

- 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. (adjustable)	Output Current max.	Efficiency typ.
TEP 160-2412	16.5 - 36 VDC (24 VDC nom.)	12 VDC (9.6 - 13.2 VDC)	13'000 mA	92 %
TEP 160-2413		15 VDC (12.0 - 16.5 VDC)	10'000 mA	92 %
TEP 160-2415		24 VDC (19.2 - 26.4 VDC)	6'500 mA	93 %
TEP 160-2416		28 VDC (22.4 - 30.8 VDC)	5'500 mA	93 %
TEP 160-2418		48 VDC (38.4 - 52.8 VDC)	3'300 mA	92 %
TEP 160-4812	33 - 75 VDC (48 VDC nom.)	12 VDC (9.6 - 13.2 VDC)	16'000 mA	92 %
TEP 160-4813		15 VDC (12.0 - 16.5 VDC)	13'000 mA	93 %
TEP 160-4815		24 VDC (19.2 - 26.4 VDC)	8'000 mA	92 %
TEP 160-4816		28 VDC (22.4 - 30.8 VDC)	7'000 mA	92 %
TEP 160-4818		48 VDC (38.4 - 52.8 VDC)	4'000 mA	92 %
TEP 160-48153		53 VDC (42.4 - 58.3 VDC)	3'700 mA	92 %

Options	
<b>Suffix -CM</b>	- Chassis mount models w/o filter: <a href="http://www.tracopower.com/products/tep160cm.pdf">www.tracopower.com/products/tep160cm.pdf</a>
<b>Suffix -CMF</b>	- Chassis mount models w/ 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> (backorder with MOQ 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>- Optional models with 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> 48 Vin models: <b>25 mA typ.</b>
Surge Voltage		24 Vin models: <b>50 VDC max.</b> (1 s max.) 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> 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) 48 Vin models: <b>10'000 mA</b> (fast acting) (The need of an external fuse has to be assessed in the final application.)
Input Filter		Internal Pi-Type

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

All specifications valid at nominal voltage, resistive 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 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
	- 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) EN 55032 class B (with external filter)
	- Radiated Emissions	EN 55032 class A (with external filter) 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		EN 55024 (IT Equipment) EN 55035 (Multimedia)
	- Electrostatic Discharge	Air: EN 61000-4-2, ±8 kV, perf. criteria A 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 EN 61000-4-5, ±2 kV, perf. criteria A
	- Conducted RF Disturbances	Ext. input component: 2x KY 200 µF EN 61000-4-6, 10 V <sub>rms</sub> , perf. criteria A
	- PF Magnetic Field	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 - Case Temperature - Storage Temperature	-40°C to +75°C +115°C max. -55°C to +125°C
Power Derating	- High Temperature	Depending on model See application note: <a href="http://www.tracopower.com/overview/tep160">www.tracopower.com/overview/tep160</a>
Over Temperature Protection Switch Off	- Protection Mode - Measurement Point	120°C typ. (Automatic recovery at 105°C typ.) Case
Cooling System		Natural convection (20 LFM)
Sense Function		10% max. of V <sub>out</sub> 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  - Off Idle Input Current - Remote Pin Input Current	On: 3.0 to 12 VDC or open circuit Off: 0 to 1.2 VDC or short circuit Refers to 'Remote' and '-Vin' Pin 3 mA typ. -0.5 to 1.0 mA

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Altitude During Operation		5'000 m max. (for basic insulation) 2'000 m max. (for reinforced insulation)
Switching Frequency		225 - 275 kHz (PWM) 250 kHz typ. (PWM)
Insulation System		<b>Reinforced Insulation</b>
Working Voltage (rated)		145 VAC (3.3 and 5 Vout models) 185 VAC (4.8 and 5.3 Vout models) 172 VAC (other output models)
Isolation Test Voltage	- Input to Output, 60 s - Input to Case, 60 s - Output to Case, 60 s	3'000 VAC 1'600 VAC 1'600 VAC
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)
Washing Process		According to Cleaning Guideline <a href="http://www.tracopower.com/info/cleaning.pdf">www.tracopower.com/info/cleaning.pdf</a>
Environment	- Vibration - Thermal Shock	MIL-STD-810F MIL-STD-810F
Housing Material		Metal
Base Material		Non-conductive FR4 (UL 94 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
Housing Type		Metal Case
Mounting Type		PCB Mount
Connection Type		THD (Through-Hole Device)
Footprint Type		Half-Brick
Weight		105 g
Thermal Impedance	- Case to Ambient	6.1 K/W typ. 4.6 K/W typ. (with Heat Sink)
Environmental Compliance	- REACH Declaration  - RoHS Declaration  - SCIP Reference Number	<a href="http://www.tracopower.com/info/reach-declaration.pdf">www.tracopower.com/info/reach-declaration.pdf</a> REACH SVHC list compliant REACH Annex XVII compliant <a href="http://www.tracopower.com/info/rohs-declaration.pdf">www.tracopower.com/info/rohs-declaration.pdf</a> Exemptions: 7a, 7c-I (RoHS exemptions refer to the component concentration only, not to the overall concentration in the product (O5A rule)) 931b6944-928b-4cea-8bfa-21644d000430

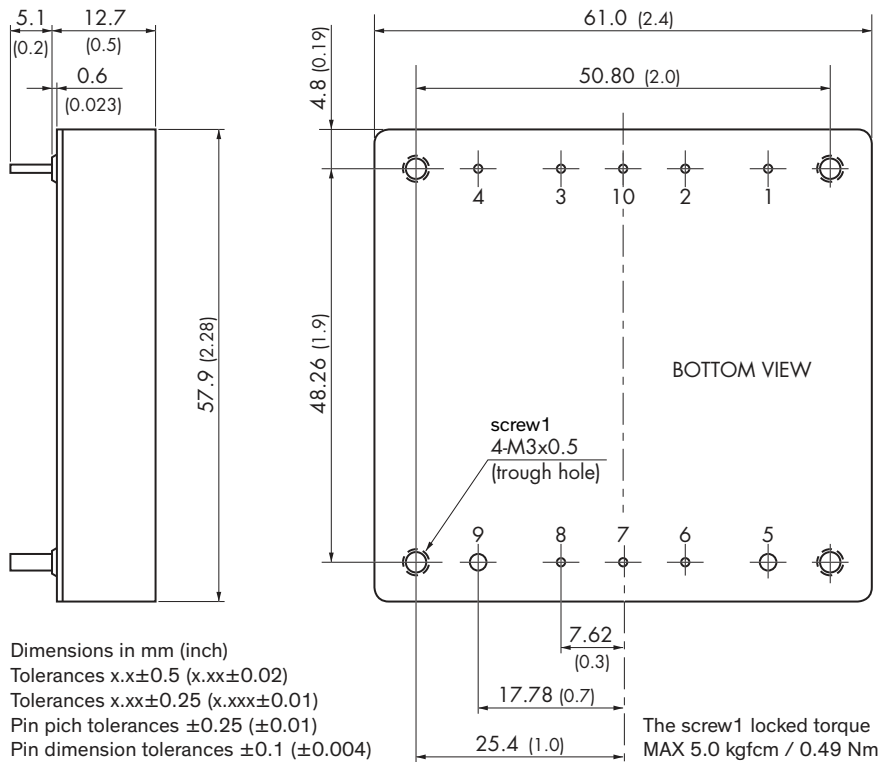
## Supporting Documents

Overview Link (for additional Documents)

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

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

### 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 (on demand)	1.0 mm (0.04 inch)