

- SIP-package fits existing TO-220 footprint
- Suitable for positive & negative output circuit
- Pin compatible with LMxx linear regulators
- Built in filter capacitors
- Operation temp. range -40°C to $+85^{\circ}\text{C}$
- No heat-sink required
- Over-temperature & short circuit protection
- Wide input range up to 36 VDC
- Excellent line/load regulation
- 3-year product warranty



The new TSRN 1 series step-down switching regulators are drop-in replacement for inefficient 78xx linear regulators. A high efficiency up to 95% allows full load operation up to $+70^{\circ}\text{C}$ ($+85^{\circ}\text{C}$ with derating) ambient temperature without the need of any heat-sink or forced air cooling. The TSRN-1 switching regulators provide other significant features over linear regulators, i.e. better output accuracy ($\pm 2\%$), lower standby current of $\sim 2\text{ mA}$ and no requirement of external capacitors. They are suitable for positive or negative output circuits. The high efficiency and low standby power consumption make these regulators an ideal solution for energy sensitive applications.

Models				
Order Code	Output Current max.	Input Voltage Range	Output Voltage nom.	Efficiency typ.
TSRN 1-2415	1'000 mA	4.6 - 36 VDC (12 VDC nom.)	1.5 VDC	77 % (at V_{in} min.)
TSRN 1-2418			1.8 VDC	81 % (at V_{in} min.)
TSRN 1-2425			2.5 VDC	84 % (at V_{in} min.)
TSRN 1-2433			3.3 VDC	88 % (at V_{in} min.)
TSRN 1-2450			5 VDC	92 % (at V_{in} min.)
TSRN 1-2465			6.5 VDC	93 % (at V_{in} min.)
TSRN 1-2490			9 VDC	95 % (at V_{in} min.)
TSRN 1-24120		12 VDC	95 % (at V_{in} min.)	
TSRN 1-24150		15 VDC	96 % (at V_{in} min.)	
			6.5 - 36 VDC (12 VDC nom.)	
		8 - 36 VDC (12 VDC nom.)		
		10.5 - 36 VDC (12 VDC nom.)		
		13.5 - 36 VDC (24 VDC nom.)		
		16.5 - 36 VDC (24 VDC nom.)		

Options	
Suffix A	- Optional models with angular pin version (see outline dimensions)

Note - For external circuit proposal for negative output voltage, refer to application note: www.tracopower.com/overview/tsrn1

Input Specifications

Input Current	- At no load	12 Vin models: 2 mA typ. 24 Vin models: 3 mA typ.
Reflected Ripple Current		100 mAp-p typ.
Recommended Input Fuse		12 Vin models: 2'000 mA (slow blow) 24 Vin models: 2'000 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) - Load Variation (10 - 100%)	0.2% max. 0.6% max. (1.5 Vout models, straight pin vers.) 1.2% max. (1.5 Vout models, angular pin vers.) 0.4% max. (1.8 Vout models, straight pin vers.) 1.2% max. (1.8 Vout models, angular pin vers.) 0.4% max. (other output models, both pin vers.)
Ripple and Noise (20 MHz Bandwidth)		24 Vin models: 75 mVp-p max. 1.5 Vout models: 50 mVp-p max. 1.8 Vout models: 50 mVp-p max. 2.5 Vout models: 50 mVp-p max. 3.3 Vout models: 50 mVp-p max. 5 Vout models: 50 mVp-p max. 6.5 Vout models: 50 mVp-p max. 9 Vout models: 75 mVp-p max.
Capacitive Load		470 µF max.
Minimum Load		Not required
Temperature Coefficient		±0.015 %/K max.
Start-up Time		5 ms typ.
Start-up Overshoot Voltage		1% max.
Short Circuit Protection		Continuous, Automatic recovery
Output Current Limitation		200% typ. of Iout max.
Transient Response	- Peak Variation - Response Time	150 mV typ. / 250 mV max. (50% Load Step) 250 µs typ. / 350 µs max. (50% Load Step)

General Specifications

Relative Humidity		95% max. (non condensing)
Temperature Ranges	- Operating Temperature - Case Temperature - Storage Temperature	-40°C to +85°C +100°C max. -55°C to +125°C
Power Derating	- High Temperature	See application note: www.tracopower.com/overview/tsrn1
Over Temperature Protection Switch Off	- Protection Mode - Measurement Point	170°C typ. (Automatic recovery) Internal IC temperature
Cooling System		Natural convection (20 LFM)
Switching Frequency		240 - 360 kHz (PWM) (1.5 - 3.3 Vout models) 464 - 696 kHz (PWM) (5 - 15 Vout models)
Insulation System		Non-isolated
Reliability	- Calculated MTBF	20'000'000 h (MIL-HDBK-217F, ground benign)
Washing Process		Allowed (hermetical product)
	See Cleaning Guideline:	www.tracopower.com/info/cleaning.pdf

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

Environment	- Vibration - Mechanical Shock - Thermal Shock	MIL-STD-810F EN 61373 MIL-STD-810F EN 61373 MIL-STD-810F
Housing Material		Non-conductive Plastic (UL 94 V-0 rated)
Potting Material		Silicone (UL 94 V-0 rated)
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		THD (Through-Hole Device)
Footprint Type		SIP3
Soldering Profile		Wave Soldering 265°C / 10 s max.
Weight		1.9 g
Environmental Compliance	- REACH Declaration - RoHS Declaration	www.tracopower.com/info/reach-declaration.pdf REACH SVHC list compliant REACH Annex XVII compliant www.tracopower.com/info/rohs-declaration.pdf Exemptions: 7a, 7c-1 (RoHS exemptions refer to the component concentration only, not to the overall concentration in the product (O5A rule). The SCIP number is provided on request.)

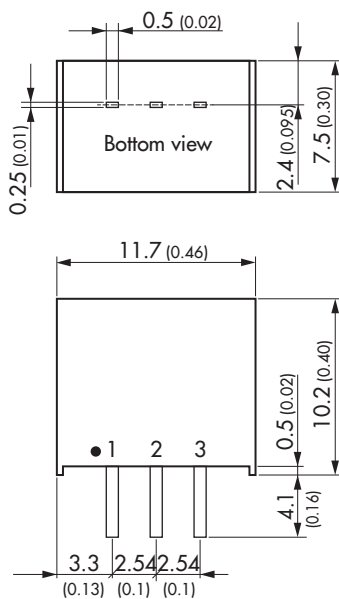
Supporting Documents

Overview Link (for additional Documents)

www.tracopower.com/overview/tsrn1

Outline Dimensions

Straight pin version (Standard)

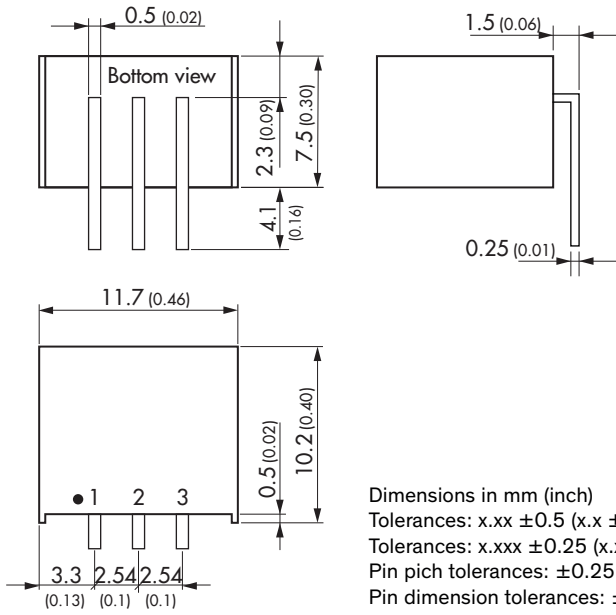


Dimensions in mm (inch)
Tolerances: x.xx ± 0.5 (x.x ± 0.02)
Tolerances: x.xxx ± 0.25 (x.xx ± 0.01)
Pin pitch tolerances: ± 0.25 (± 0.01)
Pin dimension tolerances: ± 0.1 (± 0.004)

Pinout	
Pin	Function
1	+Vin
2	GND
3	+Vout

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

Angular pin version (Suffix A)



Pinout	
Pin	Function
1	+Vin
2	GND
3	+Vout