

- **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 +85°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"x-1.45"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 +85°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	
<b>TEP-HS2</b>	- Optional Heat Sink: <a href="http://www.tracopower.com/overview/tep-hs2">www.tracopower.com/overview/tep-hs2</a>
<b>TEP-HS4</b>	- Optional Heat Sink: <a href="http://www.tracopower.com/overview/tep-hs4">www.tracopower.com/overview/tep-hs4</a>
<b>on demand</b> (backorder with MOQ non stocking item)	<ul style="list-style-type: none"> <li>- Optional Heat Sink with large profile: <a href="http://www.tracopower.com/overview/tep-hs3">www.tracopower.com/overview/tep-hs3</a></li> <li>- Optional Heat Sink with large profile: <a href="http://www.tracopower.com/overview/tep-hs5">www.tracopower.com/overview/tep-hs5</a></li> <li>- Optional model with 28 VDC and 2'150 mA Output, and 9 - 75 VDC Input</li> <li>- Optional model with 53 VDC and 1'140 mA Output, and 9 - 75 VDC Input</li> <li>- Optional model with 28 VDC and 2'150 mA Output, and 14 - 160 VDC Input</li> <li>- Optional model with 53 VDC and 1'140 mA Output, and 14 - 160 VDC Input</li> <li>- Optional models with inverse Remote On/Off function (passive = off)</li> </ul>

Input Specifications	
Input Current	- At no load 36 Vin models: <b>20 mA typ.</b> 72 Vin models: <b>17 mA typ.</b>
Surge Voltage	36 Vin models: <b>100 VDC max.</b> (1 s max.) 72 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> 72 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) 72 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) 28 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) 53 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> 28 Vout models: <b>780 µF max.</b> 48 Vout models: <b>260 µF max.</b> 53 Vout models: <b>220 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> )

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 <sub>out</sub> max.
Overvoltage Protection	120 - 135% of V <sub>out</sub> 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 <a href="http://www.tracopower.com/overview/tep60uir">www.tracopower.com/overview/tep60uir</a>
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: <a href="http://www.tracopower.com/overview/tep60uir">www.tracopower.com/overview/tep60uir</a>
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 <sub>in</sub> models: 2 x KY 220 µF / 100 V 72 V <sub>in</sub> models: 2 x KXJ 150 µF / 200 V Continuous: EN 61000-4-6, 10 V <sub>rms</sub> , perf. criteria A 1 s: EN 61000-4-8, 100 A/m, perf. criteria A EN 61000-4-8, 1000 A/m, perf. criteria A
EMC / Environmental	- Certification Documents	<a href="http://www.tracopower.com/overview/tep60uir">www.tracopower.com/overview/tep60uir</a>

### General Specifications

Relative Humidity		95% max. (non condensing)
Temperature Ranges	- Operating Temperature - Case Temperature - Storage Temperature	-40°C to +85°C +105°C max. -55°C to +125°C
Power Derating	- High Temperature	Depending on model See application note: <a href="http://www.tracopower.com/overview/tep60uir">www.tracopower.com/overview/tep60uir</a>
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 <sub>out</sub> nom.  (If sense function is not used, sense pins must be connected to corresponding polarity output pins.)

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

Remote Control	<ul style="list-style-type: none"> <li>- Voltage Controlled Remote (passive = on)</li> <li>- Off Idle Input Current</li> <li>- Remote Pin Input Current</li> </ul>	<p>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))</p>
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	<ul style="list-style-type: none"> <li>- Input to Output, 60 s</li> <li>- Input to Case, 60 s</li> <li>- Output to Case, 60 s</li> </ul>	3'000 VAC (72 Vin models) 2'250 VDC (36 Vin models) 1'500 VAC (72 Vin models) 1'600 VDC (36 Vin models) 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 <a href="http://www.tracopower.com/info/cleaning.pdf">www.tracopower.com/info/cleaning.pdf</a>
Environment	<ul style="list-style-type: none"> <li>- Vibration</li> <li>- Mechanical Shock</li> <li>- Thermal Shock</li> <li>- Flammability</li> </ul>	MIL-STD-810F EN 61373 EN 61373 MIL-STD-810F EN 45545-2 <a href="http://www.tracopower.com/info/en45545-declaration.pdf">www.tracopower.com/info/en45545-declaration.pdf</a>
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	<ul style="list-style-type: none"> <li>- REACH Declaration</li> <li>- RoHS Declaration</li> <li>- SCIP Reference Number</li> </ul>	<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.)) 83f33b01-a468-4326-85f7-d2f7813d4e6d

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