

## DC/DC Converter

## TEP 160 Series, 160 Watt

- Compact metal package
- Wide 2:1 input voltage ranges 16.5–36, 33–75 VDC
- Very high efficiency up to 93%
- No minimum load
- Soft start
- Adjustable output voltage +10/-20%
- Sense line
- Remote On/Off input
- Reverse input voltage protection
- Over temperature protection



The TEP 160 Series is a family of isolated high performance DC/DC converter modules with wide 2:1 input voltage ranges which come in a rugged, sealed industry standard half brick package.

A very high efficiency allows full power operation without forced air cooling at 25°C. This temperature can be increased to 40°C with optional mounted heatsink or up to 60°C when mounted on an iron base plate. The very wide input voltage range and reverse input voltage protection make these converters an interesting solution for battery operated systems. Typical applications are in telecom/datacom, industry control and railway systems for on board power distribution. This series is available in many optional designs on demand --> see options.

### Models

| Order Code    | Input Voltage Range            | Output Voltage nom. | Output Current max. | Efficiency typ. |
|---------------|--------------------------------|---------------------|---------------------|-----------------|
| TEP 160-2412  | 16.5 - 36 VDC<br>(24 VDC nom.) | 12 VDC              | 13'000 mA           | 92 %            |
| TEP 160-2413  |                                | 15 VDC              | 10'000 mA           | 92 %            |
| TEP 160-2415  |                                | 24 VDC              | 6'500 mA            | 93 %            |
| TEP 160-2416  |                                | 28 VDC              | 5'500 mA            | 93 %            |
| TEP 160-2418  |                                | 48 VDC              | 3'300 mA            | 92 %            |
| TEP 160-4812  | 33 - 75 VDC<br>(48 VDC nom.)   | 12 VDC              | 16'000 mA           | 92 %            |
| TEP 160-4813  |                                | 15 VDC              | 13'000 mA           | 93 %            |
| TEP 160-4815  |                                | 24 VDC              | 8'000 mA            | 92 %            |
| TEP 160-4816  |                                | 28 VDC              | 7'000 mA            | 92 %            |
| TEP 160-4818  |                                | 48 VDC              | 4'000 mA            | 92 %            |
| TEP 160-48153 |                                | 53 VDC              | 3'700 mA            | 92 %            |

## Options

|                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Suffix -CM</b>                                             | - Chassis mount models without filter: <a href="http://www.tracopower.com/products/tep160cm.pdf">www.tracopower.com/products/tep160cm.pdf</a>                                                                                                                                                                                                                                                                                                                 |
| <b>Suffix -CMF</b>                                            | - Chassis mount models with filter to meet EN 55032 class A: <a href="http://www.tracopower.com/products/tep160cmf.pdf">www.tracopower.com/products/tep160cmf.pdf</a>                                                                                                                                                                                                                                                                                         |
| <b>TEP-HS1</b>                                                | - Optional Heat Sink: <a href="http://www.tracopower.com/products/tep-hs1.pdf">www.tracopower.com/products/tep-hs1.pdf</a>                                                                                                                                                                                                                                                                                                                                    |
| <b>on demand</b><br>(backorder with MOQ<br>non stocking item) | <ul style="list-style-type: none"> <li>- Optional model with 3.3 VDC / 40'000 mA Output and 16.5 - 36 VDC Input</li> <li>- Optional model with 5 VDC / 30'000 mA Output and 16.5 - 36 VDC Input</li> <li>- Optional model with 3.3 VDC / 45'000 mA Output and 33 - 75 VDC Input</li> <li>- Optional model with 5 VDC / 34'000 mA Output and 33 - 75 VDC Input</li> <li>- Sync pin to synchronize switching frequency of up to 3 units (EMC reason)</li> </ul> |

## Input Specifications

|                        |              |                                                                                                                                                                               |
|------------------------|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Input Current          | - At no load | 24 Vin models: <b>35 mA typ.</b><br>48 Vin models: <b>25 mA typ.</b>                                                                                                          |
| Surge Voltage          |              | 24 Vin models: <b>50 VDC max.</b> (1 s max.)<br>48 Vin models: <b>100 VDC max.</b> (1 s max.)                                                                                 |
| Under Voltage Lockout  |              | 24 Vin models: <b>15.5 VDC min. / 16 VDC typ. / 16.3 VDC max.</b><br>48 Vin models: <b>31.6 VDC min. / 32 VDC typ. / 32.5 VDC max.</b>                                        |
| Recommended Input Fuse |              | 24 Vin models: <b>15'000 mA</b> (fast acting)<br>48 Vin models: <b>10'000 mA</b> (fast acting)<br>(The need of an external fuse has to be assessed in the final application.) |
| Input Filter           |              | <b>Internal Pi-Type</b>                                                                                                                                                       |

## Output Specifications

|                                        |                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------------------|----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Output Voltage Adjustment              |                                                                      | <b>-20% to +10%</b> (By external trim resistor)<br>See application note: <a href="http://www.tracopower.com/overview/tep160">www.tracopower.com/overview/tep160</a><br>Output power must not exceed rated power!                                                                                                                                                                                                                                                                                                                                                                                                       |
| Voltage Set Accuracy                   |                                                                      | <b>±1% max.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Regulation                             | - Input Variation (Vmin - Vmax)<br>- Load Variation (0 - 100%)       | <b>0.1% max.</b><br><b>0.1% max.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Ripple and Noise<br>(20 MHz Bandwidth) |                                                                      | 3.3 Vout models: <b>75 mVp-p max.</b> (w/ 1 µF X7R // 22 µF poscap)<br>5 Vout models: <b>75 mVp-p max.</b> (w/ 1 µF X7R // 22 µF poscap)<br>12 Vout models: <b>100 mVp-p max.</b> (w/ 1 µF X7R // 22 µF poscap)<br>15 Vout models: <b>100 mVp-p max.</b> (w/ 1 µF X7R // 22 µF poscap)<br>24 Vout models: <b>200 mVp-p max.</b> (w/ 4.7 µF X7R)<br>28 Vout models: <b>200 mVp-p max.</b> (w/ 4.7 µF X7R)<br>48 Vout models: <b>300 mVp-p max.</b> (w/ 2.2 µF X7R)<br>53 Vout models: <b>300 mVp-p max.</b> (w/ 2.2 µF X7R)                                                                                             |
| Capacitive Load                        | - 24 Vin input<br><br><br><br><br><br><br><br><br><br>- 48 Vin input | 53 Vout models: <b>690 µF max.</b><br>3.3 Vout models: <b>121'000 µF max.</b><br>5 Vout models: <b>60'000 µF max.</b><br>12 Vout models: <b>10'800 µF max.</b><br>15 Vout models: <b>6'600 µF max.</b><br>24 Vout models: <b>2'700 µF max.</b><br>28 Vout models: <b>1'900 µF max.</b><br>48 Vout models: <b>680 µF max.</b><br>3.3 Vout models: <b>136'000 µF max.</b><br>5 Vout models: <b>68'000 µF max.</b><br>12 Vout models: <b>13'300 µF max.</b><br>15 Vout models: <b>8'600 µF max.</b><br>24 Vout models: <b>3'300 µF max.</b><br>28 Vout models: <b>2'500 µF max.</b><br>48 Vout models: <b>830 µF max.</b> |
| Minimum Load                           |                                                                      | <b>Not required</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

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

|                           |                                                              |
|---------------------------|--------------------------------------------------------------|
| Temperature Coefficient   | ±0.02 %/K max.                                               |
| Start-up Time             | 75 ms typ.                                                   |
| Short Circuit Protection  | Continuous, Automatic recovery                               |
| Output Current Limitation | 120 - 150% of I <sub>out</sub> max.                          |
| Overvoltage Protection    | 115 - 130% of V <sub>out</sub> nom.                          |
| Transient Response        | - Response Time<br>200 µs typ. / 250 µs max. (25% Load Step) |

## Safety Specifications

|                       |                             |                                                                                            |
|-----------------------|-----------------------------|--------------------------------------------------------------------------------------------|
| Safety Standards      | - IT / Multimedia Equipment | EN 60950-1<br>EN 62368-1<br>IEC 60950-1<br>IEC 62368-1<br>UL 60950-1<br>UL 62368-1         |
|                       | - Certification Documents   | <a href="http://www.tracopower.com/overview/tep160">www.tracopower.com/overview/tep160</a> |
| Pollution Degree      |                             | PD 2                                                                                       |
| Over Voltage Category |                             | OVC II                                                                                     |

## 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:   | <a href="http://www.tracopower.com/overview/tep160">www.tracopower.com/overview/tep160</a>                              |
| EMS Immunity  | - Electrostatic Discharge   | EN 55024 (IT Equipment)<br>Air: EN 61000-4-2, ±8 kV, perf. criteria A<br>Contact: EN 61000-4-2, ±6 kV, perf. criteria A |
|               | - RF Electromagnetic Field  | EN 61000-4-3, 20 V/m, perf. criteria A                                                                                  |
|               | - EFT (Burst) / Surge       | EN 61000-4-4, ±2 kV, perf. criteria A<br>EN 61000-4-5, ±2 kV, perf. criteria A                                          |
|               | Ext. input component:       | 2x KY 200 µF                                                                                                            |
|               | - Conducted RF Disturbances | EN 61000-4-6, 10 Vrms, perf. criteria A                                                                                 |
|               | - PF Magnetic Field         | Continuous: EN 61000-4-8, 100 A/m, perf. criteria A<br>1 s: EN 61000-4-8, 1000 A/m, perf. criteria A                    |

## General Specifications

|                                        |                                                                                           |                                                                                                                                               |
|----------------------------------------|-------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Relative Humidity                      |                                                                                           | 95% max. (non condensing)                                                                                                                     |
| Temperature Ranges                     | - Operating Temperature<br>- Case Temperature<br>- Storage Temperature                    | -40°C to +75°C<br>+105°C max.<br>-55°C to +125°C                                                                                              |
| Power Derating                         | - High Temperature                                                                        | See application note: <a href="http://www.tracopower.com/overview/tep160">www.tracopower.com/overview/tep160</a>                              |
| Over Temperature Protection Switch Off | - Protection Mode<br>- Measurement Point                                                  | 115°C typ. (Automatic recovery at 105°C typ.)<br>Case                                                                                         |
| Cooling System                         |                                                                                           | Natural convection (20 LFM)                                                                                                                   |
| Sense Function                         |                                                                                           | 10% max. of V <sub>out</sub> nom.<br>(Sense line to be connected to the output either at the module or at the load under regard of polarity.) |
| Remote Control                         | - Voltage Controlled Remote<br><br>- Off Idle Input Current<br>- Remote Pin Input Current | On: 3.0 to 12 VDC or open circuit<br>Off: 0 to 1.2 VDC or short circuit<br>Refers to 'Remote' and '-Vin' Pin<br>3 mA typ.<br>-0.5 to 1.0 mA   |
| Altitude During Operation              |                                                                                           | 5'000 m max. (for basic insulation)<br>2'000 m max. (for reinforced insulation)                                                               |

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

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Switching Frequency      | 225 - 275 kHz (PWM)<br>250 kHz typ. (PWM)                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Insulation System        | Basic Insulation                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Working Voltage (rated)  | 145 VAC (3.3 and 5 Vout models)<br>185 VAC (48 and 53 Vout models)<br>172 VAC (other output models)                                                                                                                                                                                                                                                                                                                                                                                       |
| Isolation Test Voltage   | - Input to Output, 60 s<br>- Input to Case, 60 s<br>- Output to Case, 60 s                                                                                                                                                                                                                                                                                                                                                                                                                |
|                          | 3'000 VAC<br>1'600 VDC<br>1'600 VDC                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Isolation Resistance     | - Input to Output, 500 VDC                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                          | 1'000 MΩ min.                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Isolation Capacitance    | - Input to Output, 100 kHz, 1 V                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|                          | 2'500 pF max.                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Reliability              | - Calculated MTBF                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|                          | 380'000 h (MIL-HDBK-217F, ground benign)                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Environment              | - Vibration<br>- Thermal Shock                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                          | MIL-STD-810F<br>MIL-STD-810F                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Housing Material         | Metal                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Base Material            | Non-conductive FR4 (UL94 V-0 rated)                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Potting Material         | Silicone (UL 94 V-0 rated)                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Pin Material             | Copper                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Pin Foundation Plating   | Nickel (2 - 3 μm)                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Pin Surface Plating      | Tin (3 - 5 μm), matte                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Connection Type          | THD (Through-Hole Device)                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Weight                   | 105 g                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Thermal Impedance        | 6.1 K/W<br>4.6 K/W (with Heat Sink)                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Environmental Compliance | - REACH Declaration<br><br>- RoHS Declaration                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                          | <a href="http://www.tracopower.com/info/reach-declaration.pdf">www.tracopower.com/info/reach-declaration.pdf</a><br>REACH SVHC list compliant<br>REACH Annex XVII compliant<br><a href="http://www.tracopower.com/info/rohs-declaration.pdf">www.tracopower.com/info/rohs-declaration.pdf</a><br>Exemptions: 7a, 7c-I<br>(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.) |

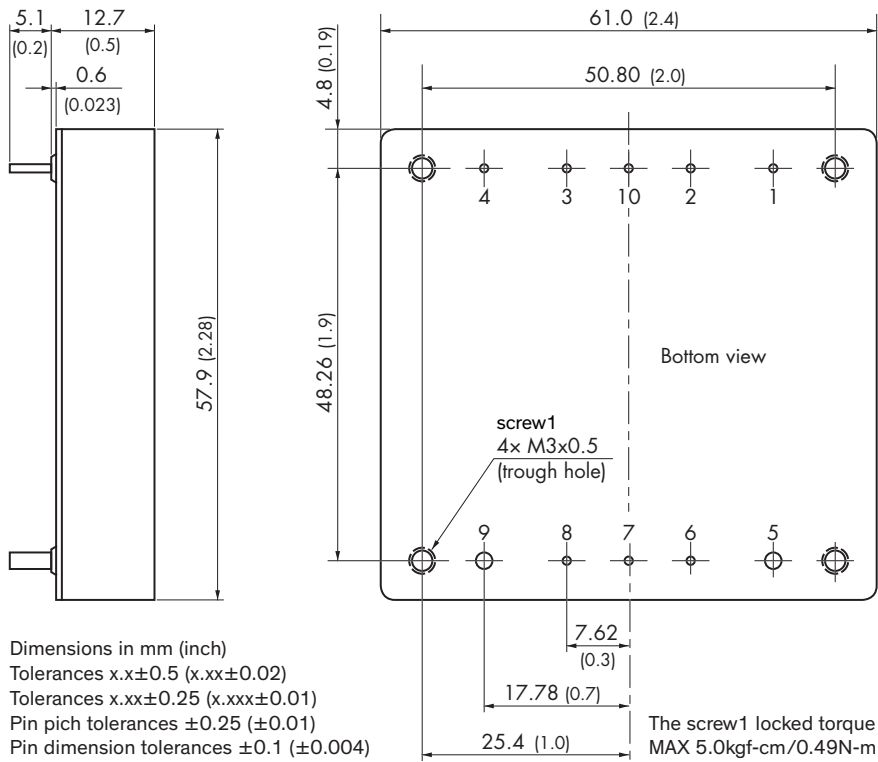
## Supporting Documents

Overview Link (for additional Documents)

[www.tracopower.com/overview/tep160](http://www.tracopower.com/overview/tep160)

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

### Outline Dimensions



| Pinout |                  |
|--------|------------------|
| Pin    | Function         |
| 1      | -Vin (GND)       |
| 2      | Case             |
| 3      | Remote           |
| 4      | +Vin (Vcc)       |
| 5      | -Vout            |
| 6      | -Sense           |
| 7      | Trim             |
| 8      | +Sense           |
| 9      | +Vout            |
| 10     | Sync (on demand) |

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