# Clip Mount Power Resistor Thick Film Technology



## FEATURES

- 150 W at 45 °C case temperature heatsink mounted
- Direct mounting ceramic on heatsink
- Broad resistance range: 1 Ω to 2.2 kΩ
- Non inductive
- TO-247 package: compact and easy to mount
- Designed for clip mounting
- UL 94 V-0 material used - compliant with EN 45545-2
- Higher pulse absorption, up to 75 J/0.1 s
- Bended option available
- **AEC-Q200 qualified**
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

RoHS COMPLIANT

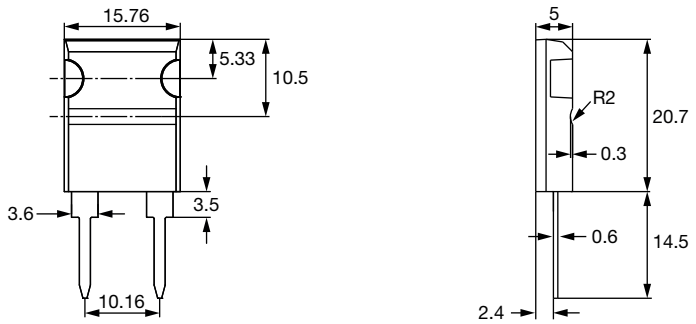
## LINKS TO ADDITIONAL RESOURCES

3D Models

LTO 150H are the extension of LTO series. The component is used in direct contact with heatsink. Fixation done by clip.

This unique design is able to absorb 30 % more energy than standard LTO 150.

## DIMENSIONS in millimeters




**Note**

- Tolerances unless stated: ± 0.3 mm

## STANDARD ELECTRICAL SPECIFICATIONS

| MODEL | SIZE | RESISTANCE RANGE Ω | RATED POWER $P_{45\,°C}$ W | LIMITING ELEMENT VOLTAGE $U_L$ V | TOLERANCE ± % | TEMPERATURE COEFFICIENT ± ppm/°C | CRITICAL RESISTANCE Ω |
|---|---|---|---|---|---|---|---|
| LTO 150H | TO-247 | 1 to 2.2K | 150 | 500 | 2, 5, 10 | 200, 350, 900 | 1.66K |

## MECHANICAL SPECIFICATIONS

| | |
|---|---|
| **Mechanical Protection** | Molded |
| **Resistive Element** | Thick film |
| **Substrate** | Alumina |
| **Connections** | Tinned copper |
| **Weight** | 4.1 g max. |
| **Clip Assembly Force** | 60 N to 110 N |

## ENVIRONMENTAL SPECIFICATIONS

| | |
|---|---|
| **Temperature Range** | -55 °C to +175 °C |
| **Climatic Category** | 55 / 175 / 56 |
| **Flammability** | IEC 60695-11-5<br>Application time: $t_a$ = 10 s<br>Burning duration: $t_b$ < 30 s |



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| TECHNICAL SPECIFICATIONS | |
|---|---|
| **Dissipation and Associated** | Onto a heatsink + clip |
| **Power Rating and Thermal Resistance of the Component** | 150 W at +45 °C (case temp.)<br>$R_{TH\ (j\ -\ c)}$: 0.87 °C/W<br>Free air: 4.5 W at +25 °C |
| **Temperature Coefficient** | See Performance table<br>± 200 ppm/°C |
| **Dielectric Strength**<br>**IEC 60115-1** | 3000 $V_{RMS}$ - 1 min<br>10 mA max. |
| **Insulation Resistance** | ≥ $10^4$ MΩ |
| **Inductance** | ≤ 0.1 µH |

| PERFORMANCE | | |
|---|---|---|
| **TESTS** | **CONDITIONS** | **REQUIREMENTS** |
| **Momentary Overload** | IEC 60115-1<br>1.5 Pr/5 s<br>$U_S < 1.5\ U_L$ | ± (0.5 % + 0.005 Ω) |
| **Load Life** | IEC 60115-1<br>1000 h Pr (free air) at +25 °C 90/30 | ± (0.5 % + 0.005 Ω) |
| **High Temperature Exposure** | AEC-Q200 rev. D conditions:<br>MIL-STD-202 method 108<br>1000 h, +175 °C, unpowered | 0.25 % ± 0.005 Ω |
| **Temperature Cycling** | AEC-Q200 rev. D conditions:<br>JESD22 method JA-104<br>1000 cycles, -55 °C to +125 °C<br>dwell time -15 min | 1 % ± 0.005 Ω |
| **Biased Humidity** | AEC-Q200 rev. D conditions:<br>MIL-STD-202 method 103<br>1000 h, 85 °C, 85 % RH (10 % of free air power) | ± (1 % + 0.005 Ω) |
| **Operational Life** | AEC-Q200 rev. D conditions:<br>MIL-STD-202 method 108<br>1000 h, 90/30, powered (free air) at +125 °C | 1 % ± 0.005 Ω |
| **ESD Human Body Model** | AEC-Q200 rev. D conditions:<br>AEC-Q200-002 IEC 61000-4-2<br>25 $kV_{AD}$ | ± (0.5 % + 0.005 Ω) |
| **Vibration** | AEC-Q200 rev. D conditions:<br>MIL-STD-202 method 204<br>5 *g*'s for 20 min, 12 cycles<br>test from 10 Hz to 2000 Hz | 0.5 % ± 0.005 Ω |
| **Mechanical Shock** | AEC-Q200 rev. D conditions:<br>MIL-STD-202 method 213<br>100 *g*'s, 6 ms, 3.75 m/s<br>3 shocks/direction | 0.5 % ± 0.005 Ω |
| **Terminal Strength** | AEC-Q200 rev. D conditions:<br>AEC-Q200-006<br>2 kgf, 60 s | 0.25 % ± 0.005 Ω |


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| SPECIAL FEATURES | | |
|---|---|---|
| **Resistance Values** | ≥ 1 | ≥ 20 |
| **Tolerances** | 2 %, 5 %, 10 % | |
| **Typical Temperature Coefficient (-55 °C to +155 °C)** | ± 350 ppm/°C | ± 200 ppm/°C |

## CHOICE OF THE HEATSINK

The user must choose according to the working conditions of the component (power, room temperature).
Maximum working temperature must not exceed 175 °C. The dissipated power is simply calculated by the following ratio:

$$P = \frac{\Delta T}{[R_{TH\ (j\ -\ c)}] + [R_{TH\ (c\ -\ h)}] + [R_{TH\ (h\ -\ a)}]} \quad (1)$$

P: expressed in W

ΔT: difference between maximum working temperature and room temperature

$R_{TH\ (j\ -\ c)}$: thermal resistance value measured between resistive layer and outer side of the resistor. It is the thermal resistance of the component

$R_{TH\ (c\ -\ h)}$: thermal resistance value measured between outer side of the resistor and upper side of the heatsink. This is the resistance of the interface (grease, thermal pad), and the quality of the fastening device

$R_{TH\ (h\ -\ a)}$: thermal resistance of the heatsink

**Example:**

$R_{TH\ (c\ -\ h)} + R_{TH\ (h\ -\ a)}$ for LTO 150 power rating 10 W at ambient temperature +25 °C

Thermal resistance $R_{TH\ (j\ -\ c)}$: 0.87 °C/W

Considering equation (1) we have:

$\Delta T = 175\ °C - 25\ °C = 150\ °C$

$$R_{TH\ (j\ -\ c)} + R_{TH\ (c\ -\ h)} + R_{TH\ (h\ -\ a)} = \frac{\Delta T}{P} = \frac{150}{10} = 15\ °C/W$$

$R_{TH\ (c\ -\ h)} + R_{TH\ (h\ -\ a)} = 15\ °C/W - 0.87\ °C/W = 14.13\ °C/W$

Example with a thermal grease $R_{TH\ (c\ -\ h)} = 0.5\ °C/W$, we need a heatsink with $R_{TH\ (h\ -\ a)} = 13.63\ °C/W$

| | CONFIGURATION 1 | CONFIGURATION 2 | CONFIGURATION 3 |
|---|---|---|---|
| **Power Dissipation (W)** | 150 | 35 | 26 |
| **T° Resistive Element (°C)** | 175 | 175 | 175 |
| **$R_{TH\ (j\ -\ c)}$ Max. (°C/W)** | 0.87 | 0.87 | 0.87 |
| **$R_{TH\ (c\ -\ h)}$ Typ. (°C/W)** | 0.127 | 0.33 | 0.33 |
| **$R_{TH\ (h\ -\ a)}$ Max. (°C/W)** | 0.069 | 3.09 | 4.57 |
| **Fluid T° (°C)** | 15 (water) | 25 (air) | 25 (air) |

**CONFIGURATION 1:** Water cooling heatsink CP15 from Lytron (304 mm x 95.3 mm x 8 mm) with water flow rate 4 LPM and thermal grease Bluesil Past 340 from BlueStar silicones. MAX08NG from AAVID screwed clip mounting.

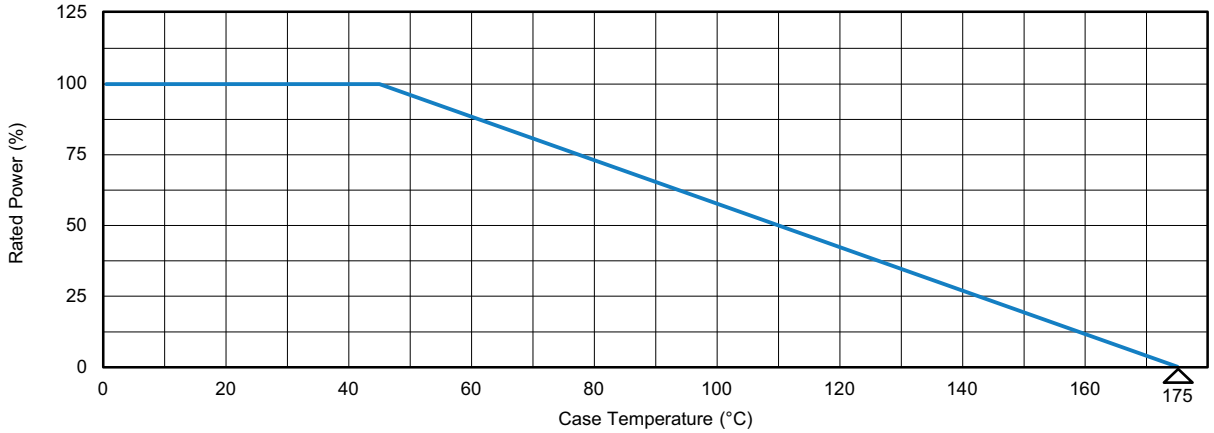
**CONFIGURATION 2:** Air cooling heatsink 0S552 from AAVID (48 mm x 80 mm x 70 mm) and thermal grease Bluesil Past 340 from BlueStar silicones. MAX03HNG from AAVID clipped mounting.

**CONFIGURATION 3:** Air cooling heatsink 0S550 from AAVID (31.75 mm x 58.7 mm x 70 mm) and thermal grease Bluesil Past 340 from BlueStar silicones. MAX03HNG from AAVID clipped mounting.


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## POWER RATING

The temperature of the case should be maintained within the limits specified.



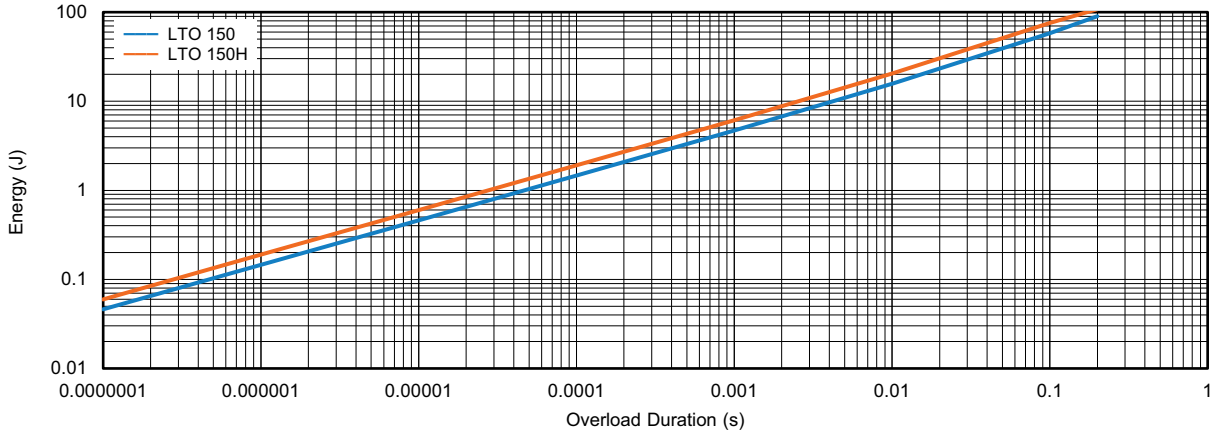

## MOMENTARY OVERLOAD

In any case the applied voltage must be lower than the maximum overload voltage of 750 V during 5 s.

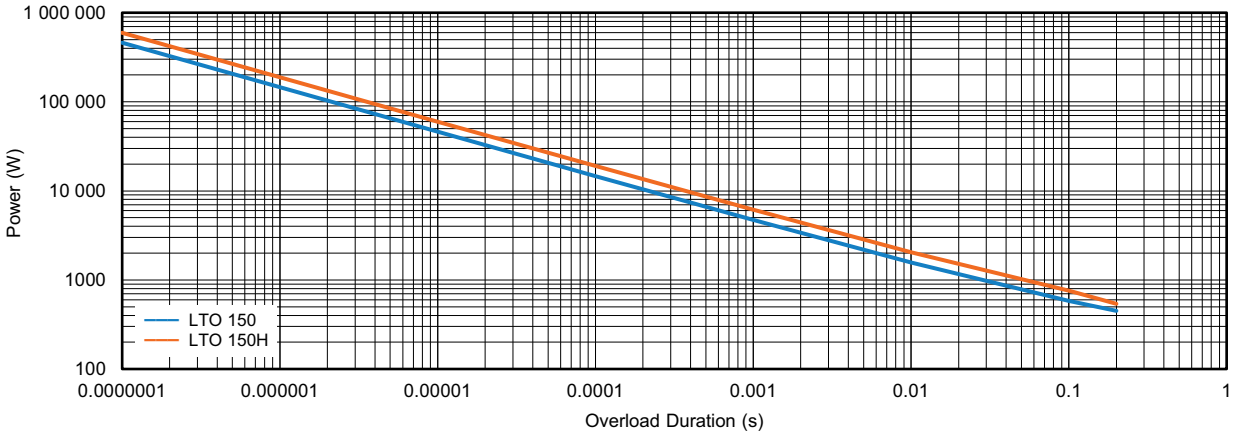
Accidental overload: the values indicated on the following graph are applicable to resistors in air or mounted onto a heatsink.

## ENERGY CURVE

The values indicated on the graph below are applicable to resistors in air or mounted onto a heatsink.




## POWER CURVE





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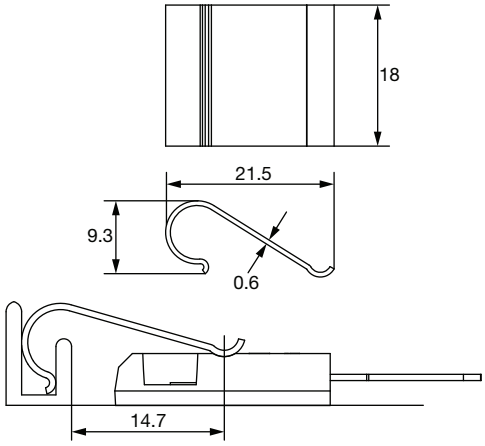
| PACKAGING |
| --- |
| Tube of 30 units |

## MARKING

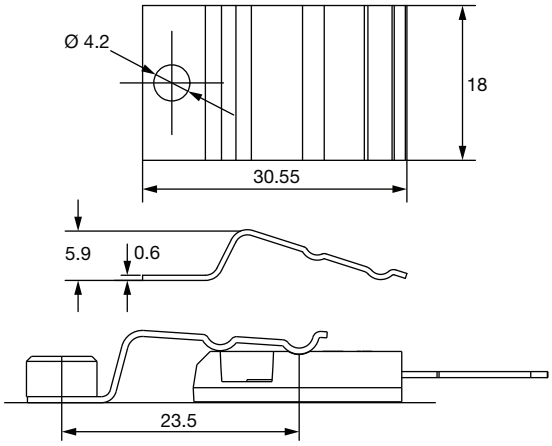
Model, style, resistance value (in Ω), tolerance (in %), manufacturing date, Vishay Sfernice trademark according IEC 60062.

## CLIPS

**ACCLLTO150CL (MAX03HNG)**

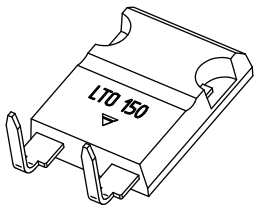
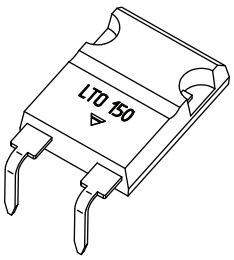
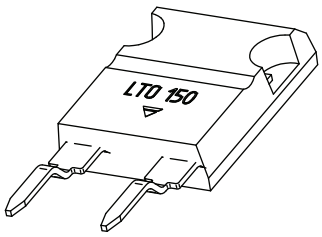



**ACCLLTO150VS (MAX08NG)**




## CLIP MOUNTING RECOMMENDATION

To improve the thermal conductivity, all surface of ceramic has to be coated with a thermal silicon grease. If you not use our clipped or screwed clip, it is recommended that a mounting force of 60 N to 110 N be applied to the center of the molding case of the component. Tightening torque 2 Nm when mounting screwed clip MAX08NG on heatsink.

| BENDING OPTIONS | | |
| --- | --- | --- |
| LTO 150 H TB7 | LTO 150 H TB8 | LTO 150 H TB9 |
|  |  |  |

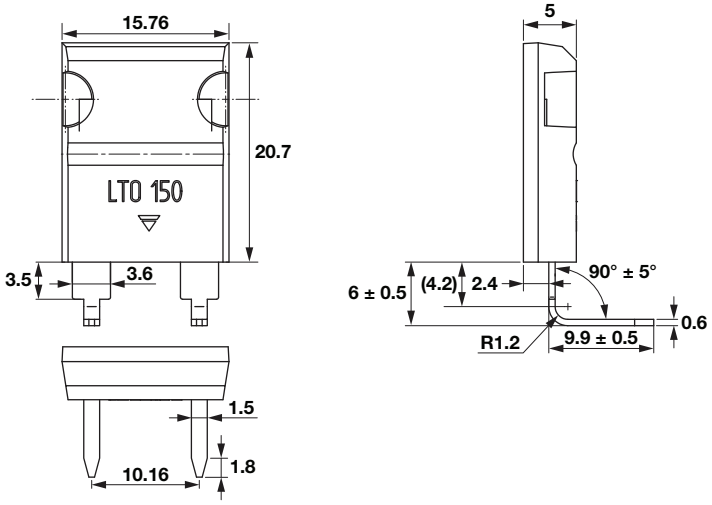


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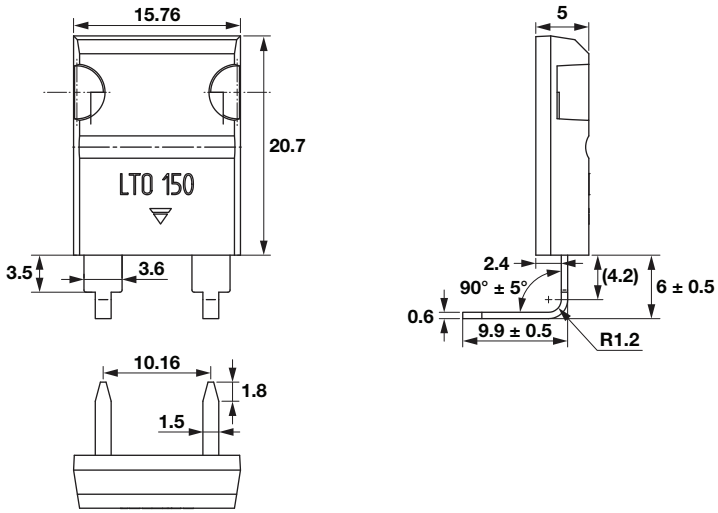
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## BENDING OPTIONS DIMENSIONS in millimeters

### LTO 150 H TB7




### LTO 150 H TB8




**Note**

- Tolerances unless stated: ± 0.3 mm

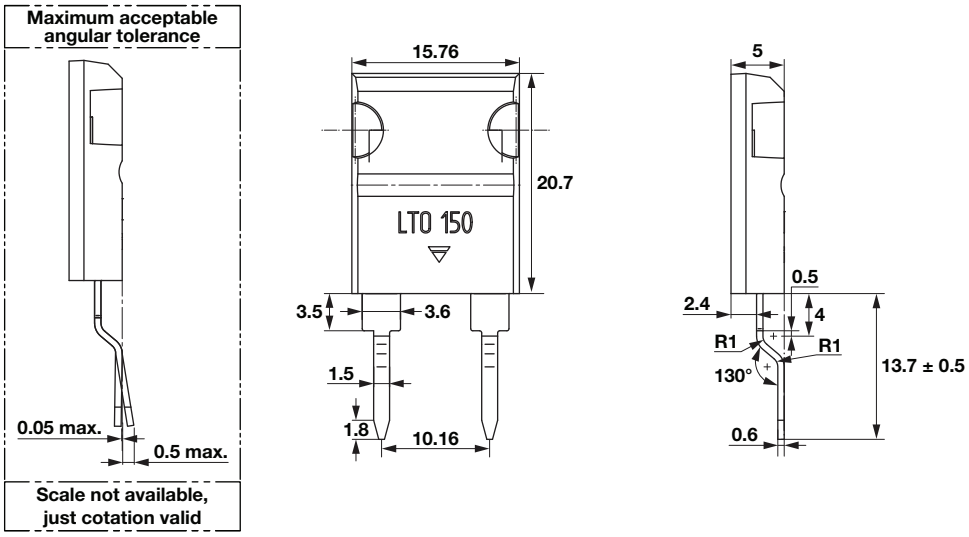


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## BENDING OPTIONS DIMENSIONS in millimeters

**LTO 150 H TB9**




**Note**

- Tolerances unless stated: ± 0.3 mm

## ORDERING INFORMATION

| LTO | 150 | H | 2.2 kΩ | ± 5 % | xxx | TU30 | e3 |
|---|---|---|---|---|---|---|---|
| MODEL | STYLE | HIGH PULSE | RESISTANCE VALUE | TOLERANCE | CUSTOM DESIGN | PACKAGING | LEAD (Pb)-FREE |
| | | | | ± 2 %<br>± 5 %<br>± 10 % | Optional on request: special TCR, shape, bended, etc. | | |

## GLOBAL PART NUMBER INFORMATION

| L | T | O | 1 | 5 | 0 | H | 2 | 2 | 0 | 0 | 0 | J | T | E | 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| GLOBAL MODEL | SIZE | ENERGY | OHMIC VALUE | TOLERANCE | PACKAGING | LEAD (Pb)-FREE |
|---|---|---|---|---|---|---|
| **LTO** | **150** | **H** = high pulse absorption | The first four digits are significant figures and the last digit specifies the number of zeros to follow. R designates decimal point.<br>**48R70** = 48.7 Ω<br>**22000** = 2200 Ω = 2.2 kΩ | **G** = 2 %<br>**J** = 5 %<br>**K** = 10 % | **T** = tube<br>Tube 30 pieces | **E3** = pure tin |

## CLIP PART NUMBER INFORMATION

| REFERENCE | PART NUMBER FOR ORDERING |
|---|---|
| Screwed clip MAX08NG | **ACCLLTO150VS** |
| Clipped clip MAX03HNG | **ACCLLTO150CL** |



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