DC/DC Converter

- Supplementary and reinforced insulation
- I/O isolation 4800 VACrms rated for 1000 Vrms (1410 Vpk) working voltage
- Medical safety to ES 60601-1 and IEC/EN 60601-1 3rd edition, 2 x MOOP
- Isolation test voltage 6000 Vpk
- Wide 2:1 input voltage ranges
- Extended operating temperature range –40°C to 85°C max.
- Input filter meets EN55022, class A
- Continuous short-circuit protection
- High reliability
- 3-year product warranty

The THB 3 series is a range of high performance, regulated DC/DC converters in a DIP-24 plastic package. A reinforced I/O-isolation system and a wide 2:1 input voltage range make this product the best choice for many demanding applications like transportation systems, industrial controls, medical equipments, instrumentations, everywhere where high basic-, supplementary- or reinforced insulation is required to meet requested safety standards. A high efficiency allows safe operation in a temperature range of –40°C to +85°C. Other features of this product are over voltage protection and internal EMI-input filter to meet EN 55022, class A without additional components. Full SMD-design with exclusive use of ceramic capacitors ensure a very high reliability and a long product lifetime.

### Models

<table>
<thead>
<tr>
<th>Order Code</th>
<th>Input Voltage Range</th>
<th>Output 1</th>
<th>Output 2</th>
<th>Efficiency typ.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vnom</td>
<td>Imax</td>
<td>Vnom</td>
<td>Imax</td>
</tr>
<tr>
<td>THB 3-0511</td>
<td>4.5 - 9 VDC (5 VDC nom.)</td>
<td>5 VDC: 600 mA</td>
<td>12 VDC: 250 mA</td>
<td>–12 VDC: 125 mA</td>
</tr>
<tr>
<td>THB 3-0512</td>
<td>4.5 - 9 VDC (5 VDC nom.)</td>
<td>24 VDC: 125 mA</td>
<td>+12 VDC: 125 mA</td>
<td>–15 VDC: 100 mA</td>
</tr>
<tr>
<td>THB 3-0515</td>
<td>4.5 - 9 VDC (5 VDC nom.)</td>
<td>+15 VDC: 100 mA</td>
<td>–12 VDC: 125 mA</td>
<td>76 %</td>
</tr>
<tr>
<td>THB 3-0522</td>
<td>4.5 - 9 VDC (5 VDC nom.)</td>
<td>–12 VDC: 125 mA</td>
<td>-15 VDC: 100 mA</td>
<td>75 %</td>
</tr>
<tr>
<td>THB 3-0523</td>
<td>4.5 - 9 VDC (5 VDC nom.)</td>
<td>–12 VDC: 125 mA</td>
<td>-15 VDC: 100 mA</td>
<td>75 %</td>
</tr>
<tr>
<td>THB 3-1211</td>
<td>9 - 18 VDC (12 VDC nom.)</td>
<td>5 VDC: 600 mA</td>
<td>12 VDC: 250 mA</td>
<td>–12 VDC: 125 mA</td>
</tr>
<tr>
<td>THB 3-1212</td>
<td>9 - 18 VDC (12 VDC nom.)</td>
<td>24 VDC: 125 mA</td>
<td>+12 VDC: 125 mA</td>
<td>–15 VDC: 100 mA</td>
</tr>
<tr>
<td>THB 3-1215</td>
<td>9 - 18 VDC (12 VDC nom.)</td>
<td>+15 VDC: 100 mA</td>
<td>–12 VDC: 125 mA</td>
<td>81 %</td>
</tr>
<tr>
<td>THB 3-1222</td>
<td>9 - 18 VDC (12 VDC nom.)</td>
<td>–12 VDC: 125 mA</td>
<td>-15 VDC: 100 mA</td>
<td>80 %</td>
</tr>
<tr>
<td>THB 3-1223</td>
<td>9 - 18 VDC (12 VDC nom.)</td>
<td>–12 VDC: 125 mA</td>
<td>-15 VDC: 100 mA</td>
<td>80 %</td>
</tr>
<tr>
<td>THB 3-2411</td>
<td>18 - 36 VDC (24 VDC nom.)</td>
<td>5 VDC: 600 mA</td>
<td>12 VDC: 250 mA</td>
<td>–12 VDC: 125 mA</td>
</tr>
<tr>
<td>THB 3-2412</td>
<td>18 - 36 VDC (24 VDC nom.)</td>
<td>24 VDC: 125 mA</td>
<td>+12 VDC: 125 mA</td>
<td>–15 VDC: 100 mA</td>
</tr>
<tr>
<td>THB 3-2415</td>
<td>18 - 36 VDC (24 VDC nom.)</td>
<td>+15 VDC: 100 mA</td>
<td>–12 VDC: 125 mA</td>
<td>84 %</td>
</tr>
<tr>
<td>THB 3-2422</td>
<td>18 - 36 VDC (24 VDC nom.)</td>
<td>–12 VDC: 125 mA</td>
<td>-15 VDC: 100 mA</td>
<td>83 %</td>
</tr>
<tr>
<td>THB 3-2423</td>
<td>18 - 36 VDC (24 VDC nom.)</td>
<td>–12 VDC: 125 mA</td>
<td>-15 VDC: 100 mA</td>
<td>83 %</td>
</tr>
<tr>
<td>THB 3-4811</td>
<td>36 - 75 VDC (48 VDC nom.)</td>
<td>5 VDC: 600 mA</td>
<td>12 VDC: 250 mA</td>
<td>–12 VDC: 125 mA</td>
</tr>
<tr>
<td>THB 3-4812</td>
<td>36 - 75 VDC (48 VDC nom.)</td>
<td>24 VDC: 125 mA</td>
<td>+12 VDC: 125 mA</td>
<td>–15 VDC: 100 mA</td>
</tr>
<tr>
<td>THB 3-4815</td>
<td>36 - 75 VDC (48 VDC nom.)</td>
<td>+15 VDC: 100 mA</td>
<td>–12 VDC: 125 mA</td>
<td>84 %</td>
</tr>
<tr>
<td>THB 3-4822</td>
<td>36 - 75 VDC (48 VDC nom.)</td>
<td>–12 VDC: 125 mA</td>
<td>-15 VDC: 100 mA</td>
<td>83 %</td>
</tr>
<tr>
<td>THB 3-4823</td>
<td>36 - 75 VDC (48 VDC nom.)</td>
<td>–12 VDC: 125 mA</td>
<td>-15 VDC: 100 mA</td>
<td>83 %</td>
</tr>
</tbody>
</table>
### Input Specifications

<table>
<thead>
<tr>
<th></th>
<th>5 Vin models</th>
<th>12 Vin models</th>
<th>24 Vin models</th>
<th>48 Vin models</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input Current</strong></td>
<td>- At no load</td>
<td>40 mA typ.</td>
<td>30 mA typ.</td>
<td>20 mA typ.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 mA typ.</td>
<td>10 mA typ.</td>
<td>10 mA typ.</td>
</tr>
<tr>
<td></td>
<td>- At full load</td>
<td>825 mA typ.</td>
<td>325 mA typ.</td>
<td>150 mA typ.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>150 mA typ.</td>
<td>75 mA typ.</td>
<td>75 mA typ.</td>
</tr>
<tr>
<td><strong>Surge Voltage</strong></td>
<td>5 Vin models</td>
<td>11 VDC max. (1 s max)</td>
<td>25 VDC max. (1 s max)</td>
<td>50 VDC max. (1 s max)</td>
</tr>
<tr>
<td></td>
<td>12 Vin models</td>
<td>8 VDC min. / 8.5 VDC typ. / 9 VDC max.</td>
<td>17 VDC min. / 17 VDC typ. / 18 VDC max.</td>
<td>30 VDC min. / 33 VDC typ. / 36 VDC max.</td>
</tr>
<tr>
<td><strong>Start-up Voltage</strong></td>
<td>5 Vin models</td>
<td>3.7 VDC min. / 4 VDC typ. / 4.5 VDC max.</td>
<td>8 VDC min. / 8.5 VDC typ. / 9 VDC max.</td>
<td>15 VDC min. / 17 VDC typ. / 18 VDC max.</td>
</tr>
<tr>
<td></td>
<td>12 Vin models</td>
<td>8 VDC min. / 8.5 VDC typ. / 9 VDC max.</td>
<td>17 VDC min. / 17 VDC typ. / 18 VDC max.</td>
<td>30 VDC min. / 33 VDC typ. / 36 VDC max.</td>
</tr>
<tr>
<td><strong>Under Voltage Lockout</strong></td>
<td>5 Vin models</td>
<td>4 VDC max.</td>
<td>8.5 VDC max.</td>
<td>17 VDC max.</td>
</tr>
<tr>
<td></td>
<td>12 Vin models</td>
<td>8.5 VDC max.</td>
<td>17 VDC max.</td>
<td>34 VDC max.</td>
</tr>
<tr>
<td><strong>Reflected Ripple Current</strong></td>
<td>5 Vin models</td>
<td>60 mA typ.</td>
<td>30 mA typ.</td>
<td>15 mA typ.</td>
</tr>
<tr>
<td></td>
<td>12 Vin models</td>
<td>30 mA typ.</td>
<td>15 mA typ.</td>
<td>10 mA typ.</td>
</tr>
<tr>
<td><strong>Recommended Input Fuse</strong></td>
<td>5 Vin models</td>
<td>2'000 mA (Slow blow)</td>
<td>1'000 mA (Slow blow)</td>
<td>500 mA (Slow blow)</td>
</tr>
<tr>
<td></td>
<td>12 Vin models</td>
<td>1'000 mA (Slow blow)</td>
<td>500 mA (Slow blow)</td>
<td>250 mA (Slow blow)</td>
</tr>
<tr>
<td></td>
<td>24 Vin models</td>
<td>500 mA (Slow blow)</td>
<td>250 mA (Slow blow)</td>
<td>100 mA (Slow blow)</td>
</tr>
<tr>
<td></td>
<td>48 Vin models</td>
<td>250 mA (Slow blow)</td>
<td>100 mA (Slow blow)</td>
<td>100 mA (Slow blow)</td>
</tr>
<tr>
<td><strong>Input Filter</strong></td>
<td>Internal Pi-Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Short Circuit Input Power</strong></td>
<td>2 W max.</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

### Output Specifications

<table>
<thead>
<tr>
<th></th>
<th>±1% max.</th>
<th>5 Vout models</th>
<th>12 Vout models</th>
<th>24 Vout models</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Voltage Set Accuracy</strong></td>
<td></td>
<td>75 mVp-p typ.</td>
<td>100 mVp-p typ.</td>
<td>100 mVp-p typ.</td>
</tr>
<tr>
<td><em>Input Variation (Vmin - Vmax)</em></td>
<td></td>
<td>100 mVp-p typ.</td>
<td>100 mVp-p typ.</td>
<td>100 mVp-p typ.</td>
</tr>
<tr>
<td><em>Load Variation (25% - 100%)</em></td>
<td></td>
<td>100 mVp-p typ.</td>
<td>100 mVp-p typ.</td>
<td>100 mVp-p typ.</td>
</tr>
<tr>
<td><strong>Ripple and Noise</strong></td>
<td></td>
<td>1'000 µF max.</td>
<td>470 µF max.</td>
<td>470 µF max.</td>
</tr>
<tr>
<td>(20 MHz Bandwidth)</td>
<td></td>
<td>220 / 220 µF max.</td>
<td>220 / 220 µF max.</td>
<td>220 / 220 µF max.</td>
</tr>
<tr>
<td><em>single output</em></td>
<td></td>
<td>5 Vout models</td>
<td>12 Vout models</td>
<td>24 Vout models</td>
</tr>
<tr>
<td><em>dual output</em></td>
<td></td>
<td>12 / -12 Vout models</td>
<td>15 / -15 Vout models</td>
<td>24 / -24 Vout models</td>
</tr>
</tbody>
</table>

All specifications valid at nominal voltage, resistive full load and +25°C after warm-up time, unless otherwise stated.
### Minimum Load
15 % of I\textsubscript{out} max.
(Operation at lower load will not damage the converter, but it may not meet all specifications)

### Temperature Coefficient
±0.05 %/K max.

### Short Circuit Protection
Continuous, Automatic recovery

### Overload Protection
Foldback Mode

### Output Current Limitation
120% min. of I\textsubscript{out} max.
150% typ. of I\textsubscript{out} max.

### Transient Response
- Response Deviation 3% typ. / 6% max. (75% to 100% Load Step)
- Response Time 150 µs typ. / 500 µs max. (75% to 100% Load Step)

### Safety Specifications

<table>
<thead>
<tr>
<th>Safety Standards</th>
<th>CSA-C22.2, No. 60950-1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Designed for EN 62368-1 (no certification)</td>
</tr>
<tr>
<td></td>
<td>EN 60950-1</td>
</tr>
<tr>
<td></td>
<td>IEC 60950-1</td>
</tr>
<tr>
<td></td>
<td>UL 60950-1</td>
</tr>
<tr>
<td></td>
<td>EN 60601-1</td>
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<tr>
<td></td>
<td>IEC 60601-1</td>
</tr>
<tr>
<td></td>
<td>ANSI/AAMI ES 60601-1</td>
</tr>
<tr>
<td></td>
<td>CSA-C22.2, No 60601-1</td>
</tr>
<tr>
<td></td>
<td>2 x MOOP (Means Of Operator Protection)</td>
</tr>
<tr>
<td></td>
<td>MOPP (Means Of Patient Protection)</td>
</tr>
<tr>
<td>Certification Documents</td>
<td><a href="http://www.tracopower.com/overview/thb3">www.tracopower.com/overview/thb3</a></td>
</tr>
</tbody>
</table>

### Pollution Degree
PD 2

### Over Voltage Category
OVC II

### EMC Specifications

<table>
<thead>
<tr>
<th>EMI Emissions</th>
<th>EN 60601-1-2 edition 4 (Medical Devices)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conducted Emissions</td>
<td>EN 55032 class A (internal filter)</td>
</tr>
<tr>
<td></td>
<td>EN 55032 class B (with external filter)</td>
</tr>
<tr>
<td>Radiated Emissions</td>
<td>FCC Part 15 class A (internal filter)</td>
</tr>
<tr>
<td></td>
<td>FCC Part 15 class B (with external filter)</td>
</tr>
<tr>
<td></td>
<td>EN 55032 class A (internal filter)</td>
</tr>
<tr>
<td></td>
<td>EN 55032 class B (with external filter)</td>
</tr>
<tr>
<td></td>
<td>FCC Part 15 class A (internal filter)</td>
</tr>
<tr>
<td></td>
<td>FCC Part 15 class B (with external filter)</td>
</tr>
</tbody>
</table>

| External filter proposal       | www.tracopower.com/overview/thb3 |

| EMS Immunity                   | EN 60601-1-2 edition 4 (Medical Devices) |

### General Specifications

<table>
<thead>
<tr>
<th>Relative Humidity</th>
<th>95% max. (non condensing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Ranges</td>
<td></td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-40°C to +85°C</td>
</tr>
<tr>
<td>Case Temperature</td>
<td>+100°C max.</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-50°C to +125°C</td>
</tr>
<tr>
<td>Power Derating</td>
<td>3.3 %/K above 70°C</td>
</tr>
<tr>
<td>Cooling System</td>
<td>Natural convection (20 LFM)</td>
</tr>
<tr>
<td>Altitude During Operation</td>
<td>5'000 m max.</td>
</tr>
<tr>
<td>Switching Frequency</td>
<td>150 kHz typ. (PWM)</td>
</tr>
<tr>
<td>Insulation System</td>
<td>Reinforced Insulation</td>
</tr>
<tr>
<td>Working Voltage (rated)</td>
<td>1'000 VAC</td>
</tr>
<tr>
<td>Isolation Test Voltage</td>
<td>- Input to Output, 60 s</td>
</tr>
<tr>
<td></td>
<td>4'000 VDC</td>
</tr>
<tr>
<td>Isolation Resistance</td>
<td>- Input to Output, 500 VDC</td>
</tr>
<tr>
<td></td>
<td>10'000 MΩ min.</td>
</tr>
<tr>
<td>Isolation Capacitance</td>
<td>- Input to Output, 100 kHz, 1 V</td>
</tr>
<tr>
<td></td>
<td>7 pF typ.</td>
</tr>
<tr>
<td></td>
<td>13 pF max.</td>
</tr>
</tbody>
</table>

All specifications valid at nominal voltage, resistive full load and +25°C after warm-up time, unless otherwise stated.
Leakage Current - Earth Leakage Current 2 µA max.
Reliability - Calculated MTBF 1'000'000 h (MIL-HDBK-217F, ground benign)
Washing Process - Allowed (hermetical product)
Housing Material - Non-conductive Plastic (UL 94 V-0 rated)
Potting Material - Silicone (UL 94 V-0 rated)
Pin Material - Copper Alloy (C6801)
Pin Foundation Plating - Nickel (2.5 µm min.)
Pin Surface Plating - Gold (75 - 125 nm), glossy
Housing Type - Plastic Case
Mounting Type - PCB Mount
Connection Type - THD (Through-Hole Device)
Footprint Type - DIP24
Soldering Profile - Wave Soldering
Weight - 13 g
Environmental Compliance - REACH Declaration
www.tracopower.com/info/reach-declaration.pdf
REACH SVHC list compliant
REACH Annex XVII compliant
www.tracopower.com/info/rohs-declaration.pdf
Exemptions: 7a
(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/thb3

Outline Dimensions

Pinout

<table>
<thead>
<tr>
<th>Pin</th>
<th>Single</th>
<th>Dual</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>+Vin (Vcc)</td>
<td>+Vin (Vcc)</td>
</tr>
<tr>
<td>11</td>
<td>No pin</td>
<td>Common</td>
</tr>
<tr>
<td>12</td>
<td>-Vout</td>
<td>No pin</td>
</tr>
<tr>
<td>13</td>
<td>+Vout</td>
<td>-Vout</td>
</tr>
<tr>
<td>15</td>
<td>No pin</td>
<td>+Vout</td>
</tr>
<tr>
<td>23</td>
<td>-Vin (GND)</td>
<td>-Vin (GND)</td>
</tr>
<tr>
<td>24</td>
<td>-Vin (GND)</td>
<td>-Vin (GND)</td>
</tr>
</tbody>
</table>

Dimensions in mm (inch)
Pin diameter Ø 0.6 ±0.05 (0.024 ±0.002)
Tolerances ±0.25 (±0.01)
Pin pitch tolerances ±0.13 (±0.005)