

DC/DC Railway Converter

TEP 60UIR Series, 60 Watt

- Ultra-wide 12:1 input voltage range 9–75, 14–160 VDC
- Compact 2.3"x1.45"x0.5" standard package (quarter brick)
- Bus pin to easily extend hold-up time
- EN 50155 and EN 61373 approval for railway applications
- Qualification for fire behavior according to EN 45545-2
- Operating temperature range –40°C to +75°C
- I/O-isolation 3'000 VAC
- High efficiency up to 91%
- Adjustable output voltage, Remote On/Off and adjustable under voltage lockout
- 3-year product warranty



The TEP 60UIR is a series of high performance 60 Watt railway DC/DC converters with ultra wide 12:1 input voltage range featuring a compact ¼ brick (2.3"x1.45"x0.5") metal package. The ultra wide input allows the converter to act as an all-in-one solution if different voltage ranges have to be covered in the same application, resolving the issue of having multiple different converters installed. An internal circuit implemented in these modules helps to extend the hold-up time with ease as it eliminates the need of expensive high voltage capacitors to cover the full input range. With only a 25V capacitor (independent of the input voltage) the whole input range can be covered effectively reducing cost, size and inrush current. All models are approved for railway applications according to EN 50155, EN 61373, EN 45545-2 and offer standard features such as high efficiency up to 91%, an operating temperature range of -40° to +75°C and an I/O-isolation voltage of 3'000 VAC. An adjustable under voltage lockout function, remote on/off and adjustable outputs round out the features and ensure that these converter modules fit in any application setup.

Models				
Order Code	Input Voltage Range	Output Voltage nom. (adjustable)	Output Current max.	Efficiency typ.
TEP 60-3611UIR	9 - 75 VDC (36 VDC nom.)	5 VDC (4.0 - 5.5 VDC)	12'000 mA	89 %
TEP 60-3612UIR		12 VDC (9.6 - 13.2 VDC)	5'000 mA	89 %
TEP 60-3613UIR		15 VDC (12.0 - 16.5 VDC)	4'000 mA	90 %
TEP 60-3615UIR		24 VDC (19.2 - 26.4 VDC)	2'500 mA	90 %
TEP 60-3618UIR		48 VDC (38.4 - 52.8 VDC)	1'250 mA	91 %
TEP 60-7211UIR	14 - 160 VDC (72 VDC nom.)	5 VDC (4.0 - 5.5 VDC)	12'000 mA	89 %
TEP 60-7212UIR		12 VDC (9.6 - 13.2 VDC)	5'000 mA	89 %
TEP 60-7213UIR		15 VDC (12.0 - 16.5 VDC)	4'000 mA	89 %
TEP 60-7215UIR		24 VDC (19.2 - 26.4 VDC)	2'500 mA	90 %
TEP 60-7218UIR		48 VDC (38.4 - 52.8 VDC)	1'250 mA	90 %

Options

TEP-HS2	- Optional Heat Sink: www.tracopower.com/products/tep-hs2.pdf
TEP-HS4	- Optional Heat Sink: www.tracopower.com/products/tep-hs4.pdf
on demand (backorder with MOQ non stocking item)	- Optional Heat Sink with large profile: www.tracopower.com/products/tep-hs3.pdf - Optional Heat Sink with large profile: www.tracopower.com/products/tep-hs5.pdf - Optional model with 28 VDC / 2'150 mA Output and 9 - 75 VDC Input - Optional model with 53 VDC / 1'140 mA Output and 9 - 75 VDC Input - Optional model with 28 VDC / 2'150 mA Output and 14 - 160 VDC Input - Optional model with 53 VDC / 1'140 mA Output and 14 - 160 VDC Input - Optional models with inverse Remote On/Off function (passive = off)

Input Specifications

Input Current	- At no load	36 Vin models: 20 mA typ. 72 Vin models: 17 mA typ.
Surge Voltage		36 Vin models: 100 VDC max. (1 s max.) 72 Vin models: 185 VDC max. (1 s max.)
Under Voltage Lockout		36 Vin models: 7.3 VDC min. / 7.7 VDC typ. / 8.1 VDC max. 72 Vin models: 10 VDC min. / 11 VDC typ. / 12 VDC max. (The Start-up voltage as well as the Shutdown voltage can be adjusted by a resistor between UVLO and -Vin pins. See application note: www.tracopower.com/overview/tep60uir)
Recommended Input Fuse		36 Vin models: 12'000 mA (fast acting) 72 Vin models: 8'000 mA (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		-20% to +10% (By external trim resistor) See application note: www.tracopower.com/overview/tep60uir Output power must not exceed rated power!
Voltage Set Accuracy		±1% max.
Regulation	- Input Variation (Vmin - Vmax) - Load Variation (0 - 100%)	0.1% max. 0.1% max.
Ripple and Noise (20 MHz Bandwidth)		5 Vout models: 75 mVp-p typ. (w/ 1 µF X7R 22 µF poscap) 12 Vout models: 100 mVp-p typ. (w/ 22 µF X7R) 15 Vout models: 100 mVp-p typ. (w/ 22 µF X7R) 24 Vout models: 200 mVp-p typ. (w/ 4.7 µF X7R) 28 Vout models: 200 mVp-p typ. (w/ 4.7 µF X7R) 48 Vout models: 300 mVp-p typ. (w/ 2.2 µF X7R) 53 Vout models: 300 mVp-p typ. (w/ 2.2 µF X7R)
Capacitive Load		5 Vout models: 24'000 µF max. 12 Vout models: 4'200 µF max. 15 Vout models: 2'700 µF max. 24 Vout models: 1'100 µF max. 28 Vout models: 780 µF max. 48 Vout models: 260 µF max. 53 Vout models: 220 µF max.
Minimum Load		Not required
Temperature Coefficient		±0.02 %/K max.
Hold-up Time		10 ms min. (acc. to EN 50155 Class S2, see application note for BUS connection: www.tracopower.com/overview/tep60uir)

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

Start-up Time	75 ms typ. / 100 ms max.
Short Circuit Protection	Continuous, Automatic recovery
Output Current Limitation	120 - 140% of I _{out} max.
Overvoltage Protection	120 - 135% of V _{out} nom.
Transient Response	- Response Time 250 µs typ. (25% Load Step)

Safety Specifications

Standards	- IT / Multimedia Equipment - Railway Applications - Certification Documents	EN 62368-1 IEC 62368-1 UL 62368-1 EN 50155 www.tracopower.com/overview/tep60uir
Pollution Degree		PD 2
Over Voltage Category		OVC II

EMC Specifications

EMI Emissions	- Conducted Emissions - Radiated Emissions	EN 50121-3-2 (EMC for Rolling Stock) EN 55032 class A (with external filter) EN 55032 class B (with external filter) EN 55032 class A (with external filter) EN 55032 class B (with external filter)
	External filter proposal:	www.tracopower.com/overview/tep60uir
EMS Immunity	- Electrostatic Discharge - RF Electromagnetic Field - EFT (Burst) / Surge - Conducted RF Disturbances - PF Magnetic Field	EN 50121-3-2 (EMC for Rolling Stock) EN 55024 (IT Equipment) EN 55035 (Multimedia) Air: EN 61000-4-2, ±8 kV, perf. criteria B Contact: EN 61000-4-2, ±6 kV, perf. criteria B EN 61000-4-3, 20 V/m, perf. criteria A EN 61000-4-4, ±2 kV, perf. criteria A EN 61000-4-5, ±2 kV, perf. criteria B Ext. input component: 36 V _{in} models: 2 x KY 220 µF 72 V _{in} models: 2 x KXJ 150 µF Continuous: EN 61000-4-6, 10 V _{rms} , perf. criteria A 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 +105°C max. -55°C to +125°C
Power Derating	- High Temperature	Depending on model
	See application note:	www.tracopower.com/overview/tep60uir
Over Temperature Protection Switch Off	- Protection Mode	110°C typ. (Automatic recovery at 95°C typ.)
Cooling System		Natural convection (20 LFM)
Sense Function		10% max. of V _{out} nom. (If sense function is not used, sense pins must be connected to corresponding polarity output pins.)
Remote Control	- Voltage Controlled Remote (passive = on) - 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 (Optional models with inverse Remote On/Off function (passive = off))

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Altitude During Operation	5'000 m max.
Switching Frequency	160 - 200 kHz (PWM) 180 kHz typ. (PWM)
Insulation System	Reinforced Insulation (72 Vin models) Basic Insulation (36 Vin models)
Working Voltage (rated)	220 VAC
Isolation Test Voltage	- Input to Output, 60 s 3'000 VAC (72 Vin models) 2'250 VDC (36 Vin models) - Input to Case, 60 s 1'500 VAC (72 Vin models) 1'600 VDC (36 Vin models) - Output to Case, 60 s 1'500 VAC (72 Vin models) 1'600 VDC (36 Vin models)
Isolation Resistance	- Input to Output, 500 VDC 1'000 MΩ min.
Isolation Capacitance	- Input to Output, 100 kHz, 1 V 1'000 pF max.
Reliability	- Calculated MTBF 738'000 h (MIL-HDBK-217F, ground benign)
Washing Process	According to Cleaning Guideline www.tracopower.com/info/cleaning.pdf
Environment	- Vibration MIL-STD-810F EN 61373 - Mechanical Shock EN 61373 - Thermal Shock MIL-STD-810F - Flammability EN 45545-2 www.tracopower.com/info/en45545-declaration.pdf
Housing Material	Alu base-plate w. plastic case
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	Plastic Case
Mounting Type	PCB Mount
Connection Type	THD (Through-Hole Device)
Footprint Type	Quarter-Brick
Soldering Profile	Lead-Free Wave Soldering 260°C / 6 s max.
Weight	64 g
Thermal Impedance	- Case to Ambient 8.3 K/W typ. (without heatsink) 7.4 K/W typ. (with heatsink TEP-HS2) 7.4 K/W typ. (with heatsink TEP-HS4) 6.2 K/W typ. (with heatsink TEP-HS3) 6.2 K/W typ. (with heatsink TEP-HS5)
Environmental Compliance	- REACH Declaration www.tracopower.com/info/reach-declaration.pdf REACH SVHC list compliant REACH Annex XVII compliant - RoHS Declaration www.tracopower.com/info/rohs-declaration.pdf 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 83f33b01-a468-4326-85f7-d2f7813d4e6d

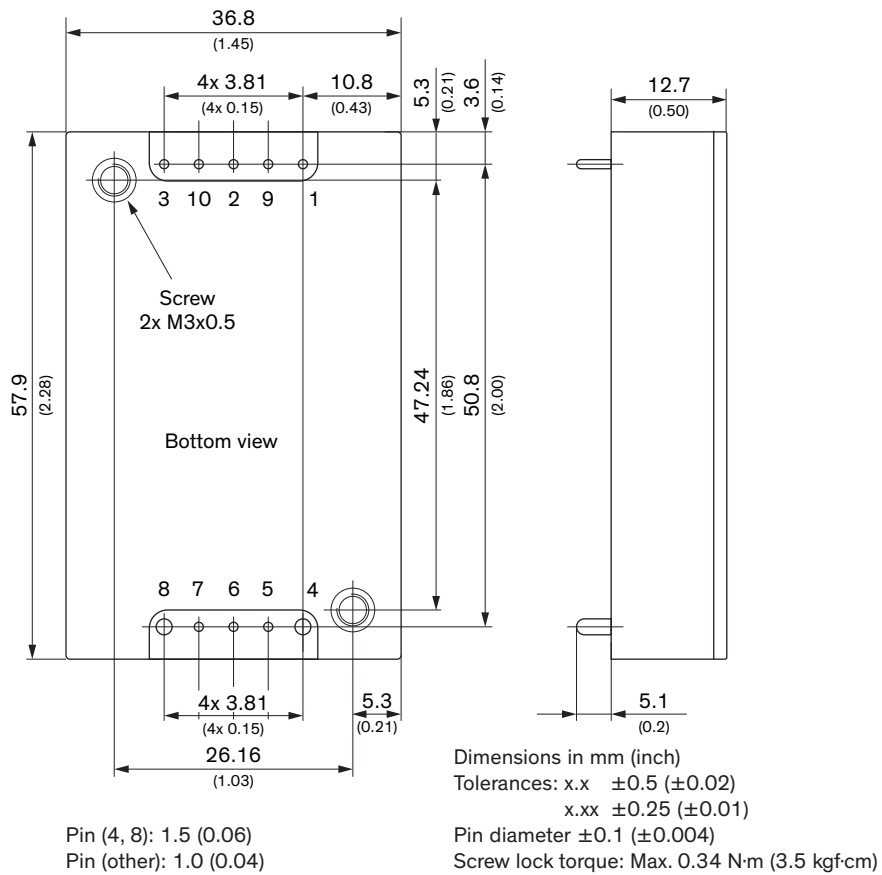
Supporting Documents

Overview Link (for additional Documents)

www.tracopower.com/overview/tep60uir

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Outline Dimensions



Pinout

Pin	Function
1	–Vin (GND)
2	Remote On/Off
3	+Vin (Vcc)
4	–Vout
5	–Sense
6	Trim
7	+Sense
8	+Vout
9	Bus
10	UVLO