

- Ultra compact 6 Watt converter in DIP-16 metal casing
- High power density of 1,6W/cm<sup>3</sup>
- 6-side shielded metal case with insulated baseplate
- Wide 2:1 input voltage range: 4.5-12, 9-18, 18-36, 36-75 VDC
- High efficiency (up to 87%) for low thermal loss
- Operating temperature range -40°C to +85°C
- Meets EN 55032 class A (conducted and radiated) with a single input capacitor
- Protection against short circuit
- 3-year product warranty



The TEL 6 is an isolated 6 Watt converters series which comes in an ultra compact DIP-16 metal package. It solidifies the new package standard in this power range with a power density of 1,6 W/cm<sup>3</sup> which almost doubles the power density compared to 6 Watt converters in DIP-24 packages. The TEL 6 offers a wide 2:1 input voltage range and featured a high efficiency of up to 87% which enables an operation temperature of up to +70°C at full load and up to 85°C with 60% load. With only a single input capacitor (SMD) the converters comply with conducted and radiated emission standard EN 55032 class A. Overall they feature an economical solution for space critical and cost sensitive applications in instrumentation, IT and industrial electronics.

### Models

Order Code	Input Voltage Range	Output 1		Output 2		Efficiency typ.
		Vnom	I <sub>max</sub>	Vnom	I <sub>max</sub>	
TEL 6-0911	4.5 - 12 VDC (9 VDC nom.)	5 VDC	1'200 mA			82 %
TEL 6-0912		12 VDC	500 mA			85 %
TEL 6-0913		15 VDC	400 mA			86 %
TEL 6-0915		24 VDC	250 mA			87 %
TEL 6-0922		+12 VDC	250 mA	-12 VDC	250 mA	85 %
TEL 6-0923		+15 VDC	200 mA	-15 VDC	200 mA	85 %
TEL 6-1211	9 - 18 VDC (12 VDC nom.)	5 VDC	1'200 mA			79 %
TEL 6-1212		12 VDC	500 mA			83 %
TEL 6-1213		15 VDC	400 mA			83 %
TEL 6-1215		24 VDC	250 mA			85 %
TEL 6-1222		+12 VDC	250 mA	-12 VDC	250 mA	85 %
TEL 6-1223		+15 VDC	200 mA	-15 VDC	200 mA	85 %
TEL 6-2411	18 - 36 VDC (24 VDC nom.)	5 VDC	1'200 mA			81 %
TEL 6-2412		12 VDC	500 mA			84 %
TEL 6-2413		15 VDC	400 mA			84 %
TEL 6-2415		24 VDC	250 mA			84 %
TEL 6-2422		+12 VDC	250 mA	-12 VDC	250 mA	85 %
TEL 6-2423		+15 VDC	200 mA	-15 VDC	200 mA	84 %
TEL 6-4811	36 - 75 VDC (48 VDC nom.)	5 VDC	1'200 mA			81 %
TEL 6-4812		12 VDC	500 mA			85 %
TEL 6-4813		15 VDC	400 mA			85 %
TEL 6-4815		24 VDC	250 mA			85 %
TEL 6-4822		+12 VDC	250 mA	-12 VDC	250 mA	86 %
TEL 6-4823		+15 VDC	200 mA	-15 VDC	200 mA	86 %

## Input Specifications

Input Current	- At no load	9 Vin models: <b>15 mA typ.</b> 12 Vin models: <b>12 mA typ.</b> 24 Vin models: <b>10 mA typ.</b> 48 Vin models: <b>10 mA typ.</b>
	- At full load	9 Vin models: <b>783 mA typ.</b> 12 Vin models: <b>599 mA typ.</b> 24 Vin models: <b>297 mA typ.</b> 48 Vin models: <b>148 mA typ.</b>
Surge Voltage		9 Vin models: <b>20 VDC max.</b> (1 s max.) 12 Vin models: <b>25 VDC max.</b> (1 s max.) 24 Vin models: <b>50 VDC max.</b> (1 s max.) 48 Vin models: <b>100 VDC max.</b> (1 s max.)
Under Voltage Lockout		9 Vin models: <b>3 VDC min. / 3.5 VDC typ.</b> 12 Vin models: <b>5.5 VDC min. / 6.5 VDC typ.</b> 24 Vin models: <b>12 VDC min. / 15.5 VDC typ.</b> 48 Vin models: <b>26 VDC min. / 30 VDC typ.</b>
Reflected Ripple Current		<b>50 mAp-p typ.</b>
Recommended Input Fuse		(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>±2% max.</b>
Regulation	- Input Variation (Vmin - Vmax)	single output models: <b>0.5% max.</b> dual output models: <b>0.5% max.</b> (Output 1) <b>1% max.</b> (Output 2)
	- Load Variation (5 - 100%)	single output models: <b>1% max.</b> dual output models: <b>1% max.</b> (Output 1) <b>1.5% max.</b> (Output 2)
	- Cross Regulation (25% / 100% asym. load)	dual output models: <b>5% max.</b>
Ripple and Noise	- 20 MHz Bandwidth	<b>100 mVp-p max.</b> (w/ 1 µF MLCC    10µF Tantalum)
Capacitive Load	- single output	5 Vout models: <b>1'000 µF max.</b> 12 Vout models: <b>470 µF max.</b> 15 Vout models: <b>220 µF max.</b> 24 Vout models: <b>100 µF max.</b>
	- dual output	12 / -12 Vout models: <b>330 / 330 µF max.</b> 15 / -15 Vout models: <b>220 / 220 µF max.</b>
Minimum Load		<b>Not required</b>
Temperature Coefficient		<b>±0.03 %/K max.</b>
Start-up Time		<b>150 ms max.</b>
Short Circuit Protection		<b>Continuous, Automatic recovery</b>
Output Current Limitation		<b>110 - 230% of Iout max.</b> <b>160% typ. of Iout max.</b>
Transient Response	- Response Deviation	<b>5% typ. / 8% max.</b> (25% Load Step) (5 Vout models) <b>3% typ. / 5% max.</b> (25% Load Step) (other models)
	- Response Time	<b>300 µs typ. / 500 µs max.</b> (25% Load Step)

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

### Safety Specifications

Safety Standards	- IT / Multimedia Equipment	EN 62368-1 IEC 62368-1 UL 62368-1
	- Certification Documents	<a href="http://www.tracopower.com/overview/tel6">www.tracopower.com/overview/tel6</a> (Max. 800 V transient on input side must be considered in final installation)
Pollution Degree		PD 2

### EMC Specifications

EMI Emissions	- Conducted Emissions	EN 55032 class A (with external filter) EN 55032 class B (with external filter)
	- Radiated Emissions	EN 55032 class A (with external filter) EN 55032 class B (with external filter)
	External filter proposal:	<a href="http://www.tracopower.com/overview/tel6">www.tracopower.com/overview/tel6</a> (Note: Class A emissions can be met using only a single input capacitor.)
EMS Immunity	- Electrostatic Discharge	Air: EN 61000-4-2, $\pm 8$ kV, perf. criteria A Contact: EN 61000-4-2, $\pm 6$ kV, perf. criteria A
	- RF Electromagnetic Field	EN 61000-4-3, 20 V/m, perf. criteria A
	- EFT (Burst) / Surge	EN 61000-4-4, $\pm 2$ kV, perf. criteria A EN 61000-4-5, $\pm 2$ kV, perf. criteria A
	- Conducted RF Disturbances	External filter proposal: <a href="http://www.tracopower.com/overview/tel6">www.tracopower.com/overview/tel6</a> EN 61000-4-6, 10 Vrms, perf. criteria A

### General Specifications

Relative Humidity		95% max. (non condensing)
Temperature Ranges	- Operating Temperature	-40°C to +85°C
	- Case Temperature	+105°C max.
	- Storage Temperature	-55°C to +125°C
Power Derating	- High Temperature	Depending on model
		See application note: <a href="http://www.tracopower.com/overview/tel6">www.tracopower.com/overview/tel6</a>
Cooling System		Natural convection (20 LFM)
Switching Frequency		150 - 402 kHz (PWM, PFM) (9 Vin models) 48 - 427 kHz (PWM, PFM) (12 Vin single models) 150 - 402 kHz (PWM, PFM) (12 Vin dual models) 48 - 427 kHz (PWM, PFM) (24 Vin models) 36 - 320 kHz (PWM, PFM) (48 Vin single models) 48 - 427 kHz (PWM, PFM) (48 Vin dual models) (Above 50% load PWM is used, below 50% load PFM is used)
Insulation System		Functional Insulation
Isolation Test Voltage	- Input to Output, 60 s	1'500 VDC
Isolation Resistance	- Input to Output, 500 VDC	1'000 M $\Omega$ min.
Isolation Capacitance	- Input to Output, 100 kHz, 1 V	2'200 pF typ.
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>
Environment	- Vibration	IEC 60068-2-6 5 g, 3 axis, random waveform, 10-150 Hz
	- Mechanical Shock	IEC 60068-2-27 15 g, 3 axis, half sine, 11 ms
	- Thermal Shock	IEC 60068-2-14
Housing Material		Alu alloy, black anodized coating
Base Material		Rynite® FR530 BK507
Potting Material		Epoxy (UL 94 V-0 rated)
Pin Material		Brass

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

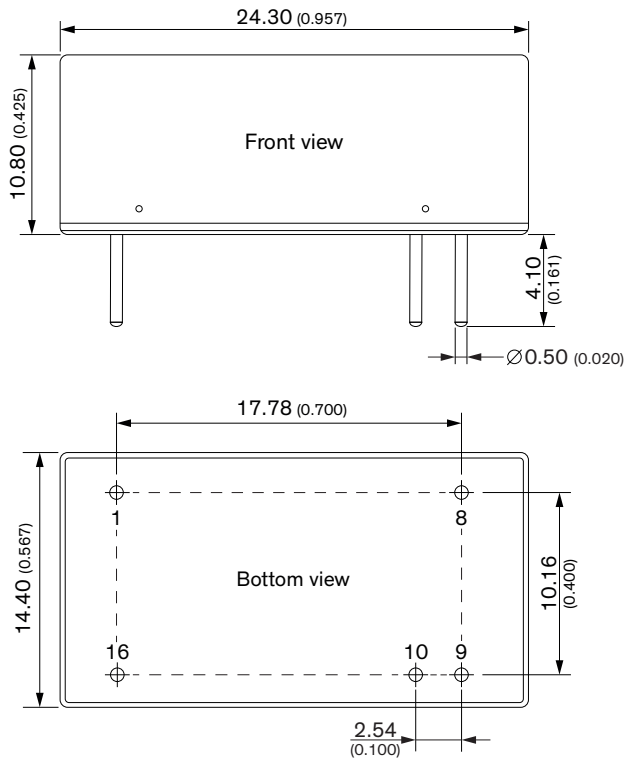
Pin Foundation Plating	Nickel (1 - 3 $\mu\text{m}$ )
Pin Surface Plating	Gold (50 - 75 nm), glossy
Housing Type	Metal Case
Mounting Type	PCB Mount
Connection Type	THD (Through-Hole Device)
Footprint Type	DIP16
Soldering Profile	Lead-Free Wave Soldering 265°C / 10 s max.
Weight	7.5 g
Thermal Impedance	- Case to Ambient 20 K/W typ. (at $V_{in}$ min.)
Environmental Compliance	- REACH Declaration <a href="http://www.tracopower.com/info/reach-declaration.pdf">www.tracopower.com/info/reach-declaration.pdf</a> 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).) - SCIP Reference Number c854e753-2226-42b6-acbb-a4745141b4a8

### Supporting Documents

Overview Link (for additional Documents)

[www.tracopower.com/overview/tel6](http://www.tracopower.com/overview/tel6)

### Outline Dimensions



Dimensions in mm (inch)  
Pin diameter tolerances:  $\pm 0.10$  ( $\pm 0.004$ )  
General tolerances:  $\pm 0.50$  ( $\pm 0.020$ )

Pinout		
Pin	Single	Dual
1	-Vin (GND)	
8	NTC	Common
9	+Vout	
10	-Vout	
16	+Vin (Vcc)	

NTC: Not to connect