MSL) 1
- ◆ Qualified for leadfree reflow solder process
- ◆ 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°C (+85°C with derating) ambient temperature without the need of forced aircooling.

The TSRN-1SM switching regulators provide other significant features over linear regulators, i.e. better output accuracy ( $\pm 2\%$ ), lower standby current of ~4 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 <sup>1)</sup>                                                                                                                                                                        | Input voltage                   | Output voltage |                          | Output current | Efficiency typ. |            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|----------------|--------------------------|----------------|-----------------|------------|
|                                                                                                                                                                                                 | range <sup>2)</sup> / (nominal) | nominal        | trim range <sup>3)</sup> | max.           | @ Vin min.      | @ Vin max. |
| TSRN 1-0525SM<br>TSRN 1-2433SM<br>TSRN 1-2450SM<br>TSRN 1-2490SM<br>TSRN 1-24120SM<br>TSRN 1-24150SM<br><br>TSRN 1-2433SM<br>TSRN 1-2450SM<br>TSRN 1-2490SM<br>TSRN 1-24120SM<br>TSRN 1-24150SM | Positive output circuit         |                |                          |                |                 |            |
|                                                                                                                                                                                                 | 3.0 – 5.5 VDC (5 VDC)           | 2.5 VDC        | 1.2 – 3.6 VDC            | 1.0 A          | 95.5 %          | 95 %       |
|                                                                                                                                                                                                 | 4.6 – 42 VDC (12 VDC)           | 3.3 VDC        | 1.5 – 5.5 VDC            |                | 87.5 %          | 80 %       |
|                                                                                                                                                                                                 | 6.5 – 42 VDC (12 VDC)           | 5.0 VDC        | 2.5 – 8.0 VDC            |                | 91.5 %          | 83.5 %     |
|                                                                                                                                                                                                 | 10.5 – 42 VDC (12 VDC)          | 9.0 VDC        | 4.5 – 12.6 VDC           |                | 94.5 %          | 89 %       |
|                                                                                                                                                                                                 | 13.5 – 42 VDC (24 VDC)          | 12 VDC         | 4.5 – 13.5 VDC           |                | 95.0 %          | 91 %       |
|                                                                                                                                                                                                 | 16.5 – 42 VDC (24 VDC)          | 15 VDC         | 4.5 – 15.5 VDC           |                | 95.5 %          | 92.5 %     |
|                                                                                                                                                                                                 | Negative output circuit         |                |                          |                |                 |            |
|                                                                                                                                                                                                 | 4.6 – 32 VDC (12 VDC)           | -3.3 VDC       | -1.5 – -5.5 VDC          | 0.6 A          | 74 %            | 77 %       |
|                                                                                                                                                                                                 | 4.6 – 31 VDC (12 VDC)           | -5.0 VDC       | -2.5 – -8.0 VDC          | 0.4 A          | 80 %            | 78 %       |
|                                                                                                                                                                                                 | 7 – 27 VDC (12 VDC)             | -9.0 VDC       | -4.5 – -12.6 VDC         | 0.3 A          | 85 %            | 82 %       |
|                                                                                                                                                                                                 | 7 – 24 VDC (12 VDC)             | -12 VDC        | -4.5 – -13.5 VDC         | 0.3 A          | 84 %            | 86 %       |
|                                                                                                                                                                                                 | 7 – 21 VDC (12 VDC)             | -15 VDC        | -4.5 – -15.5 VDC         | 0.2 A          | 85 %            | 84 %       |

1) Same order code for positive and negative output operation, see page 3 for circuits.

2) For input voltage higher 36 VDC an input capacitor 22  $\mu$ F/ 50 V is required.

3) For positive output circuit, input voltage must be higher than output voltage set: >0.5 V for TSRN1-0525SM and >1.5 V for other models.  
For negative output circuit, input voltage plus absolute output voltage set must not exceed 36 VDC ( $V_{in} + |V_{out}| < 36 \text{ VDC}$ )

## Input Specifications

|                          |                           |                                                                                                       |
|--------------------------|---------------------------|-------------------------------------------------------------------------------------------------------|
| No load input current    | – positive output circuit | TSRN 1-0525SM: 6 mA typ.<br>TSRN 1-2433SM: 1.5 mA typ.<br>other models: 4 mA typ.                     |
|                          | – negative output circuit | -3.3 / -5.5 Vout models: 3 mA typ.<br>-9.0 / -12 Vout models: 7 mA typ.<br>TSRN 1-24150SM: 10 mA typ. |
| Reflected ripple current |                           | 100 mA typ.                                                                                           |
| Input filter             |                           | internal capacitors                                                                                   |

## Output Specifications

|                                                    |                                                         |                                                         |
|----------------------------------------------------|---------------------------------------------------------|---------------------------------------------------------|
| Voltage set accuracy                               |                                                         | ±2 % (at full load)                                     |
| Regulation                                         | – Input variation                                       | 0.2 %                                                   |
|                                                    | – Load variation 0 – 100 %                              | 0.6 %                                                   |
|                                                    | – Load variation 10 – 90 %                              | 0.3 %                                                   |
| Startup voltage overshoot                          |                                                         | 1.0 % max.                                              |
| Minimum load                                       |                                                         | not required                                            |
| Ripple and noise<br>(20 MHz Bandwidth)             | –  Vout  = 1.2V – 8V                                    | 50 mVpk-pk max.                                         |
|                                                    | –  Vout  = 8.1V – 15V                                   | 75 mVpk-pk max.                                         |
| Temperature coefficient                            |                                                         | ±0.015 % / °C max.                                      |
| Dynamic load response (change of 50% to 100% load) |                                                         | 150 mV max. peak variation<br>250 µs max. response time |
| Startup time                                       | – start up time at nominal Vin, constant resistive load | 5 mS typ.                                               |
| Short circuit protection                           |                                                         | continuous, automatic recovery                          |
| Current limitation                                 | TSRN 1-0525SM:                                          | at 4.0 A typ.                                           |
|                                                    | other models:                                           | at 2.0 A typ.                                           |
| Capacitive load                                    |                                                         | 470 µF max.                                             |

## General Specifications

|                                                                       |                                                     |                                                                                                                  |
|-----------------------------------------------------------------------|-----------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| Temperature ranges                                                    | – Operating                                         | –40°C to +85°C                                                                                                   |
|                                                                       | – case temperature                                  | +130°C. max.                                                                                                     |
|                                                                       | – Storage                                           | –55°C to +125°C                                                                                                  |
| Derating                                                              | – positive output circuit                           | 1.7 %/K above +55°C                                                                                              |
|                                                                       | – negative output circuit                           | 2.5 %/K above +65°C                                                                                              |
| Thermal shock, mechanical shock & vibration                           |                                                     | EN 61373, MIL-STD-810F                                                                                           |
|                                                                       | – Test conditions                                   | <a href="http://www.tracopower.com/products/mil810.pdf">www.tracopower.com/products/mil810.pdf</a>               |
| Overtemperature protection                                            |                                                     | at +170°C (on internal IC)                                                                                       |
| Humidity (non condensing)                                             |                                                     | 90 % rel H max.                                                                                                  |
| Reliability, calculated MTBF (MIL-HDBK-217F, at +25°C, ground benign) |                                                     | >4'500'000 h                                                                                                     |
| Isolation voltage                                                     |                                                     | none                                                                                                             |
| Switching frequency                                                   | TSRN 1-0525SM:                                      | 410 kHz typ.                                                                                                     |
|                                                                       | TSRN 1-2433SM:                                      | 300 kHz typ.                                                                                                     |
|                                                                       | other models:                                       | 580 kHz typ.                                                                                                     |
| Safety standards (designed to meet)                                   |                                                     | UL/cUL 60950-1, IEC/EN 60950-1                                                                                   |
| Remote On/Off                                                         | – Control pin reference for positive output circuit | GND                                                                                                              |
|                                                                       | – Control pin reference for negative output circuit | -Vout                                                                                                            |
|                                                                       | – On:                                               | 2 – 5 VDC or open circuit.                                                                                       |
|                                                                       | – Off:                                              | 0 – 0.8 VDC or short circuit                                                                                     |
|                                                                       | – Off idle current:                                 | 1.2 mA typ.                                                                                                      |
| Environmental compliance                                              | – Reach                                             | <a href="http://www.tracopower.com/products/tsrn1sm-reach.pdf">www.tracopower.com/products/tsrn1sm-reach.pdf</a> |
|                                                                       | – RoHS                                              | RoHS directive 2011/65/EU                                                                                        |

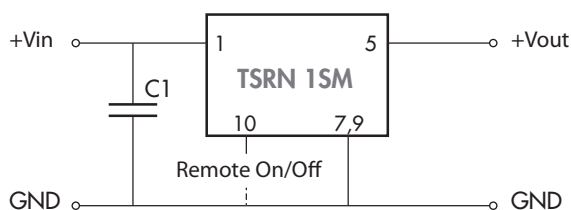
All specifications valid at nominal input voltage, full load and +25°C after warm-up time unless otherwise stated.

## Physical Specifications

|                                  |                                                                                                                                                              |
|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Casing material                  | non-conductive plastic (UL94V-0 rated)                                                                                                                       |
| Potting material                 | epoxy, (UL 94V-0 rated)                                                                                                                                      |
| Weight                           | 1.7 g (0.06 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°C for 30 min.                                                                                                                      |
| Packaging                        | <a href="http://www.tracopower.com/products/tsrn1sm-pack.pdf">www.tracopower.com/products/tsrn1sm-pack.pdf</a>                                               |

## Applications notes

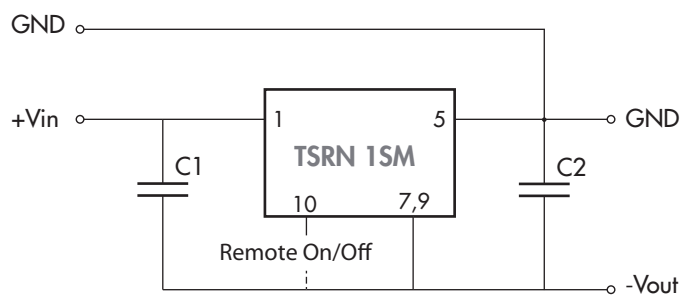
Positive output operation:



$C1 = 22 \mu\text{F} / 50 \text{ V}$  (required only if input voltage is higher than 36 V)

(Open Remote On/Off input = On)

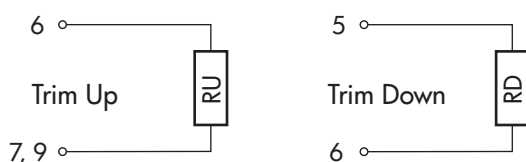
Negative output operation (not for model TSRN 1-0525SM):



$C1 = 10 \mu\text{F} / 50 \text{ V}$ , 1210 X5R MLCC  
 $C2 = 10 \mu\text{F} / 25 \text{ V}$ , 1206 X5R MLCC

(Open Remote On/Off input = On)

Output voltage adjustment:

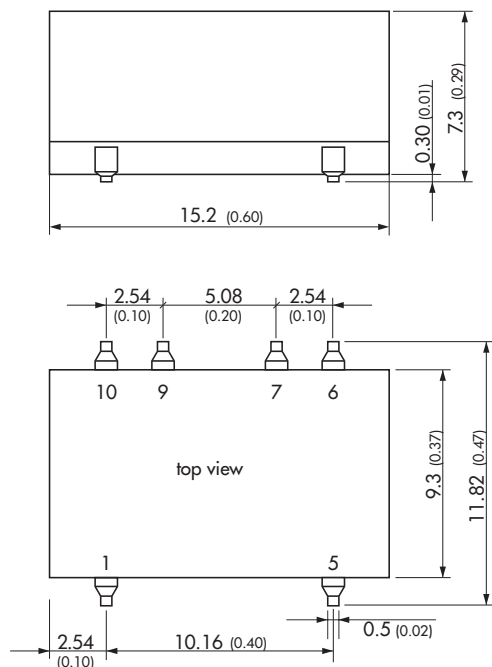
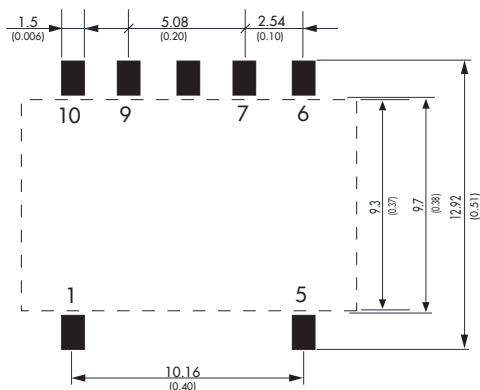


| Model          | RU [KOhm]             | RD [KOhm]                                 |
|----------------|-----------------------|-------------------------------------------|
| TSRN 1-0525SM  | $40.75 / (V_o - 2.5)$ | $(V_o \cdot 50.75 - 40.75) / (2.5 - V_o)$ |
| TSRN 1-2433SM  | $26.4 / (V_o - 3.3)$  | $(V_o \cdot 33 - 26.4) / (3.3 - V_o)$     |
| TSRN 1-2450SM  | $160 / (V_o - 5)$     | $(V_o \cdot 200 - 160) / (5 - V_o)$       |
| TSRN 1-2490SM  | $80 / (V_o - 9)$      | $(V_o \cdot 100 - 80) / (9 - V_o)$        |
| TSRN 1-24120SM | $240 / (V_o - 12)$    | $(V_o \cdot 300 - 240) / (12 - V_o)$      |
| TSRN 1-24150SM | $240 / (V_o - 15)$    | $(V_o \cdot 300 - 240) / (15 - V_o)$      |

$V_o$  = output voltage to be adjusted.

Calculate with absolute values for negative output circuit

Open Trim = nominal output voltage

**Outline Dimensions**

**Solder Pad Dimension**


| Pin-Out |               |       |
|---------|---------------|-------|
| Pin     | pos.          | neg.  |
| 1       | +Vin          | +Vin  |
| 5       | +Vout         | GND   |
| 6       | Trim          |       |
| 7       | GND           | -Vout |
| 9       | GND           | -Vout |
| 10      | Remote On/Off |       |

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

Specifications can be changed any time without notice.

Компания «Life Electronics» занимается поставками электронных компонентов импортного и отечественного производства от производителей и со складов крупных дистрибьюторов Европы, Америки и Азии.

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- Входной контроль качества.
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