

- Wide 2:1 input range
- Cost efficient design
- High power density
- High efficiency up to 86%
- Built-in EN 55032 class A filter
- I/O isolation 1'500 VDC
- Regulated outputs
- Continuous short-circuit protection
- High reliability, MTBF >1 Mio. h
- 3-year product warranty



UL 60950-1 IEC 60950-1

The TEL 5 Series is a range of DC/DC-converter modules with wide input range of 2:1. State of the art SMD-technology guarantees a product with very high reliability and excellent cost / performance ratio. High efficiency allows an operating temperature range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  at full load. This product series provides an economical solution for many cost critical applications in industrial and consumer electronics.

### Models

| Order Code | Input Voltage Range          | Output 1 |                  | Output 2 |                  | Efficiency typ. |
|------------|------------------------------|----------|------------------|----------|------------------|-----------------|
|            |                              | Vnom     | I <sub>max</sub> | Vnom     | I <sub>max</sub> |                 |
| TEL 5-1210 | 9 - 18 VDC<br>(12 VDC nom.)  | 3.3 VDC  | 1'200 mA         |          |                  | 77 %            |
| TEL 5-1211 |                              | 5 VDC    | 1'000 mA         |          |                  | 81 %            |
| TEL 5-1212 |                              | 12 VDC   | 500 mA           |          |                  | 84 %            |
| TEL 5-1222 |                              | +12 VDC  | 250 mA           | -12 VDC  | 250 mA           | 84 %            |
| TEL 5-1223 |                              | +15 VDC  | 200 mA           | -15 VDC  | 200 mA           | 84 %            |
| TEL 5-2410 | 18 - 36 VDC<br>(24 VDC nom.) | 3.3 VDC  | 1'200 mA         |          |                  | 79 %            |
| TEL 5-2411 |                              | 5 VDC    | 1'000 mA         |          |                  | 83 %            |
| TEL 5-2412 |                              | 12 VDC   | 500 mA           |          |                  | 86 %            |
| TEL 5-2422 |                              | +12 VDC  | 250 mA           | -12 VDC  | 250 mA           | 86 %            |
| TEL 5-2423 |                              | +15 VDC  | 200 mA           | -15 VDC  | 200 mA           | 86 %            |

## Input Specifications

|                           |                |                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Input Current             | - At no load   | 12 Vin models: 20 mA typ.<br>24 Vin models: 5 mA typ.                                                                                                                                                                                                                                                                                                                    |
|                           | - At full load | 12 Vin models: 429 mA typ. (3.3 Vout model)<br>514 mA typ. (5 Vout model)<br>595 mA typ. (12 Vout model)<br>595 mA typ. (12 / -12 Vout model)<br>595 mA typ. (15 / -15 Vout model)<br>24 Vin models: 209 mA typ. (3.3 Vout model)<br>251 mA typ. (5 Vout model)<br>291 mA typ. (12 Vout model)<br>291 mA typ. (12 / -12 Vout model)<br>291 mA typ. (15 / -15 Vout model) |
| Surge Voltage             |                | 12 Vin models: 25 VDC max. (1 s max.)<br>24 Vin models: 50 VDC max. (1 s max.)                                                                                                                                                                                                                                                                                           |
| Start-up Voltage          |                | 12 Vin models: 4.5 VDC min. / 6 VDC typ. / 8 VDC max.<br>24 Vin models: 8 VDC min. / 12 VDC typ. / 16 VDC max.                                                                                                                                                                                                                                                           |
| Under Voltage Lockout     |                | 12 Vin models: 8 VDC max.<br>24 Vin models: 16 VDC max.                                                                                                                                                                                                                                                                                                                  |
| Reflected Ripple Current  |                | 12 Vin models: 25 mA typ.<br>24 Vin models: 15 mA typ.                                                                                                                                                                                                                                                                                                                   |
| Recommended Input Fuse    |                | 12 Vin models: 1'250 mA (slow blow)<br>24 Vin models: 1'250 mA (slow blow)<br>(The need of an external fuse has to be assessed in the final application.)                                                                                                                                                                                                                |
| Input Filter              |                | Internal Pi-Type                                                                                                                                                                                                                                                                                                                                                         |
| Short Circuit Input Power |                | 3 W max.                                                                                                                                                                                                                                                                                                                                                                 |

## Output Specifications

|                           |                                      |                                                                                                                     |
|---------------------------|--------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| Voltage Set Accuracy      |                                      | ±1% max.                                                                                                            |
| Regulation                | - Input Variation (Vmin - Vmax)      | single output models: 0.3% max.<br>dual output models: 0.3% max.                                                    |
|                           | - Load Variation (20 - 100%)         | single output models: 1% max.<br>dual output models: 1% max. (Output 1)<br>1% max. (Output 2)                       |
|                           | - Voltage Balance (symmetrical load) | dual output models: 2% max.                                                                                         |
|                           |                                      |                                                                                                                     |
| Ripple and Noise          | - 20 MHz Bandwidth                   | 75 mVp-p max.<br>50 mVp-p typ.<br>(To further reduce Ripple and Noise, a capacitor with 3.3 µF X7R is recommended.) |
| Capacitive Load           | - single output                      | 3.3 Vout models: 6'800 µF max.<br>5 Vout models: 6'800 µF max.<br>12 Vout models: 6'800 µF max.                     |
|                           | - dual output                        | 12 / -12 Vout models: 1'000 / 1'000 µF max.<br>15 / -15 Vout models: 1'000 / 1'000 µF max.                          |
| Minimum Load              |                                      | 5 % of Iout max.<br>(Operation at lower load will not damage the converter, but it may not meet all specifications) |
| Temperature Coefficient   |                                      | ±0.02 %/K max.                                                                                                      |
| Start-up Time             |                                      | 37 ms max.                                                                                                          |
| Short Circuit Protection  |                                      | Continuous, Automatic recovery                                                                                      |
| Overload Protection       |                                      | Foldback Mode                                                                                                       |
| Output Current Limitation |                                      | 120% min. of Iout max.                                                                                              |
|                           |                                      | 150% typ. of Iout max.                                                                                              |

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

|                    |                      |                                           |
|--------------------|----------------------|-------------------------------------------|
| Transient Response | - Response Deviation | 6% max. (25% Load Step)                   |
|                    | - Response Time      | 150 µs typ. / 300 µs max. (25% Load Step) |

## Safety Specifications

|                       |                             |                                                                                                                     |
|-----------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------|
| Standards             | - IT / Multimedia Equipment | CSA-C22.2, No. 60950-1<br>Designed for IEC/EN/UL 62368-1 (not certified)<br>EN 60950-1<br>IEC 60950-1<br>UL 60950-1 |
|                       | - Certification Documents   | <a href="http://www.tracopower.com/tel5-safety-cert">www.tracopower.com/tel5-safety-cert</a>                        |
| Pollution Degree      |                             | PD 2                                                                                                                |
| Over Voltage Category |                             | Not mains connected                                                                                                 |

## EMC Specifications

|                 |                       |                                    |
|-----------------|-----------------------|------------------------------------|
| EMI (Emissions) | - Conducted Emissions | EN 55032 class A (internal filter) |
|                 | - Radiated Emissions  | EN 55032 class A (internal filter) |

## General Specifications

|                         |                                                                                                  |                                                                                                                                   |
|-------------------------|--------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Relative Humidity       |                                                                                                  | 95% max. (non condensing)                                                                                                         |
| Temperature Ranges      | - Operating Temperature                                                                          | -40°C to +85°C                                                                                                                    |
|                         | - Case Temperature                                                                               | +100°C max.                                                                                                                       |
|                         | - Storage Temperature                                                                            | -50°C to +125°C                                                                                                                   |
| Power Derating          | - High Temperature                                                                               | 3.33 %/K above 70°C                                                                                                               |
|                         | See application note: <a href="http://www.tracopower.com/tel5-cc">www.tracopower.com/tel5-cc</a> |                                                                                                                                   |
| Cooling System          |                                                                                                  | Natural convection (20 LFM)                                                                                                       |
| Regulator Topology      |                                                                                                  | RCC Converter                                                                                                                     |
| Switching Frequency     |                                                                                                  | 200 kHz min. (PFM)                                                                                                                |
|                         |                                                                                                  | 300 kHz typ. (PFM)                                                                                                                |
| Insulation System       |                                                                                                  | Functional Insulation                                                                                                             |
| Working Voltage (rated) |                                                                                                  | 120 VAC                                                                                                                           |
| Isolation Test Voltage  | - Input to Output, 60 s                                                                          | 1'500 VDC                                                                                                                         |
|                         | - Input to Output, 1 s                                                                           | 1'800 VDC                                                                                                                         |
| Isolation Resistance    | - Input to Output, 500 VDC                                                                       | 1'000 MΩ min.                                                                                                                     |
| Isolation Capacitance   | - Input to Output, 100 kHz, 1 V                                                                  | 380 pF typ.                                                                                                                       |
|                         |                                                                                                  | 500 pF max.                                                                                                                       |
| Reliability             | - Calculated MTBF                                                                                | 1'000'000 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> |
| Housing Material        |                                                                                                  | Non-conductive Plastic (UL 94 V-0 rated)                                                                                          |
| Base Material           |                                                                                                  | Non-conductive Plastic (UL 94 V-0 rated)                                                                                          |
| Potting Material        |                                                                                                  | Epoxy (UL 94 V-0 rated)                                                                                                           |
| Pin Material            |                                                                                                  | Phosphor Bronze (C5191)                                                                                                           |
| Pin Foundation Plating  |                                                                                                  | Nickel (2 - 4 µm)                                                                                                                 |
| Pin Surface Plating     |                                                                                                  | Gold (75 - 125 nm), glossy                                                                                                        |
| Housing Type            |                                                                                                  | Plastic Case                                                                                                                      |
| Mounting Type           |                                                                                                  | PCB Mount                                                                                                                         |
| Connection Type         |                                                                                                  | THD (Through-Hole Device)                                                                                                         |
| Footprint Type          |                                                                                                  | DIP24                                                                                                                             |
| Soldering Profile       |                                                                                                  | Lead-Free Wave Soldering                                                                                                          |
|                         |                                                                                                  | 260°C / 10 s max.                                                                                                                 |
| Weight                  |                                                                                                  | 12.6 g                                                                                                                            |
| Thermal Impedance       | - Case to Ambient                                                                                | 15.34 K/W typ.                                                                                                                    |

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

Environmental Compliance - REACH Declaration

[www.tracopower.com/info/reach-declaration.pdf](http://www.tracopower.com/info/reach-declaration.pdf)

- RoHS Declaration

REACH SVHC list compliant

REACH Annex XVII compliant

[www.tracopower.com/info/rohs-declaration.pdf](http://www.tracopower.com/info/rohs-declaration.pdf)

Exemptions: 7(a), 7(c)-I

(RoHS exemptions refer to the component concentration only, not to the overall concentration in the product (O5A rule).)

- SCIP Reference Number

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### Additional Information

Supporting Documents

[www.tracopower.com/overview/tel5](http://www.tracopower.com/overview/tel5)

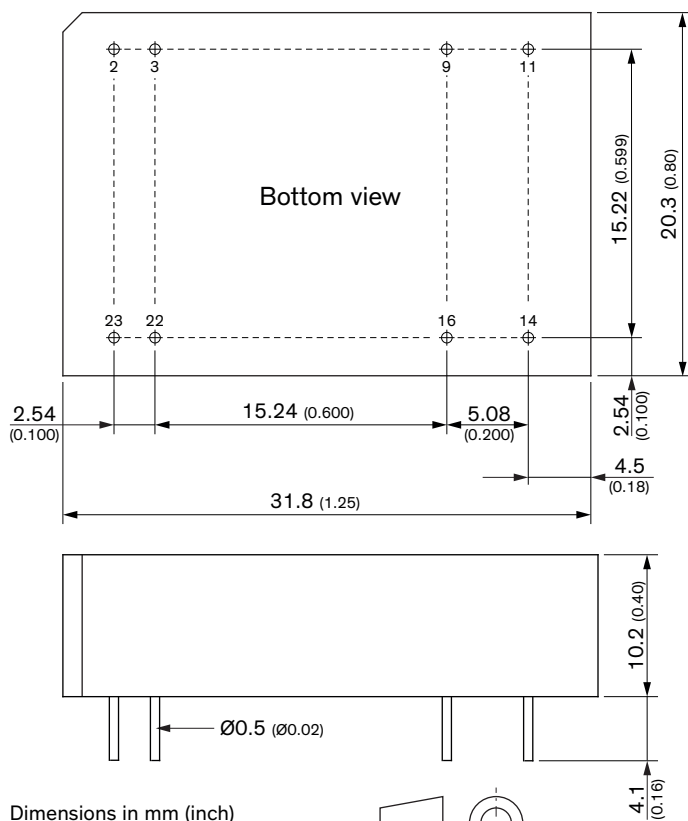
Frequently Asked Questions

[www.tracopower.com/glossary-faq](http://www.tracopower.com/glossary-faq)

Glossary

[www.tracopower.com/info/glossary.pdf](http://www.tracopower.com/info/glossary.pdf)

### Outline Dimensions



Dimensions in mm (inch)

Tolerance: x.x ±0.25 (x.xx ±0.01)

x.xx ±0.13 (x.xxx ±0.005)

Pin diameter tolerance: x.x ±0.05 (x.xx ±0.002)

### Pinout

| Pin | Single     | Dual   |
|-----|------------|--------|
| 2   | -Vin (GND) |        |
| 3   | -Vin (GND) |        |
| 9   | No pin     | Common |
| 11  | NC         | -Vout  |
| 14  | +Vout      |        |
| 16  | -Vout      | Common |
| 22  | +Vin (VCC) |        |
| 23  | +Vin (VCC) |        |

NC: Not connected