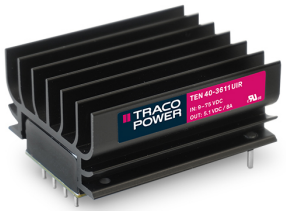
TRACO POWER

DC/DC Railway Converter

TEN 40UIR Series, 40 Watt

- **Compact 2”x1” housing**
- **Ultra-wide 12:1 input voltage range: 9–75, 14–160 VDC**
- **–40°C up to +70°C natural convection cooling without derating**
- **EN 50155, EN 45545-2 and EN 61373 certified**
- **Dedicated holdup capacitor connection**
- **Fully encapsulated**
- **3000VDC I/O isolation**
- **Remote on/off and trim function**
- **Protection against short-circuit (SCP), overvoltage (OVP) and overtemperature (OTP)**
- **3-year product warranty**



UL 62368-1 IEC 62368-1

The TEN 40UIR is a series of high-performance DC/DC converters with an ultra-wide 12:1 input voltage range and a power output of 40 watt. The TEN 40UIR comes in a compact, fully encapsulated 2”x1” housing for highest reliability and effective cooling. Thanks to its dedicated holdup capacitor connection, the TEN 40UIR meets extended holdup-time requirements without the need for bulky input capacitors. The TEN 40UIR is EN 50155 certified for rolling stock applications, EN 61373 certified for resistance against mechanical shock and vibration and EN 45545-2 certified for fire behavior. The TEN 40UIR also comes with IEC/EN/UL 62368-1 safety approvals for use in a wide range of demanding industrial applications.

Models

Order Code	Input Voltage Range	Output 1		Output 2		Efficiency
		Vnom	Imax	Vnom	Imax	typ.
TEN 40-3611UIR	9 - 75 VDC (36 VDC nom.)	5.1 VDC	8'000 mA			89 %
TEN 40-3612UIR		12 VDC	3'330 mA			90 %
TEN 40-3613UIR		15 VDC	2'670 mA			90 %
TEN 40-3615UIR		24 VDC	1'670 mA			90 %
TEN 40-7211UIR	14 - 160 VDC (72 VDC nom.)	5.1 VDC	8'000 mA			89 %
TEN 40-7212UIR		12 VDC	3'330 mA			90 %
TEN 40-7213UIR		15 VDC	2'670 mA			90 %
TEN 40-7215UIR		24 VDC	1'670 mA			90 %
TEN 40-7222UIR		+12 VDC	1'670 mA	–12 VDC	1'670 mA	90 %
TEN 40-7223UIR		+15 VDC	1'330 mA	–15 VDC	1'330 mA	90 %

Options

TEN-HS8	- Optional Heat Sink with Height = 0.3 inch: www.tracopower.com/overview/ten-hs8
on demand (backorder with MOQ non stocking item)	- Optional Heat Sink with Height = 0.8 inch: www.tracopower.com/overview/ten-hs10
	- Optional Heat Sink with Height = 0.5 inch: www.tracopower.com/overview/ten-hs9
	- Optional model with +12/-12 VDC and 1'670/1'670 mA Output, and 9 - 75 VDC Input
	- Optional model with +15/-15 VDC and 1'330/1'330 mA Output, and 9 - 75 VDC Input
	- Optional models with inverse Remote On/Off function (passive = off)
	- Optional models without adjustable UVLO and without BUS pin
	- Optional models with adjustable UVLO but without BUS pin
	- Optional models without heatsink
	- Optional models with pre-assembled heatsink acc. to the list above

Note - 72 Vin models: If the input voltage exceeds 110 VDC, use an external 100 µF / 200 V capacitor between +Vin and -Vin to reduce voltage transient.

Input Specifications

Input Current	- At no load	36 Vin models:	**30 mA typ.** (5.1 Vout model)
			20 mA typ. (12 Vout model)
			20 mA typ. (15 Vout model)
			20 mA typ. (24 Vout model)
			20 mA typ. (12 / -12 Vout model)
			20 mA typ. (15 / -15 Vout model)
		72 Vin models:	**15 mA typ.** (5.1 Vout model)
			10 mA typ. (12 Vout model)
			10 mA typ. (15 Vout model)
			10 mA typ. (24 Vout model)
			10 mA typ. (12 / -12 Vout model)
			10 mA typ. (15 / -15 Vout model)
Surge Voltage		36 Vin models:	**100 VDC max.** (1 s max.)
		72 Vin models:	**200 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.**
Recommended Input Fuse		36 Vin models:	**8'000 mA** (fast acting)
		72 Vin models:	**5'000 mA** (slow blow)
			(The need of an external fuse has to be assessed in the final application.)
Input Filter			Internal Pi-Type

Output Specifications

Output Voltage Adjustment			**–10% to +20%** (15 Vout and 24 Vout model)
			±10% (other models)
			(single output models only)
			(By external trim resistor)
		See application note:	www.tracopower.com/overview/ten40uir
			Output power must not exceed rated power!
Voltage Set Accuracy			**±1% max.**
Regulation	- Input Variation (Vmin - Vmax)	single output models:	**0.2% max.**
		dual output models:	**0.2% max.**
	- Load Variation (0 - 100%)	single output models:	**0.5% max.**
		dual output models:	**1% max.** (Output 1)
			1% max. (Output 2)
	- Voltage Balance (symmetrical load)	dual output models:	**1% max.**
	- Cross Regulation (25% / 100% asym. load)	dual output models:	**5% max.**
Ripple and Noise (20 MHz Bandwidth)	- single output	5.1 Vout models:	**100 mVp-p max.** (w/ 22µF/25V/X7R MLCC)
		12 Vout models:	**125 mVp-p max.** (w/ 1µF/50V/X7R MLCC)
		15 Vout models:	**125 mVp-p max.** (w/ 1µF/50V/X7R MLCC)
		24 Vout models:	**200 mVp-p max.** (w/ 1µF/50V/X7R MLCC)
	- dual output	12 / -12 Vout models:	**125 / 125 mVp-p max.** (w/ 1µF/50V/X7R MLCC)
		15 / -15 Vout models:	**125 / 125 mVp-p max.** (w/ 1µF/50V/X7R MLCC)
	- single output	5.1 Vout models:	**80 mVp-p typ.** (w/ 22µF/25V/X7R MLCC)
		12 Vout models:	**110 mVp-p typ.** (w/ 1µF/50V/X7R MLCC)
		15 Vout models:	**110 mVp-p typ.** (w/ 1µF/50V/X7R MLCC)
		24 Vout models:	**160 mVp-p typ.** (w/ 1µF/50V/X7R MLCC)
	- dual output	12 / -12 Vout models:	**110 / 110 mVp-p typ.** (w/ 1µF/50V/X7R MLCC)
		15 / -15 Vout models:	**110 / 110 mVp-p typ.** (w/ 1µF/50V/X7R MLCC)

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

Capacitive Load	- single output	5.1 Vout models:	12'240 µF max.
		12 Vout models:	2'000 µF max.
		15 Vout models:	1'320 µF max.
		24 Vout models:	490 µF max.
	- dual output	12 / -12 Vout models:	1'000 / 1'000 µF max.
		15 / -15 Vout models:	630 / 630 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/ten40uir)
Start-up Time			60 ms typ. / 90 ms max.
Short Circuit Protection			Continuous, Automatic recovery
Output Current Limitation			130 - 190% of Iout max. 160% typ. of Iout max.
Overvoltage Protection			125% typ. of Vout nom.
Transient Response	- Response Time		250 µs typ. (75% to 100% Load Step)

Safety Specifications

Standards	- IT / Multimedia Equipment		EN 62368-1 IEC 62368-1 UL 62368-1
	- Railway Applications		EN 50155
	- Certification Documents		www.tracopower.com/overview/ten40uir
Pollution Degree			PD 2
Over Voltage Category			OVC II (not mains connected)

EMC Specifications

EMI (Emissions)			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:	www.tracopower.com/overview/ten40uir
EMS (Immunity)			EN 50121-3-2 (EMC for Rolling Stock) 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
		Ext. input component:	2x 220µF/100V/KZN || TVS SMDJ120A (36 Vin) 2x 150µF/200V/KZN || TVS SMDJ170A (72 Vin)
	- 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
EMC / Environmental	- Certification Documents		www.tracopower.com/overview/ten40uir

General Specifications

Relative Humidity			95% max. (non condensing)
Temperature Ranges	- Operating Temperature		–40°C to +90°C
	- Case Temperature		+105°C max.
	- Storage Temperature		–55°C to +125°C
Power Derating	- High Temperature		Depending on model
		See application note:	www.tracopower.com/overview/ten40uir

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

Over Temperature Protection Switch Off	- Protection Mode	115°C typ. (Automatic recovery at 100°C typ.)
	- Measurement Point	Case
Cooling System		Natural convection (20 LFM)
Remote Control	- Voltage Controlled Remote (passive = on)	On: 3.5 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 0.5 mA
		(Optional models with inverse Remote On/Off function (passive = off))
Altitude During Operation		5'000 m max.
Regulator Topology		Flyback Converter
Switching Frequency		180 - 220 kHz (PWM) (200 kHz typ.) (5.1 Vout models) 144 - 176 kHz (PWM) (160 kHz typ.) (other models)
Insulation System		Functional Insulation
Isolation Test Voltage	- Input to Output, 60 s	3'000 VDC
	- Input to Case, 60 s	2'250 VDC
	- Output to Case, 60 s	2'250 VDC
Isolation Resistance	- Input to Output, 500 VDC	1'000 MΩ min.
Isolation Capacitance	- Input to Output, 100 kHz, 1 V	1'500 pF max.
Reliability	- Calculated MTBF	843'400 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	MIL-STD-810F EN 61373
	- Thermal Shock	MIL-STD-810F
	- Flammability	EN 45545-2 www.tracopower.com/info/en45545-declaration.pdf
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 (2.5 - 3 µm)
Pin Surface Plating		Tin (3 - 5 µm), bright
Housing Type		Metal Case
Mounting Type		PCB Mount
Connection Type		THD (Through-Hole Device)
Footprint Type		2" x 1"
Soldering Profile		Lead-Free Wave Soldering 260°C / 6 s max.
Weight		34.5 g
Thermal Impedance	- Case to Ambient	6.2 K/W typ. (standard version) 8.3 K/W typ. (with heatsink TEN-HS8) 7.0 K/W typ. (with heatsink TEN-HS9) 5.7 K/W typ. (with heatsink TEN-HS10) 10.8 K/W typ. (without heatsink)
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: No Exemptions

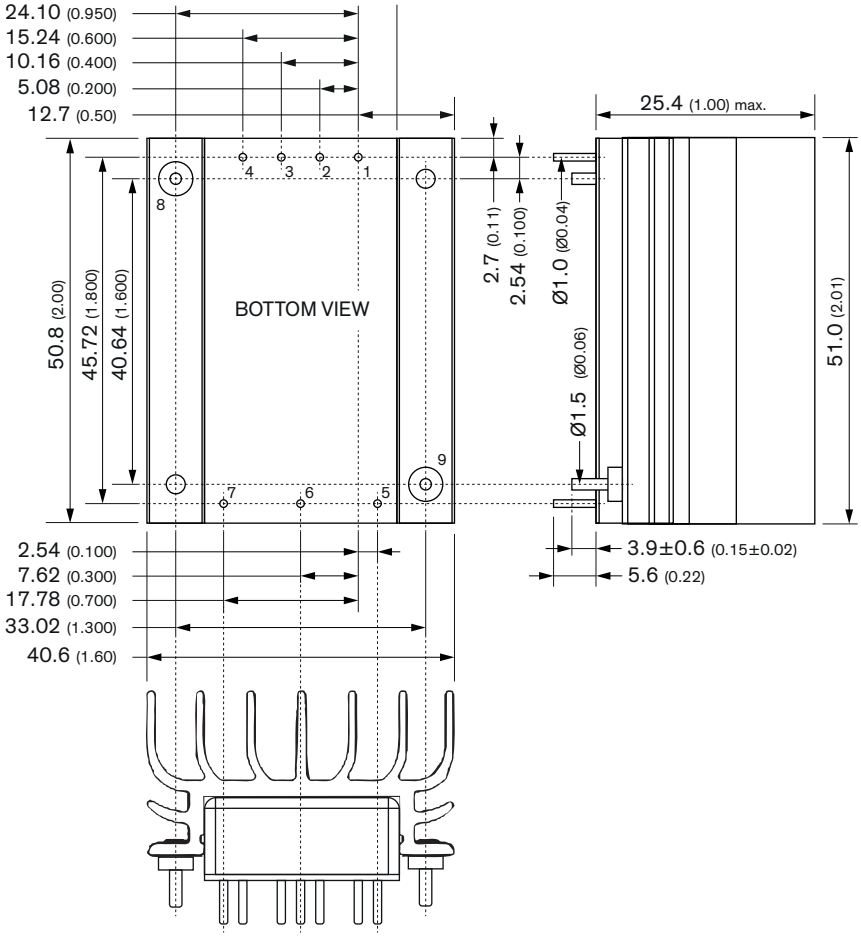
All specifications valid at nominal voltage, resistive full load and +25°C after warm-up time, unless otherwise stated.

Supporting Documents

Overview Link (for additional Documents) www.tracopower.com/overview/ten40uir

Outline Dimensions

Standard model



Pinout		
Pin	**Single**	**Dual**
1	+Vin	
2	–Vin	
3	No Pin* / BUS / UVLO**	
4	Remote On/Off (CTRL)	
5	+Vout	
6	–Vout	Common
7	Trim	–Vout
8	Heatsink	
9	Heatsink	

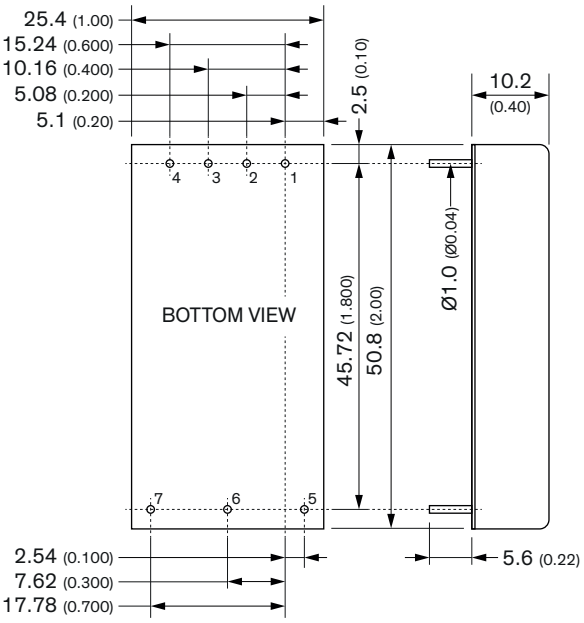
* If neither BUS nor UVLO is present

** UVLO function is optional

Dimensions in mm (inch)
Tolerances: x.x ±0.5 (x.xx ±0.02)
x.xx ±0.25 (x.xxx ±0.010)
Pin diameter tolerances: ±0.10 (±0.004)

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

Optional model without heatsink



Dimensions in mm (inch)
Tolerances: x.x ±0.5 (x.xx ±0.02)
x.xx ±0.25 (x.xxx ±0.010)
Pin diameter tolerances: ±0.10 (±0.004)

Pinout		
Pin	**Single**	**Dual**
1	+Vin	
2	–Vin	
3	No Pin* / BUS / UVLO**	
4	Remote On/Off (CTRL)	
5	+Vout	
6	–Vout	Common
7	Trim	–Vout

* If neither BUS nor UVLO is present

** UVLO function is optional

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