

- **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.	Output Current max.	Efficiency typ.
TEP 60-3611UIR	9 - 75 VDC (36 VDC nom.)	5 VDC	12'000 mA	89 %
TEP 60-3612UIR		12 VDC	5'000 mA	89 %
TEP 60-3613UIR		15 VDC	4'000 mA	90 %
TEP 60-3615UIR		24 VDC	2'500 mA	90 %
TEP 60-3618UIR		48 VDC	1'250 mA	91 %
TEP 60-7211UIR	14 - 160 VDC (110 VDC nom.)	5 VDC	12'000 mA	89 %
TEP 60-7212UIR		12 VDC	5'000 mA	89 %
TEP 60-7213UIR		15 VDC	4'000 mA	89 %
TEP 60-7215UIR		24 VDC	2'500 mA	90 %
TEP 60-7218UIR		48 VDC	1'250 mA	90 %

Options	
TEP-HS2	- Optional Heat Sink: <a href="http://www.tracopower.com/products/tep-hs2.pdf">www.tracopower.com/products/tep-hs2.pdf</a>
TEP-HS4	- Optional Heat Sink: <a href="http://www.tracopower.com/products/tep-hs4.pdf">www.tracopower.com/products/tep-hs4.pdf</a>
on demand (backorder with MOQ non stocking item)	- Remote On/Off function with inverse logic - Optional Heat Sink with large profile: <a href="http://www.tracopower.com/products/tep-hs3.pdf">www.tracopower.com/products/tep-hs3.pdf</a> - Optional Heat Sink with large profile: <a href="http://www.tracopower.com/products/tep-hs5.pdf">www.tracopower.com/products/tep-hs5.pdf</a>

## Input Specifications

Input Current	- At no load	36 Vin models: <b>20 mA typ.</b> 110 Vin models: <b>17 mA typ.</b>
Surge Voltage		36 Vin models: <b>100 VDC max.</b> (1 s max.) 110 Vin models: <b>185 VDC max.</b> (1 s max.)
Under Voltage Lockout		36 Vin models: <b>7.3 VDC min. / 7.7 VDC typ. / 8.1 VDC max.</b> 110 Vin models: <b>10 VDC min. / 11 VDC typ. / 12 VDC max.</b> (The Start-up voltage as well as the Shutdown voltage can be adjusted by a resistor between UVLO and -Vin pins. See application note: <a href="http://www.tracopower.com/overview/tep60uir">www.tracopower.com/overview/tep60uir</a> )
Recommended Input Fuse		36 Vin models: <b>12'000 mA</b> (fast acting) 110 Vin models: <b>8'000 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		<b>-20% to +10%</b> (By external trim resistor) See application note: <a href="http://www.tracopower.com/overview/tep60uir">www.tracopower.com/overview/tep60uir</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)		5 Vout models: <b>75 mVp-p typ.</b> (w/ 1 µF X7R // 22 µF poscap) 12 Vout models: <b>100 mVp-p typ.</b> (w/ 22 µF X7R) 15 Vout models: <b>100 mVp-p typ.</b> (w/ 22 µF X7R) 24 Vout models: <b>200 mVp-p typ.</b> (w/ 4.7 µF X7R) 48 Vout models: <b>300 mVp-p typ.</b> (w/ 2.2 µF X7R)
Capacitive Load		5 Vout models: <b>24'000 µF max.</b> 12 Vout models: <b>4'200 µF max.</b> 15 Vout models: <b>2'700 µF max.</b> 24 Vout models: <b>1'100 µF max.</b> 48 Vout models: <b>260 µF max.</b>
Minimum Load		<b>Not required</b>
Temperature Coefficient		<b>±0.02 %/K max.</b>
Hold-up Time		<b>10 ms min.</b> (acc. to EN 50155 Class S2, see application note for BUS connection: <a href="http://www.tracopower.com/overview/tep60uir">www.tracopower.com/overview/tep60uir</a> )
Start-up Time		<b>75 ms typ. / 100 ms max.</b>
Short Circuit Protection		<b>Continuous, Automatic recovery</b>
Output Current Limitation		<b>120 - 140% of Iout max.</b>
Overvoltage Protection		<b>120 - 135% of Vout nom.</b>
Transient Response	- Response Time	<b>250 µs typ.</b> (25% Load Step)

## Safety Specifications

Safety Standards	- IT / Multimedia Equipment	<b>EN 62368-1</b> <b>IEC 62368-1</b> <b>UL 62368-1</b>
	- Railway Applications	<b>EN 50155</b>
	- Certification Documents	<a href="http://www.tracopower.com/overview/tep60uir">www.tracopower.com/overview/tep60uir</a>

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

## EMC Specifications

<b>EMI Emissions</b>		EN 50121-3-2 (EMC for Rolling Stock)
- 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/tep60uir">www.tracopower.com/overview/tep60uir</a>
<b>EMS Immunity</b>		EN 50155 (Railway Applications)
		EN 55024 (IT Equipment)
- Electrostatic Discharge	Air:	EN 61000-4-2, $\pm 8$ kV, perf. criteria B
	Contact:	EN 61000-4-2, $\pm 6$ kV, perf. criteria B
- 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 B
	Ext. input component:	36 Vin models: 2 x KY 220 $\mu$ F
		110 Vin models: 2 x KXJ 150 $\mu$ F
- 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
	1 s:	EN 61000-4-8, 1000 A/m, perf. criteria A

## General Specifications

<b>Relative Humidity</b>		95% max. (non condensing)
<b>Temperature Ranges</b>		-40°C to +75°C
- Operating Temperature		+105°C max.
- Case Temperature		-55°C to +125°C
- Storage Temperature		
<b>Power Derating</b>	- High Temperature	See application note: <a href="http://www.tracopower.com/overview/tep60uir">www.tracopower.com/overview/tep60uir</a>
<b>Over Temperature Protection Switch Off</b>	- Protection Mode	110°C typ. (Automatic recovery at 95°C typ.)
<b>Cooling System</b>		Natural convection (20 LFM)
<b>Sense Function</b>		10% max. of Vout nom. (If sense function is not used, sense pins should be connected to output pins.)
<b>Remote Control</b>	- 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 (Optional models with inverse logic available)
<b>Altitude During Operation</b>		5'000 m max.
<b>Switching Frequency</b>		160 - 200 kHz 180 kHz typ.
<b>Insulation System</b>		Reinforced Insulation (110 Vin models) Basic Insulation (36 Vin models)
<b>Working Voltage (rated)</b>		220 VAC
<b>Isolation Test Voltage</b>	- Input to Output, 60 s	3'000 VAC (110 Vin models) 2'250 VDC (36 Vin models)
	- Input to Case, 60 s	1'500 VAC (110 Vin models) 1'600 VDC (36 Vin models)
	- Output to Case, 60 s	1'500 VAC (110 Vin models) 1'600 VDC (36 Vin models)
<b>Isolation Resistance</b>	- Input to Output, 500 VDC	1'000 M $\Omega$ min.
<b>Isolation Capacitance</b>	- Input to Output, 100 kHz, 1 V	1'000 pF max.
<b>Reliability</b>	- Calculated MTBF	738'000 h (MIL-HDBK-217F, ground benign)

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

