

# Surface Mounted Power Resistor Thick Film Technology



## FEATURES

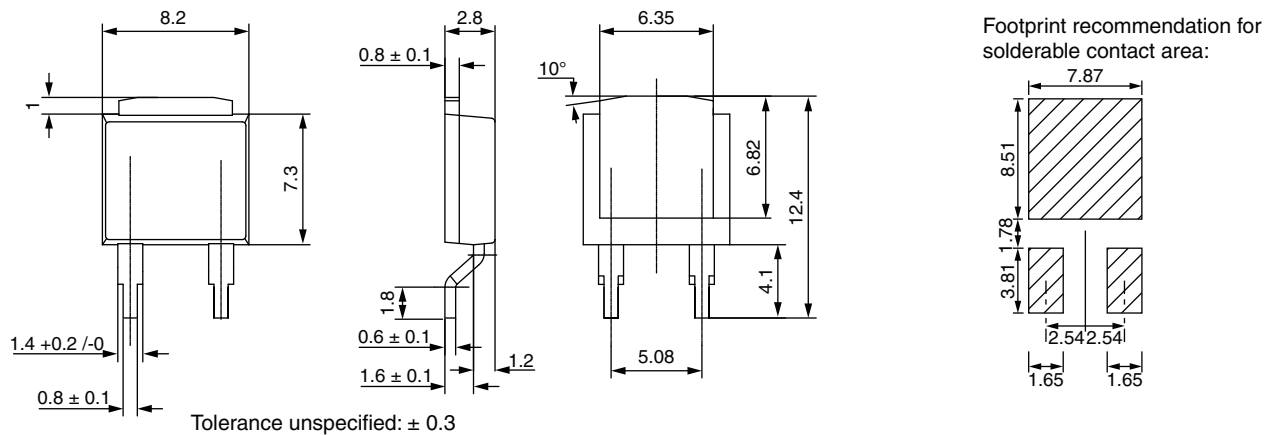
- AEC-Q200 qualified
- 35 W at 25 °C case temperature
- Surface mounted resistor - TO-252 (DPAK) style package
- Wide resistance range: 0.016 Ω to 700 kΩ
- Non inductive
- Resistor isolated from metal tab
- Solder reflow secure at 270 °C / 10 s, MSL = 1
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)


**RoHS  
COMPLIANT**

## LINKS TO ADDITIONAL RESOURCES



## DIMENSIONS in millimeters



### Notes

- For the assembly, we recommend the lead (Pb)-free thermal profile as per J-STD-020C
- Power dissipation is 4.5 W at an ambient temperature of 25 °C when mounted on a double sided copper board using FR4 HTG, 70 μm of copper, 39 mm x 30 mm x 1.6 mm, with thermal vias
- For other information about dissipation, see the Application Note 52027: "Thermal Management on SMD Thick Film Resistors (D2TO20, D2TO35, DTO25, DTO35)"

## STANDARD ELECTRICAL SPECIFICATIONS

| MODEL | SIZE          | RESISTANCE RANGE<br>Ω | RATED POWER<br>$P_{25\text{ }^\circ\text{C}}$<br>W | LIMITING ELEMENT VOLTAGE $U_L$<br>V | TOLERANCE<br>± % | TEMPERATURE COEFFICIENT<br>± ppm/°C | CRITICAL RESISTANCE<br>Ω |
|-------|---------------|-----------------------|--|-------------------------------------|------------------|-------------------------------------|--------------------------|
| DTO35 | TO-252 (DPAK) | 0.016 to 700K         | 35   | 500                                 | 1, 2, 5, 10      | 150                                 | 7.1K                     |

## MECHANICAL SPECIFICATIONS

|                       |                               |
|-----------------------|-------------------------------|
| Mechanical Protection | Molded                        |
| Resistive Element     | Thick film                    |
| Substrate             | Alumina                       |
| Connections           | Tinned copper, Ni under layer |
| Weight                | 2 g max.                      |

## 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 |

## ELECTRICAL SPECIFICATIONS

|                                     |   |
|-------------------------------------|---|
| Tolerances                          | From 0.016 Ω to 0.047 Ω:<br>± 5 % and ± 10 %<br>> 0.047 Ω to 0.1 Ω:<br>± 2 % to ± 10 %<br>≥ 0.11 Ω: ± 1 % to ± 10 % |
| Power Rating and Thermal Resistance | 35 W at +25 °C case temperature $R_{TH(j-c)}$ : 4.28 °C/W   |
| Temperature Coefficient             | See Special Feature table<br>± 150 ppm/°C   |
| Dielectric Strength                 | 1500 $V_{RMS}$ - 1 min - 15 mA max.<br>(between terminals and board)  |
| Insulation Resistance               | ≥ 10 <sup>4</sup> MΩ  |
| Inductance                          | ≤ 0.1 μH  |



| DIMENSIONS       |                     |
|------------------|---------------------|
| Standard Package | TO-252 style (DPAK) |

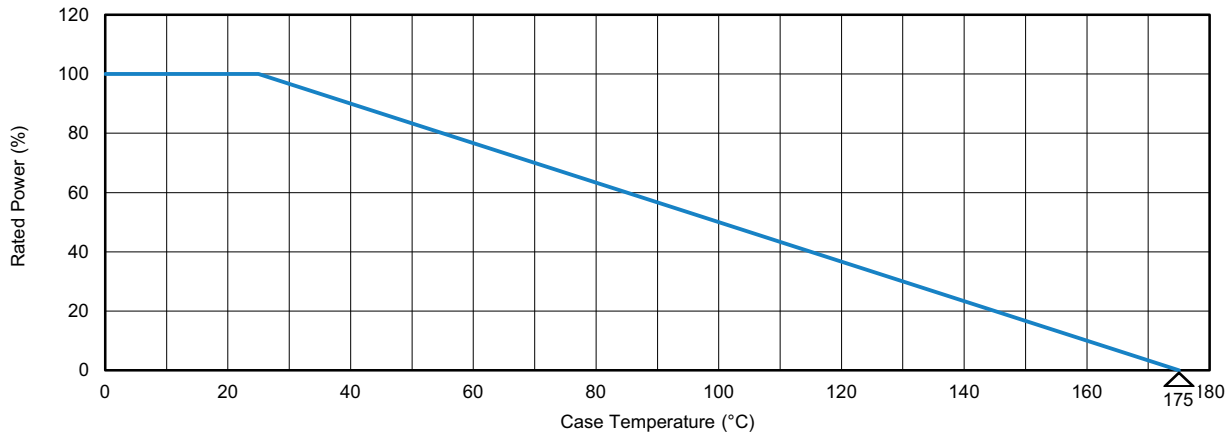
| SPECIAL FEATURES  |              |              |              |
|---|--------------|--------------|--------------|
| Resistance Values   | ≥ 0.016      | ≥ 0.1        | ≥ 0.5        |
| Requirement Temperature Coefficient (TCR)<br>(-55 °C +175 °C) IEC 60115-1 | ± 900 ppm/°C | ± 350 ppm/°C | ± 150 ppm/°C |

| PERFORMANCE               |   |                      |
|---------------------------|---|----------------------|
| TESTS                     | CONDITIONS  | REQUIREMENTS         |
| Momentary Overload        | IEC 60115-1 §4.13<br>1.6 Pr 5 s<br>US < 1.5 UL  | ± (0.25 % + 0.005 Ω) |
| Load Life                 | IEC 60115-1<br>1000 h, 90/30 Pr at +25 °C   | ± (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   | ± (0.5 % + 0.005 Ω)  |
| Temperature Cycling       | AEC-Q200 rev. D conditions:<br>pre-conditioning 3 reflows according<br>JESTD020D<br>JESD22 method JA-104<br>1000 cycles, (-55 °C to +125 °C)<br>dwell time 15 min | ± (0.5 % + 0.005 Ω)  |
| Biased Humidity           | AEC-Q200 rev. D conditions:<br>MIL-STD-202 method 103<br>1000 h, 85 °C, 85 % RH   | ± (0.5 % + 0.005 Ω)  |
| Operational Life          | AEC-Q200 rev. D conditions:<br>pre-conditioning 3 reflows according<br>JESTD020D<br>MIL-STD-202 method 108<br>1000 h, 90/30, powered, +125 °C                     | ± (0.5 % + 0.005 Ω)  |
| ESD Human Body Model      | AEC-Q200 rev. D conditions:<br>AEC-Q200-002<br>25 kV <sub>AD</sub>  | ± (0.5 % + 0.005 Ω)  |
| Vibration                 | AEC-Q200 rev. D conditions:<br>MIL-STD-202 method 204<br>20 g's for 20 min, 12 cycles<br>test from 10 Hz to 2000 Hz   | ± (0.2 % + 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  | ± (0.2 % + 0.005 Ω)  |
| Board Flex                | AEC-Q200 rev. D conditions:<br>AEC-Q200-005<br>bending 2 mm, 60 s   | ± (0.25 % + 0.01 Ω)  |
| Terminal Strength         | AEC-Q200 rev. D conditions:<br>AEC-Q200-006<br>1.8 kgf, 60 s  | ± (0.25 % + 0.01 Ω)  |

| ASSEMBLY SPECIFICATIONS  |  |   |
|--|--|---|
| For the assembly on board, we recommend the lead (Pb)-free thermal profile as per J-STD-020C |  |   |
| TESTS  | CONDITIONS   | REQUIREMENTS  |
| Resistance to Soldering Heat   | AEC-Q200 rev. D<br>MIL-STD-202 method 210<br>Solder bath method: 270 °C / 10 s | ± (0.5 % + 0.005 Ω)   |
| Moisture Sensitivity Level (MSL)   | IPC / JEDEC® J-STD-020C<br>85 °C / 85 % RH / 168 h                             | Level: 1<br>+ pass requirements of TCR overload and dielectric strength after MSL |

## POWER RATING

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



## CHOICE OF THE BOARD

The user must choose the board 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: 4.28 °C/W.

$R_{TH(c-h)}$ : Thermal resistance value measured between outer side of the resistor and upper side of the board. This is the thermal resistance of the solder layer.

$R_{TH(h-a)}$ : Thermal resistance of the board.

### Example:

$R_{TH(c-h)} + R_{TH(h-a)}$  for DTO35 power rating 3.5 W at ambient temperature +25 °C.

Thermal resistance  $R_{TH(j-c)}$ : 4.28 °C/W

Considering equation (1) we have:

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

$$R_{TH(j-c)} + R_{TH(c-h)} + R_{TH(h-a)} = \Delta T / P = 150 / 3.5 = 42.8 \text{ °C/W}$$

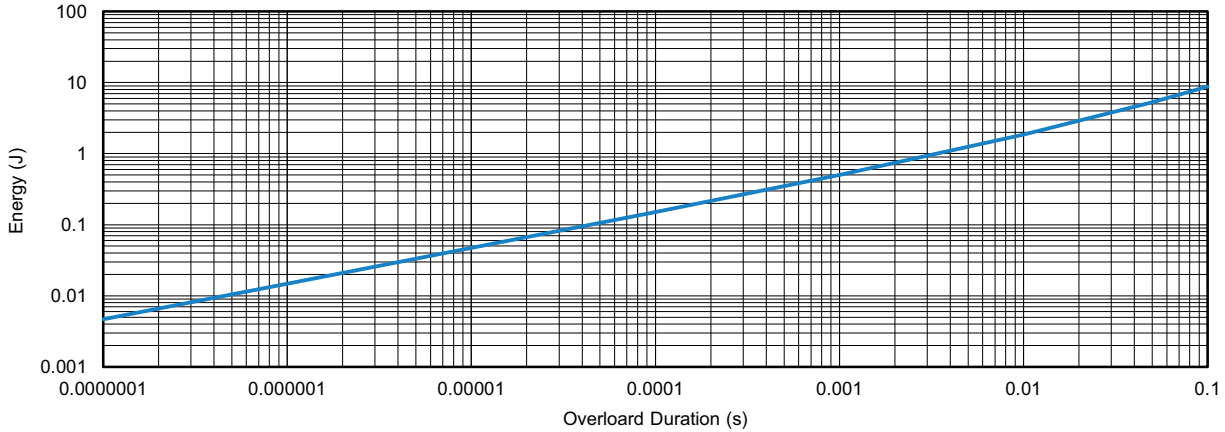
$$R_{TH(c-h)} + R_{TH(h-a)} = 42.8 \text{ °C/W} - 4.28 \text{ °C/W} = 38.52 \text{ °C/W}$$

## ACCIDENTAL OVERLOAD

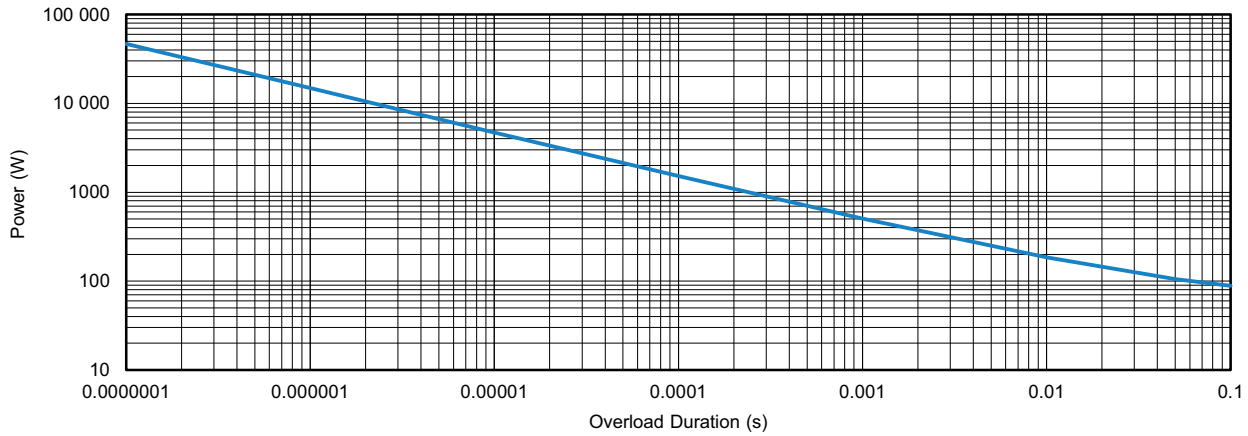
In any case the applied voltage must be lower than the maximum overload voltage of  $U_s = 750 \text{ V}$ . The values indicated on the graph below are applicable to resistors onto a board.



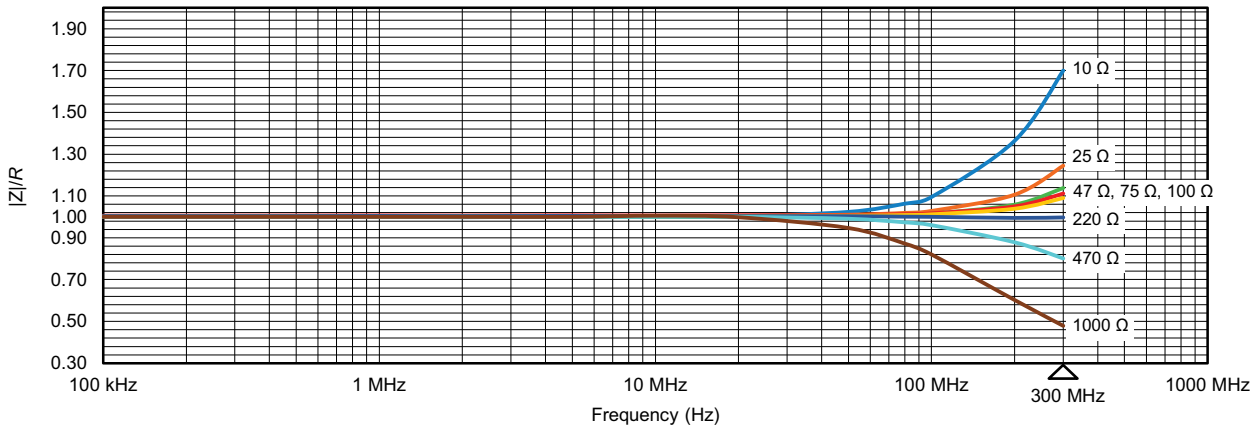
ENERGY CURVE



POWER CURVE

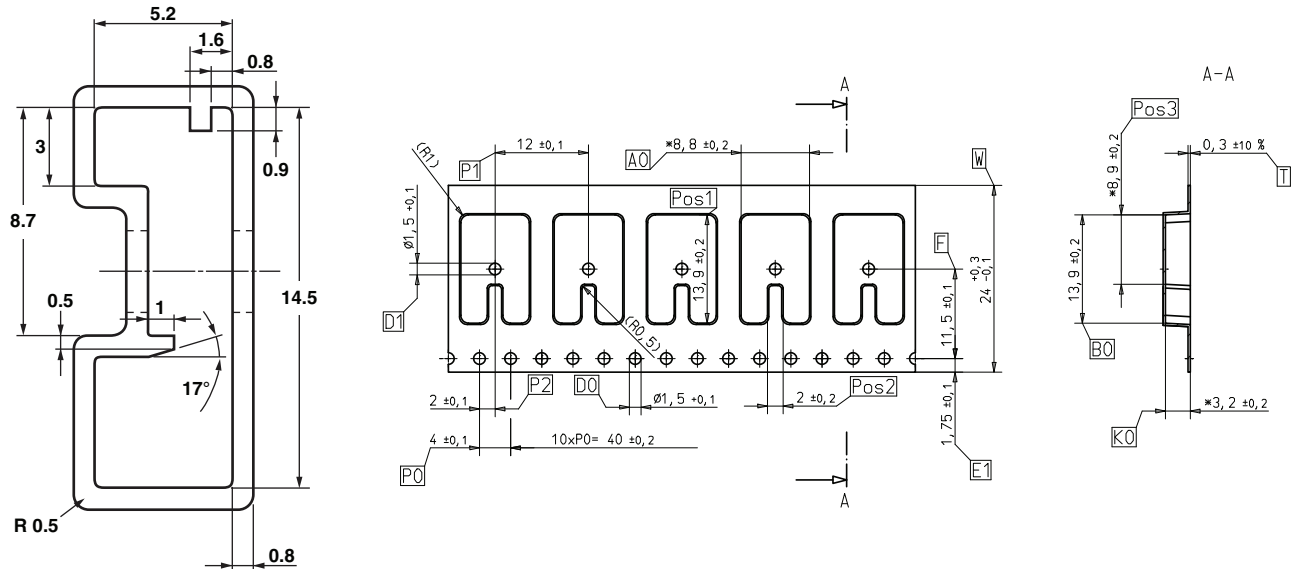


IMPEDANCE CURVE 10 Ω to 1 kΩ from 100 kHz to 300 MHz



**PACKAGING**

- Tube: max. 50 units per tube
- Reel: max. 500 units per reel



**MARKING**

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

| ORDERING INFORMATION |            |             |                  |   |                                    |                |
|----------------------|------------|-------------|------------------|---|------------------------------------|----------------|
| <b>DTO</b>           | <b>035</b> | <b>C</b>    | <b>100 kΩ</b>    | <b>± 1 %</b>                                      | <b>XXX</b>                         | <b>e3</b>      |
| MODEL                | STYLE      | CONNECTIONS | RESISTANCE VALUE | TOLERANCE   | CUSTOM DESIGN                      | LEAD (Pb)-FREE |
|                      |            |             |                  | F = ± 1 %<br>G = ± 2 %<br>J = ± 5 %<br>K = ± 10 % | Optional on request:<br>shape, etc |                |

| SAP PART NUMBERING GUIDELINES |      |                   |   |   |   |   |   |   |                |   |   |   |   |   |   |
|-------------------------------|------|-------------------|---|---|---|---|---|---|----------------|---|---|---|---|---|---|
| D                             | T    | O                 | 0   | 3 | 5 | C | 1   | 0   | 0              | 0 | 2 | F | R | E | 3 |
| GLOBAL MODEL                  | SIZE | LEADS             | OHMIC VALUE   |   |   |   | TOLERANCE                                 | PACKAGING                                       | LEAD (Pb)-FREE |   |   |   |   |   |   |
| DTO                           | 035  | C = surface mount | The first four digits are significant figures and the last digit specifies the number of zeros to follow. R designates decimal point.<br><br><b>48R70</b> = 48.7 Ω<br><b>48701</b> = 48 700 Ω<br><b>10002</b> = 100 000 Ω<br><b>R0100</b> = 0.01 Ω<br><b>R6800</b> = 0.68 Ω<br><b>27000</b> = 2700 Ω = 2.7 kΩ |   |   |   | F = 1 %<br>G = 2 %<br>J = 5 %<br>K = 10 % | R = reel<br>500 pieces<br>T = tube<br>50 pieces | E3 = pure tin  |   |   |   |   |   |   |



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