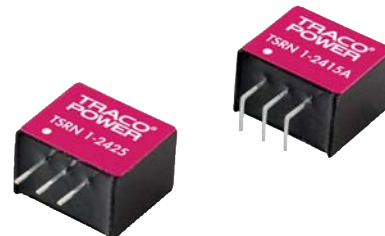


#### Features

- ◆ SIP-package fits existing TO-220 footprint
- ◆ Suitable for positive & negative output circuit
- ◆ Pin compatible with LMxx linear regulators
- ◆ Built in filter capacitors
- ◆ Operation temp. range  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- ◆ No heat-sink required
- ◆ Over-temperature protection
- ◆ Short circuit protection
- ◆ Wide input range up to 42 VDC
- ◆ Excellent line / load regulation
- ◆ Low standby current
- ◆ 3-year product warranty



The new TSRN-1 series step-down switching regulators are drop-in replacement for inefficient 78xx linear regulators. A high efficiency up to 95 % allows full load operation up to  $+70^{\circ}\text{C}$  ( $+85^{\circ}\text{C}$  with derating) ambient temperature without the need of any heat-sink or forced air cooling.

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

#### Models

| Order code <sup>1)</sup>                                                                                                              |                                                                                                                                                | Input voltage                   | Output voltage | Output current | Efficiency typ. |            |
|---------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|----------------|----------------|-----------------|------------|
| straight pins                                                                                                                         | angular pins                                                                                                                                   | range <sup>2)</sup> / (nominal) |                | max.           | @ Vin min.      | @ Vin max. |
| TSRN 1-2415<br>TSRN 1-2418<br>TSRN 1-2425<br>TSRN 1-2433<br>TSRN 1-2450<br>TSRN 1-2465<br>TSRN 1-2490<br>TSRN 1-24120<br>TSRN 1-24150 | TSRN 1-2415A<br>TSRN 1-2418A<br>TSRN 1-2425A<br>TSRN 1-2433A<br>TSRN 1-2450A<br>TSRN 1-2465A<br>TSRN 1-2490A<br>TSRN 1-24120A<br>TSRN 1-24150A | Positive output circuit         |                |                |                 |            |
|                                                                                                                                       |                                                                                                                                                | 4.6 – 42 VDC (12 VDC)           | 1.5 VDC        | 1.0 A          | 77 %            | 66 %       |
|                                                                                                                                       |                                                                                                                                                | 4.6 – 42 VDC (12 VDC)           | 1.8 VDC        |                | 80 %            | 70 %       |
|                                                                                                                                       |                                                                                                                                                | 4.6 – 42 VDC (12 VDC)           | 2.5 VDC        |                | 83 %            | 75 %       |
|                                                                                                                                       |                                                                                                                                                | 4.6 – 42 VDC (12 VDC)           | 3.3 VDC        |                | 87 %            | 79 %       |
|                                                                                                                                       |                                                                                                                                                | 6.5 – 42 VDC (12 VDC)           | 5.0 VDC        |                | 91 %            | 83 %       |
|                                                                                                                                       |                                                                                                                                                | 8.0 – 42 VDC (12 VDC)           | 6.5 VDC        |                | 93 %            | 86 %       |
|                                                                                                                                       |                                                                                                                                                | 10.5 – 42 VDC (12 VDC)          | 9.0 VDC        |                | 94 %            | 88 %       |
|                                                                                                                                       |                                                                                                                                                | 13.5 – 42 VDC (24 VDC)          | 12 VDC         |                | 95 %            | 91 %       |
|                                                                                                                                       |                                                                                                                                                | 16.5 – 42 VDC (24 VDC)          | 15 VDC         |                | 95 %            | 92 %       |
| Negative output circuit                                                                                                               |                                                                                                                                                |                                 |                |                |                 |            |
| TSRN 1-2415                                                                                                                           | TSRN 1-2415A                                                                                                                                   | 4.6 – 32 VDC (12 VDC)           | –1.5 VDC       | 0.6 A          | 69 %            | 64 %       |
| TSRN 1-2418                                                                                                                           | TSRN 1-2418A                                                                                                                                   | 4.6 – 32 VDC (12 VDC)           | –1.8 VDC       | 0.6 A          | 72 %            | 67 %       |
| TSRN 1-2425                                                                                                                           | TSRN 1-2425A                                                                                                                                   | 4.6 – 32 VDC (12 VDC)           | –2.5 VDC       | 0.6 A          | 72 %            | 74 %       |
| TSRN 1-2433                                                                                                                           | TSRN 1-2433A                                                                                                                                   | 4.6 – 32 VDC (12 VDC)           | –3.3 VDC       | 0.6 A          | 74 %            | 77 %       |
| TSRN 1-2450                                                                                                                           | TSRN 1-2450A                                                                                                                                   | 6.5 – 31 VDC (12 VDC)           | –5.0 VDC       | 0.4 A          | 79 %            | 78 %       |
| TSRN 1-2465                                                                                                                           | TSRN 1-2465A                                                                                                                                   | 8.0 – 29 VDC (12 VDC)           | –6.5 VDC       | 0.3 A          | 84 %            | 80 %       |
| TSRN 1-2490                                                                                                                           | TSRN 1-2490A                                                                                                                                   | 10.5 – 27 VDC (12 VDC)          | –9.0 VDC       | 0.3 A          | 85 %            | 82 %       |
| TSRN 1-24120                                                                                                                          | TSRN 1-24120A                                                                                                                                  | 13.5 – 24 VDC (12 VDC)          | –12 VDC        | 0.3 A          | 85 %            | 85 %       |
| TSRN 1-24150                                                                                                                          | TSRN 1-24150A                                                                                                                                  | 16.5 – 21 VDC (12 VDC)          | –15 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  $\mu\text{F}$  / 50 V is required

## Input Specifications

|                          |                                                                           |
|--------------------------|---------------------------------------------------------------------------|
| No load input current    | <= 3.3 VDC output models: 1 mA typ.<br>>= 5.0 VDC Output models: 3 mA typ |
| Reflected ripple current | 100 mA typ.                                                               |
| Input filter             | internal capacitors                                                       |

## Output Specifications

|                                                    |                                                                                                                                                                                                                                                                                                              |
|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Voltage set accuracy                               | ±2 % (at full load)                                                                                                                                                                                                                                                                                          |
| Regulation                                         | <div>– Input variation</div> <div>– Load variation (10 – 100 %)</div> <div>1.5 VDC models: 0.2 %</div> <div>1.8 VDC models: 0.6 % straight pin vers., 1.2 % angular pin vers.</div> <div>other models: 0.4 % straight pin vers., 1.2 % angular pin vers.</div> <div>other models: 0.4 % (all versions)</div> |
| Startup voltage overshoot                          | 1.0 % max.                                                                                                                                                                                                                                                                                                   |
| Minimum load                                       | not required                                                                                                                                                                                                                                                                                                 |
| Ripple and noise (20 MHz Bandwidth)                | <div>1.5 – 6.5 VDC models: 50 mVpk-pk max.</div> <div>9 – 15 VDC models: 75 mVpk-pk max.</div>                                                                                                                                                                                                               |
| Temperature coefficient                            | ±0.015 % / °C max.                                                                                                                                                                                                                                                                                           |
| Dynamic load response (change of 50% to 100% load) | <div>150 mV max. peak variation</div> <div>250 µS max. response time</div>                                                                                                                                                                                                                                   |
| Startup time                                       | <div>– start up time at nominal Vin, constant resistive load</div> <div>– rise time for 10 % to 90 % Vout</div> <div>5 mS typ.</div> <div>3.5 mS typ.</div>                                                                                                                                                  |
| Short circuit protection                           | continuous, automatic recovery                                                                                                                                                                                                                                                                               |
| Current limitation (for positive output circuit)   | at 2.0 A typ.                                                                                                                                                                                                                                                                                                |
| Capacitive load                                    | 470 µF max.                                                                                                                                                                                                                                                                                                  |

## General Specifications

|                                                                       |                                                                                                                                                         |
|-----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| Temperature ranges                                                    | <div>– Operating</div> <div>– Max. casing temperature</div> <div>– Storage</div> <div>–40°C to +85°C</div> <div>+100°C</div> <div>–55°C to +125°C</div> |
| Derating                                                              | 2.7 %/K above +70°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) | >6'000'000 h                                                                                                                                            |
| Isolation voltage                                                     | none                                                                                                                                                    |
| Switching frequency                                                   | <div>1.5 – 3.3 VDC models: 300 kHz typ.</div> <div>5.0 – 15 VDC models: 580 kHz typ.</div>                                                              |

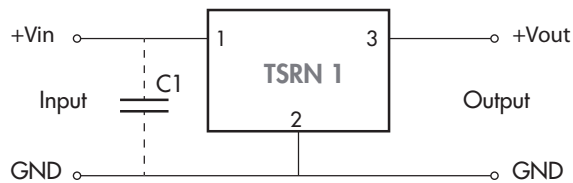
## Physical Specifications

|                          |                                                                                                                                                                                                   |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Casing material          | non-conductive plastic                                                                                                                                                                            |
| Potting material         | silicon (flammability to UL 94V-0 rated)                                                                                                                                                          |
| Weight                   | 1.9 g (0.07 oz)                                                                                                                                                                                   |
| Soldering profile        | max. +265°C / 10 sec. (wave soldering)                                                                                                                                                            |
| Environmental compliance | <div>– Reach</div> <div>– RoHS</div> <div><a href="http://www.tracopower.com/products/tsrn1-reach.pdf">www.tracopower.com/products/tsrn1-reach.pdf</a></div> <div>RoHS directive 2011/65/EU</div> |

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

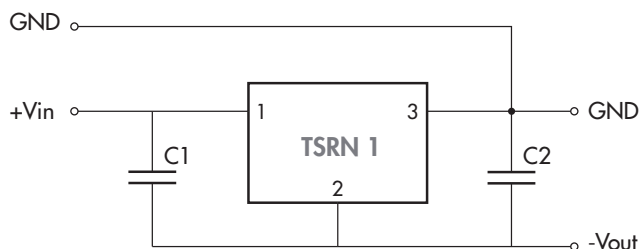
## Applications notes

Positive output operation:



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

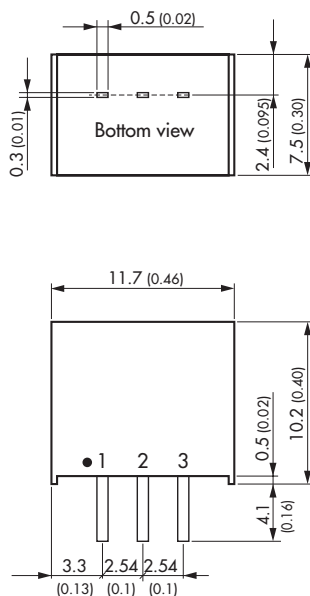
Negative output operation:



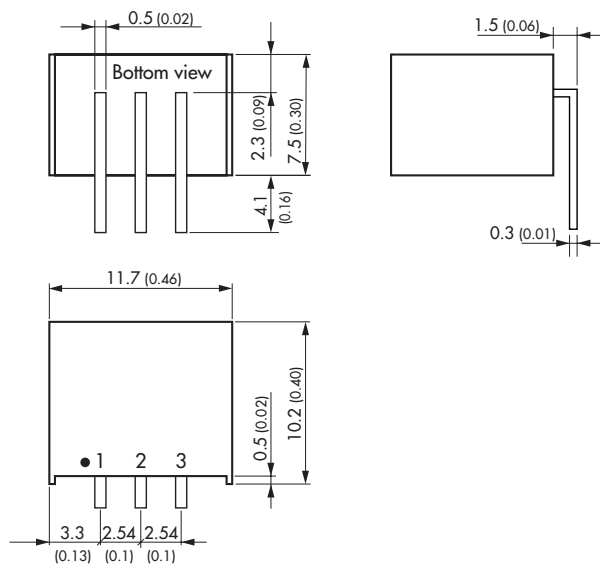
$C1 = 10 \mu\text{F} / 50 \text{ V}$ , 1210 X5R MLCC  
 $C2 = 10 \mu\text{F} / 25 \text{ V}$ , 1206 X5R MLCC

## Outline Dimensions

Straight pin version



Angular pin version (suffix A)



### Pin-Out

| Pin | pos.  | neg.  |
|-----|-------|-------|
| 1   | +Vin  | +Vin  |
| 2   | GND   | -Vout |
| 3   | +Vout | GND   |

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

**Solder Pad Layout:** [www.tracopower.com/products/tsrn1-solderpadlayout.pdf](http://www.tracopower.com/products/tsrn1-solderpadlayout.pdf)

Specifications can be changed any time without notice.

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Rev. 11/12

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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- Специальные условия для постоянных клиентов.
- Подбор аналогов.
- Поставку компонентов в любых объемах, удовлетворяющих вашим потребностям.
- Приемлемые сроки поставки, возможна ускоренная поставка.
- Доставку товара в любую точку России и стран СНГ.
- Комплексную поставку.
- Работу по проектам и поставку образцов.
- Формирование склада под заказчика.
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- Техническую поддержку проекта.
- Защиту от снятия компонента с производства.
- Оценку стоимости проекта по компонентам.
- Изготовление тестовой платы монтаж и пусконаладочные работы.



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