

- Compact metal package
- Ultra wide 4:1 input voltage ranges  
9–36, 18–75, 43–160 VDC
- EN 50155 approval for railway applications
- Very high efficiency up to 91%
- No minimum load
- Soft start
- Adjustable output voltage +10 / -20%
- Sense line
- Remote On/Off input
- Under voltage lock-out circuit



The TEP 160WIR Series is a family of isolated high performance DC/DC converter modules with ultra-wide 4:1 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. These series is available in many optional designs on demand --> see options.

| Models          |                                |                                  |                     |                 |
|-----------------|--------------------------------|----------------------------------|---------------------|-----------------|
| Order Code      | Input Voltage Range            | Output Voltage nom. (adjustable) | Output Current max. | Efficiency typ. |
| TEP 160-2412WIR | 9 - 36 VDC<br>(24 VDC nom.)    | 12 VDC (9.6 - 13.2 VDC)          | 12'000 mA           | 90 %            |
| TEP 160-2413WIR |                                | 15 VDC (12.0 - 16.5 VDC)         | 9'500 mA            | 91 %            |
| TEP 160-2415WIR |                                | 24 VDC (19.2 - 26.4 VDC)         | 6'000 mA            | 90 %            |
| TEP 160-2416WIR |                                | 28 VDC (22.4 - 30.8 VDC)         | 5'000 mA            | 90 %            |
| TEP 160-2418WIR |                                | 48 VDC (38.4 - 52.8 VDC)         | 3'000 mA            | 90 %            |
| TEP 160-4812WIR | 18 - 75 VDC<br>(48 VDC nom.)   | 12 VDC (9.6 - 13.2 VDC)          | 13'000 mA           | 91 %            |
| TEP 160-4813WIR |                                | 15 VDC (12.0 - 16.5 VDC)         | 10'000 mA           | 91 %            |
| TEP 160-4815WIR |                                | 24 VDC (19.2 - 26.4 VDC)         | 6'500 mA            | 91 %            |
| TEP 160-4816WIR |                                | 28 VDC (22.4 - 30.8 VDC)         | 5'500 mA            | 91 %            |
| TEP 160-4818WIR |                                | 48 VDC (38.4 - 52.8 VDC)         | 3'200 mA            | 91 %            |
| TEP 160-7212WIR | 43 - 160 VDC<br>(110 VDC nom.) | 12 VDC (9.6 - 13.2 VDC)          | 15'000 mA           | 90 %            |
| TEP 160-7213WIR |                                | 15 VDC (12.0 - 16.5 VDC)         | 12'000 mA           | 90 %            |
| TEP 160-7215WIR |                                | 24 VDC (19.2 - 26.4 VDC)         | 7'500 mA            | 90 %            |
| TEP 160-7216WIR |                                | 28 VDC (22.4 - 30.8 VDC)         | 6'500 mA            | 90 %            |
| TEP 160-7218WIR |                                | 48 VDC (38.4 - 52.8 VDC)         | 3'800 mA            | 90 %            |

## Options

|                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <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 non stocking item) | <ul style="list-style-type: none"> <li>- Optional model with 3.3 VDC / 40'000 mA Output and 9 - 36 VDC Input</li> <li>- Optional model with 5 VDC / 28'000 mA Output and 9 - 36 VDC Input</li> <li>- Optional model with 3.3 VDC / 40'000 mA Output and 18 - 75 VDC Input</li> <li>- Optional model with 5 VDC / 30'000 mA Output and 18 - 75 VDC Input</li> <li>- Optional model with 3.3 VDC / 43'000 mA Output and 43 - 160 VDC Input</li> <li>- Optional model with 5 VDC / 32'000 mA Output and 43 - 160 VDC Input</li> <li>- Optional models with Sync pin to synchronize switching frequency of up to 3 units (EMC reason)</li> <li>- Chassis mount models w/o filter: <a href="http://www.tracopower.com/products/tep160wircm.pdf">www.tracopower.com/products/tep160wircm.pdf</a></li> <li>- Chassis mount models w/ filter to meet EN 55032 class A: <a href="http://www.tracopower.com/products/tep160wircmf.pdf">www.tracopower.com/products/tep160wircmf.pdf</a></li> <li>- Optional models with inverse remote on/off function (passiv = off)</li> </ul> |

## Input Specifications

|                        |              |                                                                                                                                                                                                                                |
|------------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Input Current          | - At no load | 24 Vin models: <b>25 mA typ.</b><br>48 Vin models: <b>20 mA typ.</b><br>110 Vin models: <b>10 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.)<br>110 Vin models: <b>185 VDC max.</b> (1 s max.)                                                                                |
| Under Voltage Lockout  |              | 24 Vin models: <b>7.3 VDC min. / 7.7 VDC typ. / 8.1 VDC max.</b><br>48 Vin models: <b>15.5 VDC min. / 16 VDC typ. / 16.3 VDC max.</b><br>110 Vin models: <b>33 VDC min. / 34.5 VDC typ. / 36 VDC max.</b>                      |
| Recommended Input Fuse |              | 24 Vin models: <b>25'000 mA</b> (fast acting)<br>48 Vin models: <b>15'000 mA</b> (fast acting)<br>110 Vin models: <b>8'000 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/tep160wir">www.tracopower.com/overview/tep160wir</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 // 25 µF poscap)<br>5 Vout models: <b>75 mVp-p max.</b> (w/ 1 µF X7R // 25 µF poscap)<br>12 Vout models: <b>100 mVp-p max.</b> (w/ 1 µF X7R // 25 µF poscap)<br>15 Vout models: <b>100 mVp-p max.</b> (w/ 1 µF X7R // 25 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) |

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

|                           |                 |                                           |                 |
|---------------------------|-----------------|-------------------------------------------|-----------------|
| Capacitive Load           | - 24 Vin input  | 3.3 Vout models:                          | 121'000 µF max. |
|                           |                 | 5 Vout models:                            | 56'000 µF max.  |
|                           |                 | 12 Vout models:                           | 10'000 µF max.  |
|                           |                 | 15 Vout models:                           | 6'300 µF max.   |
|                           |                 | 24 Vout models:                           | 2'500 µF max.   |
|                           |                 | 28 Vout models:                           | 1'700 µF max.   |
|                           | - 48 Vin input  | 48 Vout models:                           | 620 µF max.     |
|                           |                 | 3.3 Vout models:                          | 121'000 µF max. |
|                           |                 | 5 Vout models:                            | 60'000 µF max.  |
|                           |                 | 12 Vout models:                           | 10'800 µF max.  |
|                           |                 | 15 Vout models:                           | 6'600 µF max.   |
|                           |                 | 24 Vout models:                           | 2'700 µF max.   |
|                           | - 110 Vin input | 28 Vout models:                           | 1'900 µF max.   |
|                           |                 | 48 Vout models:                           | 660 µF max.     |
|                           |                 | 3.3 Vout models:                          | 130'000 µF max. |
|                           |                 | 5 Vout models:                            | 64'000 µF max.  |
|                           |                 | 12 Vout models:                           | 12'500 µF max.  |
|                           |                 | 15 Vout models:                           | 8'000 µF max.   |
|                           |                 | 24 Vout models:                           | 3'100 µF max.   |
|                           |                 | 28 Vout models:                           | 2'300 µF max.   |
|                           | 48 Vout models: | 790 µF max.                               |                 |
| Minimum Load              |                 | Not required                              |                 |
| Temperature Coefficient   |                 | ±0.02 %/K max.                            |                 |
| Start-up Time             |                 | 75 ms typ.                                |                 |
| Short Circuit Protection  |                 | Continuous, Automatic recovery            |                 |
| Output Current Limitation |                 | 120 - 150% of Iout max.                   |                 |
| Overvoltage Protection    |                 | 115 - 130% of Vout nom.                   |                 |
| Transient Response        | - Response Time | 200 µs typ. / 250 µs max. (25% Load Step) |                 |

## Safety Specifications

|                       |                             |                                                                                                  |
|-----------------------|-----------------------------|--------------------------------------------------------------------------------------------------|
| Safety Standards      | - IT / Multimedia Equipment | EN 60950-1                                                                                       |
|                       |                             | EN 62368-1                                                                                       |
|                       |                             | IEC 60950-1                                                                                      |
|                       |                             | IEC 62368-1                                                                                      |
|                       |                             | UL 60950-1                                                                                       |
|                       |                             | UL 62368-1                                                                                       |
|                       | - Railway Applications      | EN 50155                                                                                         |
|                       | - Certification Documents   | <a href="http://www.tracopower.com/overview/tep160wir">www.tracopower.com/overview/tep160wir</a> |
| Pollution Degree      |                             | PD 2                                                                                             |
| Over Voltage Category |                             | OVC II                                                                                           |

## EMC Specifications

|                                                                                                                            |                       |                                         |
|----------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------------------------------------|
| EMI Emissions                                                                                                              | - Conducted Emissions | EN 55011 class A (with external filter) |
|                                                                                                                            |                       | EN 55011 class B (with external filter) |
|                                                                                                                            |                       | EN 55032 class A (with external filter) |
|                                                                                                                            |                       | EN 55032 class B (with external filter) |
|                                                                                                                            | - Radiated Emissions  | EN 55011 class A (with external filter) |
|                                                                                                                            |                       | EN 55011 class B (with external filter) |
|                                                                                                                            |                       | EN 55032 class A (with external filter) |
|                                                                                                                            |                       | EN 55032 class B (with external filter) |
| External filter proposal: <a href="http://www.tracopower.com/overview/tep160wir">www.tracopower.com/overview/tep160wir</a> |                       |                                         |

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

|                                                                                                                                                |                       |                                            |
|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|--------------------------------------------|
| <b>EMS Immunity</b>                                                                                                                            |                       | EN 50155 (Railway Applications)            |
|                                                                                                                                                |                       | EN 50121-3-2 (EMC for Rolling Stock)       |
| <ul style="list-style-type: none"> <li>- Electrostatic Discharge</li> <li>- RF Electromagnetic Field</li> <li>- EFT (Burst) / Surge</li> </ul> | Air:                  | EN 61000-4-2, $\pm 8$ kV, perf. criteria A |
|                                                                                                                                                | Contact:              | EN 61000-4-2, $\pm 6$ kV, perf. criteria A |
|                                                                                                                                                |                       | EN 61000-4-3, 20 V/m, perf. criteria A     |
|                                                                                                                                                |                       | EN 61000-4-4, $\pm 2$ kV, perf. criteria A |
|                                                                                                                                                |                       | EN 61000-4-5, $\pm 2$ kV, perf. criteria A |
| <ul style="list-style-type: none"> <li>- Conducted RF Disturbances</li> <li>- PF Magnetic Field</li> </ul>                                     | Ext. input component: | 24 & 48 Vin models: 2x KY 220 $\mu$ F      |
|                                                                                                                                                |                       | 110 Vin models: 2x KXJ 150 $\mu$ F         |
|                                                                                                                                                |                       | EN 61000-4-6, 10 Vrms, perf. criteria A    |
|                                                                                                                                                | Continuous:           | EN 61000-4-8, 100 A/m, perf. criteria A    |
|                                                                                                                                                | 1 s:                  | EN 61000-4-8, 1000 A/m, perf. criteria A   |

| General Specifications    |                                 |                                                                                                                        |
|---------------------------|---------------------------------|------------------------------------------------------------------------------------------------------------------------|
| Relative Humidity         |                                 | 95% max. (non condensing)                                                                                              |
| Temperature Ranges        | - Operating Temperature         | -40°C to +75°C                                                                                                         |
|                           | - Case Temperature              | +115°C max.                                                                                                            |
|                           | - Storage Temperature           | -55°C to +125°C                                                                                                        |
| Power Derating            | - High Temperature              | See application note: <a href="http://www.tracopower.com/overview/tep160wir">www.tracopower.com/overview/tep160wir</a> |
| Over Temperature          | - Protection Mode               | 120°C typ. (Automatic recovery at 105°C typ.)                                                                          |
| Protection Switch Off     | - Measurement Point             | Base-Plate                                                                                                             |
| Cooling System            |                                 | Natural convection (20 LFM)                                                                                            |
| Sense Function            |                                 | 10% max. of Vout nom.                                                                                                  |
|                           |                                 | (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     | On: 3.0 to 12 VDC or open circuit                                                                                      |
|                           |                                 | Off: 0 to 1.2 VDC or short circuit                                                                                     |
|                           |                                 | Refers to 'Remote' and '-Vin' Pin                                                                                      |
|                           | - Off Idle Input Current        | 3 mA typ.                                                                                                              |
|                           | - Remote Pin Input Current      | -0.5 to 1.0 mA                                                                                                         |
| Altitude During Operation |                                 | 2'000 m max. (for reinforced insulation)                                                                               |
|                           |                                 | 5'000 m max. (for functional insulation)                                                                               |
| Switching Frequency       |                                 | 225 - 275 kHz (PWM)                                                                                                    |
|                           |                                 | 250 kHz typ. (PWM)                                                                                                     |
| Insulation System         |                                 | Reinforced Insulation                                                                                                  |
| Working Voltage (rated)   |                                 | 145 VAC (3.3 and 5 Vout models)                                                                                        |
|                           |                                 | 185 VAC (48 Vout models)                                                                                               |
|                           |                                 | 172 VAC (other output models)                                                                                          |
| Isolation Test Voltage    | - Input to Output, 60 s         | 3'000 VAC                                                                                                              |
|                           | - Input to Case, 60 s           | 1'500 VAC                                                                                                              |
|                           | - Output to Case, 60 s          | 1'500 VAC                                                                                                              |
| Isolation Resistance      | - Input to Output, 500 VDC      | 1'000 M $\Omega$ min.                                                                                                  |
| Isolation Capacitance     | - Input to Output, 100 kHz, 1 V | 2'500 pF max.                                                                                                          |
| Reliability               | - Calculated MTBF               | 350'000 h (MIL-HDBK-217F, ground benign)                                                                               |
| Washing Process           |                                 | Allowed (hermetical product)                                                                                           |
|                           | See Cleaning Guideline:         | <a href="http://www.tracopower.com/info/cleaning.pdf">www.tracopower.com/info/cleaning.pdf</a>                         |
| Environment               | - Vibration                     | MIL-STD-810F                                                                                                           |
|                           |                                 | EN 61373                                                                                                               |
|                           | - Mechanical Shock              | MIL-STD-810F                                                                                                           |
|                           |                                 | EN 61373                                                                                                               |
|                           | - Thermal Shock                 | MIL-STD-810F                                                                                                           |
| Housing Material          |                                 | EN 50155                                                                                                               |
|                           |                                 | Alu base-plate w. metal case (24 and 48 Vin models)                                                                    |
|                           |                                 | Alu base-plate w. plastic case (110 Vin models)                                                                        |

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

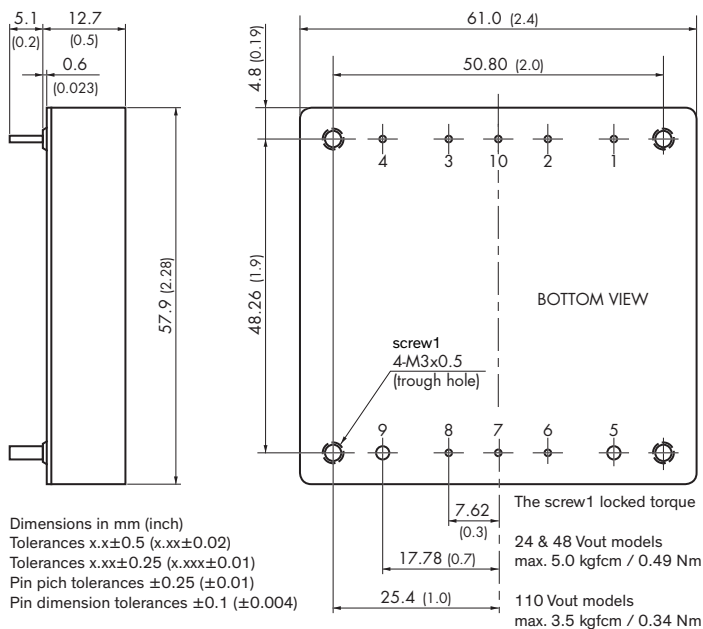
|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Base Material            | Non-conductive FR4 (UL 94 V-0 rated) (24 and 48 Vin models only)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Housing Type             | Metal Case (24 and 48 Vin models)<br>Plastic Case (110 Vin models)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Mounting Type            | PCB Mount                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Connection Type          | THD (Through-Hole Device)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Footprint Type           | Half-Brick                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Weight                   | 105 g                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Thermal Impedance        | - Case to Ambient<br>6.1 K/W typ.<br>4.6 K/W typ. (with Heat Sink)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Environmental Compliance | - REACH Declaration<br><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>- RoHS Declaration<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.)<br>- Flammability (EN 45545-2)<br><a href="http://www.tracopower.com/info/en45545-declaration.pdf">www.tracopower.com/info/en45545-declaration.pdf</a> |

## Supporting Documents

Overview Link (for additional Documents)

[www.tracopower.com/overview/tep160wir](http://www.tracopower.com/overview/tep160wir)

## Outline Dimensions



| Pinout |                     |                    |
|--------|---------------------|--------------------|
| Pin    | Single              | Pin Diameter       |
| 1      | −Vin (GND)          | 1.0 mm (0.04 inch) |
| 2      | Case                | 1.0 mm (0.04 inch) |
| 3      | Remote On/Off       | 1.0 mm (0.04 inch) |
| 4      | +Vin (Vcc)          | 1.0 mm (0.04 inch) |
| 5      | −Vout               | 2.0 mm (0.08 inch) |
| 6      | −Sense              | 1.0 mm (0.04 inch) |
| 7      | Trim                | 1.0 mm (0.04 inch) |
| 8      | +Sense              | 1.0 mm (0.04 inch) |
| 9      | +Vout               | 2.0 mm (0.08 inch) |
| 10     | Sync<br>(on demand) | 1.0 mm (0.04 inch) |