

- 2" x 1" x 0.4" metal package
- Ultra wide 4:1 input voltage range  
9–36, 18–75, 43–160 VDC
- EN 50155 approval for railway applications
- Thermal shock and vibration resistant according EN 61373
- Input filter meets EN 55032 class B without external components
- High efficiency up to 89%
- Operating temperature range  
–40°C to +85°C
- Under voltage lock-out circuit
- Remote On/Off and Output voltage adjustable
- 3-year product warranty



The TEN 20WIR series is a family of high performance 20 Watt DC/DC converter modules featuring ultra wide 4:1 input voltage ranges in a 2" x 1" x 0.4" package with industry-standard footprint. Input voltages up to 160 VDC, excellent EMC characteristics and EN 50155 approval make this product the best choice for many demanding applications in railroad and transportation systems. Further standard features include remote On/Off, over voltage protection, under voltage lockout and short circuit protection. Low input current characteristics at minimal load make these converters also the ideal solution for battery-operated systems. Typical applications are in wireless networks, telecom/-datacom, industry control systems and measurement equipment.

### Models

Order Code	Input Voltage Range	Output 1		Output 2		Efficiency typ.
		Vnom	I <sub>max</sub>	Vnom	I <sub>max</sub>	
TEN 20-2410WIR	9 - 36 VDC (24 VDC nom.)	3.3 VDC	4'500 mA			85 %
TEN 20-2411WIR		5 VDC	4'000 mA			88 %
TEN 20-2412WIR		12 VDC	1'670 mA			89 %
TEN 20-2413WIR		15 VDC	1'330 mA			88 %
TEN 20-2422WIR		+12 VDC	833 mA	-12 VDC	833 mA	88 %
TEN 20-2423WIR		+15 VDC	667 mA	-15 VDC	667 mA	89 %
TEN 20-4810WIR	18 - 75 VDC (48 VDC nom.)	3.3 VDC	4'500 mA			85 %
TEN 20-4811WIR		5 VDC	4'000 mA			88 %
TEN 20-4812WIR		12 VDC	1'670 mA			89 %
TEN 20-4813WIR		15 VDC	1'330 mA			89 %
TEN 20-4822WIR		+12 VDC	833 mA	-12 VDC	833 mA	88 %
TEN 20-4823WIR		+15 VDC	667 mA	-15 VDC	667 mA	89 %
TEN 20-7210WIR	43 - 160 VDC (110 VDC nom.)	3.3 VDC	4'500 mA			85 %
TEN 20-7211WIR		5 VDC	4'000 mA			87 %
TEN 20-7212WIR		12 VDC	1'670 mA			88 %
TEN 20-7213WIR		15 VDC	1'330 mA			88 %
TEN 20-7222WIR		+12 VDC	833 mA	-12 VDC	833 mA	88 %
TEN 20-7223WIR		+15 VDC	667 mA	-15 VDC	667 mA	89 %

### Options

TEN-HS1	- Optional Heat Sink: <a href="http://www.tracopower.com/products/ten-hs1.pdf">www.tracopower.com/products/ten-hs1.pdf</a>
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## Input Specifications

Input Current	- At no load	24 Vin models: <b>6 mA typ.</b> 48 Vin models: <b>4 mA typ.</b> 110 Vin models: <b>3 mA typ.</b>
Surge Voltage		24 Vin models: <b>50 VDC max.</b> (100 ms max.) 48 Vin models: <b>100 VDC max.</b> (100 ms max.) 110 Vin models: <b>170 VDC max.</b> (100 ms max.)
Under Voltage Lockout		24 Vin models: <b>7.5 VDC min. / 8 VDC typ. / 8.8 VDC max.</b> 48 Vin models: <b>15.5 VDC min. / 16 VDC typ. / 17.5 VDC max.</b> 110 Vin models: <b>38.5 VDC min. / 40 VDC typ. / 42 VDC max.</b>
Reflected Ripple Current		24 Vin models: <b>30 mA<sub>p-p</sub> typ.</b> 48 Vin models: <b>30 mA<sub>p-p</sub> typ.</b> 110 Vin models: <b>30 mA<sub>p-p</sub> typ.</b>
Recommended Input Fuse		24 Vin models: <b>4'000 mA</b> (slow blow) 48 Vin models: <b>2'000 mA</b> (slow blow) 110 Vin models: <b>1'000 mA</b> (slow blow) <small>(The need of an external fuse has to be assessed in the final application.)</small>
Input Filter		<b>Internal Pi-Type</b> (110 Vin models) <b>Common Choke</b> (other models)

## Output Specifications

Output Voltage Adjustment		<b>±10%</b> (single output models only) (By external trim resistor) See application note: <a href="http://www.tracopower.com/overview/ten20wir">www.tracopower.com/overview/ten20wir</a> Output power must not exceed rated power!
Voltage Set Accuracy		<b>±1% max.</b>
Regulation	- Input Variation (V <sub>min</sub> - V <sub>max</sub> )	single output models: <b>0.2% max.</b> dual output models: <b>0.5% max.</b>
	- Load Variation (10 - 90%)	single output models: <b>0.1% max.</b> dual output models: <b>0.8% max.</b> (Output 1) <b>0.8% max.</b> (Output 2)
	- Cross Regulation (25% / 100% asym. load)	dual output models: <b>5% max.</b>
Ripple and Noise (20 MHz Bandwidth)	- single output	3.3 V <sub>out</sub> models: <b>75 mV<sub>p-p</sub> typ.</b> (w/ 1 µF, 50 V X7R) 5 V <sub>out</sub> models: <b>75 mV<sub>p-p</sub> typ.</b> (w/ 1 µF, 50 V X7R) 12 V <sub>out</sub> models: <b>100 mV<sub>p-p</sub> typ.</b> (w/ 1 µF, 50 V X7R) 15 V <sub>out</sub> models: <b>100 mV<sub>p-p</sub> typ.</b> (w/ 1 µF, 50 V X7R)
	- dual output	12 / -12 V <sub>out</sub> models: <b>100 / 100 mV<sub>p-p</sub> typ.</b> (w/ 1 µF, 50 V X7R) 15 / -15 V <sub>out</sub> models: <b>100 / 100 mV<sub>p-p</sub> typ.</b> (w/ 1 µF, 50 V X7R)
Capacitive Load	- single output	3.3 V <sub>out</sub> models: <b>7'000 µF max.</b> 5 V <sub>out</sub> models: <b>5'000 µF max.</b> 12 V <sub>out</sub> models: <b>850 µF max.</b> 15 V <sub>out</sub> models: <b>700 µF max.</b>
	- dual output	12 / -12 V <sub>out</sub> models: <b>500 / 500 µF max.</b> 15 / -15 V <sub>out</sub> models: <b>350 / 350 µF max.</b>
Minimum Load		<b>Not required</b>
Temperature Coefficient		<b>±0.02 %/K max.</b>
Start-up Time		<b>30 ms max.</b>
Short Circuit Protection		<b>Continuous, Automatic recovery</b>
Output Current Limitation		<b>125 - 188% of I<sub>out</sub> max.</b> <b>150% typ. of I<sub>out</sub> max.</b>
Overvoltage Protection		<b>110 - 165% of V<sub>out</sub> nom.</b>
Transient Response	- Response Time	<b>250 µs typ.</b> (25% Load Step)

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

### Safety Specifications

Safety Standards	- IT / Multimedia Equipment	EN 60950-1 IEC 60950-1 UL 60950-1
	- Railway Applications	EN 50155
	- Certification Documents	<a href="http://www.tracopower.com/overview/ten20wir">www.tracopower.com/overview/ten20wir</a>
Pollution Degree		PD 2
Over Voltage Category		OVC I

### EMC Specifications

EMI Emissions	- Conducted Emissions	EN 50121-3-2 (EMC for Rolling Stock)
	- Radiated Emissions	EN 55032 class B (internal filter)
		EN 55032 class B (internal filter)
		External filter proposal: <a href="http://www.tracopower.com/overview/ten20wir">www.tracopower.com/overview/ten20wir</a> (110 Vin models: external filter for class B)
EMS Immunity	- Electrostatic Discharge	EN 50155 (Railway Applications)
		EN 50121-3-2 (EMC for Rolling Stock)
	- RF Electromagnetic Field	Air: EN 61000-4-2, $\pm 8$ kV, perf. criteria A
	- EFT (Burst) / Surge	Contact: EN 61000-4-2, $\pm 6$ kV, perf. criteria A
		EN 61000-4-3, 10 V/m, perf. criteria A
		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: 220 $\mu$ F, 100 V, KY (24 & 48 Vin models)
	- PF Magnetic Field	100 $\mu$ F, 250 V, BXF (110 Vin model)
		EN 61000-4-6, 10 Vrms, perf. criteria A
		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 +86°C
	- Case Temperature	-40°C to +91°C (with Heat Sink)
	- Storage Temperature	+105°C max.
		-55°C to +125°C
Power Derating	- High Temperature	4.5 %/K above 73°C
		5.3 %/K above 78°C (with Heat Sink)
Cooling System		Natural convection (20 LFM)
Remote Control	- Voltage Controlled Remote	On: 0 to 1.2 VDC or short circuit
		Off: 3 to 12 VDC or open circuit
		Refers to 'Remote' and '-Vin' Pin
	- Off Idle Input Current	2.5 mA typ.
	- Remote Pin Input Current	-0.5 to 1.0 mA
Altitude During Operation		2'000 m max.
Switching Frequency		297 - 363 kHz (PWM)
		330 kHz typ. (PWM)
Insulation System		Functional Insulation
Isolation Test Voltage	- Input to Output, 60 s	2'250 VDC
	- Input to Case, 60 s	1'600 VDC
Isolation Resistance	- Input to Output, 500 VDC	1'000 M $\Omega$ min.
Isolation Capacitance	- Input to Output, 100 kHz, 1 V	3'000 pF max.
Reliability	- Calculated MTBF	1'500'000 h (MIL-HDBK-217F, ground benign)

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

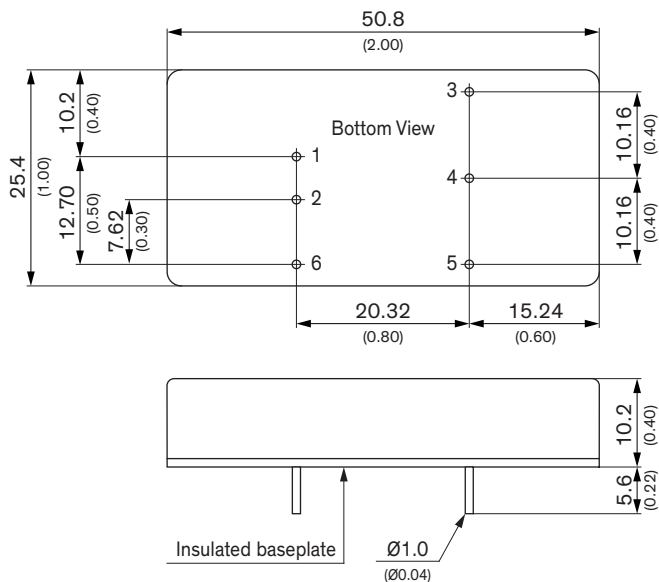
Environment	- Vibration - Mechanical Shock - Thermal Shock	MIL-STD-810F EN 61373 MIL-STD-810F EN 61373 MIL-STD-810F EN 50155
Housing Material		Copper, Nickel plated
Base Material		Non-conductive FR4 (UL94 V-0 rated)
Potting Material		Silicone (UL 94 V-0 rated)
Pin Material		Copper
Pin Foundation Plating		Nickel (2 - 3 µm)
Pin Surface Plating		Tin (3 - 5 µm), matte
Soldering Profile		Wave Soldering 265°C / 10 s max.
Connection Type		THD (Through-Hole Device)
Weight		30 g
Thermal Impedance		12 K/W 10 K/W (with Heat Sink)
Environmental Compliance	- Reach - RoHS - Flammability (EN 45545-2)	<a href="http://www.tracopower.com/info/reach-declaration.pdf">www.tracopower.com/info/reach-declaration.pdf</a> <a href="http://www.tracopower.com/info/rohs-declaration.pdf">www.tracopower.com/info/rohs-declaration.pdf</a> <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/ten20wir](http://www.tracopower.com/overview/ten20wir)

### Outline Dimensions



Pinout		
Pin	Single	Dual
1	+Vin (Vcc)	+Vin (Vcc)
2	-Vin (GND)	-Vin (GND)
3	+Vout	+Vout
4	Trim	Common
5	-Vout	-Vout
6	Remote On/Off	Remote On/Off

Dimensions in mm (inch)  
Tolerance: x.x ±0.50 (±0.02)  
Tolerance: x.xx ±0.25 (±0.01)  
Pin pitch tolerance ±0.25 (0.01)  
Pin dimension tolerance ±0.10 (0.04)

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