

- 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<br>(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<br>(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<br>(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: <a href="http://www.tracopower.com/products/ten-hs1.pdf">www.tracopower.com/products/ten-hs1.pdf</a>   |
| <b>TEN-HS10</b> | - Optional Heat Sink: <a href="http://www.tracopower.com/products/ten-hs10.pdf">www.tracopower.com/products/ten-hs10.pdf</a> |
| <b>TEN-HS8</b>  | - Optional Heat Sink: <a href="http://www.tracopower.com/products/ten-hs8.pdf">www.tracopower.com/products/ten-hs8.pdf</a>   |
| <b>TEN-HS9</b>  | - Optional Heat Sink: <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><br>48 Vin models: <b>10 mA typ.</b><br>110 Vin models: <b>10 mA typ.</b>  |
| Surge Voltage            |              | 24 Vin models: <b>50 VDC max.</b> (1 s max.)<br>48 Vin models: <b>100 VDC max.</b> (1 s max.)<br>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><br>48 Vin models: <b>15 VDC min. / 16 VDC typ. / 17.5 VDC max.</b><br>110 Vin models: <b>37 VDC min. / 40 VDC typ. / 42 VDC max.</b>                      |
| Reflected Ripple Current |              | <b>20 mA<sub>p-p</sub> typ.</b>  |
| Recommended Input Fuse   |              | 24 Vin models: <b>8'000 mA</b> (fast acting)<br>48 Vin models: <b>4'000 mA</b> (slow blow)<br>110 Vin models: <b>3'150 mA</b> (slow blow)<br>(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)<br><b><math>\pm 10\%</math></b> (other models)<br>(single output models only)<br>(By external trim resistor)<br>See application note: <a href="http://www.tracopower.com/overview/ten40wir">www.tracopower.com/overview/ten40wir</a><br>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><br>dual output models: <b>0.2% max.</b>  |
|                           | - Load Variation (0 - 100%)                | single output models: <b>0.5% max.</b><br>dual output models: <b>1% max.</b> (Output 1)<br><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.

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

## Safety Specifications

|                         |   |  |
|-------------------------|---|--|
| <b>Safety Standards</b> | - IT / Multimedia Equipment                         | EN 60950-1<br>EN 62368-1<br>IEC 60950-1<br>IEC 62368-1<br>UL 60950-1<br>UL 62368-1                         |
|                         | - Railway Applications<br>- Certification Documents | EN 50155<br><a href="http://www.tracopower.com/overview/ten40wir">www.tracopower.com/overview/ten40wir</a> |
| <b>Pollution Degree</b> |   | PD 2   |

## EMC Specifications

|                      |                           |  |
|----------------------|---------------------------|--|
| <b>EMI Emissions</b> | - Conducted Emissions     | EN 50121-3-2 (EMC for Rolling Stock)<br>EN 55032 class A (with external filter)<br>EN 55032 class B (with external filter) |
|                      | - Radiated Emissions      | EN 55032 class A (with external filter)<br>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> <li>- Conducted RF Disturbances</li> <li>- PF Magnetic Field</li> </ul> | EN 50155 (Railway Applications)<br>EN 50121-3-2 (EMC for Rolling Stock)<br>Air: EN 61000-4-2, $\pm 8$ kV, perf. criteria A<br>Contact: EN 61000-4-2, $\pm 6$ kV, perf. criteria A<br>EN 61000-4-3, 20 V/m, perf. criteria A<br>EN 61000-4-4, $\pm 2$ kV, perf. criteria A<br>EN 61000-4-5, $\pm 2$ kV, perf. criteria A<br>Ext. input component: 220 $\mu$ F, 100 V, KY // SMDJ58A (24 Vin)<br>220 $\mu$ F, 100 V, KY // SMDJ120A (48 Vin)<br>2x 150 $\mu$ F, 200 V, KXJ // 2x SMDJ90A (110 Vin)<br>Continuous: EN 61000-4-6, 10 Vrms, perf. criteria A<br>EN 61000-4-8, 100 A/m, perf. criteria A<br>1 s: EN 61000-4-8, 1000 A/m, perf. criteria A |
|--------------|--|---|

## General Specifications

|                           |   |   |
|---------------------------|---|---|
| Relative Humidity         |   | 95% max. (non condensing)   |
| Temperature Ranges        | <ul style="list-style-type: none"> <li>- Operating Temperature</li> <li>- Case Temperature</li> <li>- Storage Temperature</li> </ul>                | -40°C to +85°C<br>-40°C to +90°C (with Heat Sink)<br>+105°C max.<br>-55°C to +125°C   |
| Power Derating            | <ul style="list-style-type: none"> <li>- High Temperature</li> </ul>  | 2.5 %/K above 60°C<br>2.8 %/K above 65°C (with Heat Sink)   |
| Cooling System            |   | Natural convection (20 LFM)   |
| Remote Control            | <ul style="list-style-type: none"> <li>- Voltage Controlled Remote</li> <li>- Off Idle Input Current</li> <li>- Remote Pin Input Current</li> </ul> | On: 3.5 to 12 VDC or open circuit<br>Off: 0 to 1.2 VDC or short circuit<br>Refers to 'Remote' and '-Vin' Pin<br>3 mA max.<br>-0.5 to 0.5 mA |
| Altitude During Operation |   | 5'000 m max.  |
| Switching Frequency       |   | 225 - 275 kHz (PWM)<br>250 kHz typ. (PWM)   |
| Insulation System         |   | Functional Insulation   |
| Isolation Test Voltage    | <ul style="list-style-type: none"> <li>- Input to Output, 60 s</li> </ul>   | 3'000 VDC (110 Vin models)<br>1600 VDC (other models)   |
| Isolation Resistance      | <ul style="list-style-type: none"> <li>- Input to Output, 500 VDC</li> </ul>  | 1'000 M $\Omega$ min.   |
| Isolation Capacitance     | <ul style="list-style-type: none"> <li>- Input to Output, 100 kHz, 1 V</li> </ul>   | 1'500 pF max.   |
| Reliability               | <ul style="list-style-type: none"> <li>- Calculated MTBF</li> </ul>   | 900'000 h (MIL-HDBK-217F, ground benign)  |
| Washing Process           | See Cleaning Guideline:   | Allowed (hermetical product)<br><a href="http://www.tracopower.com/info/cleaning.pdf">www.tracopower.com/info/cleaning.pdf</a>              |
| Environment               | <ul style="list-style-type: none"> <li>- Vibration</li> <li>- Mechanical Shock</li> <li>- Thermal Shock</li> </ul>                                  | MIL-STD-810F<br>EN 61373<br>MIL-STD-810F<br>EN 61373<br>MIL-STD-810F<br>EN 50155  |
| 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.

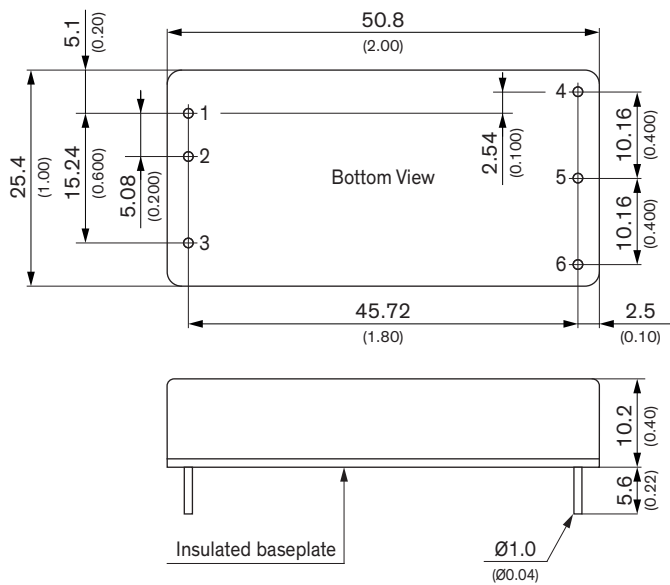
|                          |  |
|--------------------------|--|
| Soldering Profile        | Wave Soldering<br>265°C / 10 s max.  |
| Weight                   | 32 g   |
| Thermal Impedance        | 10.8 K/W<br>10.3 K/W (with Heat Sink)  |
| Environmental Compliance | <p>- REACH Declaration <a href="http://www.tracopower.com/info/reach-declaration.pdf">www.tracopower.com/info/reach-declaration.pdf</a><br/>REACH SVHC list compliant<br/>REACH Annex XVII compliant</p> <p>- RoHS Declaration <a href="http://www.tracopower.com/info/rohs-declaration.pdf">www.tracopower.com/info/rohs-declaration.pdf</a><br/><b>Exemptions: 7a, 7c-I</b><br/>(RoHS exemptions refer to the component concentration only, not to the overall concentration in the product (O5A rule).<br/>The SCIP number is provided on request.)</p> <p>- Flammability (EN 45545-2) <a href="http://www.tracopower.com/info/en45545-declaration.pdf">www.tracopower.com/info/en45545-declaration.pdf</a></p> |

### 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         |