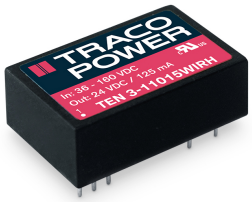
TRACO POWER

DC/DC Railway Converter

TEN 3WIRH Series, 3 Watt

- **Fully encapsulated DIP-24 package**
- **3000 VAC I/O isolation (reinforced)**
- **4:1 input voltage range: 36 – 160 VDC**
- **EN 50155 and EN 61373 certified**
- **Internal class A EMI filter**
- **-40°C up to +95°C without derating**
- **EN 45545-2 fire behavior**
- **Remote on/off function**
- **Undervoltage lockout (UVLO), short-circuit protection (SCP), and overvoltage protection (OVP)**
- **3-year product warranty**



UL 62368-1 IEC 62368-1

The TEN 3WIRH is a series of railway-certified DC/DC converters with reinforced I/O isolation for highest reliability in harsh environments. The proven and certified design guarantees highest resistance against thermal shocks, moisture, mechanical shocks, and vibration. The TEN 3WIRH comes with additional EN 62368-1 safety approvals for IT equipment and EN 45545-2 certification for fire behavior. Thanks to its favorable operating temperature range of -40°C to +95°C without derating (depending on the model), the TEN 3WIRH presents a first choice for demanding applications.

Models

Order Code	Input Voltage Range	Output 1		Output 2		Efficiency
		Vnom	Imax	Vnom	Imax	typ.
TEN 3-11010WIRH	36 - 160 VDC (110 VDC nom.)	3.3 VDC	1'000 mA			80 %
TEN 3-11011WIRH		5 VDC	600 mA			82 %
TEN 3-11012WIRH		12 VDC	250 mA			85 %
TEN 3-11013WIRH		15 VDC	200 mA			84 %
TEN 3-11015WIRH		24 VDC	125 mA			85 %
TEN 3-11021WIRH		+5 VDC	300 mA	−5 VDC	300 mA	81 %
TEN 3-11022WIRH		+12 VDC	125 mA	−12 VDC	125 mA	84 %
TEN 3-11023WIRH		+15 VDC	100 mA	−15 VDC	100 mA	85 %

Options

on demand (backorder with MOQ non stocking item)	- Optional models with adjustable output voltage

Input Specifications

Input Current	- At no load		3 mA typ.
Surge Voltage			200 VDC max. (1 s max.)
Input Inrush Current			35 A typ.
Under Voltage Lockout			32 VDC min. / 34 VDC typ. / 35.8 VDC max.
Recommended Input Fuse			315 mA (slow blow) (The need of an external fuse has to be assessed in the final application.)
Input Filter			Internal Pi-Type

Output Specifications

Voltage Set Accuracy			±1% max.
Regulation	- Input Variation (Vmin - Vmax)	single output models:	0.2% max.
		dual output models:	0.5% max.
	- Load Variation (0 - 100%)	single output models:	0.2% max.
		dual output models:	1% max. (Output 1)
			1% max. (Output 2)
	- Voltage Balance (symmetrical load)	dual output models:	2% max.
	- Cross Regulation (25% / 100% asym. load)	dual output models:	5% max.
Ripple and Noise (20 MHz Bandwidth)	- single output	3.3 Vout models:	50 mVp-p typ. (w/ 10 µF)
		5 Vout models:	50 mVp-p typ. (w/ 10 µF)
		12 Vout models:	75 mVp-p typ. (w/ 10 µF)
		15 Vout models:	75 mVp-p typ. (w/ 10 µF)
		24 Vout models:	75 mVp-p typ. (w/ 4.7 µF)
	- dual output	5 / -5 Vout models:	75 / 75 mVp-p typ. (w/ 10 µF)
		12 / -12 Vout models:	75 / 75 mVp-p typ. (w/ 10 µF)
		15 / -15 Vout models:	75 / 75 mVp-p typ. (w/ 10 µF)
Capacitive Load	- single output	3.3 Vout models:	1'050 µF max.
		5 Vout models:	750 µF max.
		12 Vout models:	130 µF max.
		15 Vout models:	100 µF max.
		24 Vout models:	39 µF max.
	- dual output	5 / -5 Vout models:	430 / 430 µF max.
		12 / -12 Vout models:	75 / 75 µF max.
		15 / -15 Vout models:	56 / 56 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 ext. capacitor calculation: www.tracopower.com/info/holdup_en50155.pdf)
Start-up Time			30 ms typ. / 60 ms max.
Short Circuit Protection			Continuous, Automatic recovery
Output Current Limitation			150% typ. of Iout max.
Overvoltage Protection			112 - 151% of Vout nom. (depending on model) 3.7 - 5 VDC (3.3 VDC model) 5.6 - 7 VDC (5 VDC model) 13.5 - 16 VDC (12 VDC model) 18.3 - 22 VDC (15 VDC model) 29.1 - 34.5 VDC (24 VDC model) 5.6 - 7 VDC (±5 VDC model) 13.5 - 18.2 VDC (±12 VDC model) 17 - 22 VDC (±15 VDC model)

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

Transient Response	- Peak Variation	125 mV typ. / 160 mV max. (75% to 100% Load Step)
	- Response Time	250 µs typ. / 300 µs max. (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/ten3wirh
Pollution Degree		PD 2
Over Voltage Category		OVC II

EMC Specifications

EMI Emissions			EN 50121-3-2 (EMC for Rolling Stock)
	- Conducted Emissions		EN 55032 class A (internal filter) EN 55032 class B (with external filter)
	- Radiated Emissions		EN 55032 class A (internal filter) EN 55032 class B (with external filter)
		External filter proposal:	www.tracopower.com/overview/ten3wirh
EMS Immunity			EN 50121-3-2 (EMC for Rolling Stock) EN 55024 (IT Equipment) 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 220 µF, 200 V, KXJ || SMBJ220A
	- 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

Relative Humidity			95% max. (non condensing)
Temperature Ranges	- Operating Temperature		–40°C to +95°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/ten3wirh
Cooling System			Natural convection (20 LFM)
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		2.5 mA typ. / 3 mA max.
Altitude During Operation			5'000 m max.
Regulator Topology			Flyback Converter
Switching Frequency			215 - 265 kHz (PWM) 240 kHz typ. (PWM)
Insulation System			Reinforced Insulation
Working Voltage (rated)			189 VAC
Isolation Test Voltage	- Input to Output, 60 s		3'000 VAC
	- Input to Case, 60 s		3'000 VAC
	- Output to Case, 60 s		2'000 VAC
Creepage	- Input to Output		4.5 mm min.

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Clearance	- Input to Output	4.5 mm min.
Isolation Resistance	- Input to Output, 500 VDC	1'000 MΩ min.
Isolation Capacitance	- Input to Output, 100 kHz, 1 V	650 pF typ. 1'000 pF max.
Reliability	- Calculated MTBF	5'069'000 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	MIL-STD-810F EN 61373
	- Thermal Shock	MIL-STD-810F
	- Flammability	EN 45545-2 www.tracopower.com/info/en45545-declaration.pdf
Housing Material		Non-conductive Plastic (UL 94 V-0 rated)
Base Material		Non-conductive Plastic (UL 94 V-0 rated)
Potting Material		Silicone (UL 94 V-0 rated)
Pin Material		Tinned 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		DIP24
Soldering Profile		Lead-Free Wave Soldering 260°C / 6 s max.
Weight		14 g
Thermal Impedance	- Case to Ambient	19.2 K/W typ.
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	f11ec6f9-b3d0-4ad2-8bb6-3aca7f2b20e6

Supporting Documents

Overview Link (for additional Documents)	www.tracopower.com/overview/ten3wirh

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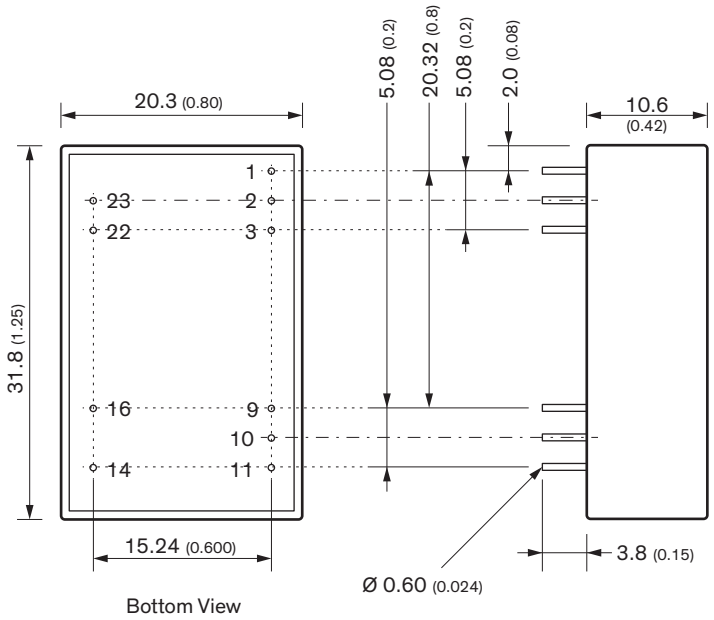
Outline Dimensions



Bottom View

All dimension in mm (inch)
Tolerance: X.X ±0.5 (X.XX ±0.02)
X.XX ±0.25 (X.XXX ±0.010)
Pin dimension tolerance ±0.10 (±0.004)

Pinout		
Pin	**Single**	**Dual**
1	Remote On/Off	
2	–Vin	
3	–Vin	
9	NC	Common
10	No pin / Trim (option)	
11	NC	–Vout
14	+Vout	
16	–Vout	Common
22	+Vin	
23	+Vin	

NC: Not connected