

## DC/DC Converter

## TEN 20WIN Series, 20 Watt

- 2" x 1" x 0.4" metal package
- Ultra wide 4:1 input range
- Operating temperature range -40°C to +85°C
- I/O isolation 1500 VDC
- Input filter to meet EN 55022 class A
- Adjustable output voltage
- Remote On/Off



The TEN 20WIN series is a family of high performance 20W DC/DC converter modules featuring ultra wide 4:1 input voltage ranges in a ultra compact 2" x 1" low profile package with industry-standard footprint. A very high efficiency allows an operating temperature range of -40°C to 85°C. Further standard features include remote On/Off, output voltage trimming, over voltage protection and short circuit protection. Typical applications for these converters are battery operated equipment and distributed power architectures in communication and industrial electronics, everywhere where isolated, tightly regulated voltages are required.

### Models

| Order Code     | Input Voltage Range          | Output 1 |                  | Output 2 |                  | Efficiency typ. |
|----------------|------------------------------|----------|------------------|----------|------------------|-----------------|
|                |                              | Vnom     | I <sub>max</sub> | Vnom     | I <sub>max</sub> |                 |
| TEN 20-2410WIN | 9 - 36 VDC<br>(24 VDC nom.)  | 3.3 VDC  | 5'500 mA         |          |                  | 85 %            |
| TEN 20-2411WIN |                              | 5 VDC    | 4'000 mA         |          |                  | 88 %            |
| TEN 20-2412WIN |                              | 12 VDC   | 1'670 mA         |          |                  | 86 %            |
| TEN 20-2413WIN |                              | 15 VDC   | 1'330 mA         |          |                  | 86 %            |
| TEN 20-2421WIN |                              | +5 VDC   | 2'000 mA         | -5 VDC   | 2'000 mA         | 88 %            |
| TEN 20-2422WIN |                              | +12 VDC  | 833 mA           | -12 VDC  | 833 mA           | 87 %            |
| TEN 20-2423WIN |                              | +15 VDC  | 667 mA           | -15 VDC  | 667 mA           | 87 %            |
| TEN 20-4810WIN | 18 - 75 VDC<br>(48 VDC nom.) | 3.3 VDC  | 5'500 mA         |          |                  | 85 %            |
| TEN 20-4811WIN |                              | 5 VDC    | 4'000 mA         |          |                  | 88 %            |
| TEN 20-4812WIN |                              | 12 VDC   | 1'670 mA         |          |                  | 87 %            |
| TEN 20-4813WIN |                              | 15 VDC   | 1'330 mA         |          |                  | 87 %            |
| TEN 20-4821WIN |                              | +5 VDC   | 2'000 mA         | -5 VDC   | 2'000 mA         | 89 %            |
| TEN 20-4822WIN |                              | +12 VDC  | 833 mA           | -12 VDC  | 833 mA           | 88 %            |
| TEN 20-4823WIN |                              | +15 VDC  | 667 mA           | -15 VDC  | 667 mA           | 88 %            |

### Options

|         |                                                                                                                            |
|---------|----------------------------------------------------------------------------------------------------------------------------|
| TEN-HS1 | - Optional Heat Sink: <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: | 50 mA typ. (3.3 Vout model)<br>65 mA typ. (5 Vout model)<br>22 mA typ. (12 Vout model)<br>22 mA typ. (15 Vout model)<br>55 mA typ. (5 / -5 Vout model)<br>30 mA typ. (12 / -12 Vout model)<br>30 mA typ. (15 / -15 Vout model) |
|                          |                | 48 Vin models: | 35 mA typ. (3.3 Vout model)<br>35 mA typ. (5 Vout model)<br>15 mA typ. (12 Vout model)<br>15 mA typ. (15 Vout model)<br>35 mA typ. (5 / -5 Vout model)<br>17 mA typ. (12 / -12 Vout model)<br>17 mA typ. (15 / -15 Vout model) |
|                          | - At full load | 24 Vin models: | 2'750 mA max.                                                                                                                                                                                                                  |
|                          |                | 48 Vin models: | 2'750 mA max.                                                                                                                                                                                                                  |
| Surge Voltage            |                | 24 Vin models: | 50 VDC max. (100 ms max.)                                                                                                                                                                                                      |
|                          |                | 48 Vin models: | 100 VDC max. (100 ms max.)                                                                                                                                                                                                     |
| Under Voltage Lockout    |                | 24 Vin models: | 7 VDC min. / 8 VDC typ. / 8.8 VDC max.                                                                                                                                                                                         |
|                          |                | 48 Vin models: | 14.5 VDC min. / 16 VDC typ. / 17.5 VDC max.                                                                                                                                                                                    |
| Reflected Ripple Current |                |                | 20 mA typ.                                                                                                                                                                                                                     |
| Recommended Input Fuse   |                | 24 Vin models: | 4'000 mA (slow blow)                                                                                                                                                                                                           |
|                          |                | 48 Vin models: | 2'000 mA (slow blow)                                                                                                                                                                                                           |
|                          |                |                | (The need of an external fuse has to be assessed in the final application.)                                                                                                                                                    |
| Input Filter             |                |                | Internal Pi-Type                                                                                                                                                                                                               |

## Output Specifications

|                                        |                                            |                       |                                                                                                |
|----------------------------------------|--------------------------------------------|-----------------------|------------------------------------------------------------------------------------------------|
| Output Voltage Adjustment              |                                            |                       | ±10% (By external trim resistor)                                                               |
|                                        |                                            | See application note: | <a href="http://www.tracopower.com/overview/ten20win">www.tracopower.com/overview/ten20win</a> |
|                                        |                                            |                       | Output power must not exceed rated power!                                                      |
| 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: | 0.5% max.                                                                                      |
|                                        |                                            | dual output models:   | 1% max. (Output 1)<br>1% max. (Output 2)                                                       |
|                                        | - Cross Regulation (25% / 100% asym. load) | dual output models:   | 5% max.                                                                                        |
| Ripple and Noise<br>(20 MHz Bandwidth) | - single output                            | 3.3 Vout models:      | 60 mVp-p typ. (w/ 0.1 µF, 50 V MLCC)                                                           |
|                                        |                                            | 5 Vout models:        | 75 mVp-p typ. (w/ 0.1 µF, 50 V MLCC)                                                           |
|                                        |                                            | 12 Vout models:       | 75 mVp-p typ. (w/ 0.1 µF, 50 V MLCC)                                                           |
|                                        |                                            | 15 Vout models:       | 75 mVp-p typ. (w/ 0.1 µF, 50 V MLCC)                                                           |
|                                        | - dual output                              | 5 / -5 Vout models:   | 100 / 100 mVp-p typ. (w/ 0.1 µF, 50 V MLCC)                                                    |
|                                        |                                            | 12 / -12 Vout models: | 100 / 100 mVp-p typ. (w/ 0.1 µF, 50 V MLCC)                                                    |
|                                        |                                            | 15 / -15 Vout models: | 100 / 100 mVp-p typ. (w/ 0.1 µF, 50 V MLCC)                                                    |
| Capacitive Load                        | - single output                            | 3.3 Vout models:      | 18'000 µF max.                                                                                 |
|                                        |                                            | 5 Vout models:        | 9'600 µF max.                                                                                  |
|                                        |                                            | 12 Vout models:       | 1'650 µF max.                                                                                  |
|                                        |                                            | 15 Vout models:       | 1'050 µF max.                                                                                  |
|                                        | - dual output                              | 5 / -5 Vout models:   | 4'800 / 4'800 µF max.                                                                          |
|                                        |                                            | 12 / -12 Vout models: | 825 / 825 µF max.                                                                              |
|                                        |                                            | 15 / -15 Vout models: | 525 / 525 µF max.                                                                              |
| Minimum Load                           |                                            |                       | Not required                                                                                   |
| Temperature Coefficient                |                                            |                       | ±0.02 %/K max.                                                                                 |

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

|                           |                                                                                                                                                                                   |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Start-up Time             | 20 ms typ. / 60 ms max.                                                                                                                                                           |
| Short Circuit Protection  | Continuous, Automatic recovery                                                                                                                                                    |
| Overload Protection       | Indefinite Mode                                                                                                                                                                   |
| Output Current Limitation | 125 - 170% of I <sub>out</sub> max.<br>150% typ. of I <sub>out</sub> max.                                                                                                         |
| Overvoltage Protection    | 122% typ. of V <sub>out</sub> nom.<br>(depending on model)<br>3.9 VDC (3.3 VDC model)<br>6.2 VDC (5 / ±5 VDC model)<br>15 VDC (12 / ±12 VDC model)<br>18 VDC (15 / ±15 VDC model) |
| Transient Response        | - Peak Variation<br>220 mV max. (25% Load Step)<br>- Response Time<br>250 µs typ. (25% Load Step)                                                                                 |

## Safety Specifications

|                       |                             |                                                                                                |
|-----------------------|-----------------------------|------------------------------------------------------------------------------------------------|
| Safety Standards      | - 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             |
|                       | - Certification Documents   | <a href="http://www.tracopower.com/overview/ten20win">www.tracopower.com/overview/ten20win</a> |
| Pollution Degree      |                             | PD 2                                                                                           |
| Over Voltage Category |                             | Not mains connected                                                                            |

## EMC Specifications

|               |                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EMI Emissions | - Conducted Emissions<br>- Radiated Emissions                                                                                          | EN 61204-3 (Low Voltage Power Supplies)<br>EN 55032 class A (with external filter)<br>EN 55032 class B (with external filter)<br>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/ten20win">www.tracopower.com/overview/ten20win</a>                                                                                                                                                                                                                                                                                                                                          |
| EMS Immunity  | - Electrostatic Discharge<br>- RF Electromagnetic Field<br>- EFT (Burst) / Surge<br>- Conducted RF Disturbances<br>- PF Magnetic Field | EN 61204-3 (Low Voltage Power Supplies)<br>Air: EN 61000-4-2, ±8 kV, perf. criteria B<br>Contact: EN 61000-4-2, ±6 kV, perf. criteria B<br>EN 61000-4-3, 10 V/m, perf. criteria A<br>EN 61000-4-4, ±2 kV, perf. criteria B<br>EN 61000-4-5, ±1 kV, perf. criteria A<br>Ext. input component: KY 220 µF / 100 V<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        | - Operating Temperature<br>- Case Temperature<br>- Storage Temperature                | -40°C to +85°C<br>+105°C max.<br>-55°C to +125°C                                                                                              |
| Power Derating            | - High Temperature                                                                    | See application note: <a href="http://www.tracopower.com/overview/ten20win">www.tracopower.com/overview/ten20win</a>                          |
| Cooling System            |                                                                                       | Natural convection (20 LFM)                                                                                                                   |
| Remote Control            | - Voltage Controlled Remote<br>- Off Idle Input Current<br>- Remote Pin Input Current | On: 3.0 to 12 VDC or open circuit<br>Off: 0 to 1.2 VDC or short circuit<br>Refers to 'Remote' and '-Vin' Pin<br>2.5 mA typ.<br>-0.5 to 0.5 mA |
| Altitude During Operation |                                                                                       | 5'000 m max.                                                                                                                                  |

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

|                          |                                                                                                                                                                  |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Switching Frequency      | 360 - 440 kHz (PWM)<br>400 kHz typ. (PWM)                                                                                                                        |
| Insulation System        | Functional Insulation                                                                                                                                            |
| Isolation Test Voltage   | 1'600 VDC                                                                                                                                                        |
| - Input to Output, 60 s  | 1'600 VDC                                                                                                                                                        |
| - Input to Case, 60 s    | 1'600 VDC                                                                                                                                                        |
| - Output to Case, 60 s   | 1'600 VDC                                                                                                                                                        |
| Isolation Resistance     | 1'000 MΩ min.                                                                                                                                                    |
| Isolation Capacitance    | 1'500 pF max.                                                                                                                                                    |
| Reliability              | 1'800'000 h (MIL-HDBK-217F, ground benign)                                                                                                                       |
| Washing Process          | Allowed (hermetical product)                                                                                                                                     |
| See Cleaning Guideline:  | <a href="http://www.tracopower.com/info/cleaning.pdf">www.tracopower.com/info/cleaning.pdf</a>                                                                   |
| Environment              | MIL-STD-810F                                                                                                                                                     |
| - Vibration              | 7.7 g, 3 axis, random waveform, 60 min                                                                                                                           |
| - Mechanical Shock       | MIL-STD-810F                                                                                                                                                     |
| - Thermal Shock          | 40 g, 3 axis, terminal peak sawtooth, 11 ms                                                                                                                      |
|                          | MIL-STD-810F                                                                                                                                                     |
|                          | -55°C to +125°C, 72 cycles, 30 min each                                                                                                                          |
| Housing Material         | Copper, Nickel plated                                                                                                                                            |
| Base Material            | Non-conductive FR4 (UL 94 V-0 rated)                                                                                                                             |
| Potting Material         | Epoxy (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        | Wave Soldering<br>260°C / 6 s max.                                                                                                                               |
| Weight                   | 27 g                                                                                                                                                             |
| Thermal Impedance        | 12 K/W<br>10 K/W (with Heat Sink)                                                                                                                                |
| Environmental Compliance | <a href="http://www.tracopower.com/info/reach-declaration.pdf">www.tracopower.com/info/reach-declaration.pdf</a>                                                 |
| - REACH Declaration      | 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.) |

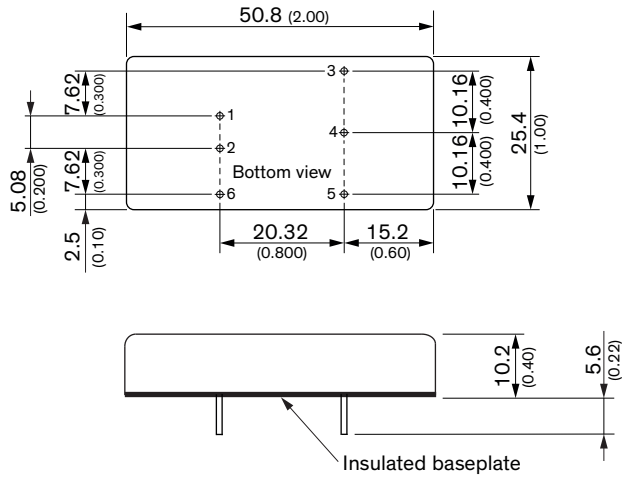
## Supporting Documents

Overview Link (for additional Documents)

[www.tracopower.com/overview/ten20win](http://www.tracopower.com/overview/ten20win)

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

## Outline Dimensions



Dimensions in mm (inch)  
Pin diameter: 1.0 ±0.1 (0.04 ±0.004)  
Tolerances: x.x ±0.5 (x.xx ±0.02)  
              x.xx ±0.25 (x.xxx ±0.01)

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