

## Features

- ◆ Compact SMD package
- ◆ Very high efficiency up to 97%
- ◆ Excellent line / load regulation
- ◆ Low standby current
- ◆ Operating temperature range -40 to 90°C
- ◆ Over-temperature protection
- ◆ Remote On/Off input
- ◆ Adjustable output voltage
- ◆ Short circuit protection
- ◆ Moisture sensitivity level 2 as per IPC J-STD-020D.1
- ◆ 3-year product warranty



TSR-0.5SM is a series of step-down non-isolated switching regulators in compact SIP package. These converters are an ideal alternative to LM78 linear regulators when energy efficiency is a parameter of the design. The high efficiency up to 97 % allows full load operation up to +80°C (+90°C with 50% load) ambient temperature without the need of forced aircooling.

Excellent output voltage accuracy and low standby current are other features that distinguish switching regulators from linear regulators.

## Models

Order code	Input voltage range <sup>1)</sup>	Output voltage		Output current max.	Efficiency typ.	
		nominal	trim range <sup>2)</sup>		@ Vin min.	@ Vin 32VDC
TSR 0.5-2415SM	4.75 – 32 VDC	1.5 VDC	1.4 – 2.5 VDC	0.5 A	73 %	63 %
TSR 0.5-2418SM		1.8 VDC	1.5 – 3.0 VDC		82 %	71 %
TSR 0.5-2425SM		2.5 VDC	1.5 – 3.0 VDC		87 %	77 %
TSR 0.5-2433SM		3.3 VDC	3.0 – 5.5 VDC		91 %	81 %
TSR 0.5-2450SM	6.5 – 32 VDC	5.0 VDC	3.0 – 8.0 VDC		94 %	86 %
TSR 0.5-2465SM	8 – 32 VDC	6.5 VDC	3.3 – 11.0 VDC		95 %	88 %
TSR 0.5-2490SM	11 – 32 VDC	9.0 VDC	4.5 – 12.6 VDC		96 %	92 %
TSR 0.5-24120SM	15 – 32 VDC	12 VDC	4.5 – 13.5 VDC		97 %	94 %
TSR 0.5-24150SM	18 – 32 VDC	15 VDC	4.5 – 15.5 VDC		97 %	95 %

1) For input voltage higher 24 VDC an input capacitor 22 µF/ 50 V is required

2) Input voltage must be higher than output voltage set: >1.5 V for 3.3–5.0V and >3 V for 6.5–15.0V

### Input Specifications

No load input current (at 24Vin)	5 mA typ.
Short circuit input power	1.5 W max.
Surge voltage	-0.3 / 34 VDC max.
Input filter	internal capacitor, see filter suggestion page 3 for to meet EN55022 class A, class B
ESD (electrostatic discharge)	EN 61000-4-2, air $\pm 8$ kV, perf. criteria A
Radiated immunity	EN 61000-4-3 3 V/m, perf. criteria A
Fast transient	EN 61000-4-4, $\pm 0.5$ kV, perf. criteria A with external input capacitor e.g. Nippon chemi-con KY 330 $\mu$ F, 100 V
Conducted immunity	EN 61000-4-6, 3 Vrms, perf. criteria A
Magnetic field immunity	EN 61000-4-8, 3 A/m, perf. criteria A

### Output Specifications

Voltage set accuracy	$\pm 3$ % (at full load)
Regulation	<ul style="list-style-type: none"> <li>- Input variation 1.5 to 6.5 Vin models: 0.4 %</li> <li style="padding-left: 150px;">other models: 0.2 %</li> <li>- Load variation (10 – 100 %) 1.5 to 6.5 Vin models: 0.6 %</li> <li style="padding-left: 150px;">other models: 0.4 %</li> </ul>
Minimum load	not required
Ripple and noise	<ul style="list-style-type: none"> <li>1.5 to 6.5 Vin models: 30 mVp-p max.</li> <li>other models: 40 mVp-p max.</li> </ul>
Temperature coefficient	$\pm 0.015$ %/K max.
Dynamic load (50% load step change)	<ul style="list-style-type: none"> <li>- Peak variation <math>\pm 2</math> % max.</li> <li>- Response time 100 <math>\mu</math>S max.</li> </ul>
Short circuit protection	continuous, automatic recovery
Capacitive load	220 $\mu$ F max.

### General Specifications

Temperature ranges	<ul style="list-style-type: none"> <li>- Operating -40°C to +90°C</li> <li>- Case temperature +100°C. max.</li> <li>- Storage -55°C to +125°C</li> </ul>
Derating	- positive output circuit 5 %/K above +80°C
Overtemperature protection	at +160°C (on internal IC)
Humidity (non condensing)	95 % rel H max.
Reliability, calculated MTBF (MIL-HDBK-217F, at +25°C, ground benign)	>2'000'000 h
Isolation voltage	none
Switching frequency	330 kHz $\pm 50$ kHz (pulse width modulation)
Remote On/Off	<ul style="list-style-type: none"> <li>- On: 2.4 – 5.0 VDC (ref. to GND) or open circuit.</li> <li>- Off: 0 – 1.6 VDC (ref. to GND) or connect. to GND</li> <li>- Off idle current (at 24 Vin): 35 <math>\mu</math>A max.</li> </ul>
Environmental compliance	<ul style="list-style-type: none"> <li>- Reach</li> <li>- RoHS</li> </ul> RoHS directive 2011/65/EU

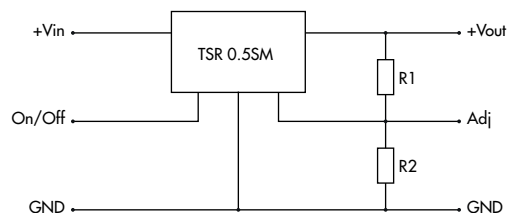
### Physical Specifications

Casing material	non-conductive plastic (UL94V-0 rated)
Pin material	phosphor bronze
Weight	1.7 g (0.6 oz)
Lead-free reflow solder process	as per J-STD-020D.01
Moisture sensitivity level (MSL)	level 2 as per IPC J-STD-020D.1 (to find at: <a href="http://www.jedec.org">www.jedec.org</a> - free registration required)
Washing	baking after washing: 100°C for 30 min.
Packaging	

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

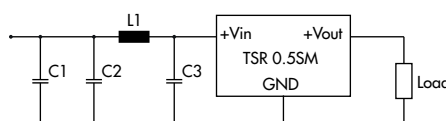
## Applications notes

### Output voltage adjustment



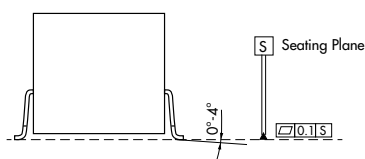
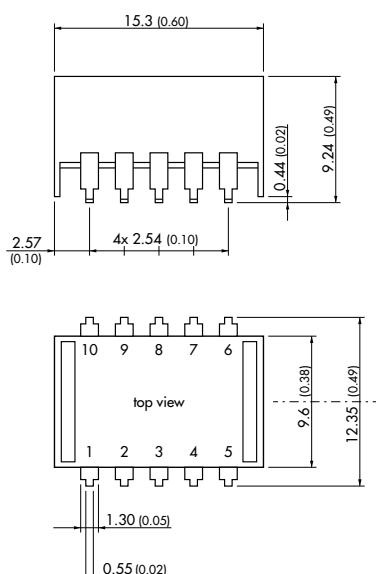
	R1 <----- open -----> R2				
	[KOhm]	Min.	Nominal	Max.	[KOhm]
TSR 0.5-2415SM	1.0	1.4 VDC	1.5 VDC	2.5 VDC	0.47
TSR 0.5-2418SM	3	1.5 VDC	1.8 VDC	3.0 VDC	4.64
TSR 0.5-2425SM	0.2	1.5 VDC	2.5 VDC	3.0 VDC	44.2
TSR 0.5-2433SM	88.4	3.0 VDC	3.3 VDC	5.5 VDC	3.9
TSR 0.5-2450SM	17	3.0 VDC	5.0 VDC	8.0 VDC	2.32
TSR 0.5-2465SM	15	3.3 VDC	6.5 VDC	11 VDC	0.825
TSR 0.5-2490SM	26	4.5 VDC	9.0 VDC	12.6 VDC	0
TSR 0.5-24120SM	17	4.5 VDC	12 VDC	13.5 VDC	57.6
TSR 0.5-24150SM	10.5	4.5 VDC	15 VDC	15.5 VDC	300

### EMI filter for EN 55022 class A & B

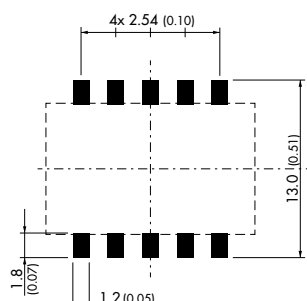


Class	C1	C2 & C3	L1 value	order code (SMD type)
A	-	4.7 $\mu$ F / 50 V 1206 MLCC	3.3 $\mu$ H	TCK-044
B	4.7 $\mu$ F / 50 V 1206 MLCC		10 $\mu$ H	TCK-047

## Outline Dimensions



Recommended solder pad:



### Pinout

Pin	Function
1	+Vin
2	+Vin
3	GND
4	+Vout
5	+Vout
6	adj.
7	GND
8	GND
9	GND
10	On/Off

Dimensions in [mm], ( ) = Inch  
Tolerances:  $\pm 0.5$  ( $\pm 0.02$ )  
Pin pitch tolerances:  $\pm 0.25$  ( $\pm 0.01$ )