

- Fully encapsulated DIP-24 package
- 4000 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), overtemperature protection (OTP), and overvoltage protection (OVP)
- 3-year product warranty



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 typ.
		Vnom	I <sub>max</sub>	Vnom	I <sub>max</sub>	
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

<b>on demand</b> (backorder with MOQ non stocking item)	- Optional models with adjustable output voltage
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### Input Specifications

Input Current	- At no load	3 mA typ.
Surge Voltage		200 VDC max. (1 s max.)
Input Inrush Current		35 A typ.
Start-up Voltage		36 VDC
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/ 10µF)
		5 Vout models: 50 mVp-p typ. (w/ 10µF)
		12 Vout models: 75 mVp-p typ. (w/ 10µF)
		15 Vout models: 75 mVp-p typ. (w/ 10µF)
		24 Vout models: 75 mVp-p typ. (w/ 4.7µF)
	- dual output	5 / -5 Vout models: 75 / 75 mVp-p typ. (w/ 10µF)
		12 / -12 Vout models: 75 / 75 mVp-p typ. (w/ 10µF)
	15 / -15 Vout models: 75 / 75 mVp-p typ. (w/ 10µF)	
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.
	- dual output	24 Vout models: 39 µF max.
		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.
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 $\mu$ s typ. / 300 $\mu$ s max. (75% to 100% Load Step)

### Safety Specifications

Safety Standards	- IT / Multimedia Equipment	EN 62368-1 IEC 62368-1 UL 62368-1
	- Railway Applications - Certification Documents	EN 50155 <a href="http://www.tracopower.com/overview/ten3wirh">www.tracopower.com/overview/ten3wirh</a>
Pollution Degree		PD 2
Over Voltage Category		OVC II

### EMC Specifications

EMI Emissions	- Conducted Emissions	EN 50121-3-2 (EMC for Rolling Stock) 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:	<a href="http://www.tracopower.com/overview/ten3wirh">www.tracopower.com/overview/ten3wirh</a>
EMS Immunity		EN 50155 (Railway Applications) EN 50121-3-2 (EMC for Rolling Stock) EN 55024 (IT Equipment)
	- Electrostatic Discharge	Air: EN 61000-4-2, $\pm 8$ kV, perf. criteria A Contact: EN 61000-4-2, $\pm 6$ kV, perf. criteria A
	- RF Electromagnetic Field	EN 61000-4-3, 20 V/m, perf. criteria A
	- EFT (Burst) / Surge	EN 61000-4-4, $\pm 2$ kV, perf. criteria A EN 61000-4-5, $\pm 2$ kV, perf. criteria A
	- Conducted RF Disturbances	Ext. input component: 2x 220 $\mu$ F, 200 V, KXJ // SMBJ220A 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	See application note: <a href="http://www.tracopower.com/overview/ten3wirh">www.tracopower.com/overview/ten3wirh</a>
Cooling System		Natural convection (20 LFM)
Remote Control	- 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 2.5 mA typ. / 3 mA max.
	- Off Idle Input Current	
Altitude During Operation		5'000 m max.
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.
Clearance	- Input to Output	4.5 mm min.
Isolation Resistance	- Input to Output, 500 VDC	1'000 M $\Omega$ min.

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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		Allowed (hermetical product) Baking after washing: 100°C for 45 min <a href="http://www.tracopower.com/info/cleaning.pdf">www.tracopower.com/info/cleaning.pdf</a>
Environment	- Vibration	MIL-STD-810F EN 61373
	- Mechanical Shock	MIL-STD-810F EN 61373
	- Thermal Shock	MIL-STD-810F EN 50155
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
Soldering Profile		Wave Soldering 260°C / 6 s max.
Connection Type		THD (Through-Hole Device)
Weight		14 g
Thermal Impedance		19.2 K/W
Environmental Compliance	- REACH Declaration	<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
	- RoHS Declaration	<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). The SCIP number is provided on request.)
	- Flammability (EN 45545-2)	<a href="http://www.tracopower.com/info/en45545-declaration.pdf">www.tracopower.com/info/en45545-declaration.pdf</a>

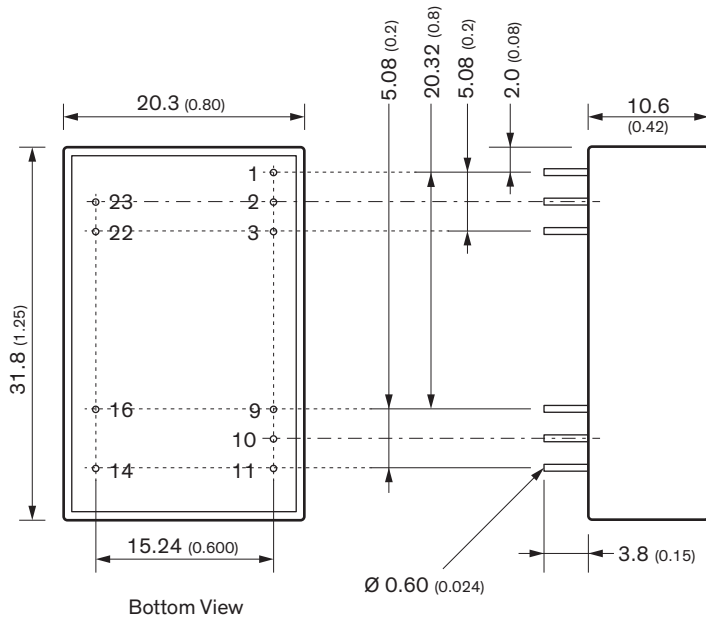
## Supporting Documents

Overview Link (for additional Documents)

[www.tracopower.com/overview/ten3wirh](http://www.tracopower.com/overview/ten3wirh)

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**Outline Dimensions**



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	Ctrl	Ctrl
2	- Vin	- Vin
3	- Vin	- Vin
9	NC	Common
10	No Pin / Trim (option)	No Pin / Trim (option)
11	NC	- Vout
14	+ Vout	+ Vout
16	- Vout	Common
22	+ Vin	+ Vin
23	+ Vin	+ Vin

NC = not connected