



**THE DATASHEET OF  
TEN 20-7223WIR**



- 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 with Height = 0.22 inch: <a href="http://www.tracopower.com/products/ten-hs1.pdf">www.tracopower.com/products/ten-hs1.pdf</a>

## 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		<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) (The need of an external fuse has to be assessed in the final application.)
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>
Hold-up Time		<b>10 ms min.</b> (acc. to EN 50155 Class S2, see application note for ext. capacitor calculation: <a href="http://www.tracopower.com/info/holdup_en50155.pdf">www.tracopower.com/info/holdup_en50155.pdf</a> )
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, resistive full load and +25°C after warm-up time, unless otherwise stated.

### Safety Specifications

Standards	- IT / Multimedia Equipment	EN 60950-1 EN 62368-1 IEC 60950-1 IEC 62368-1 UL 60950-1 UL 62368-1
	- 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 - Radiated Emissions	EN 50121-3-2 (EMC for Rolling Stock) 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 - RF Electromagnetic Field - EFT (Burst) / Surge	EN 50121-3-2 (EMC for Rolling Stock) Air: EN 61000-4-2, ±8 kV, perf. criteria A Contact: EN 61000-4-2, ±6 kV, perf. criteria A EN 61000-4-3, 10 V/m, perf. criteria A EN 61000-4-4, ±2 kV, perf. criteria A EN 61000-4-5, ±2 kV, perf. criteria A
	Ext. input component:	220 µF, 100 V, KY (24 & 48 Vin models) 100 µF, 250 V, BXF (110 Vin model)
	- Conducted RF Disturbances - PF Magnetic Field	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 -40°C to +91°C (with Heat Sink)
	- Case Temperature	+105°C max.
	- Storage Temperature	-55°C to +125°C
Power Derating	- High Temperature	Depending on model
	See application note:	<a href="http://www.tracopower.com/overview/ten20wir">www.tracopower.com/overview/ten20wir</a>
Cooling System		Natural convection (20 LFM)
Remote Control	- Voltage Controlled Remote (passive = on) - Off Idle Input Current - Remote Pin Input Current	On: 3.0 to 15 VDC or open circuit Off: 0 to 1.2 VDC or short circuit Refers to 'Remote' and '-Vin' Pin 2.5 mA typ. -0.5 to 1.0 mA
Altitude During Operation		5'000 m max.
Regulator Topology		Flyback Converter
Switching Frequency		297 - 363 kHz (PWM) 330 kHz typ. (PWM)
Insulation System		Functional Insulation
Isolation Test Voltage	- Input to Output, 60 s - Input to Case, 60 s	2'250 VDC 1'600 VDC
Isolation Resistance	- Input to Output, 500 VDC	1'000 MΩ 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)
Washing Process		According to Cleaning Guideline <a href="http://www.tracopower.com/info/cleaning.pdf">www.tracopower.com/info/cleaning.pdf</a>

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

Environment	- Vibration	MIL-STD-810F EN 61373
	- Mechanical Shock	MIL-STD-810F EN 61373
	- Thermal Shock	MIL-STD-810F
	- Flammability	EN 45545-2 <a href="http://www.tracopower.com/info/en45545-declaration.pdf">www.tracopower.com/info/en45545-declaration.pdf</a>
Housing Material		Copper, Nickel plated
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 - 3 µm)
Pin Surface Plating		Tin (3 - 5 µm), matte
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 265°C / 10 s max.
Weight		30 g
Thermal Impedance	- Case to Ambient	12 K/W typ.
		10 K/W typ. (with Heat Sink)
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-1 (RoHS exemptions refer to the component concentration only, not to the overall concentration in the product (O5A rule).)
	- SCIP Reference Number	adacaa16-264a-497b-ab20-9b54c430be79

## Supporting Documents

Overview Link (for additional Documents)

[www.tracopower.com/overview/ten20wir](http://www.tracopower.com/overview/ten20wir)

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**Outline Dimensions**



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)

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

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