# Power Resistor Thick Film Technology


## FEATURES

- 100 W at 25 °C case temperature heatsink mounted
- Direct mounting ceramic on heatsink
- Broad resistance range: 0.015 Ω to 1 MΩ
- Non inductive
- TO-247 package: compact and easy to mount
- **AEC-Q200 qualified**
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE GRADE

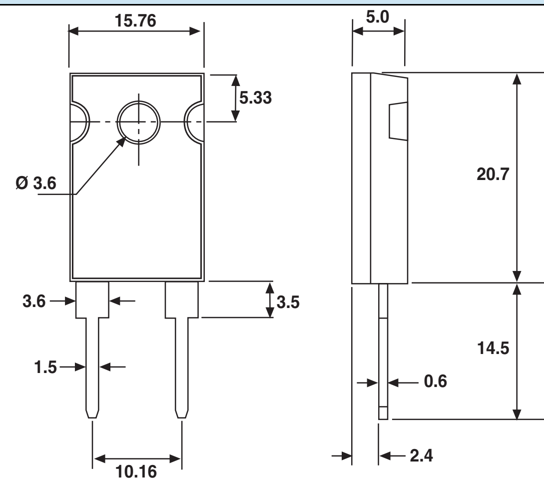
RoHS COMPLIANT

**DESIGN SUPPORT TOOLS** click logo to get started

3D Models Available

LTO series are the extension of RTO types. We used the direct ceramic mounting design (no metal tab) of our RCH power resistors applied to semiconductor packages.

## DIMENSIONS in millimeters




**Note**
- Tolerances unless stated: ± 0.3 mm

## STANDARD ELECTRICAL SPECIFICATIONS

| MODEL | SIZE | RESISTANCE RANGE Ω | RATED POWER $P_{25\ °C}$ W | LIMITING ELEMENT VOLTAGE $U_L$ V | TOLERANCE ± % | TEMPERATURE COEFFICIENT ± ppm/°C | CRITICAL RESISTANCE Ω |
|---|---|---|---|---|---|---|---|
| LTO 100 | TO-247 | 0.015 to 1 M | 100 | 500 | 1, 2, 5, 10 | 200, 350, 900 | 2.5 K |

## MECHANICAL SPECIFICATIONS

| | |
|---|---|
| **Mechanical Protection** | Molded |
| **Resistive Element** | Thick film |
| **Substrate** | Alumina |
| **Connections** | Tinned copper |
| **Weight** | 3.5 g max. |
| **Mounting Torqure** | 1 Nm |

## ENVIRONMENTAL SPECIFICATIONS

| | |
|---|---|
| **Temperature Range** | -55 °C to +175 °C |
| **Climatic Category** | 55 / 175 / 56 |
| **Flammability** | IEC 60695-11-5<br>2 applications 30 s<br>separated by 60 s |

## TECHNICAL SPECIFICATIONS

| | |
|---|---|
| **Dissipation and Associated** | Onto a heatsink |
| **Power Rating and Thermal Resistance of the Component** | 100 W at +25 °C (case temp.)<br>$R_{TH\ (j - c)}$: 1.5 °C/W<br>Free air:<br>3.5 W at +25 °C |
| **Temperature Coefficient** | See Performance table<br>± 150 ppm/°C |
| **Dielectric Strength MIL STD 202** | 3000 $V_{RMS}$ - 1 min<br>10 mA max. |
| **Insulation Resistance** | ≥ $10^4$ MΩ |
| **Inductance** | ≤ 0.1 µH |

## PERFORMANCE

| TESTS | CONDITIONS | REQUIREMENTS |
|---|---|---|
| **Momentary Overload** | EN 60115-1<br>1.5 Pr/5 s<br>$U_S < 1.5\ U_L$ | ± (0.5 % + 0.005 Ω) |
| **Load Life** | EN 60115-1<br>1000 h Pr at +25 °C | ± (1 % + 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 | ± (1 % +0.005 Ω) |
| **Operational Life** | AEC-Q200 REV D conditions:<br>MIL-STD-202 method 108<br>2000 h, 90/30, powered, +125 °C | ± (1 % +0.005 Ω) |
| **ESD Human Body Model** | AEC-Q200 REV D conditions:<br>AEC-Q200-002<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 sec | ± (0.25 % +0.01 Ω) |

## SPECIAL FEATURES

| | | | |
|---|---|---|---|
| **Resistance Values** | ≥ 0.015 | ≥ 0.1 | > 20 |
| **Tolerances** | ± 1 % at ± 10 % | | |
| **Typical Temperature Coefficient (-55 ° to +175 °C)** | ± 900 ppm/°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 thermal 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 100 power rating 10 W at ambient temperature +25 °C
Thermal resistance $R_{TH\ (j-c)}$: 1.5 °C/W
Considering equation (1) we have:

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

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

$$R_{TH\ (c-h)} + R_{TH\ (h-a)} = 15\ °C/W - 1.5\ °C/W = 13.5\ °C/W$$

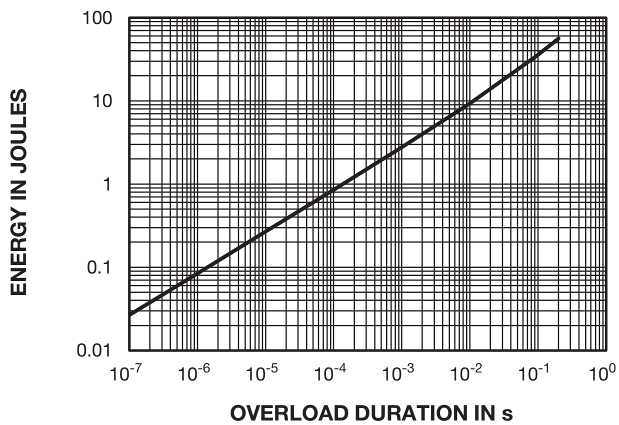
with a thermal grease $R_{TH\ (c-h)}$ = 1 °C/W, we need a heatsink with $R_{TH\ (h-a)}$ = 12.5 °C/W.

## OVERLOADS

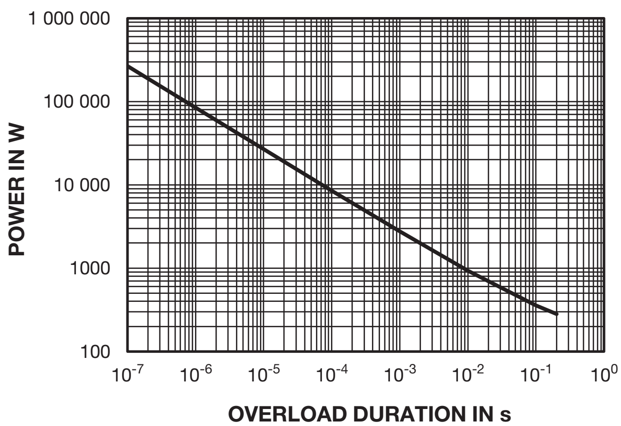
In any case the applied voltage must be lower than the maximum overload voltage of 750 V.

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

## ENERGY CURVE



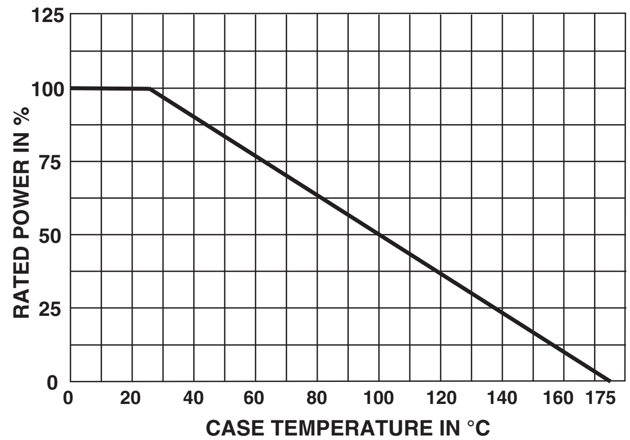

## POWER CURVE




## POWER RATING

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

To improve the thermal conductivity, surfaces in contact should be coated with a silicone grease and the torque applied on the screw for tightening should be around 1 Nm.




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

## MARKING

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

## ORDERING INFORMATION

| LTO | 100 | F | 2.7 kΩ | ± 1 % | xxx | TU30 | e3 |
|---|---|---|---|---|---|---|---|
| MODEL | STYLE | CONNECTIONS | RESISTANCE VALUE | TOLERANCE | CUSTOM DESIGN | PACKAGING | LEAD (Pb)-FREE |
| | | | | ± 1 %<br>± 2 %<br>± 5 %<br>± 10 % | Optional on request: special TCR, shape etc. | | |

## GLOBAL PART NUMBER INFORMATION

| L | T | O | 1 | 0 | 0 | F | 2 | 7 | 0 | 0 | 0 | J | T | E | 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| GLOBAL MODEL | SIZE | LEADS | OHMIC VALUE | TOLERANCE | PACKAGING | LEAD (Pb)-FREE |
|---|---|---|---|---|---|---|
| **LTO** | **100** | **F** = radial leads | 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>**48701** = 48 700 Ω<br>**10002** = 100 000 Ω<br>**R0100** = 0.01 Ω<br>**R4700** = 0.47 Ω<br>**27000** = 2700 Ω = 2.7 kΩ | **F** = 1 %<br>**G** = 2 %<br>**J** = 5 %<br>**K** = 10 % | **T** = tube<br><br>Tube 30 pieces | **E3** = pure tin |

# Disclaimer

ALL PRODUCT, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE TO IMPROVE RELIABILITY, FUNCTION OR DESIGN OR OTHERWISE.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, “Vishay”), disclaim any and all liability for any errors, inaccuracies or incompleteness contained in any datasheet or in any other disclosure relating to any product.

Vishay makes no warranty, representation or guarantee regarding the suitability of the products for any particular purpose or the continuing production of any product. To the maximum extent permitted by applicable law, Vishay disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.

Statements regarding the suitability of products for certain types of applications are based on Vishay’s knowledge of typical requirements that are often placed on Vishay products in generic applications. Such statements are not binding statements about the suitability of products for a particular application. It is the customer’s responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. Parameters provided in datasheets and / or specifications may vary in different applications and performance may vary over time. All operating parameters, including typical parameters, must be validated for each customer application by the customer’s technical experts. Product specifications do not expand or otherwise modify Vishay’s terms and conditions of purchase, including but not limited to the warranty expressed therein.

Except as expressly indicated in writing, Vishay products are not designed for use in medical, life-saving, or life-sustaining applications or for any other application in which the failure of the Vishay product could result in personal injury or death. Customers using or selling Vishay products not expressly indicated for use in such applications do so at their own risk. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay. Product names and markings noted herein may be trademarks of their respective owners.