TRACO POWER

DC/DC Converter

TEL 6 Series, 6 Watt

- **Ultra compact 6 Watt converter in DIP-16 metal casing**
- **High power density of 1,6W/cm3**
- **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**

UL 62368-1 IEC 62368-1

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/cm3 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
		Vnom	Imax	Vnom	Imax	typ.
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:	15 mA typ.
		12 Vin models:	12 mA typ.
		24 Vin models:	10 mA typ.
		48 Vin models:	10 mA typ.
	- At full load	9 Vin models:	783 mA typ.
		12 Vin models:	599 mA typ.
		24 Vin models:	297 mA typ.
		48 Vin models:	148 mA typ.
Surge Voltage		9 Vin models:	20 VDC max. (1 s max.)
		12 Vin models:	25 VDC max. (1 s max.)
		24 Vin models:	50 VDC max. (1 s max.)
		48 Vin models:	100 VDC max. (1 s max.)
Under Voltage Lockout		9 Vin models:	3 VDC min. / 3.5 VDC typ.
		12 Vin models:	5.5 VDC min. / 6.5 VDC typ.
		24 Vin models:	12 VDC min. / 15.5 VDC typ.
		48 Vin models:	26 VDC min. / 30 VDC typ.
Reflected Ripple Current			50 mAp-p typ.
Recommended Input Fuse		9 Vin models:	3'150 mA (slow blow)
		12 Vin models:	2'000 mA (slow blow)
		24 Vin models:	1'000 mA (slow blow)
		48 Vin models:	315 mA (slow blow)
			(The need of an external fuse has to be assessed in the final application.)
Input Filter			Internal Pi-Type

Output Specifications

Voltage Set Accuracy			±2% max.
Regulation	- Input Variation (Vmin - Vmax)	single output models:	0.5% max.
		dual output models:	0.5% max. (Output 1)
			1% max. (Output 2)
	- Load Variation (5 - 100%)	single output models:	1% max.
		dual output models:	1% max. (Output 1)
			1.5% max. (Output 2)
	- Cross Regulation (25% / 100% asym. load)	dual output models:	5% max.
Ripple and Noise	- 20 MHz Bandwidth		100 mVp-p max. (w/ 1 µF MLCC || 10µF Tantalum)
Capacitive Load	- single output	5 Vout models:	1'000 µF max.
		12 Vout models:	470 µF max.
		15 Vout models:	220 µF max.
		24 Vout models:	100 µF max.
	- dual output	12 / -12 Vout models:	330 / 330 µF max.
		15 / -15 Vout models:	220 / 220 µF max.
Minimum Load			Not required
Temperature Coefficient			±0.03 %/K max.
Start-up Time			150 ms max.
Short Circuit Protection			Continuous, Automatic recovery
Output Current Limitation			110 - 230% of Iout max.
			160% typ. of Iout max.
Transient Response	- Response Deviation		5% typ. / 8% max. (25% Load Step) (5 Vout models)
			3% typ. / 5% max. (25% Load Step) (other models)
	- Response Time		300 µs typ. / 500 µs max. (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		www.tracopower.com/overview/tel6 (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:	www.tracopower.com/overview/tel6 (Note: Class A emissions can be met using only a single input capacitor.)
EMS Immunity	- Electrostatic Discharge	Air:	EN 61000-4-2, ±8 kV, perf. criteria A
		Contact:	EN 61000-4-2, ±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, ±2 kV, perf. criteria A
			EN 61000-4-5, ±2 kV, perf. criteria A
		External filter proposal:	www.tracopower.com/overview/tel6
	- Conducted RF Disturbances		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:	www.tracopower.com/overview/tel6
Cooling System			Natural convection (20 LFM)
Altitude During Operation			5'000 m max.
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 MΩ 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 www.tracopower.com/info/cleaning.pdf
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)

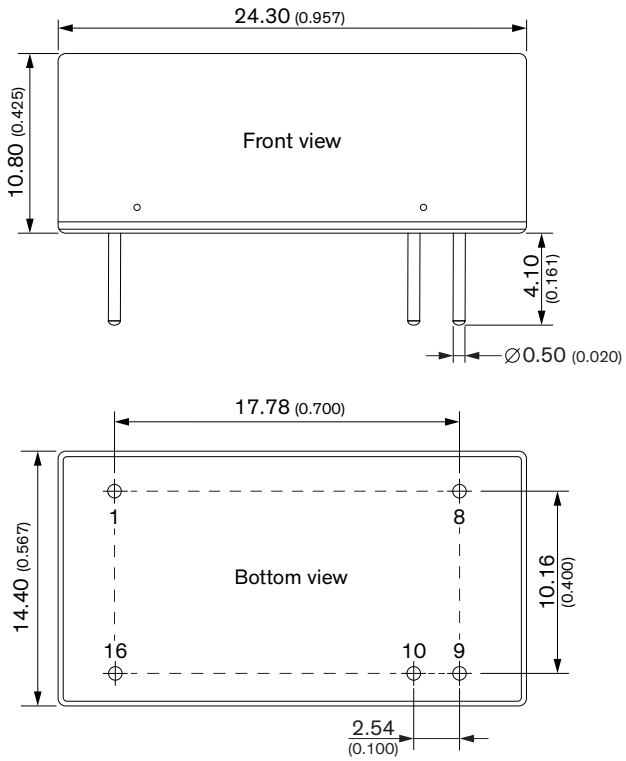
All specifications valid at nominal voltage, resistive full load and +25°C after warm-up time, unless otherwise stated.

Pin Material		Brass
Pin Foundation Plating		Nickel (1 - 3 µm)
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 Vin min.)
Environmental Compliance	- REACH Declaration	www.tracopower.com/info/reach-declaration.pdf
		REACH SVHC list compliant REACH Annex XVII compliant
	- RoHS Declaration	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	c854e753-2226-42b6-acbb-a4745141b4a8

Supporting Documents

Overview Link (for additional Documents)	www.tracopower.com/overview/tel6

Outline Dimensions



Dimensions in mm (inch)
Pin diameter tolerances: ±0.10 (±0.004)
General tolerances: ±0.50 (±0.020)

Pinout

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

NTC: Not to connect