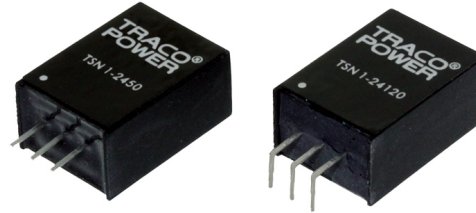


- Non-isolated converter for negative output
- Small size and low profile
- Pin compatible with LM79xx linear regulators
- No heatsink required
- High efficiency up to 96%
- Operation temp. range  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- Protection against overload, short circuit and over-temperature
- Fixed switching frequency
- Wide input range up to  $-32\text{ VDC}$
- Excellent line / load regulation



The new TSN 1 series step-down switching regulators are drop-in replacement for inefficient LM79xx linear regulators. A high efficiency up to 96 % 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 TSN 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 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.
TSN 1-2450	1'000 mA	$-7$ to $-32\text{ VDC}$ ( $-12\text{ VDC}$ nom.)	$-5\text{ VDC}$	88 %
TSN 1-2452			$-5.2\text{ VDC}$	89 %
TSN 1-2460		$-8$ to $-32\text{ VDC}$ ( $-12\text{ VDC}$ nom.)	$-6\text{ VDC}$	90 %
TSN 1-2480		$-10.5$ to $-32\text{ VDC}$ ( $-12\text{ VDC}$ nom.)	$-8\text{ VDC}$	92 %
TSN 1-2490		$-11.5$ to $-32\text{ VDC}$ ( $-24\text{ VDC}$ nom.)	$-9\text{ VDC}$	93 %
TSN 1-24120		$-15$ to $-32\text{ VDC}$ ( $-24\text{ VDC}$ nom.)	$-12\text{ VDC}$	94 %
TSN 1-24150		$-18$ to $-32\text{ VDC}$ ( $-24\text{ VDC}$ nom.)	$-15\text{ VDC}$	95 %

### Options

Suffix A	- Optional models with angular pin version
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### Input Specifications

Input Current	- At no load	-12 Vin models: <b>3 mA typ.</b> -24 Vin models: <b>3 mA typ.</b>
Reflected Ripple Current		<b>100 mA<sub>p-p</sub> typ.</b>
Recommended Input Fuse		-12 Vin models: <b>1'600 mA</b> (slow blow) -24 Vin models: <b>1'600 mA</b> (slow blow) (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 (V <sub>min</sub> - V <sub>max</sub> ) - Load Variation (10 - 100%)	<b>1% max.</b> <b>0.6% max.</b>
Ripple and Noise (20 MHz Bandwidth)		-24 Vin models: <b>75 mV<sub>p-p</sub> max.</b> -5 Vout models: <b>50 mV<sub>p-p</sub> max.</b> -5.2 Vout models: <b>50 mV<sub>p-p</sub> max.</b> -6 Vout models: <b>75 mV<sub>p-p</sub> max.</b> -8 Vout models: <b>75 mV<sub>p-p</sub> max.</b>
Capacitive Load		-5 Vout models: <b>1'600 µF max.</b> -5.2 Vout models: <b>1'600 µF max.</b> -6 Vout models: <b>1'000 µF max.</b> -8 Vout models: <b>1'000 µF max.</b> -9 Vout models: <b>1'000 µF max.</b> -12 Vout models: <b>470 µF max.</b> -15 Vout models: <b>470 µF max.</b>
Minimum Load		<b>10 % of I<sub>out</sub> max.</b>
Temperature Coefficient		<b>±0.015 %/K max.</b>
Start-up Time		<b>15 ms max.</b>
Short Circuit Protection		<b>Continuous, Automatic recovery</b>
Transient Response	- Response Deviation - Response Time	<b>5% typ. / 7% max.</b> (50% to 100% Load Step) <b>250 µs typ. / 350 µs max.</b> (50% to 100% Load Step)

### General Specifications

Relative Humidity		<b>95% max.</b> (non condensing)
Temperature Ranges	- Operating Temperature - Storage Temperature	<b>-40°C to +85°C</b> <b>-55°C to +125°C</b>
Power Derating	- High Temperature	Depending on model See application note: <a href="http://www.tracopower.com/overview/tsn1">www.tracopower.com/overview/tsn1</a>
Over Temperature Protection Switch Off	- Protection Mode - Measurement Point	<b>165°C typ.</b> (Latch off) <b>Internal IC temperature</b> Operation at lower load will not damage the converter, but it may not meet all specifications listed
Cooling System		<b>Natural convection</b> (20 LFM)
Switching Frequency		<b>323 - 437 kHz</b> (PWM) (380 kHz typ.) (5 & 5.2 Vout models) <b>425 - 575 kHz</b> (PWM) (500 kHz typ.) (other Vout models)
Insulation System		<b>Non-isolated</b>
Reliability	- Calculated MTBF	<b>8'475'000 h</b> (MIL-HDBK-217F, ground benign)
Washing Process		<b>Allowed</b> (hermetical product) See Cleaning Guideline: <a href="http://www.tracopower.com/info/cleaning.pdf">www.tracopower.com/info/cleaning.pdf</a>

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 MIL-STD-810F MIL-STD-810F
Housing Material		Plastic (UL 94 V-0 rated)
Potting Material		Silicone (UL 94 V-0 rated)
Pin Material		Copper
Pin Foundation Plating		Nickel (2 - 3 $\mu\text{m}$ )
Pin Surface Plating		Tin (3 - 5 $\mu\text{m}$ ), 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		3.1 g
Environmental Compliance	- REACH Declaration  - RoHS 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 <a href="http://www.tracopower.com/info/rohs-declaration.pdf">www.tracopower.com/info/rohs-declaration.pdf</a> Exemptions: 7a, 7c-I (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.)

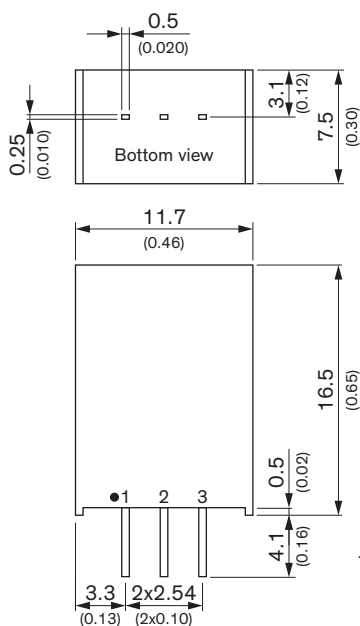
### Supporting Documents

Overview Link (for additional Documents)

[www.tracopower.com/overview/tsn1](http://www.tracopower.com/overview/tsn1)

### Outline Dimensions

#### Straight pin version

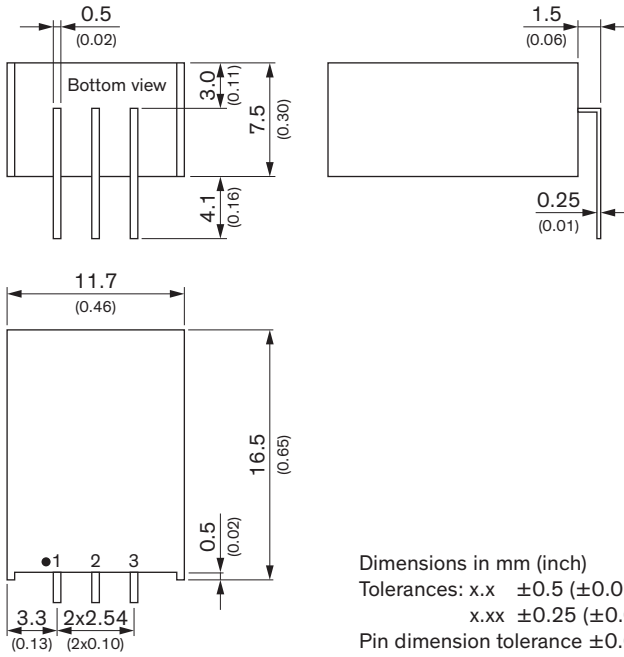


Dimensions in mm (inch)  
Tolerances: x.x  $\pm 0.5$  ( $\pm 0.02$ )  
x.xx  $\pm 0.25$  ( $\pm 0.01$ )  
Pin dimension tolerance  $\pm 0.004$  ( $\pm 0.1$ )

Pinout	
Pin	Single
1	GND
2	-Vin
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	Single
1	GND
2	-Vin
3	-Vout