

- DIP-24 package with industry standard footprint
- Wide 2:1 input voltage range
- Input filter meets EN 55032, class A
- Extended operating temperature range: -40°C to +85°C
- Remote On/Off
- Shielded metal casing with insulated baseplate
- Lead free design, RoHS compliant
- 3-year product warranty



UL 62368-1 IEC 62368-1

The TEN 8 series is a family of high performance 8 Watt DC/DC-converter modules featuring wide 2:1 input voltage ranges in a DIP-24 package with industry standard footprint. A very high efficiency allows an operating temperature range of -40°C to +85°C. A built-in EMI input filter complies with EN 55032, class A without external components. Further standard features include remote On/Off and short circuit protection.

Typical applications for these converters are battery operated equipment, instrumentation, communication and industrial electronics, everywhere where isolated, tightly regulated voltages are required and space is limited on the PCB.

| Models     |                              |          |                  |          |                  |                 |
|------------|------------------------------|----------|------------------|----------|------------------|-----------------|
| Order Code | Input Voltage Range          | Output 1 |                  | Output 2 |                  | Efficiency typ. |
|            |                              | Vnom     | I <sub>max</sub> | Vnom     | I <sub>max</sub> |                 |
| TEN 8-1210 | 9 - 18 VDC<br>(12 VDC nom.)  | 3.3 VDC  | 2'000 mA         |          |                  | 80 %            |
| TEN 8-1211 |                              | 5 VDC    | 1'500 mA         |          |                  | 83 %            |
| TEN 8-1212 |                              | 12 VDC   | 666 mA           |          |                  | 88 %            |
| TEN 8-1213 |                              | 15 VDC   | 533 mA           |          |                  | 87 %            |
| TEN 8-1221 |                              | +5 VDC   | 800 mA           | -5 VDC   | 800 mA           | 83 %            |
| TEN 8-1222 |                              | +12 VDC  | 333 mA           | -12 VDC  | 333 mA           | 87 %            |
| TEN 8-1223 |                              | +15 VDC  | 267 mA           | -15 VDC  | 267 mA           | 85 %            |
| TEN 8-2410 | 18 - 36 VDC<br>(24 VDC nom.) | 3.3 VDC  | 2'000 mA         |          |                  | 80 %            |
| TEN 8-2411 |                              | 5 VDC    | 1'500 mA         |          |                  | 83 %            |
| TEN 8-2412 |                              | 12 VDC   | 666 mA           |          |                  | 86 %            |
| TEN 8-2413 |                              | 15 VDC   | 533 mA           |          |                  | 85 %            |
| TEN 8-2421 |                              | +5 VDC   | 800 mA           | -5 VDC   | 800 mA           | 82 %            |
| TEN 8-2422 |                              | +12 VDC  | 333 mA           | -12 VDC  | 333 mA           | 86 %            |
| TEN 8-2423 |                              | +15 VDC  | 267 mA           | -15 VDC  | 267 mA           | 85 %            |
| TEN 8-4810 | 36 - 75 VDC<br>(48 VDC nom.) | 3.3 VDC  | 2'000 mA         |          |                  | 80 %            |
| TEN 8-4811 |                              | 5 VDC    | 1'500 mA         |          |                  | 83 %            |
| TEN 8-4812 |                              | 12 VDC   | 666 mA           |          |                  | 86 %            |
| TEN 8-4813 |                              | 15 VDC   | 533 mA           |          |                  | 86 %            |
| TEN 8-4821 |                              | +5 VDC   | 800 mA           | -5 VDC   | 800 mA           | 85 %            |
| TEN 8-4822 |                              | +12 VDC  | 333 mA           | -12 VDC  | 333 mA           | 87 %            |
| TEN 8-4823 |                              | +15 VDC  | 267 mA           | -15 VDC  | 267 mA           | 87 %            |

## Input Specifications

|                        |                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Input Current          | - At no load   | 12 Vin models: <b>15 mA typ.</b><br>24 Vin models: <b>15 mA typ.</b><br>48 Vin models: <b>10 mA typ.</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|                        | - At full load | 12 Vin models: <b>720 mA max.</b> (3.3 Vout model)<br><b>800 mA max.</b> (5 Vout model)<br><b>800 mA max.</b> (12 Vout model)<br><b>800 mA max.</b> (15 Vout model)<br><b>800 mA max.</b> (5 / -5 Vout model)<br><b>800 mA max.</b> (12 / -12 Vout model)<br><b>800 mA max.</b> (15 / -15 Vout model)<br>24 Vin models: <b>360 mA max.</b> (3.3 Vout model)<br><b>400 mA max.</b> (5 Vout model)<br><b>400 mA max.</b> (12 Vout model)<br><b>400 mA max.</b> (15 Vout model)<br><b>400 mA max.</b> (5 / -5 Vout model)<br><b>400 mA max.</b> (12 / -12 Vout model)<br><b>400 mA max.</b> (15 / -15 Vout model)<br>48 Vin models: <b>180 mA max.</b> (3.3 Vout model)<br><b>200 mA max.</b> (5 Vout model)<br><b>200 mA max.</b> (12 Vout model)<br><b>200 mA max.</b> (15 Vout model)<br><b>200 mA max.</b> (5 / -5 Vout model)<br><b>200 mA max.</b> (12 / -12 Vout model)<br><b>200 mA max.</b> (15 / -15 Vout model) |
| Surge Voltage          |                | 12 Vin models: <b>36 VDC max.</b> (100 ms max.)<br>24 Vin models: <b>50 VDC max.</b> (100 ms max.)<br>48 Vin models: <b>100 VDC max.</b> (100 ms max.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Recommended Input Fuse |                | 12 Vin models: <b>2'000 mA</b> (slow blow)<br>24 Vin models: <b>1'000 mA</b> (slow blow)<br>48 Vin models: <b>500 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

|                          |                                            |                                                                                                                                                          |
|--------------------------|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Voltage Set Accuracy     |                                            | <b>±1% 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>                                                                                                                       |
| Ripple and Noise         | - 20 MHz Bandwidth                         | <b>50 mVp-p typ.</b>                                                                                                                                     |
| Capacitive Load          | - single output                            | 3.3 Vout models: <b>3'300 µF max.</b><br>5 Vout models: <b>1'600 µF max.</b><br>12 Vout models: <b>350 µF max.</b><br>15 Vout models: <b>240 µF max.</b> |
|                          | - dual output                              | 5 / -5 Vout models: <b>1'000 / 1'000 µF max.</b><br>12 / -12 Vout models: <b>160 / 160 µF max.</b><br>15 / -15 Vout models: <b>100 / 100 µF max.</b>     |
| Minimum Load             |                                            | <b>Not required</b>                                                                                                                                      |
| Temperature Coefficient  |                                            | <b>±0.02 %/K max.</b>                                                                                                                                    |
| Start-up Time            |                                            | <b>700 ms typ.</b> (Power On)<br><b>5 ms typ.</b> (Remote On)                                                                                            |
| Short Circuit Protection |                                            | <b>Continuous, Automatic recovery</b>                                                                                                                    |

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

|                           |                  |                                                                                                                                                                                                                       |
|---------------------------|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Output Current Limitation |                  | 150% typ. of I <sub>out</sub> max.                                                                                                                                                                                    |
| Transient Response        | - Peak Variation | 165 mV typ. / 264 mV max. (25% Load Step)<br>(3.3 V <sub>out</sub> models)<br>250 mV typ. / 400 mV max. (25% Load Step)<br>(5 V <sub>out</sub> models)<br>225 mV typ. / 450 mV max. (25% Load Step)<br>(other models) |
|                           | - Response Time  | 200 µs typ. (25% Load Step)                                                                                                                                                                                           |

## Safety Specifications

|                       |                             |                                                                                                                                                                                                                       |
|-----------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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<br><br>- Certification Documents<br><a href="http://www.tracopower.com/ten8-safety-cert/">www.tracopower.com/ten8-safety-cert/</a> |
| Energy Source         | - Output, acc. to 62368-1   | ES1                                                                                                                                                                                                                   |
| Power Source          | - Output, acc. to 62368-1   | PS1                                                                                                                                                                                                                   |
| Pollution Degree      |                             | PD 2                                                                                                                                                                                                                  |
| Over Voltage Category |                             | Not mains connected                                                                                                                                                                                                   |

## EMC Specifications

|                 |                             |                                                                                                                                                                                                                  |
|-----------------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EMI (Emissions) | - Conducted Emissions       | 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)<br><br>External filter proposal: <a href="http://www.tracopower.com/ten8-emc-filter/">www.tracopower.com/ten8-emc-filter/</a> |
| EMS (Immunity)  |                             | EN 55024 (IT Equipment)<br>EN 55035 (Multimedia)                                                                                                                                                                 |
|                 | - Electrostatic Discharge   | Air: EN 61000-4-2, ±8 kV, perf. criteria A<br>Contact: EN 61000-4-2, ±6 kV, perf. criteria A                                                                                                                     |
|                 | - RF Electromagnetic Field  | EN 61000-4-3, 10 V/m, perf. criteria A                                                                                                                                                                           |
|                 | - EFT (Burst) / Surge       | EN 61000-4-4, ±2 kV, perf. criteria A<br>EN 61000-4-5, ±1 kV, perf. criteria A                                                                                                                                   |
|                 |                             | Ext. input component: Nippon chemi-con KY series, 220µF/100V                                                                                                                                                     |
|                 | - Conducted RF Disturbances | EN 61000-4-6, 10 Vrms, perf. criteria A                                                                                                                                                                          |
|                 | - PF Magnetic Field         | Continuous: 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>+100°C max.<br>-55°C to +125°C                                                                                              |
| Power Derating            | - High Temperature                                                                                       | Depending on model<br><br>See application note: <a href="http://www.tracopower.com/ten8-cc/">www.tracopower.com/ten8-cc/</a>                  |
| Cooling System            |                                                                                                          | Natural convection (20 LFM)                                                                                                                   |
| Remote Control            | - Voltage Controlled Remote (passive = on)<br><br>- Off Idle Input Current<br>- Remote Pin Input Current | 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>2.5 mA max.<br>-0.5 to 0.5 mA |
| Altitude During Operation |                                                                                                          | 4'000 m max.                                                                                                                                  |
| Switching Frequency       |                                                                                                          | 270 - 330 kHz (PWM)<br>300 kHz typ. (PWM)                                                                                                     |

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

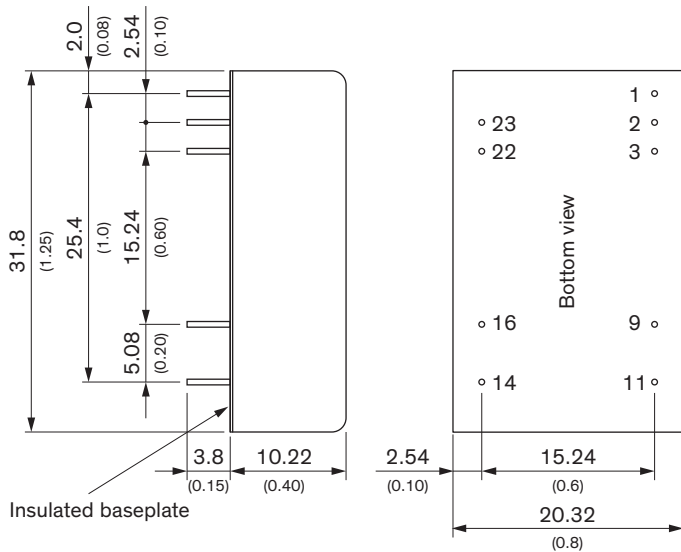
|                          |                                 |                                                                                                                                                                                                                                                                        |
|--------------------------|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Insulation System        |                                 | Functional Insulation                                                                                                                                                                                                                                                  |
| Isolation Test Voltage   | - 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     | - Input to Output, 500 VDC      | 1'000 MΩ min.                                                                                                                                                                                                                                                          |
| Isolation Capacitance    | - Input to Output, 100 kHz, 1 V | 300 pF max.                                                                                                                                                                                                                                                            |
| Reliability              | - Calculated MTBF               | 3'500'000 h (MIL-HDBK-217F, ground benign)                                                                                                                                                                                                                             |
| Washing Process          |                                 | According to Cleaning Guideline<br><a href="http://www.tracopower.com/info/cleaning.pdf">www.tracopower.com/info/cleaning.pdf</a>                                                                                                                                      |
| Environment              | - Vibration                     | MIL-STD-810F                                                                                                                                                                                                                                                           |
|                          | - Thermal Shock                 | MIL-STD-810F                                                                                                                                                                                                                                                           |
| Housing Material         |                                 | Copper, Nickel plated                                                                                                                                                                                                                                                  |
| Base Material            |                                 | Non-conductive Plastic (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           |                                 | DIP24                                                                                                                                                                                                                                                                  |
| Soldering Profile        |                                 | Lead-Free Wave Soldering<br>260°C / 6 s max.                                                                                                                                                                                                                           |
| Weight                   |                                 | 18 g                                                                                                                                                                                                                                                                   |
| Thermal Impedance        | - Case to Ambient               | 20.0 K/W typ.                                                                                                                                                                                                                                                          |
| Environmental Compliance | - 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                                                                                            |
|                          | - RoHS Declaration              | <a href="http://www.tracopower.com/info/rohs-declaration.pdf">www.tracopower.com/info/rohs-declaration.pdf</a><br>Exemptions: 7(a), 7(c)-I<br>(RoHS exemptions refer to the component concentration only, not to the overall concentration in the product (O5A rule).) |
|                          | - SCIP Reference Number         | c7564013-1ca8-4e6c-8756-0eb24832a380                                                                                                                                                                                                                                   |

## Additional Information

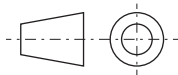
|                            |                                                                                                |
|----------------------------|------------------------------------------------------------------------------------------------|
| Supporting Documents       | <a href="http://www.tracopower.com/overview/ten8">www.tracopower.com/overview/ten8</a>         |
| Frequently Asked Questions | <a href="http://www.tracopower.com/glossary-faq">www.tracopower.com/glossary-faq</a>           |
| Glossary                   | <a href="http://www.tracopower.com/info/glossary.pdf">www.tracopower.com/info/glossary.pdf</a> |
| Service Portal             | <a href="http://www.tracoserviceportal.com">www.tracoserviceportal.com</a>                     |

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)  
Tolerances: x.x ±0.5 (x.xx ±0.02)  
x.xx ±0.25 (x.xxx ±0.01)  
Pin Ø 0.5 ±0.1 (0.02 ±0.004)



| Pinout |               |               |
|--------|---------------|---------------|
| Pin    | Single        | Dual          |
| 1      | Remote On/Off | Remote On/Off |
| 2      | -Vin (GND)    | -Vin (GND)    |
| 3      | -Vin (GND)    | -Vin (GND)    |
| 9      | NC            | Common        |
| 11     | NC            | -Vout         |
| 14     | +Vout         | +Vout         |
| 16     | -Vout         | Common        |
| 22     | +Vin (Vcc)    | +Vin (Vcc)    |
| 23     | +Vin (Vcc)    | +Vin (Vcc)    |

NC: Not connected

Avoid routing PCB traces under the converter.