TRACO POWER

Non-Isolated DC/DC Converter (POL) — TSR 1.5E Series, 1.5 A

- **Highly cost efficient design**
- **Pin compatible with TO-220 package 78xx linear regulators**
- **Operation temperature range –40°C to +85°C without derating**
- **Efficiency up to 97%**
- **Wide input operating range 7-36 VDC**
- **Short circuit protection**
- **Excellent line / load regulation**
- **3-year product warranty**

The TSR 1.5E is a 1.5 Ampere step-down switching regulator series and a drop-in replacement for inefficient LM78xx linear regulators. This series comes in a compact SIP-3 open frame package and complements our existing POL portfolio with a series focusing strongly on a cost efficient design while maintaining our quality standards. There are 3 output voltages available: 3.3, 5.0 and 12VDC. The effective design allows full load operation up to +85°C ambient temperature without the need of any heat sink or forced cooling. The TSR 1.5E switching regulators provide other significant features over linear regulators, i.e. better output accuracy, lower standby current and no requirement of external capacitors. The TSR 1.5E series 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 1.5-2433E	1'500 mA	7 - 36 VDC (24 VDC nom.)	3.3 VDC	93 % (at Vin min.)
TSR 1.5-2450E			5 VDC	95 % (at Vin min.)
TSR 1.5-24120E	1'000 mA	15 - 36 VDC (24 VDC nom.)	12 VDC	97 % (at Vin min.)

Note - For input voltage higher 24 VDC an input capacitor of 22 µF is required

Input Specifications

Input Current	- At no load		15 mA max.
Surge Voltage			40 VDC max. (1 s max.)
Input Inrush Current			70 A typ. (12 Vout model) 30 A typ. (other models)
Recommended Input Fuse			2'000 mA (fast acting) (The need of an external fuse has to be assessed in the final application.)
Input Filter			Internal Capacitor

Output Specifications

Voltage Set Accuracy			±4% max. (at 50% load)
Regulation	- Input Variation (Vmin - Vmax)		0.7% max.
	- Load Variation (25 - 100%)		0.7% max.
Ripple and Noise (20 MHz Bandwidth)		3.3 Vout models:	40 mVp-p max. (w/ 47 µF)
		5 Vout models:	75 mVp-p max. (w/ 47 µF)
		12 Vout models:	75 mVp-p max. (w/ 47 µF)
Capacitive Load		3.3 Vout models:	1'200 µF max.
		5 Vout models:	660 µF max.
		12 Vout models:	470 µF max.
Minimum Load			Not required
Temperature Coefficient			±0.02 %/K max.
Hold-up Time			40 µs min. (3.3 Vout model) 160 µs min. (5 Vout model) 1'400 µs min. (12 Vout model)
Start-up Time			2.1 ms max.
Short Circuit Protection			Continuous, Automatic recovery
Output Current Limitation			200 - 500% of Iout max.
Transient Response	- Peak Variation		70 mV max. (50% to 100% Load Step) (3.3 Vout model) 90 mV max. (50% to 100% Load Step) (5 Vout model) 130 mV max. (50% to 100% Load Step) (12 Vout model)
	- Response Time		75 µs typ. (50% to 100% 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/tsr1-5e

General Specifications

Relative Humidity			95% max. (non condensing)
Temperature Ranges	- Operating Temperature		–40°C to +85°C
	- Case Temperature		+130°C max.
	- Storage Temperature		–55°C to +125°C
Power Derating	- High Temperature		Depending on model
		See application note:	www.tracopower.com/overview/tsr1-5e
Over Temperature Protection Switch Off	- Protection Mode		130°C to 140°C (Automatic recovery at 130°C typ.)
	- Measurement Point		Internal IC temperature
Cooling System			Natural convection (20 LFM)
Altitude During Operation			2'000 m max.

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

Switching Frequency		320 - 500 kHz (PWM) 410 kHz typ. (PWM)
Insulation System		Non-isolated
Reliability	- Calculated MTBF	16'000'000 h (12 Vout model) 6'800'000 h (other models) (MIL-HDBK-217F, ground benign)
Washing Process		Not allowed (non-hermetical product)
Pin Material		Copper Alloy
Pin Foundation Plating		Nickel (0.5 µm min.)
Pin Surface Plating		Gold (10 nm min.), bright
Housing Type		Open Frame
Mounting Type		PCB Mount
Connection Type		THD (Through-Hole Device)
Footprint Type		SIP3
Soldering Profile		Wave Soldering 265 °C / 5 s max.
Weight		2 g
Thermal Impedance	- Case to Ambient	60 K/W typ.
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 (O5A rule). The SCIP number is provided on request.)

Supporting Documents

Overview Link (for additional Documents)	www.tracopower.com/overview/tsr1-5e

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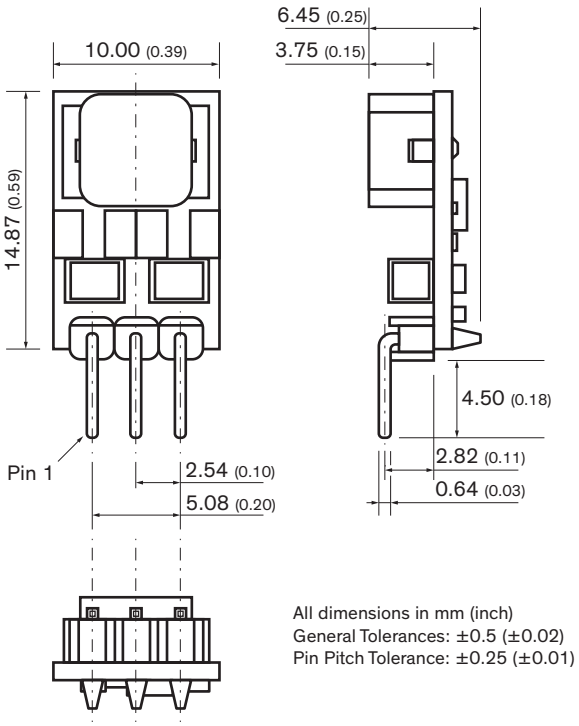
Outline Dimensions



All dimensions in mm (inch)
General Tolerances: ±0.5 (±0.02)
Pin Pitch Tolerance: ±0.25 (±0.01)

Pin Assignment	
Pin	**Function**
1	+ Vin
2	Common Ground
3	+ Vout