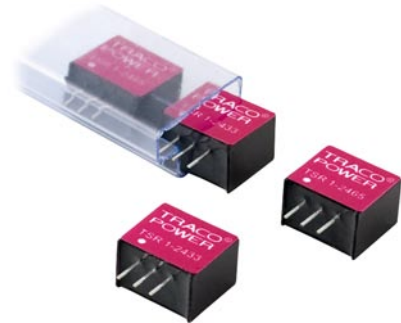


### Features

- ◆ Up to 96 % efficiency  
→ No heat-sink required
- ◆ Pin compatible with LMxx linear regulators
- ◆ SIP-package fitsexisting TO-220 footprint
- ◆ Built in filter capacitors
- ◆ Operation temp. range -40 to +85 °C
- ◆ Short circuit protection
- ◆ Wide input operating range
- ◆ Excellent line / load regulation
- ◆ Low standby current
- ◆ 3-year product warranty



The new 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 °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		Output voltage	Output current max.	Efficiency typ.	
	range	nominal			@ Vin min.	@ Vin max.
TSR 1-2415	4.75 – 32 VDC	9 VDC	1.5 VDC	1.0 A	78 %	65 %
TSR 1-2418	4.75 – 32 VDC		1.8 VDC		81 %	68 %
TSR 1-2425	4.75 – 32 VDC		2.5 VDC		87 %	75 %
TSR 1-2433	5.5 – 32 VDC		3.3 VDC		90 %	79 %
TSR 1-2450	6.5 – 32 VDC	12 VDC	5.0 VDC		93 %	84 %
TSR 1-2465	9.0 – 32 VDC		6.5 VDC		94 %	87 %
TSR 1-2490	12 – 32 VDC	24 VDC	9.0 VDC		95 %	89 %
TSR 1-24120	15 – 32 VDC		12 VDC		95 %	91 %
TSR 1-24150	18 – 32 VDC		15 VDC		96 %	94 %

### Input Specifications

Maximum input current (@ Vin min. and 1 A output current)	1 A
No load input current	24 V models: 1 mA max. other models: 2 mA max.
Reflected ripple current	150 mA
Input filter	internal capacitors

### Output Specifications

Voltage set accuracy	±2 % (at full load)
Regulation	- Input variation: 0.2 % - Load variation (10 – 100 %): 0.4 %
Overshoot startup voltage	1.0 % max.
Minimum load	not required
Ripple and noise (20 MHz Bandwidth)	1.5 – 6.5 VDC models: 50 mVpk-pk max. 9 – 15 VDC models: 75 mVpk-pk 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	@ 2.5 A typ.
Capacitive load	470 µF max.

### General Specifications

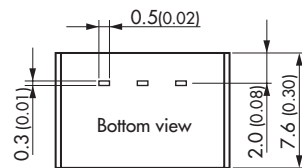
Temperature ranges	- Operating: -40 °C to +85 °C - Storage: -55 °C to +125 °C
Derating	2.4 %/K above 60 °C
Thermal shock	acc. MIL-STD-810F
Humidity (non condensing)	95 % rel H max.
Reliability, calculated MTBF (MIL-HDBK-217F, ground benign)	>5'350'000 h @ 25 °C
Isolation voltage	none
Isolation capacity	- Input/Output: 40 pF typ.
Isolation resistance	- Input/Output: >1'000 Mohm
Switching frequency	500 kHz typ.

### Physical Specifications

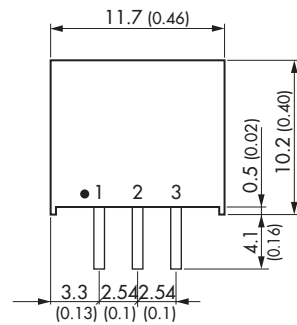
Case material	non-conductive plastic
Potting material	epoxy (flammability to UL 94V-0 rated)
Package weight	1.9 g (0.07 oz)
Soldering profile	max. 265 °C / 10 sec. (wave soldering)

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

**Outline Dimensions**



Pin-Out	
1	+Vin
3	GND
7	+Vout



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

Specifications can be changed any time without notice.