

- Up to 96 % efficiency
 - No heat-sink required
- Pin compatible with LMxx linear regulators
- SIP-package fits existing TO-220 footprint
- Built in filter capacitors
- Operation temp. range -40°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 TSR-1 series step-down switching regulators are drop-in replacement for inefficient 78Xx linear regulators. A high efficiency up to 96 % allows full load operation up to $+60^{\circ}\text{C}$ ambient temperature without the need of any heat-sink or forced cooling. The TSR-1 switching regulators provide other significant features over linear regulators, i.e. better output accuracy ($\pm 2\%$), lower standby current of 2 mA and no requirement of external capacitors. The high efficiency and low standby power consumption makes these regulators an ideal solution for many battery powered applications.

| Models | | | | | |
|-------------|---------------------|----------------|---------------------|-----------------|------------|
| Order code | Input voltage range | Output voltage | Output current max. | Efficiency typ. | |
| | | | | @ Vin min. | @ Vin max. |
| TSR 1-2412 | 4.6 – 36 VDC* | 1.2 VDC | 1.0 A | 74 % | 62 % |
| TSR 1-2415 | 4.6 – 36 VDC* | 1.5 VDC | | 78 % | 65 % |
| TSR 1-2418 | 4.6 – 36 VDC* | 1.8 VDC | | 82 % | 69 % |
| TSR 1-2425 | 4.6 – 36 VDC* | 2.5 VDC | | 87 % | 75 % |
| TSR 1-2433 | 4.75 – 36 VDC* | 3.3 VDC | | 91 % | 78 % |
| TSR 1-2450 | 6.5 – 36 VDC* | 5.0 VDC | | 94 % | 84 % |
| TSR 1-2465 | 9.0 – 36 VDC* | 6.5 VDC | | 93 % | 87 % |
| TSR 1-2490 | 12 – 36 VDC* | 9.0 VDC | | 95 % | 90 % |
| TSR 1-24120 | 15 – 36 VDC* | 12 VDC | | 95 % | 92 % |
| TSR 1-24150 | 18 – 36 VDC* | 15 VDC | | 96 % | 94 % |

* For input voltage higher than 32 VDC an input capacitor 22 μF / 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 mAp-p |
| Input filter | internal capacitors see application notes (page 3) to meet EN55032 class A |

Output Specifications

| | |
|--|--|
| Voltage set accuracy | $\pm 2\%$ (at full load) |
| Regulation | <ul style="list-style-type: none"> – Input variation: 0.2 % – Load variation (10–100 %): 1.2 & 1.5 VDC models: 0.6 % other models: 0.4 % |
| Overshoot startup voltage | 1.0 % max. |
| Minimum load | not required |
| Ripple and noise (20 MHz Bandwidth) | <ul style="list-style-type: none"> 1.2 – 6.5 VDC models: 50 mV max. 9 – 15 VDC models: 75 mV max. |
| Temperature coefficient | $\pm 0.015\%/K$ max. |
| Dynamic load response 50% load change (upper half) | 150 mV max. peak variation 250 μ s max. response time |
| Startup rise time (10 % to 90 % V_{out}) | 2 ms |
| Short circuit protection | continuous, automatic recovery |
| Current limitation | at 2.5 A typ. |
| Capacitive load | 470 μ F max. |

General Specifications

| | |
|--|--|
| Temperature ranges | <ul style="list-style-type: none"> – Operating: -40°C to $+85^{\circ}\text{C}$ – Storage: -55°C to $+125^{\circ}\text{C}$ |
| Derating | 2.4 %/K above 60°C |
| Thermal shock and vibration | acc. MIL-STD-810F |
| Humidity (non condensing) | 95 % rel H max. |
| Reliability, calculated MTBF (MIL-HDBK-217F, at $+25^{\circ}\text{C}$, ground benign) | $>25'710'000$ h |
| Isolation voltage | none |
| Switching frequency | 400 – 500 kHz (pulse width modulation) |
| Environmental compliance | <ul style="list-style-type: none"> – Reach: www.tracopower.com/products/reach-declaration.pdf – RoHS: RoHS directive 2011/65/EU |

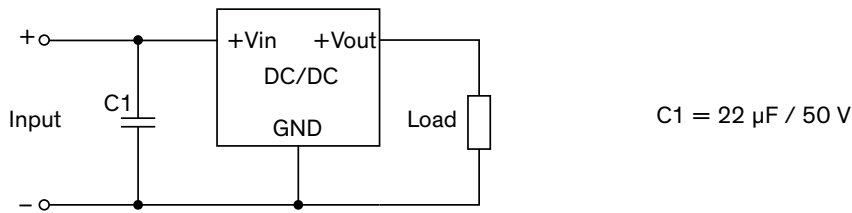
Physical Specifications

| | |
|-------------------|---|
| Casing material | non-conductive plastic |
| Potting material | silicon (flammability to UL 94V-0 rated) |
| Package weight | 1.9 g (0.07 oz) |
| Soldering profile | max. 265°C / 10 sec. (wave soldering) |

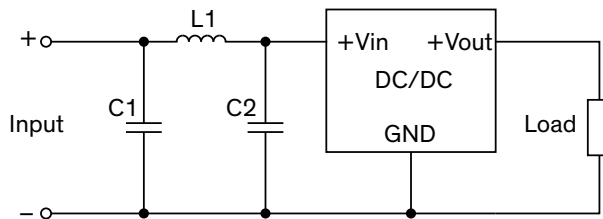
All specifications valid at nominal input voltage, full load and $+25^{\circ}\text{C}$ after warm-up time unless otherwise stated.

Applications notes

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

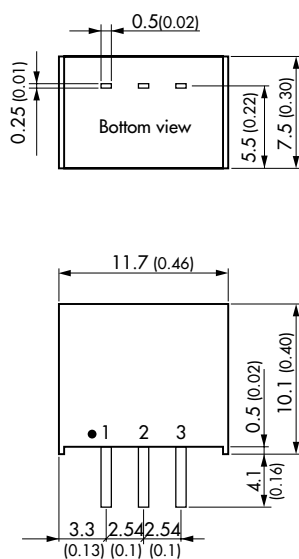


Suggested filter to comply with EN55032 Class A limits



| Models | C1 & C2 | L1 | inductor (accessory) | |
|------------|--------------------------------------|------------------------------|----------------------|--|
| | | | order code | datasheet |
| all models | 10 μF / 50 V 1206 MLCC | 5.6 μH / 3.5 A | TCK-141 | www.tracopower.com/products/tck141.pdf |

Outline Dimensions



Pin-Out

| | |
|---|-------|
| 1 | +Vin |
| 2 | GND |
| 3 | +Vout |

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