DC/DC Converters
TSH Series, 2 Watt

Features
- Ultra compact SMD package (SOIC-14/18)
- Isolated single and dual output models
- I/O isolation 1’000 VDC
- High efficiency up to 82%
- Operating temperature –40°C to +85°C
- Reflow solder temperature up to 245°C
- High accuracy of pin Co-planarity
- Available in tape and reel package
- Lead free design, RoHS compliant
- 3–year product warranty

The TSH series are ultra miniature, isolated 2 Watt DC/DC-converters in SMD pack-
age. The devices can be soldered without any problems in a high temperature lead
free solder process. Requiring only 1.5 cm² board space they offer the ideal solution
in many space critical applications. These converters are the ideal solution for point
of load power conversion, ground loop elimination, noise reduction and digital
interface applications.

Models

<table>
<thead>
<tr>
<th>Ordercode</th>
<th>Input voltage</th>
<th>Output voltage</th>
<th>Output current max.</th>
<th>Efficiency typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSH 0505S</td>
<td>5 VDC ±10%</td>
<td>5 VDC</td>
<td>400 mA</td>
<td>77 %</td>
</tr>
<tr>
<td>TSH 0512S</td>
<td>5 VDC ±10%</td>
<td>12 VDC</td>
<td>165 mA</td>
<td>81 %</td>
</tr>
<tr>
<td>TSH 0505S</td>
<td>±5 VDC</td>
<td>±200 mA</td>
<td>77 %</td>
<td></td>
</tr>
<tr>
<td>TSH 0512S</td>
<td>±12 VDC</td>
<td>±80 mA</td>
<td>79 %</td>
<td></td>
</tr>
<tr>
<td>TSH 0512S</td>
<td>±15 VDC</td>
<td>±65 mA</td>
<td>79 %</td>
<td></td>
</tr>
<tr>
<td>TSH 0515S</td>
<td>±12 VDC</td>
<td>±65 mA</td>
<td>79 %</td>
<td></td>
</tr>
<tr>
<td>TSH 0512S</td>
<td>±15 VDC</td>
<td>±65 mA</td>
<td>79 %</td>
<td></td>
</tr>
<tr>
<td>TSH 0515S</td>
<td>±15 VDC</td>
<td>±65 mA</td>
<td>79 %</td>
<td></td>
</tr>
<tr>
<td>TSH 1205S</td>
<td>12 VDC ±10%</td>
<td>5 VDC</td>
<td>400 mA</td>
<td>78 %</td>
</tr>
<tr>
<td>TSH 1212S</td>
<td>±12 VDC</td>
<td>±80 mA</td>
<td>82 %</td>
<td></td>
</tr>
<tr>
<td>TSH 1212S</td>
<td>±15 VDC</td>
<td>±65 mA</td>
<td>82 %</td>
<td></td>
</tr>
<tr>
<td>TSH 1215D</td>
<td>±15 VDC</td>
<td>±65 mA</td>
<td>82 %</td>
<td></td>
</tr>
<tr>
<td>TSH 2405S</td>
<td>24 VDC ±10%</td>
<td>5 VDC</td>
<td>400 mA</td>
<td>78 %</td>
</tr>
<tr>
<td>TSH 2412S</td>
<td>±12 VDC</td>
<td>±80 mA</td>
<td>81 %</td>
<td></td>
</tr>
<tr>
<td>TSH 2412S</td>
<td>±15 VDC</td>
<td>±65 mA</td>
<td>82 %</td>
<td></td>
</tr>
</tbody>
</table>
## DC/DC Converters

**TSH Series**
**2 Watt**

### Input Specifications

<table>
<thead>
<tr>
<th>Input current no load / full load</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Vin models: 60 mA / 500 mA typ.</td>
</tr>
<tr>
<td>12 Vin models: 30 mA / 200 mA typ.</td>
</tr>
<tr>
<td>24 Vin models: 15 mA / 100 mA typ.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Surge voltage (1 sec. max.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 Vin models: 9 V max.</td>
</tr>
<tr>
<td>12 Vin models: 18 V max.</td>
</tr>
<tr>
<td>24 Vin models: 30 V max.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reflected input ripple current</th>
</tr>
</thead>
<tbody>
<tr>
<td>can be reduced by ext. 1–3.3 µF polyester film capacitor</td>
</tr>
</tbody>
</table>

### Output Specifications

### Voltage set accuracy

<table>
<thead>
<tr>
<th>Voltage set accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>±4 % max.</td>
</tr>
</tbody>
</table>

### Voltage balance (dual output models)

<table>
<thead>
<tr>
<th>Voltage balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>±1 % max.</td>
</tr>
</tbody>
</table>

### Regulation

- Input variation: 1.2 % / 1% change Vin
- Load variation: 20 – 100 %
- 10 % max.

### Ripple and noise (20 MHz Bandwidth)

<table>
<thead>
<tr>
<th>Ripple and noise</th>
</tr>
</thead>
<tbody>
<tr>
<td>75 mV pk-pk max.</td>
</tr>
</tbody>
</table>

### Temperature coefficient

<table>
<thead>
<tr>
<th>Temperature coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>± 0.02 %/K</td>
</tr>
</tbody>
</table>

### Short circuit protection

<table>
<thead>
<tr>
<th>Short circuit protection</th>
</tr>
</thead>
<tbody>
<tr>
<td>limited 1 sec. max.</td>
</tr>
</tbody>
</table>

### Capacitive load

<table>
<thead>
<tr>
<th>Capacitive load</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 VDC single output models: 47 µF max.</td>
</tr>
<tr>
<td>5 VDC dual output model: 10 µF max.</td>
</tr>
<tr>
<td>12 VDC single output models: 10 µF max.</td>
</tr>
<tr>
<td>12/15 VDC dual output models: 4.7 µF max.</td>
</tr>
</tbody>
</table>

### General Specifications

### Temperature ranges

- Operating: -40°C to +85°C (no derating)
- Case temperature: +95°C max.
- Storage: -55°C to +125°C

### Humidity (non condensing)

<table>
<thead>
<tr>
<th>Humidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>95 % rel H max.</td>
</tr>
</tbody>
</table>

### Reliability, calculated MTTF (MIL-HDBK-217F, @+25°C, ground benign)

<table>
<thead>
<tr>
<th>Reliability, calculated MTTF</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;2'000'000 h</td>
</tr>
</tbody>
</table>

### Isolation voltage (60 sec.)

<table>
<thead>
<tr>
<th>Isolation voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1'000 VDC</td>
</tr>
</tbody>
</table>

### Isolation capacitance

<table>
<thead>
<tr>
<th>Isolation capacitance</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 pF typ.</td>
</tr>
</tbody>
</table>

### Isolation resistance

<table>
<thead>
<tr>
<th>Isolation resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;1'000 Mohm (at 500VDC)</td>
</tr>
</tbody>
</table>

### Switching frequency

<table>
<thead>
<tr>
<th>Switching frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 kHz typ. (frequency modulation)</td>
</tr>
</tbody>
</table>

### Frequency change over line and load

<table>
<thead>
<tr>
<th>Frequency change over line and load</th>
</tr>
</thead>
<tbody>
<tr>
<td>±30 % max.</td>
</tr>
</tbody>
</table>

### Physical Specifications

<table>
<thead>
<tr>
<th>Casing material</th>
</tr>
</thead>
<tbody>
<tr>
<td>non conductive black plastic (UL 94-V0 rated)</td>
</tr>
</tbody>
</table>

### Package weight

<table>
<thead>
<tr>
<th>Package weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>single output models: 1.5 g (0.08 oz)</td>
</tr>
<tr>
<td>dual output models: 2.2 g (0.05 oz)</td>
</tr>
</tbody>
</table>

### Lead-free reflow solder process

<table>
<thead>
<tr>
<th>Lead-free reflow solder process</th>
</tr>
</thead>
<tbody>
<tr>
<td>as per IPC/JEDEC J-STD-020C</td>
</tr>
<tr>
<td>peak temp. 245°C (20 sec. max.)</td>
</tr>
</tbody>
</table>

---

All specifications valid at nominal input voltage, full load and +25°C after warm-up time unless otherwise stated.
DC/DC Converters
TSH Series  2 Watt

Outline Dimensions

Single Output Models

Dual Output Models

Pin-Out

<table>
<thead>
<tr>
<th>Pin</th>
<th>Single</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>–Vin (GND)</td>
</tr>
<tr>
<td>3</td>
<td>+Vin (Vcc)</td>
</tr>
<tr>
<td>7</td>
<td>–Vout</td>
</tr>
<tr>
<td>8</td>
<td>+Vout</td>
</tr>
<tr>
<td>14</td>
<td>Ntc.</td>
</tr>
</tbody>
</table>

Ntc. = not to connect

<table>
<thead>
<tr>
<th>Pin</th>
<th>Dual</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>–Vin (GND)</td>
</tr>
<tr>
<td>3</td>
<td>+Vin (Vcc)</td>
</tr>
<tr>
<td>7</td>
<td>Common</td>
</tr>
<tr>
<td>9</td>
<td>–Vout</td>
</tr>
<tr>
<td>12</td>
<td>+Vout</td>
</tr>
<tr>
<td>18</td>
<td>Ntc.</td>
</tr>
</tbody>
</table>

Ntc. = not to connect

Dimensions in [mm], | = Inches
Tolerances ±0.25 (±0.01), pins ±0.05 (±0.002)
Packaging: Single Output Models

Standard Packaging - Tube

- 1 Tube contains 10 converters

Optional Packaging - Tape & Reel

- Specifications according IEC 286-3
- 1 Reel contains 300 Converters
- Use appendix «-TR» on order code

Dimensions in [mm], Tolerance ±0.1mm
Packaging: Dual Output Models

Standard Packaging - Tube

1 Tube contains 10 Converters

Optional Packaging - Tape & Reel

- Specifications according IEC 286-3
- 1 Reel contains 300 Converters
- Use appendix «TR» on order code

Specifications can be changed any time without notice.

Dimensions in [mm], Tolerance ±0.1mm