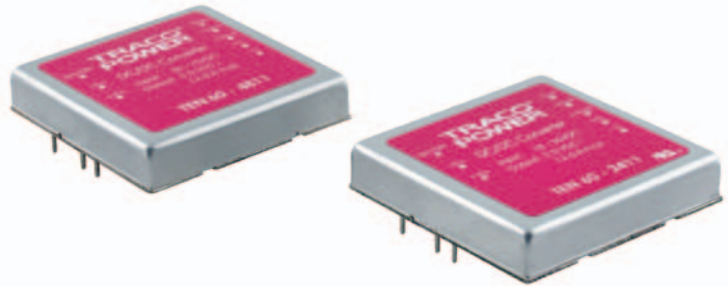


### Features

- ◆ Highest power density: 60W in a 51x51x10mm (2"x2"x0.4") package
- ◆ Wide 2:1 input voltage range
- ◆ Very high efficiency up to 90%
- ◆ No minimum load required
- ◆ Over temperature protection
- ◆ Under voltage lockout
- ◆ Remote On/Off
- ◆ Shielded metal case with insulated baseplate
- ◆ Optional heatsink
- ◆ Lead free design - RoHS compliant
- ◆ 3-year product warranty



The TEN 60 series is a family of high performance 60W dc-dc converter modules with wide 2:1 input voltage ranges in a compact low profile case with industry-standard footprint. A very high efficiency allows an operating temperature range of  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ . Built-in filters for both input and output minimizes the need for external filtering. Further standard features include remote On/Off, output voltage trimming, over voltage protection, under voltage lockout and short circuit protection.

Typical applications for these products are battery operated equipment and distributed power architectures in 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 voltage	Output current max.	Efficiency typ.
TEN 60-2410	<b>18 – 36 VDC</b> (24 VDC nominal)	3.3 VDC	14.0 A	89 %
TEN 60-2411		5.0 VDC	12.0 A	90 %
TEN 60-2412		12 VDC	5.0 A	90 %
TEN 60-2413		15 VDC	4.0 A	90 %
TEN 60-4810	<b>36 – 75 VDC</b> (48 VDC nominal)	3.3 VDC	14.0 A	89 %
TEN 60-4811		5.0 VDC	12.0 A	90 %
TEN 60-4812		12 VDC	5.0 A	90 %
TEN 60-4813		15 VDC	4.0 A	90 %

### Input Specifications

Input current at no load	24 V models: 120 mA typ. 48 V models: 100 mA typ.
Input current at full load (nominal input 24/48 Vin)	3.3 V output models: 2250 / 1150 mA typ. 5.0 V models: 2850 / 1450 mA typ. 12V & 15 V output models: 2900 / 1450 mA typ.
Input voltage variation (dv/dt)	5 V/ms, max. (complies with ETS300 132 part 4.4)
Start-up voltage / under voltage lockout	24 Vin models: 17 VDC / 15 VDC typ. 48 Vin models: 34 VDC / 32 VDC typ.
Surge voltage (100 msec. max.)	24 Vin models: 50 V 48 Vin models: 100 V
Conducted noise (input)	EN 55022 level A, FCC part 15, level A with external capacitor, see application note:
ESD (input)	EN 61000-4-2, perf. criteria B
Fast transient (input)	EN 61000-4-4, perf. criteria B
Surge (input)	EN 61000-4-5, perf. criteria B

### Output Specifications

Voltage set accuracy	±1 %
Output voltage adjustment	±10 %
Regulation	– Input variation Vin min. to Vin max. 0.2 % max. – Load variation 0 – 100 % 0.5 % max.
Temperature coefficient	±0.02 %/K max.
Ripple and noise (20 MHz Bandwidth)	3.3 V & 5 V outputs: 75 mVpk-pk max. 12 V & 15 V outputs: 100 mVpk-pk max.
Start up time (nominal Vin and constant resistive load)	20 ms typ.
Transient response time (25% load change)	250 µs typ.
Short circuit protection	indefinite (automatic recovery)
Over load protection	150 % of lout max typ.
Minimum Load	not required
Thermal shutdown	at +110°C typ
Over voltage protection	3.3 V output: 3.7 V 5 V output: 5.6 V 12 V output: 13.5 V 15 V output: 16.8 V
Capacitive load	3.3 V output: 36'000 µF 5 V output: 20'400 µF 12 V output: 3'550 µF 15 V output: 2'300 µF

### General Specifications

Temperature ranges	– Operating –40°C to +85°C – Case temperature +105°C max. – Storage –55°C to +125°C
Derating	see application note:
Humidity (non condensing)	95 % rel H max.
Reliability, calculated MTF (MIL-HDBK-217F, at +25°C, ground benign)	>110'000 h

**General Specifications**

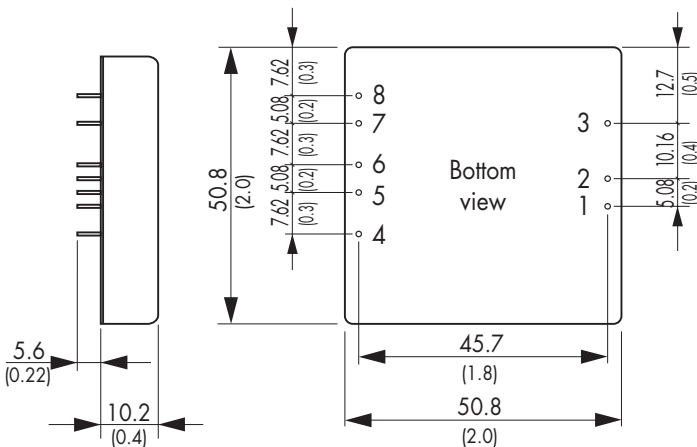
Isolation (Input/Output)	– Voltage – Capacitance – Resistance	1'500 VDC 1'500 pF max. >1'000 MOhm
Remote On/Off	– On: – Off: – Off idle current:	3.0 ... 12 VDC or open circuit. 0 ... 1.2 VDC or short circuit pin 3 and pin 2 3.0 mA max.
Switching frequency (fixed)		300 kHz typ. (Pulse width modulation PWM)
Vibration		10 – 55Hz, 10G, 30 minutes along X,Y,Z
Safety standards		UL 60950-1, IEC/EN 60950-1
Safety approvals		UL/cUL pending
Environmental compliance	– Reach – RoHS	<a href="http://www.tracopower.com/products/ten60-reach.pdf">www.tracopower.com/products/ten60-reach.pdf</a> RoHS directive 2002/95/EC

**Physical Specifications**

Casing material		copper, nickel plated
Baseplate material		none conductive FR4
Potting material		epoxy (UL 94V-0-rated)
Weight		60 g (2.1 oz)
Soldering temperature		max. 265°C / 10 sec.

**Application note:** [www.tracopower.com/products/ten60-application.pdf](http://www.tracopower.com/products/ten60-application.pdf)

**Outline Dimensions**



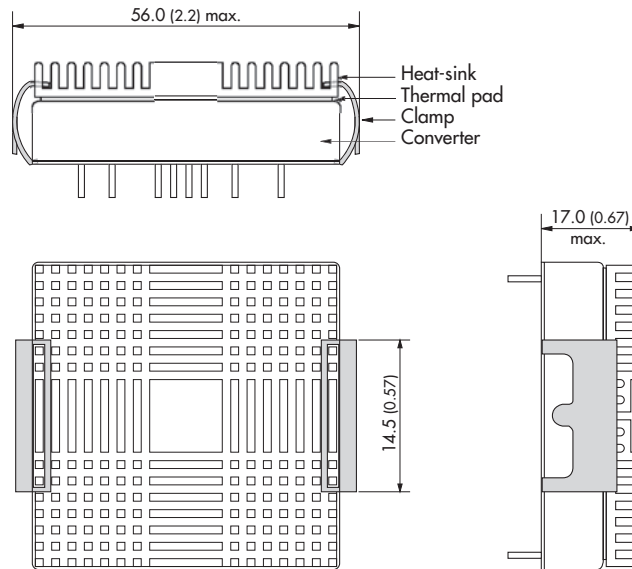
Pin-Out	
Pin	
1	+Vin (Vcc)
2	-Vin (GND)
3	Remote On/Off
4	-Sense
5	+Sense
6	+Vout
7	-Vout
8	Trim

Dimensions in [mm], ( ) = Inch  
 Pin diameter: 1.0 ±0.05 (0.02 ±0.002)  
 Pin pitch tolerances: ±0.35 (±0.014)  
 Case tolerances: ±0.5 (±0.02)

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

**Outline Dimensions**

**Heat-sink TEN-HS3**



**Order code:** TEN-HS3 (cont.: heat-sink, thermal pad, 2 clamps)

**Material:** Aluminum

**Finish:** Anodic treatment (black)

**Weight:** 22 g (0.78oz) (without converter)

**Note:**

The product label on converter has to be removed before mounting the heat-sink.

For volume orders converters will be supplied with heat-sinks already mounted. Please contact factory for quotation.

Separate heat-sinks are only available for prototypes and small quantity orders.

Specifications can be changed any time without notice.