

- **Highly cost-efficient design**
- **Compact SIP-3 package:**  
14 x 7.6 x 10.2 mm
- **Pin compatible with TO-220 package**  
linear regulators
- **Excellent thermal capabilities**
- **Operation temperature. range -40°C to +95°C**
- **Efficiency up to 95%**
- **Wide input operating range 4.6-36 VDC**
- **Short circuit protection, current limitation and under voltage lockout features**
- **Excellent line / load regulation**
- **3-year product warranty**



The TSR 2N is a 2 Amp step-down switching regulator series and a drop-in replacement for any TO-220 package linear regulators. It comes in a compact SIP-3 plastic package and complements our new generation of POL converters focusing strongly on a cost-efficient design while also improving on critical electrical specifications. The Input ranges from 4.6 to 36 VDC and output voltages are available between 1.2 and 15VDC. Depending on the model, the efficient design allows full load operation up to +95°C ambient temperature (at nominal Vin) without the need of any heat sink or forced cooling. The TSR 2N series provides other significant features like short circuit protection, current limitation and under voltage lockout. Overall, it offers a broad application range in many environments and is especially suited for high volume projects where the series will help to reduce production cost by delivering not only a highly cost efficient but also reliable solution.

### Models

Order Code	Output Current max.	Input Voltage Range	Output Voltage nom.	Efficiency typ.
TSR 2-2412N	2'000 mA	4.6 - 28 VDC (12 VDC nom.)	1.2 VDC	85 %
TSR 2-2415N		4.6 - 32 VDC (12 VDC nom.)	1.5 VDC	87 %
TSR 2-2418N		4.6 - 36 VDC (12 VDC nom.)	1.8 VDC	88 %
TSR 2-2425N			2.5 VDC	90 %
TSR 2-2433N		3.3 VDC	91 %	
TSR 2-2450N		6.5 - 36 VDC (12 VDC nom.)	5 VDC	93 %
TSR 2-2465N		9 - 36 VDC (12 VDC nom.)	6.5 VDC	94 %
TSR 2-2490N		11 - 36 VDC (24 VDC nom.)	9 VDC	93 %
TSR 2-24120N		15 - 36 VDC (24 VDC nom.)	12 VDC	94 %
TSR 2-24150N		18 - 36 VDC (24 VDC nom.)	15 VDC	95 %

## Input Specifications

Input Current	- At no load	12 Vin models: <b>1 mA typ.</b> 24 Vin models: <b>1 mA typ.</b>
	- At full load	12 Vin models: <b>240 mA typ. / 607 mA max.</b> (1.2 Vout model) <b>293 mA typ. / 746 mA max.</b> (1.5 Vout model) <b>347 mA typ. / 885 mA max.</b> (1.8 Vout model) <b>471 mA typ. / 1'203 mA max.</b> (2.5 Vout model) <b>615 mA typ. / 1'571 mA max.</b> (3.3 Vout model) <b>912 mA typ. / 1'658 mA max.</b> (5 Vout model) <b>1'173 mA typ. / 1'548 mA max.</b> (6.5 Vout model) 24 Vin models: <b>821 mA typ. / 1'745 mA max.</b> (9 Vout model) <b>1'083 mA typ. / 1'697 mA max.</b> (12 Vout model) <b>1'340 mA typ. / 1'768 mA max.</b> (15 Vout model)
Input Inrush Current		<b>63 A typ.</b>
Under Voltage Lockout		12 Vin models: <b>2.2 VDC min.</b> 24 Vin models: <b>2.2 VDC min.</b>
Recommended Input Fuse	- 12 Vin input	24 Vin models: <b>7'000 mA</b> (fast acting) 1.2 Vout models: <b>3'000 mA</b> (fast acting) 1.5 Vout models: <b>3'500 mA</b> (fast acting) 1.8 Vout models: <b>4'000 mA</b> (fast acting) 2.5 Vout models: <b>5'000 mA</b> (fast acting) 3.3 Vout models: <b>7'000 mA</b> (fast acting) 5 Vout models: <b>7'000 mA</b> (fast acting) 6.5 Vout models: <b>7'000 mA</b> (fast acting) (The need of an external fuse has to be assessed in the final application.)
Input Filter		<b>Internal Capacitor</b>

## Output Specifications

Voltage Set Accuracy		<b>±2% max.</b>
Regulation	- Input Variation (Vmin - Vmax) - Load Variation (0 - 100%)	<b>0.5% max.</b> <b>2% max.</b>
Ripple and Noise (20 MHz Bandwidth)		24 Vin models: <b>75 mVp-p typ.</b> (w/ 10 µF) 1.2 Vout models: <b>50 mVp-p typ.</b> (w/ 10 µF) 1.5 Vout models: <b>50 mVp-p typ.</b> (w/ 10 µF) 1.8 Vout models: <b>50 mVp-p typ.</b> (w/ 10 µF) 2.5 Vout models: <b>50 mVp-p typ.</b> (w/ 10 µF) 3.3 Vout models: <b>50 mVp-p typ.</b> (w/ 10 µF) 5 Vout models: <b>50 mVp-p typ.</b> (w/ 10 µF) 6.5 Vout models: <b>75 mVp-p typ.</b> (w/ 10 µF)
Capacitive Load		1.2 Vout models: <b>2'200 µF max.</b> 1.5 Vout models: <b>2'200 µF max.</b> 1.8 Vout models: <b>1'500 µF max.</b> 2.5 Vout models: <b>1'500 µF max.</b> 3.3 Vout models: <b>1'200 µF max.</b> 5 Vout models: <b>820 µF max.</b> 6.5 Vout models: <b>620 µF max.</b> 9 Vout models: <b>620 µF max.</b> 12 Vout models: <b>470 µF max.</b> 15 Vout models: <b>470 µF max.</b>
Minimum Load		<b>Not required</b>
Temperature Coefficient		<b>±0.02 %/K max.</b>
Start-up Time		<b>20 ms typ.</b>

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

Short Circuit Protection	Continuous, Automatic recovery
Output Current Limitation	400% typ. of I <sub>out max.</sub> (1.2 - 3.3 V <sub>out</sub> models) 360% typ. (other V <sub>out</sub> models)

### Safety Specifications

Standards	- IT / Multimedia Equipment	Designed for IEC/EN/UL 62368-1 (not certified)
Pollution Degree		PD 2

### 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:		<a href="http://www.tracopower.com/overview/tsr2n">www.tracopower.com/overview/tsr2n</a>
EMS (Immunity)	- EFT (Burst) / Surge	EN 61000-4-4, ±2 kV, perf. criteria A EN 61000-4-5, ±2 kV, perf. criteria A
	Ext. input component:	1500 µF / 100 V

### General Specifications

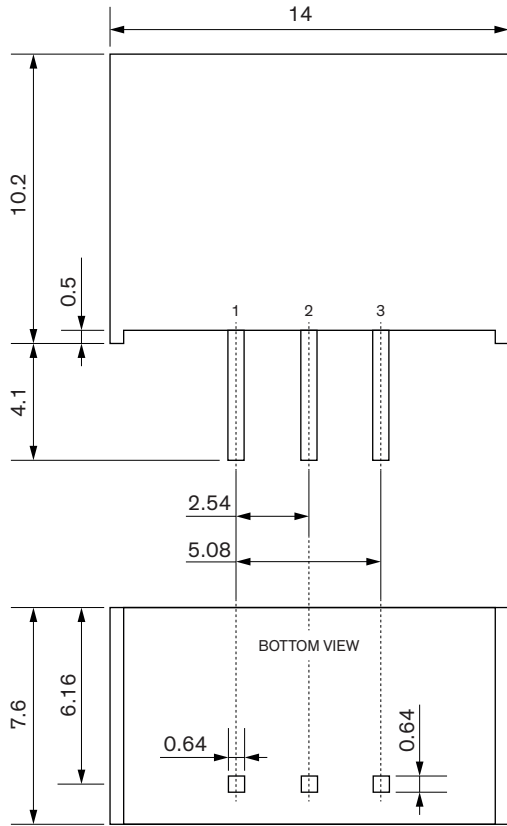
Relative Humidity		95% max. (non condensing)
Temperature Ranges	- Operating Temperature	-40°C to +90°C
	- Case Temperature	+110°C max.
	- Storage Temperature	-55°C to +125°C
Power Derating	- High Temperature	Depending on model
	See application note:	<a href="http://www.tracopower.com/overview/tsr2n">www.tracopower.com/overview/tsr2n</a>
Cooling System		Natural convection (20 LFM)
Regulator Topology		Buck Converter
Switching Frequency		380 kHz typ. (PWM) (1.2-2.5 V <sub>out</sub> models)
		850 kHz typ. (PWM) (3.3-6.5 V <sub>out</sub> models)
		1000 kHz typ. (PWM) (9-15 V <sub>out</sub> models)
Insulation System		Non-isolated
Reliability	- Calculated MTBF	3'200'000 h (MIL-HDBK-217F, ground benign)
Washing Process		Not allowed
Environment	- Vibration	MIL-STD-810F MIL-STD-202
Housing Material		Plastic (UL 94 V-0 rated)
Base Material		Non-conductive Plastic (UL 94 V-0 rated)
Potting Material		Silicone (UL 94 V-0 rated)
Housing Type		Plastic Case
Mounting Type		PCB Mount
Connection Type		THD (Through-Hole Device)
Footprint Type		SIP3
Soldering Profile		Lead-Free Wave Soldering
		260°C / 5 s max.
Weight		2.6 g
Thermal Impedance	- Case to Ambient	40 K/W typ.
Environmental Compliance	- REACH Declaration	<a href="http://www.tracopower.com/info/reach-declaration.pdf">www.tracopower.com/info/reach-declaration.pdf</a> REACH SVHC list compliant REACH Annex XVII compliant
	- RoHS Declaration	<a href="http://www.tracopower.com/info/rohs-declaration.pdf">www.tracopower.com/info/rohs-declaration.pdf</a> Exemptions: No Exemptions

### Supporting Documents

Overview Link (for additional Documents)	<a href="http://www.tracopower.com/overview/tsr2n">www.tracopower.com/overview/tsr2n</a>
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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
2	Ground
3	+Vout

Dimensions in mm  
 General tolerances:  $\pm 0.5$   
 Pin tolerances:  $\pm 0.1$

