# 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.) |
| Recommended Input Fuse | | | 2'000 mA (fast acting)<br>(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<br>(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)<br>160 µs min. (5 Vout model)<br>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)<br>90 mV max. (50% to 100% Load Step) (5 Vout model)<br>130 mV max. (50% to 100% Load Step) (12 Vout model) |
| | - Response Time | | 75 µs typ. (50% to 100% Load Step) |

## Safety Specifications

| | | | |
|---|---|---|---|
| Over Voltage Category | | | Not mains connected |

## EMC Specifications

| | | | |
|---|---|---|---|
| EMI (Emissions) | - Conducted Emissions | | EN 55032 class A (with external filter)<br>EN 55032 class B (with external filter) |
| | - Radiated Emissions | | EN 55032 class A (with external filter)<br>EN 55032 class B (with external filter) |
| | | External filter proposal: | www.tracopower.com/tsr1-5e-emc-filter |

## 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/tsr1-5e-cc |
| 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) |

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

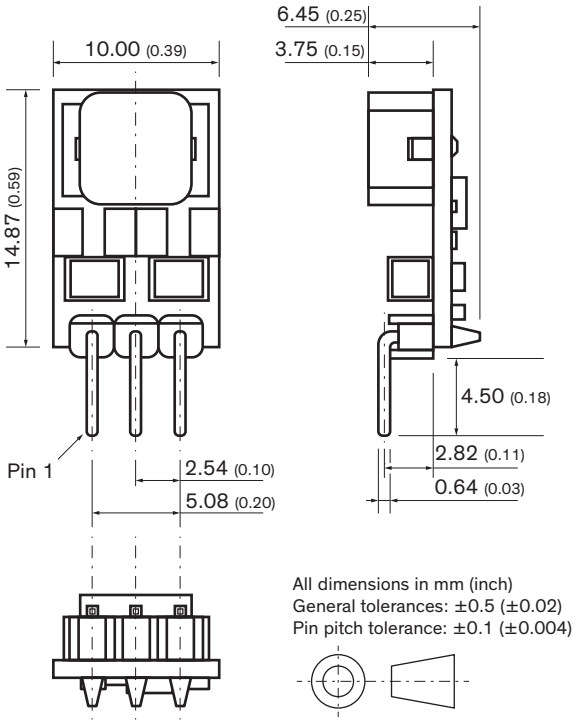
| | | |
|---|---|---|
| Altitude During Operation | | 2'000 m max. |
| Regulator Topology | | Buck Converter |
| Switching Frequency | | 320 - 500 kHz (PWM)<br>410 kHz typ. (PWM) |
| Insulation System | | Non-isolated |
| Reliability | - Calculated MTBF | 16'000'000 h (12 Vout model)<br>6'800'000 h (other models)<br>(MIL-HDBK-217F, ground benign) |
| Washing Process | | Not allowed |
| 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 | | Lead-Free Wave Soldering<br>265 °C / 5 s max. |
| Weight | | 2 g |
| Thermal Impedance | - Case to Ambient | 60.0 K/W typ. |
| Environmental Compliance | - REACH Declaration | www.tracopower.com/info/reach-declaration.pdf<br>REACH SVHC list compliant<br>REACH Annex XVII compliant |
| | - RoHS Declaration | www.tracopower.com/info/rohs-declaration.pdf<br>Exemptions: 7(a), 7(c)-I<br>(RoHS exemptions refer to the component concentration only, not to the overall concentration in the product (O5A rule).) |
| | - SCIP Reference Number | 1eac0446-aaf9-4e48-a349-df18b8b203b0 |

## Additional Information

| | |
|---|---|
| Supporting Documents | www.tracopower.com/overview/tsr1-5e |
| Frequently Asked Questions | www.tracopower.com/glossary-faq |
| Glossary | www.tracopower.com/info/glossary.pdf |

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

## Outline Dimensions




All dimensions in mm (inch)
General tolerances: ±0.5 (±0.02)
Pin pitch tolerance: ±0.1 (±0.004)

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

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