

- 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
- Over temperature protection
- 3-year product warranty



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 makes 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/overview/tep160cm">www.tracopower.com/overview/tep160cm</a>
<b>Suffix -CMF</b>	- Chassis mount models w/ filter to meet EN 55032 class A: <a href="http://www.tracopower.com/overview/tep160cmf">www.tracopower.com/overview/tep160cmf</a>
<b>TEP-HS1</b>	- Optional Heat Sink: <a href="http://www.tracopower.com/overview/tep-hs1">www.tracopower.com/overview/tep-hs1</a>
<b>on demand</b> (backorder with MOQ non stocking item)	- Optional model with 3.3 VDC / 40'000 mA Output and 16.5 - 36 VDC Input - Optional model with 5 VDC / 30'000 mA Output and 16.5 - 36 VDC Input - Optional model with 3.3 VDC / 45'000 mA Output and 33 - 75 VDC Input - Optional model with 5 VDC / 34'000 mA Output and 33 - 75 VDC Input - Optional models with Sync pin to synchronize switching frequency of up to 3 units (EMC reason)

## 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		<b>Internal Pi-Type</b>

## Output Specifications

Output Voltage Adjustment		-20% to +10% (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  - 48 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> 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		<b>Not required</b>
Temperature Coefficient		<b>±0.02 %/K max.</b>
Start-up Time		<b>75 ms typ.</b>
Short Circuit Protection		<b>Continuous, Automatic recovery</b>
Output Current Limitation		<b>120 - 150% of Iout max.</b>
Overvoltage Protection		<b>115 - 130% of Vout nom.</b>
Transient Response	- Response Time	<b>200 µs typ. / 250 µs max.</b> (25% Load Step)

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

### Safety Specifications

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, $\pm 8$ kV, perf. criteria A Contact: EN 61000-4-2, $\pm 6$ kV, perf. criteria A
	- RF Electromagnetic Field	EN 61000-4-3, 20 V/m, perf. criteria A
	- EFT (Burst) / Surge	EN 61000-4-4, $\pm 2$ kV, perf. criteria A EN 61000-4-5, $\pm 2$ kV, perf. criteria A
	- Conducted RF Disturbances	Ext. input component: 2x KY 200 $\mu$ F EN 61000-4-6, 10 Vrms, 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	-40°C to +75°C
	- Case Temperature	+115°C max.
	- Storage Temperature	-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 Vout nom. (If sense function is not used, sense pins must be connected to corresponding polarity output pins.)
Remote Control	- Voltage Controlled Remote (passive = on)	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		5'000 m max. (for basic insulation) 2'000 m max. (for reinforced insulation)
Regulator Topology		Forward Converter
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 and 53 Vout models)
		172 VAC (other output models)

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

Isolation Test Voltage	- Input to Output, 60 s	3'000 VAC
	- Input to Case, 60 s	1'600 VAC
	- Output to Case, 60 s	1'600 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	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	MIL-STD-810F
	- Thermal Shock	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 $\mu$ m)
Pin Surface Plating		Tin (3 - 5 $\mu$ m), matte
Housing Type		Metal Case
Mounting Type		PCB Mount
Connection Type		THD (Through-Hole Device)
Footprint Type		Half-Brick
Soldering Profile		Lead-Free Wave Soldering 260°C / 6 s max.
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	<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
	- RoHS Declaration	<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))
	- SCIP Reference Number	931b6944-928b-4cea-8bfa-21644d000430

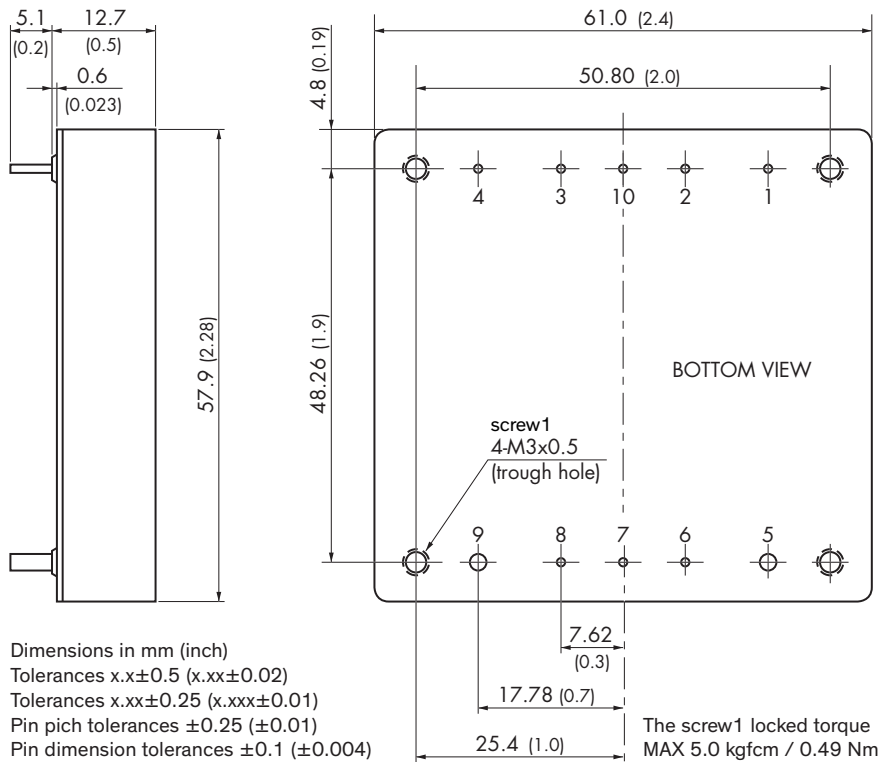
## Supporting Documents

Overview Link (for additional Documents)

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

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### 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)