

- 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		3.8 - 5.5 VDC (5 VDC nom.)	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.)	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		4.75 - 36 VDC (12 VDC nom.)	3.3 VDC	91 % (at Vin min.)
TSR 1-2450SM		6.5 - 36 VDC (12 VDC nom.)	5 VDC	94 % (at Vin min.)
TSR 1-2465SM		9 - 36 VDC (12 VDC nom.)	6.5 VDC	94 % (at Vin min.)
TSR 1-2490SM		12 - 36 VDC (24 VDC nom.)	9 VDC	95 % (at Vin min.)
TSR 1-24120SM		15 - 36 VDC (24 VDC nom.)	12 VDC	95 % (at Vin min.)
TSR 1-24150SM		18 - 36 VDC (24 VDC nom.)	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		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)	5 Vin models:	50 mVp-p typ.
	12 Vin models:	50 mVp-p typ.
	24 Vin 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)

EMC Specifications

EMI (Emissions)	- Conducted Emissions	EN 55032 class A (with external filter) EN 55032 class B (with external filter)
	- Radiated Emissions	EN 55032 class A (with external filter) EN 55032 class B (with external filter)
External filter proposal: www.tracopower.com/overview/tsr1sm		

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
		See application note: www.tracopower.com/overview/tsr1sm
Over Temperature	- Protection Mode	150°C typ. (Automatic recovery)
Protection Switch Off	- Measurement Point	Internal IC temperature

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

Cooling System	Natural convection (20 LFM)
Regulator Topology	Buck Converter
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	According to Cleaning Guideline www.tracopower.com/info/cleaning.pdf
Environment - Vibration	MIL-STD-810F
- Thermal Shock	MIL-STD-810F
Housing Material	Non-conductive Plastic (UL 94 V-0 rated)
Base Material	Non-conductive Plastic (UL 94 V-0 rated)
Potting Material	Epoxy (UL 94 V-0 rated) (Converter halfway potted on top of the PCB, not visible through vent hole)
Pin Material	Copper
Pin Foundation Plating	Nickel (2 - 3 µm)
Pin Surface Plating	Tin (3 - 5 µm), matte
Housing Type	Plastic Case
Mounting Type	PCB Mount
Connection Type	SMD (Surface-Mount Device)
Footprint Type	SMD10
Soldering Profile	Lead-Free Reflow Soldering (acc. J-STD-020E) 245°C max. (Tp) 10 s max. (tp, at Tp - 5°C) 100 s max. (tL, time above 217°C) See application note: www.tracopower.com/info/reflow-soldering.pdf
Weight	1.7 g
Environmental Compliance - REACH Declaration	www.tracopower.com/info/reach-declaration.pdf REACH SVHC list compliant REACH Annex XVII compliant
- RoHS Declaration	www.tracopower.com/info/rohs-declaration.pdf Exemptions: 7a, 7c-I (RoHS exemptions refer to the component concentration only, not to the overall concentration in the product (Q5A rule).)
- SCIP Reference Number	88c49d6d-d291-4109-a33e-aaca264fda7b

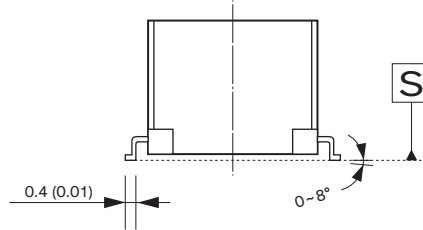
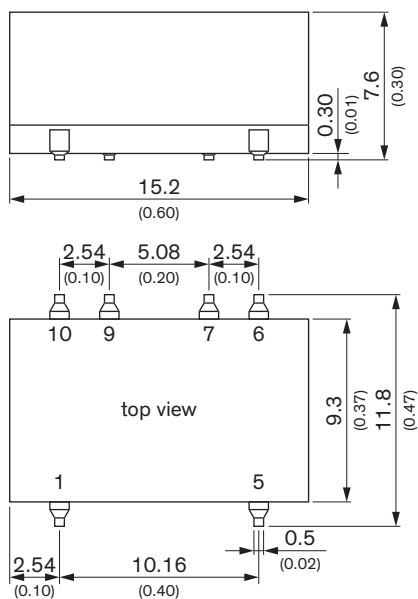
Supporting Documents

Overview Link (for additional Documents)

www.tracopower.com/overview/tsr1sm

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

Outline Dimensions

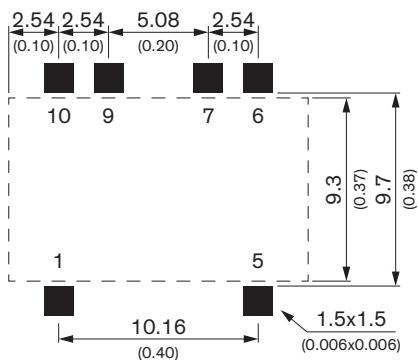


Pinout

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

NC: Not connected

Recommended Solder Pad Layout



Mouser Electronics

Authorized Distributor

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<u>TSR 1-0512SM</u>	<u>TSR 1-0515SM</u>	<u>TSR 1-0518SM</u>	<u>TSR 1-0525SM</u>	<u>TSR 1-24120SM</u>	<u>TSR 1-2412SM</u>	<u>TSR 1-2415SM</u>
<u>TSR 1-2418SM</u>	<u>TSR 1-2425SM</u>	<u>TSR 1-2433SM</u>	<u>TSR 1-2450SM</u>	<u>TSR 1-2465SM</u>	<u>TSR 1-2490SM</u>	<u>TSR 1-24150SM</u>