

- SMD-package
- Up to 96% efficiency
- No thermal layer required
- 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 new TSR-1SM series models of step-down switching regulators have a high efficiency up to 96% which allows full load operation up to $+65^{\circ}\text{C}$ ambient temperature without the need of any heat transmission layer. Excellent output voltage accuracy ($\pm 2\%$) and low standby current ($\sim 1 \mu\text{A}$) are features that distinguish these switching regulators from linear regulators.

Models					
Order Code	Output Current max.	Input Voltage Range	Output Voltage nom.	Efficiency typ.	
TSR 1-0512SM	1'000 mA	3 - 5.5 VDC (5 VDC nom.)	1.2 VDC	91 % (at Vin min.)	
TSR 1-0515SM			1.5 VDC	92 % (at Vin min.)	
TSR 1-0518SM			1.8 VDC	93 % (at Vin min.)	
TSR 1-0525SM			2.5 VDC	95 % (at Vin min.)	
TSR 1-2412SM		4.6 - 36 VDC (12 VDC nom.)	4.6 - 36 VDC (12 VDC nom.)	1.2 VDC	74 % (at Vin min.)
TSR 1-2415SM				1.5 VDC	79 % (at Vin min.)
TSR 1-2418SM				1.8 VDC	82 % (at Vin min.)
TSR 1-2425SM				2.5 VDC	87 % (at Vin min.)
TSR 1-2433SM				3.3 VDC	91 % (at Vin min.)
TSR 1-2450SM				5 VDC	94 % (at Vin min.)
TSR 1-2465SM				6.5 VDC	94 % (at Vin min.)
TSR 1-2490SM				9 VDC	95 % (at Vin min.)
TSR 1-24120SM		12 VDC	95 % (at Vin min.)		
TSR 1-24150SM		15 VDC	96 % (at Vin min.)		

Input Specifications

Input Current	- At no load	5 Vin models: 1 mA typ. 12 Vin models: 1 mA typ. 24 Vin models: 1 mA typ.
	- At full load	5 Vin models: 1'000 mA max. 12 Vin models: 1'000 mA max. 24 Vin models: 1'000 mA max. (at Vin min.)
Reflected Ripple Current		5 Vin models: 150 mAp-p typ. 12 Vin models: 150 mAp-p typ. 24 Vin models: 150 mAp-p typ.
Recommended Input Fuse	- 12 Vin input	5 Vin models: 1'000 mA (slow blow) 24 Vin models: 1'600 mA (slow blow) 1.2 Vout models: 800 mA (slow blow) 1.5 Vout models: 800 mA (slow blow) 1.8 Vout models: 800 mA (slow blow) 2.5 Vout models: 1'250 mA (slow blow) 3.3 Vout models: 1'250 mA (slow blow) 5 Vout models: 1'250 mA (slow blow) 6.5 Vout models: 1'250 mA (slow blow) (The need of an external fuse has to be assessed in the final application.)
Input Filter		Internal Capacitor

Output Specifications

Voltage Set Accuracy		±2% max.
Regulation	- Input Variation (Vmin - Vmax)	0.2% max.
	- Load Variation (0 - 100%)	0.6% max.
Ripple and Noise (20 MHz Bandwidth)		1.2 Vout models: 50 mVp-p typ. 1.5 Vout models: 50 mVp-p typ. 1.8 Vout models: 50 mVp-p typ. 2.5 Vout models: 50 mVp-p typ. 3.3 Vout models: 50 mVp-p typ. 5 Vout models: 50 mVp-p typ. 6.5 Vout models: 50 mVp-p typ. 9 Vout models: 75 mVp-p typ. 12 Vout models: 75 mVp-p typ. 15 Vout models: 75 mVp-p typ.
Capacitive Load		470 µF max.
Minimum Load		Not required
Temperature Coefficient		±0.015 %/K max.
Start-up Time		5 ms typ.
Short Circuit Protection		Continuous, Automatic recovery
Output Current Limitation		480% typ. of Iout max. (5 Vin models) 250% typ. (other models)
Transient Response	- Peak Variation	200 mV typ. / 400 mV max. (50% Load Step)
	- Response Time	250 µs typ. / 350 µs max. (50% Load Step)

General Specifications

Relative Humidity		95% max. (non condensing)
Temperature Ranges	- Operating Temperature	-40°C to +85°C
	- Case Temperature	+105°C max.
	- Storage Temperature	-55°C to +125°C
Power Derating	- High Temperature	2.5 %/K above 65°C

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

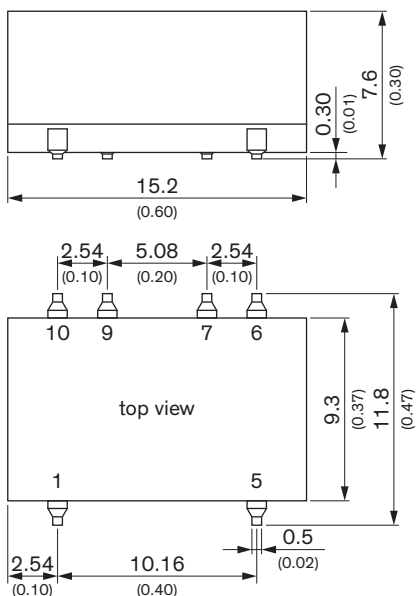
Over Temperature	- Protection Mode	150°C typ. (Automatic recovery)
Protection Switch Off	- Measurement Point	Internal IC temperature
Cooling System		Natural convection (20 LFM)
Switching Frequency		1200 kHz typ. (PWM) (5 Vin models) 500 kHz typ. (PWM) (other models)
Insulation System		Non-isolated
Reliability	- Calculated MTBF	12'000'000 h (MIL-HDBK-217F, ground benign)
Moisture Sensitivity (MSL)		Level 1 (J-STD-033C)
Washing Process		Baking after washing: 100°C for 30 min
Environment	- Vibration - Thermal Shock	MIL-STD-810F MIL-STD-810F
Housing Material		Non-conductive Plastic (UL94 V-0 rated)
Base Material		Non-conductive Plastic (UL 94 V-0 rated)
Pin Material		Copper
Pin Foundation Plating		Nickel (2 - 3 µm)
Pin Surface Plating		Tin (3 - 5 µm), matte
Soldering Profile		Reflow Soldering (J-STD-020E) 245°C max.
Connection Type		SMD (Surface-Mount Device)
Weight		1.7 g
Environmental Compliance	- Reach - RoHS	www.tracopower.com/info/reach-declaration.pdf www.tracopower.com/info/rohs-declaration.pdf

Supporting Documents

Overview Link (for additional Documents)

www.tracopower.com/overview/tsr1sm

Outline Dimensions



Pinout

Pin	Function
1	+Vin
5	+Vout
6	NC
7	GND
9	GND
10	NC

NC: Not connected

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

Recommended Solder Pad Layout

