# TRACO POWER

DC/DC Step-Down Converter

TSR 1 Series, 1 Amp

- **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°C**

- **Short circuit protection**

- **Wide input operating range**

- **Excellent line / load regulation**

- **Low standby current**

- **3-year product warranty**
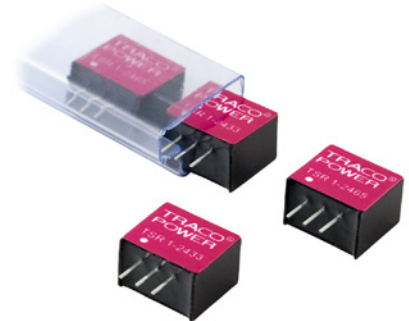
The TSR-1 series step-down switching regulators are drop-in replacement for inefficient 78×x linear regulators. A high efficiency up to 96 % allows full load operation up to +60°C ambient temperature without the need of any heat-sink or forced cooling. The TSR-1 switching regulators provide other significant features over linear regulators, i.e. better output accuracy (±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		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	1.0 A	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 Vin min. and 1 A output current)	1 A
No load input current	1 mA typ.
Reflected ripple current	150 mA
Input filter	**internal capacitors,** see application notes for to meet EN55022 class A

Output Specifications

Voltage set accuracy		**±2 %** (at full load)
Regulation	– 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)	1.2 – 6.5 VDC models:	**50 mV max**.
	9 – 15 VDC models:	**75 mV max**.
Temperature coefficient		**±0.015 % / °C max.**
Dynamic load response 50% load change (upper half)		**150 mV max.** peak variation
		250 µS max. response time
Startup rise time 10 % to 90 % Vout		**2 mS**
Short circuit protection		**continuous, automatic recovery**
Current limitation		**at 2.5 A typ.**
Capacitive load		**470 µF max.**

General Specifications

Temperature ranges	– Operating	**−40°C to +85°C**	**(−40°F to +185°F)**
	– Storage	**−55°C to +125°C**	**(−67°F to +257°F)**
Derating		**2.4 %/K above 60°C**	
Thermal shock		**acc. MIL-STD-810F**	
Humidity (non condensing)		**95 % rel H max.**	
Reliability, calculated MTBF (MIL-HDBK-217F, at +25°C, ground benign)		**>5'350'000 h**	
Isolation voltage		**none**	
Switching frequency		**500 kHz ±10 %** (pulse width modulation)	
Environmental compliance	– 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°C after warm-up time unless otherwise stated.
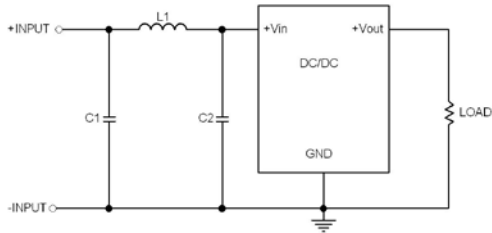
Applications notes
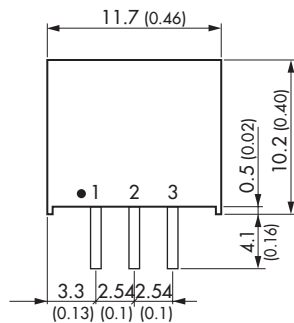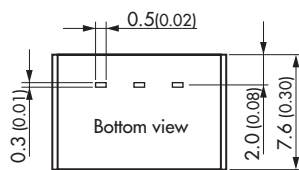
For input voltage higher than 32 VDC (max. 36 VDC)
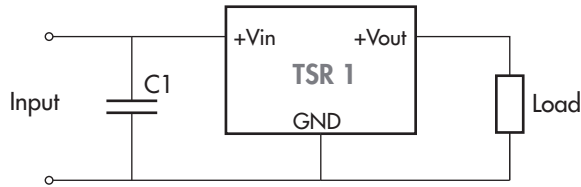
C1 = 22 µF / 50 V

Suggested filter to comply with EN55022 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)