

- 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



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 (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 (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: <b>20 mA typ.</b> 24 Vin models: <b>5 mA typ.</b>
	- At full load	12 Vin models: <b>429 mA typ.</b> (3.3 Vout model) <b>514 mA typ.</b> (5 Vout model) <b>595 mA typ.</b> (12 Vout model) <b>595 mA typ.</b> (12 / -12 Vout model) <b>595 mA typ.</b> (15 / -15 Vout model) 24 Vin models: <b>209 mA typ.</b> (3.3 Vout model) <b>251 mA typ.</b> (5 Vout model) <b>291 mA typ.</b> (12 Vout model) <b>291 mA typ.</b> (12 / -12 Vout model) <b>291 mA typ.</b> (15 / -15 Vout model)
Surge Voltage		12 Vin models: <b>25 VDC max.</b> (1 s max.) 24 Vin models: <b>50 VDC max.</b> (1 s max.)
Start-up Voltage		12 Vin models: <b>4.5 VDC min. / 6 VDC typ. / 8 VDC max.</b> 24 Vin models: <b>8 VDC min. / 12 VDC typ. / 16 VDC max.</b>
Under Voltage Lockout		12 Vin models: <b>8 VDC max.</b> 24 Vin models: <b>16 VDC max.</b>
Reflected Ripple Current		12 Vin models: <b>25 mA typ.</b> 24 Vin models: <b>15 mA typ.</b>
Recommended Input Fuse		12 Vin models: <b>1'250 mA</b> (slow blow) 24 Vin models: <b>1'250 mA</b> (slow blow) (The need of an external fuse has to be assessed in the final application.)
Input Filter		<b>Internal Pi-Type</b>
Short Circuit Input Power		<b>3 W max.</b>

## Output Specifications

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

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 $\mu$ s typ. / 300 $\mu$ s max. (25% Load Step)

### Safety Specifications

Safety Standards	- IT / Multimedia Equipment	CSA-C22.2, No. 60950-1 Designed for EN 62368-1 (no certification) EN 60950-1 IEC 60950-1 UL 60950-1
	- Certification Documents	<a href="http://www.tracopower.com/overview/tel5">www.tracopower.com/overview/tel5</a>
Pollution Degree		PD 2

### 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	+90°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/overview/tel5">www.tracopower.com/overview/tel5</a>
Cooling System		Natural convection (20 LFM)
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 M $\Omega$ 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 <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 $\mu$ m)
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		Wave Soldering
		260°C / 10 s max.
Weight		16.9 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: 7a, 7c-I

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

- SCIP Reference Number

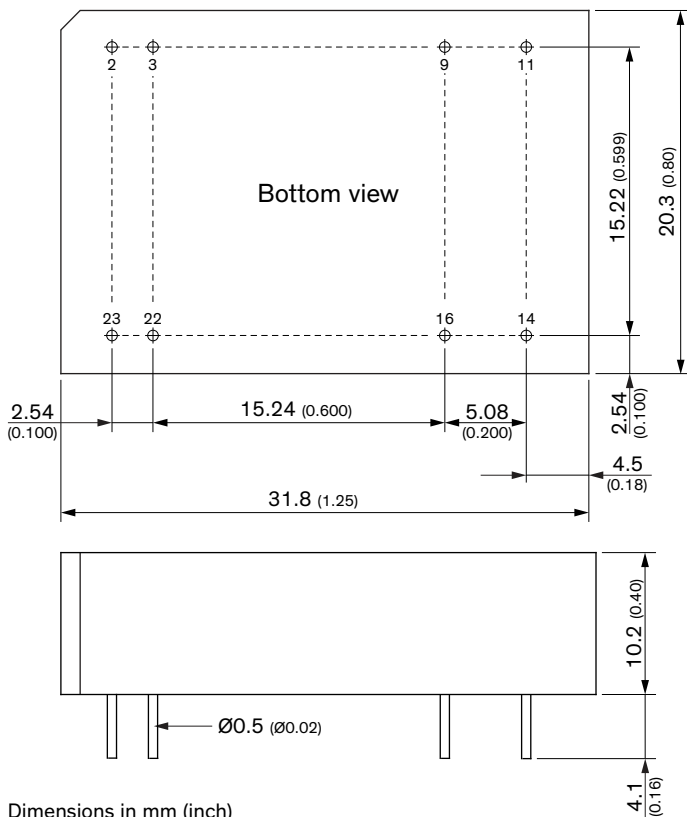
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### Supporting Documents

Overview Link (for additional Documents)

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

### 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