

## Power Resistor Thick Film Technology



### LINKS TO ADDITIONAL RESOURCES



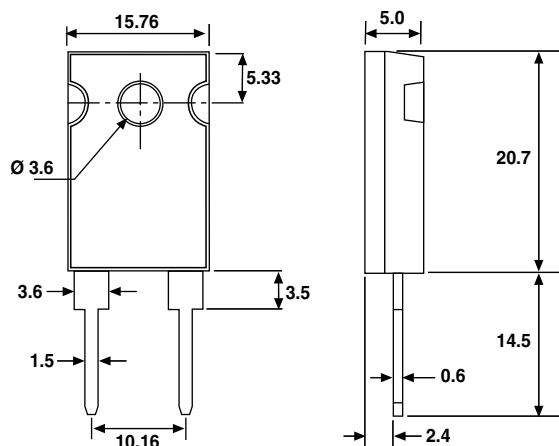
### FEATURES

- 100 W at 25 °C case temperature heatsink mounted
- Direct mounting ceramic on heatsink
- Broad resistance range: 0.015  $\Omega$  to 1 M $\Omega$
- Non inductive
- TO-247 package: compact and easy to mount
- Bended option available
- **AEC-Q200 qualified**
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS**  
COMPLIANT

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:  $\pm 0.3$  mm

### STANDARD ELECTRICAL SPECIFICATIONS

| MODEL   | SIZE   | RESISTANCE RANGE<br>$\Omega$ | RATED POWER<br>$P_{25\text{ }^{\circ}\text{C}}$<br>W | LIMITING ELEMENT VOLTAGE $U_L$<br>V | TOLERANCE<br>$\pm \%$ | TEMPERATURE COEFFICIENT<br>$\pm \text{ppm}/^{\circ}\text{C}$ | CRITICAL RESISTANCE<br>$\Omega$ |
|---------|--------|------------------------------|------------------------------------------------------|-------------------------------------|-----------------------|--------------------------------------------------------------|---------------------------------|
| LTO 100 | TO-247 | 0.015 to < 0.2               | 100                                                  | 500                                 | 5, 10                 | 350, 900                                                     | n/a                             |
|         |        | 0.2 to 1M                    | 100                                                  | 500                                 | 1, 2, 5, 10           | 200, 350                                                     | 2.5 K                           |

### MECHANICAL SPECIFICATIONS

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

### ENVIRONMENTAL SPECIFICATIONS

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

**TECHNICAL SPECIFICATIONS**

|                                                      |                                                                                          |
|------------------------------------------------------|------------------------------------------------------------------------------------------|
| Dissipation and Associated                           | Onto a heatsink                                                                          |
| Power Rating and Thermal Resistance of the Component | 100 W at +25 °C (case temp.)<br>$R_{TH(j-a)}$ : 1.5 °C/W<br>Free air:<br>3.5 W at +25 °C |
| Temperature Coefficient                              | See Performance table<br>$\pm 150$ ppm/°C                                                |
| Dielectric Strength<br>MIL STD 202                   | 3000 V <sub>RMS</sub> - 1 min<br>10 mA max.                                              |
| Insulation Resistance                                | $\geq 10^4$ M $\Omega$                                                                   |
| Inductance                                           | $\leq 0.1$ $\mu$ H                                                                       |

**PERFORMANCE**

| TESTS                     | CONDITIONS                                                                                                         | REQUIREMENTS                   |
|---------------------------|--------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Momentary Overload        | EN 60115-1<br>1.5 Pr/5 s<br>$U_S < 1.5 U_L$                                                                        | $\pm (0.5 \% + 0.005 \Omega)$  |
| Load Life                 | EN 60115-1<br>1000 h Pr at +25 °C                                                                                  | $\pm (0.5 \% + 0.005 \Omega)$  |
| High Temperature Exposure | AEC-Q200 rev. D conditions:<br>MIL-STD-202 method 108<br>1000 h, +175 °C, unpowered                                | $\pm (0.25 \% + 0.005 \Omega)$ |
| 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        | $\pm (0.5 \% + 0.005 \Omega)$  |
| Biased Humidity           | AEC-Q200 rev. D conditions:<br>MIL-STD-202 method 103<br>1000 h, 85 °C, 85 % RH                                    | $\pm (1 \% + 0.005 \Omega)$    |
| Operational Life          | AEC-Q200 rev. D conditions:<br>MIL-STD-202 method 108<br>2000 h, 90/30, powered, +125 °C                           | $\pm (0.5 \% + 0.005 \Omega)$  |
| ESD Human Body Model      | AEC-Q200 rev. D conditions:<br>AEC-Q200-002<br>25 kV <sub>AD</sub>                                                 | $\pm (0.5 \% + 0.005 \Omega)$  |
| 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 | $\pm (0.2 \% + 0.005 \Omega)$  |
| 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             | $\pm (0.2 \% + 0.005 \Omega)$  |
| Terminal Strength         | AEC-Q200 rev. D conditions:<br>AEC-Q200-006<br>2 kgf, 60 s                                                         | $\pm (0.25 \% + 0.01 \Omega)$  |

**SPECIAL FEATURES**

|                                                        |                  |                  |                     |                  |
|--------------------------------------------------------|------------------|------------------|---------------------|------------------|
| Resistance Values                                      | $\geq 0.015$     | $\geq 0.1$       | $\geq 0.2$          | $\geq 20$        |
| Tolerances                                             | 5 %, 10 %        |                  | 1 %, 2 %, 5 %, 10 % |                  |
| Typical Temperature Coefficient<br>(-55 °C to +155 °C) | $\pm 900$ ppm/°C | $\pm 350$ ppm/°C | $\pm 350$ ppm/°C    | $\pm 200$ 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

$\Delta T$ : 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:

$$\Delta T = 175\text{ °C} - 25\text{ °C} = 150\text{ °C}$$

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

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

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

Single Pulse

These informations are for a single pulse on a cold resistor at 25 °C (not already used for a dissipation) and for pulses of 100 ms maximum duration.

The formula used to calculate  $E$  is:

$$E = P \times t = \frac{U^2}{R} \times t$$

with:

$E$  (J): pulse energy

$P$  (W): pulse power

$t$  (s): pulse duration

$U$  (V): pulse voltage

$R$  ( $\Omega$ ): resistor

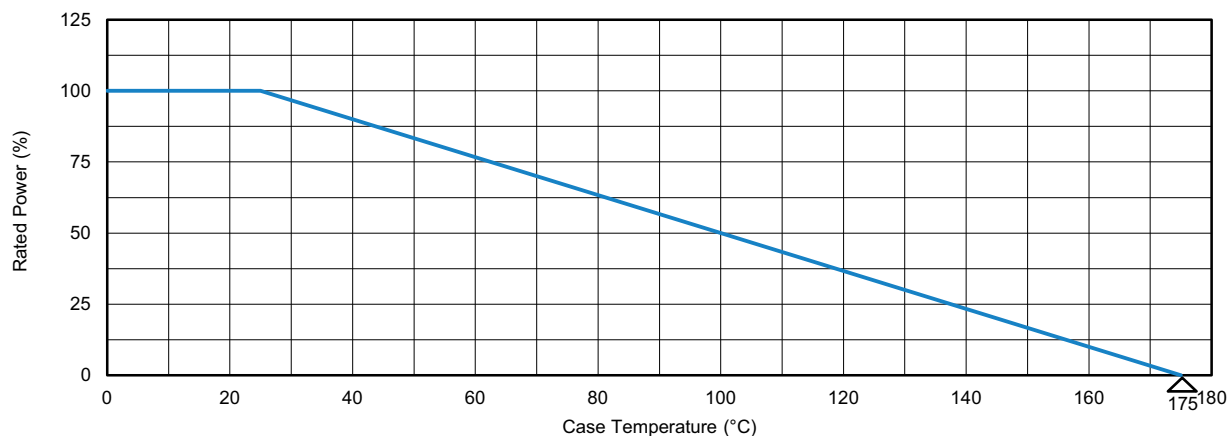
The energy calculated must be less than that allowed by the graph.



## 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.

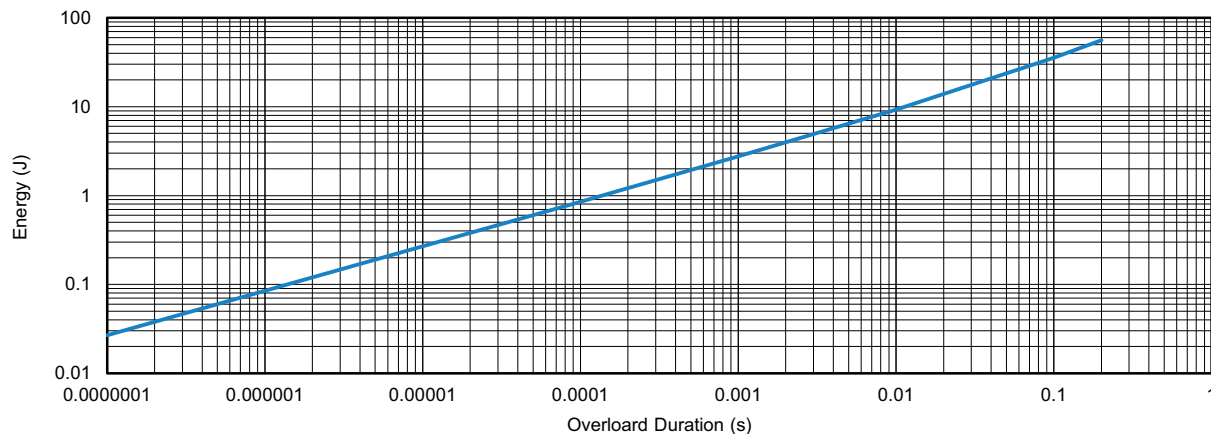


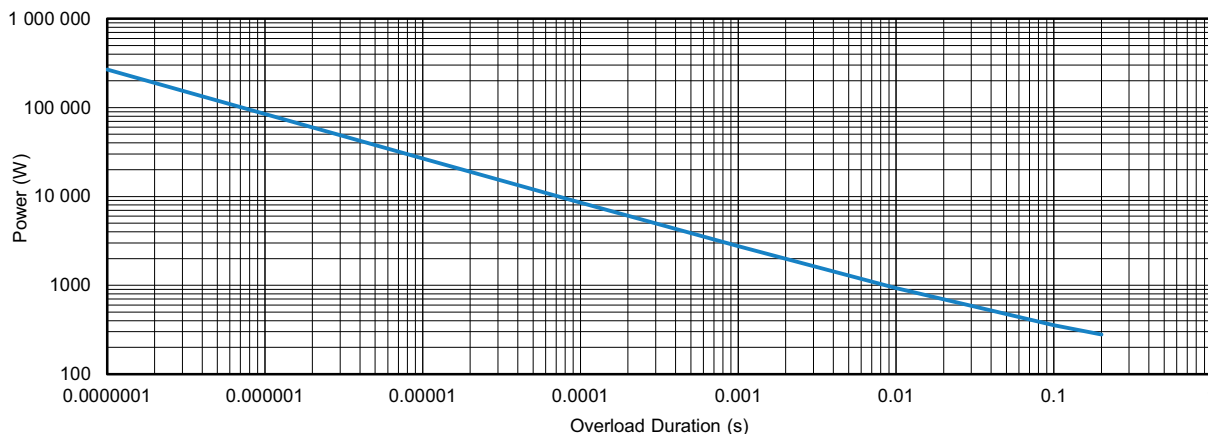
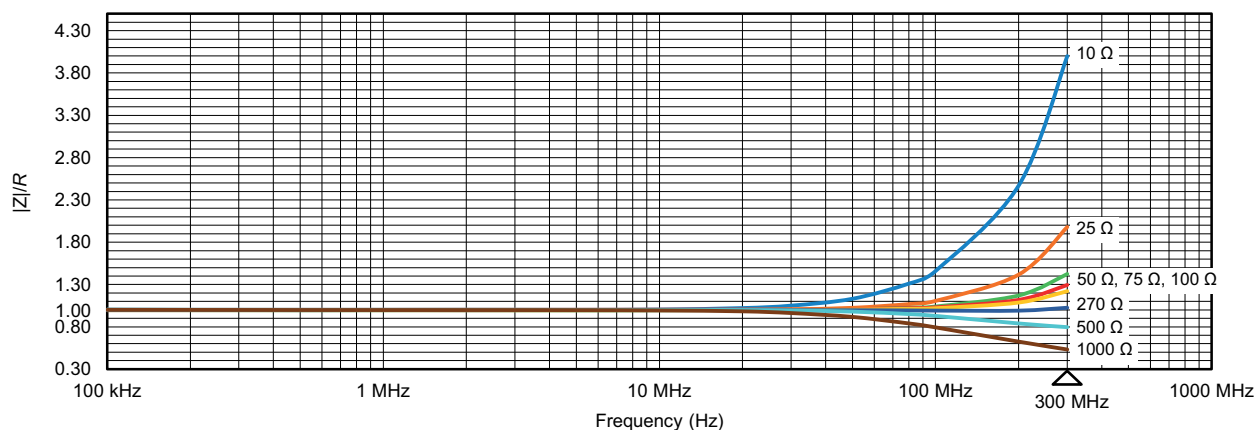
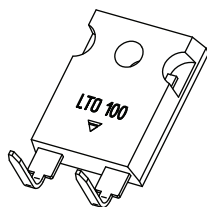
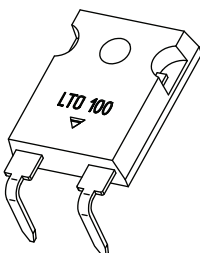
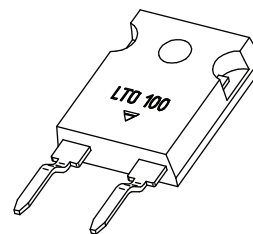
## OVERLOADS

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

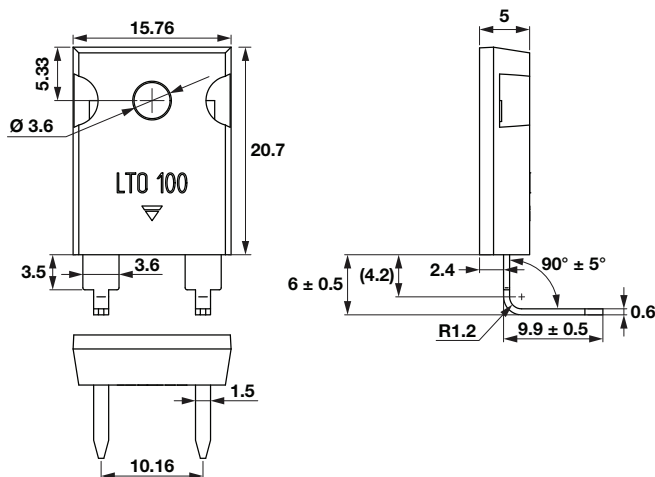
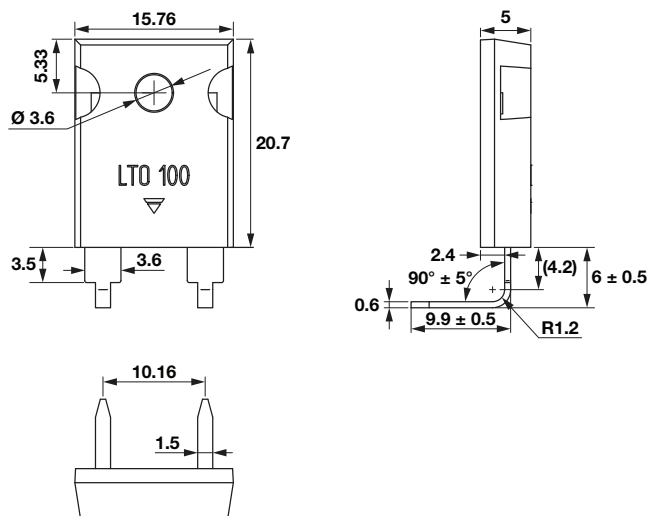
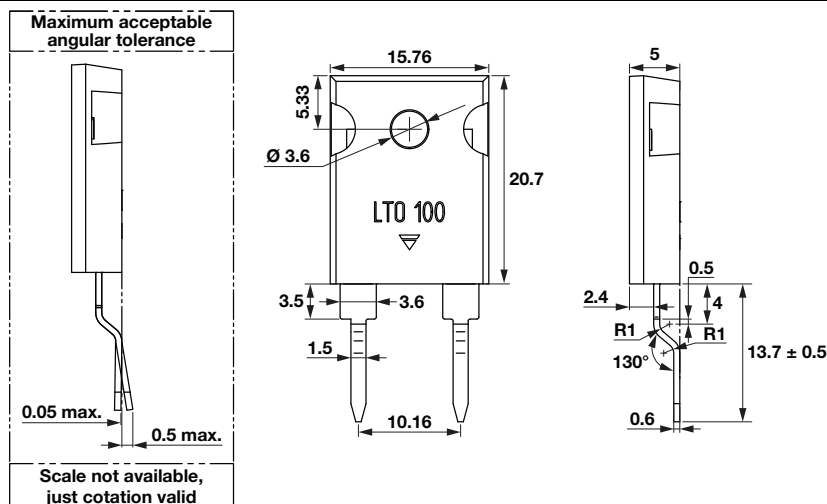
Accidental overload: The values indicated on the following graph are applicable to resistors in air or mounted onto a heatsink.

## ENERGY CURVE



**POWER CURVE**

**IMPEDANCE CURVE 10  $\Omega$  to 1 k $\Omega$  from 100 kHz to 300 MHz**

**BENDING OPTIONS**
**LTO 100 TB7**

**LTO 100 TB8**

**LTO 100 TB9**


**BENDING OPTIONS DIMENSIONS** in millimeters

**LTO 100 TB7**

**LTO 100 TB8**

**LTO 100 TB9**

**Note**

- Tolerances unless stated:  $\pm$  0.3 mm



## PACKAGING

Tube of 30 units

## MARKING

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

## ORDERING INFORMATION

| LTO   | 100   | F           | 2.7 k $\Omega$   | $\pm 1\%$                                         | xxx                                                           | TU30      | e3             |
|-------|-------|-------------|------------------|---------------------------------------------------|---------------------------------------------------------------|-----------|----------------|
| MODEL | STYLE | CONNECTIONS | RESISTANCE VALUE | TOLERANCE                                         | CUSTOM DESIGN                                                 | PACKAGING | LEAD (Pb)-FREE |
|       |       |             |                  | $\pm 1\%$<br>$\pm 2\%$<br>$\pm 5\%$<br>$\pm 10\%$ | Optional<br>on request:<br>special TCR,<br>shape, bended 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 $\Omega$<br>48701 = 48 700 $\Omega$<br>10002 = 100 000 $\Omega$<br>R0100 = 0.01 $\Omega$<br>R4700 = 0.47 $\Omega$<br>27000 = 2700 $\Omega$ = 2.7 k $\Omega$ |   |   |   | F = 1 %<br>G = 2 %<br>J = 5 %<br>K = 10 % |   | T = tube<br>Tube 30 pieces |   | E3 = pure tin  |   |   |   |   |



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