



**THE DATASHEET OF  
TEN 40-2412WIR**



- 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
- High efficiency up to 92%
- 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 40WIR series is a family of high performance 40 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 40-2410WIR	9 - 36 VDC (24 VDC nom.)	3.3 VDC	10'000 mA			90 %
TEN 40-2411WIR		5 VDC	8'000 mA			91 %
TEN 40-2412WIR		12 VDC	3'333 mA			92 %
TEN 40-2413WIR		15 VDC	2'666 mA			92 %
TEN 40-2415WIR		24 VDC	1'666 mA			91 %
TEN 40-2422WIR		+12 VDC	1'666 mA	-12 VDC	1'666 mA	90 %
TEN 40-2423WIR		+15 VDC	1'333 mA	-15 VDC	1'333 mA	90 %
TEN 40-2425WIR		+24 VDC	833 mA	-24 VDC	833 mA	91 %
TEN 40-4810WIR	18 - 75 VDC (48 VDC nom.)	3.3 VDC	10'000 mA			90 %
TEN 40-4811WIR		5 VDC	8'000 mA			91 %
TEN 40-4812WIR		12 VDC	3'333 mA			92 %
TEN 40-4813WIR		15 VDC	2'666 mA			92 %
TEN 40-4815WIR		24 VDC	1'666 mA			91 %
TEN 40-4822WIR		+12 VDC	1'666 mA	-12 VDC	1'666 mA	90 %
TEN 40-4823WIR		+15 VDC	1'333 mA	-15 VDC	1'333 mA	90 %
TEN 40-4825WIR		+24 VDC	833 mA	-24 VDC	833 mA	91 %
TEN 40-7210WIR	43 - 160 VDC (110 VDC nom.)	3.3 VDC	10'000 mA			88 %
TEN 40-7211WIR		5 VDC	8'000 mA			89 %
TEN 40-7212WIR		12 VDC	3'333 mA			91 %
TEN 40-7213WIR		15 VDC	2'666 mA			91 %
TEN 40-7215WIR		24 VDC	1'666 mA			90 %
TEN 40-7222WIR		+12 VDC	1'666 mA	-12 VDC	1'666 mA	89 %
TEN 40-7223WIR		+15 VDC	1'333 mA	-15 VDC	1'333 mA	89 %
TEN 40-7225WIR		+24 VDC	833 mA	-24 VDC	833 mA	91 %

Options	
<b>TEN-HS1</b>	- 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>
<b>TEN-HS8</b>	- Optional Heat Sink with Height = 0.3 inch: <a href="http://www.tracopower.com/products/ten-hs8.pdf">www.tracopower.com/products/ten-hs8.pdf</a>
<b>on demand</b> (backorder with MOQ non stocking item)	- Optional Heat Sink with Height = 0.8 inch: <a href="http://www.tracopower.com/products/ten-hs10.pdf">www.tracopower.com/products/ten-hs10.pdf</a>
	- Optional Heat Sink with Height = 0.5 inch: <a href="http://www.tracopower.com/products/ten-hs9.pdf">www.tracopower.com/products/ten-hs9.pdf</a>

Note - The outputs of the  $\pm 24$  Vout models can also be used in serial circuit for 48 VDC operation. Free-wheeling diodes are not necessary but recommended for increased performance for start-up with inductive / capacitive load operation.

Input Specifications	
Input Current	- At no load 24 Vin models: <b>15 mA typ.</b> 48 Vin models: <b>10 mA typ.</b> 110 Vin models: <b>10 mA typ.</b>
Surge Voltage	24 Vin models: <b>50 VDC max.</b> (1 s max.) 48 Vin models: <b>100 VDC max.</b> (1 s max.) 110 Vin models: <b>170 VDC max.</b> (1 s 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 VDC min. / 16 VDC typ. / 17.5 VDC max.</b> 110 Vin models: <b>37 VDC min. / 40 VDC typ. / 42 VDC max.</b>
Reflected Ripple Current	<b>20 mAp-p typ.</b>
Recommended Input Fuse	24 Vin models: <b>8'000 mA</b> (fast acting) 48 Vin models: <b>4'000 mA</b> (slow blow) 110 Vin models: <b>3'150 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>

Output Specifications	
Output Voltage Adjustment	<b>-10% to +20%</b> (15 & 24 Vout models) <b><math>\pm 10\%</math></b> (other models) (single output models only) (By external trim resistor) See application note: <a href="http://www.tracopower.com/overview/ten40wir">www.tracopower.com/overview/ten40wir</a> Output power must not exceed rated power!
Voltage Set Accuracy	<b><math>\pm 1\%</math> max.</b>
Regulation	- Input Variation (Vmin - Vmax) single output models: <b>0.2% max.</b> dual output models: <b>0.2% max.</b> - Load Variation (0 - 100%) single output models: <b>0.5% max.</b> dual output models: <b>1% max.</b> (Output 1) <b>1% max.</b> (Output 2) - Cross Regulation (25% / 100% asym. load) dual output models: <b>5% max.</b>

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

Ripple and Noise (20 MHz Bandwidth)	- single output	3.3 Vout models: <b>100 mVp-p max.</b> (w/ 0.1 $\mu$ F, 50 V X7R) 5 Vout models: <b>100 mVp-p max.</b> (w/ 0.1 $\mu$ F, 50 V X7R) 12 Vout models: <b>125 mVp-p max.</b> (w/ 0.1 $\mu$ F, 50 V X7R) 15 Vout models: <b>125 mVp-p max.</b> (w/ 0.1 $\mu$ F, 50 V X7R) 24 Vout models: <b>200 mVp-p max.</b> (w/ 0.1 $\mu$ F, 50 V X7R)
	- dual output	12 / -12 Vout models: <b>125 / 125 mVp-p max.</b> (w/ 0.1 $\mu$ F, 50 V X7R) 15 / -15 Vout models: <b>125 / 125 mVp-p max.</b> (w/ 0.1 $\mu$ F, 50 V X7R) 24 / -24 Vout models: <b>200 / 200 mVp-p max.</b> (w/ 0.1 $\mu$ F, 50 V X7R)
	- single output	3.3 Vout models: <b>75 mVp-p typ.</b> (w/ 0.1 $\mu$ F, 50 V X7R) 5 Vout models: <b>75 mVp-p typ.</b> (w/ 0.1 $\mu$ F, 50 V X7R) 12 Vout models: <b>100 mVp-p typ.</b> (w/ 0.1 $\mu$ F, 50 V X7R) 15 Vout models: <b>100 mVp-p typ.</b> (w/ 0.1 $\mu$ F, 50 V X7R) 24 Vout models: <b>150 mVp-p typ.</b> (w/ 0.1 $\mu$ F, 50 V X7R)
	- dual output	12 / -12 Vout models: <b>100 / 100 mVp-p typ.</b> (w/ 0.1 $\mu$ F, 50 V X7R) 15 / -15 Vout models: <b>100 / 100 mVp-p typ.</b> (w/ 0.1 $\mu$ F, 50 V X7R) 24 / -24 Vout models: <b>150 / 150 mVp-p typ.</b> (w/ 0.1 $\mu$ F, 50 V X7R)
	Capacitive Load	3.3 Vout models: <b>26'600 <math>\mu</math>F max.</b> 5 Vout models: <b>20'000 <math>\mu</math>F max.</b> 12 Vout models: <b>3'900 <math>\mu</math>F max.</b> 15 Vout models: <b>2'600 <math>\mu</math>F max.</b> 24 Vout models: <b>1'300 <math>\mu</math>F max.</b>
	- dual output	12 / -12 Vout models: <b>2'600 / 2'600 <math>\mu</math>F max.</b> 15 / -15 Vout models: <b>1'600 / 1'600 <math>\mu</math>F max.</b> 24 / -24 Vout models: <b>650 / 650 <math>\mu</math>F max.</b>
Minimum Load		Not required
Temperature Coefficient		$\pm 0.02$ %/K max.
Hold-up Time		10 ms min. (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		60 ms typ.
Short Circuit Protection		Continuous, Automatic recovery
Overload Protection		Indefinite Mode
Output Current Limitation		125 - 210% of Iout max. 150% typ. of Iout max.
Overvoltage Protection		125% typ. of Vout nom. (By Zener diode)
Transient Response	- Response Deviation	10% max. (25% Load Step)
	- Response Time	250 $\mu$ s typ. (25% Load Step)

### 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 - Certification Documents	EN 50155 <a href="http://www.tracopower.com/overview/ten40wir">www.tracopower.com/overview/ten40wir</a>
Pollution Degree		PD 2

### EMC Specifications

EMI Emissions	- Conducted Emissions	EN 50121-3-2 (EMC for Rolling Stock) 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: <a href="http://www.tracopower.com/overview/ten40wir">www.tracopower.com/overview/ten40wir</a>

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

EMS Immunity	<ul style="list-style-type: none"> <li>- Electrostatic Discharge</li> <li>- RF Electromagnetic Field</li> <li>- EFT (Burst) / Surge</li> </ul>	Air:	EN 50121-3-2 (EMC for Rolling Stock)
		Contact:	EN 61000-4-2, $\pm 8$ kV, perf. criteria A EN 61000-4-2, $\pm 6$ kV, perf. criteria A EN 61000-4-3, 20 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
	<ul style="list-style-type: none"> <li>- Conducted RF Disturbances</li> <li>- PF Magnetic Field</li> </ul>	Ext. input component:	220 $\mu$ F, 100 V, KY   SMDJ58A (24 Vin) 220 $\mu$ F, 100 V, KY    SMDJ120A (48 Vin) 2x 150 $\mu$ F, 200 V, KXJ    2x SMDJ90A (110 Vin)
		Continuous:	EN 61000-4-6, 10 Vrms, perf. criteria A 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 +85°C
	- Case Temperature	-40°C to +90°C (with Heat Sink)
	- Storage Temperature	+105°C max. -55°C to +125°C
Power Derating	- High Temperature	2.5 %/K above 60°C
		2.8 %/K above 65°C (with Heat Sink)
		See application note: <a href="http://www.tracopower.com/overview/ten40wir">www.tracopower.com/overview/ten40wir</a>
Cooling System		Natural convection (20 LFM)
Remote Control	<ul style="list-style-type: none"> <li>- Voltage Controlled Remote (passive = on)</li> <li>- Off Idle Input Current</li> <li>- Remote Pin Input Current</li> </ul>	On: 3.5 to 12 VDC or open circuit
		Off: 0 to 1.2 VDC or short circuit
		Refers to 'Remote' and '-Vin' Pin 3 mA max. -0.5 to 0.5 mA
Altitude During Operation		5'000 m max.
Regulator Topology		Flyback Converter
Switching Frequency		225 - 275 kHz (PWM) 250 kHz typ. (PWM)
Insulation System		Functional Insulation
Isolation Test Voltage	- Input to Output, 60 s	3'000 VDC (110 Vin models)
		1600 VDC (other models)
Isolation Resistance	- Input to Output, 500 VDC	1'000 M $\Omega$ min.
Isolation Capacitance	- Input to Output, 100 kHz, 1 V	1'500 pF max.
Reliability	- Calculated MTBF	900'000 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>
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
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 $\mu$ m)
Pin Surface Plating		Tin (3 - 5 $\mu$ m), matte
Housing Type		Metal Case
Mounting Type		PCB Mount
Connection Type		THD (Through-Hole Device)
Footprint Type		2" x 1"

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

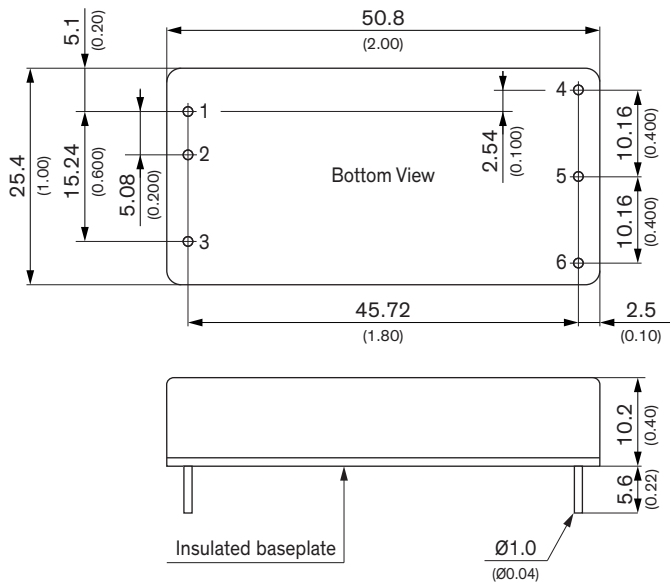
Soldering Profile		Lead-Free Wave Soldering 265°C / 10 s max.
Weight		32 g
Thermal Impedance	- Case to Ambient	10.8 K/W <i>typ.</i> (without heatsink) 10.3 W/K <i>typ.</i> (with heatsink TEN-HS1)
Environmental Compliance	- REACH Declaration	<a href="http://www.tracopower.com/info/reach-declaration.pdf">www.tracopower.com/info/reach-declaration.pdf</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).)
	- SCIP Reference Number	00c7ae30-3d8c-4682-88e1-0d2e69ce3142

### Supporting Documents

Overview Link (for additional Documents)

[www.tracopower.com/overview/ten40wir](http://www.tracopower.com/overview/ten40wir)

### 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	Remote On/Off	Remote On/Off
4	+Vout	+Vout
5	-Vout	Common
6	Trim	-Vout

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