

# Surface Mounted Power Resistor Thick Film Technology



## FEATURES

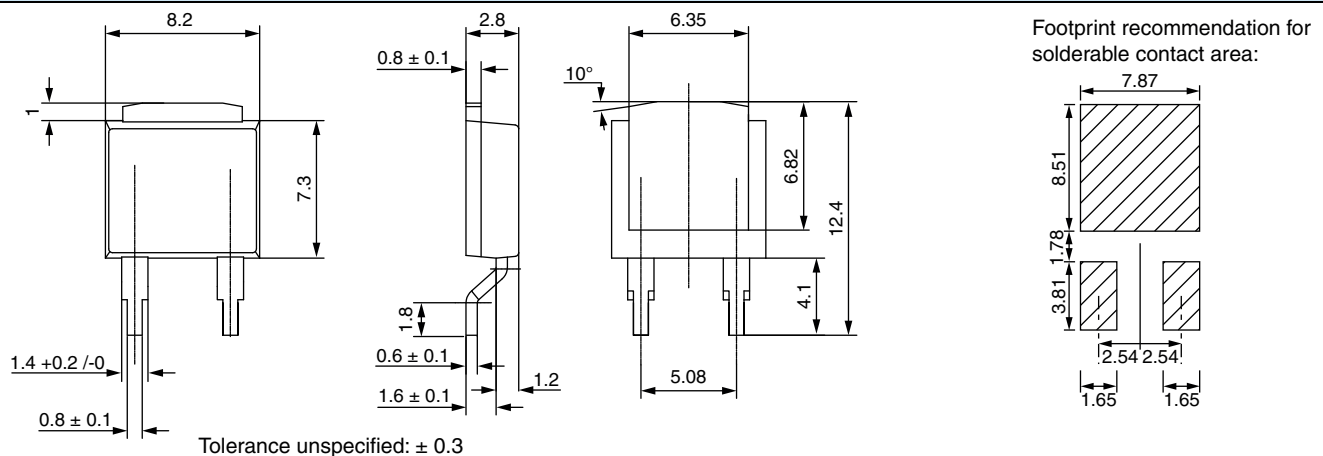
- AEC-Q200 qualified
- 25 W at 25 °C case temperature
- Surface mounted resistor - TO-252 (DPAK) style package
- Wide resistance range: 0.016 Ω to 700 kΩ
- Non inductive
- Resistor isolated from metal tab
- Solder reflow secure at 270 °C / 10 s, MSL = 1
- Material categorization: for definitions of compliance 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 3.2 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, D2TO25)"

## STANDARD ELECTRICAL SPECIFICATIONS

MODEL	SIZE	RESISTANCE RANGE Ω	RATED POWER $P_{25\text{ °C}}$ W	LIMITING ELEMENT VOLTAGE $U_L$ V	TOLERANCE ± %	TEMPERATURE COEFFICIENT ± ppm/°C	CRITICAL RESISTANCE Ω
DTO25	TO-252 (DPAK)	0.016 to 700K	25	500	1, 2, 5, 10	150	10K

## 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 +150 °C
Climatic Category	55 / 150 / 56
Flammability	IEC 60695-11-5 Application time: $t_a = 10$ s Burning duration: $t_b < 30$ s

## ELECTRICAL SPECIFICATIONS

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



DIMENSIONS	
Standard Package	TO-252 style (DPAK)

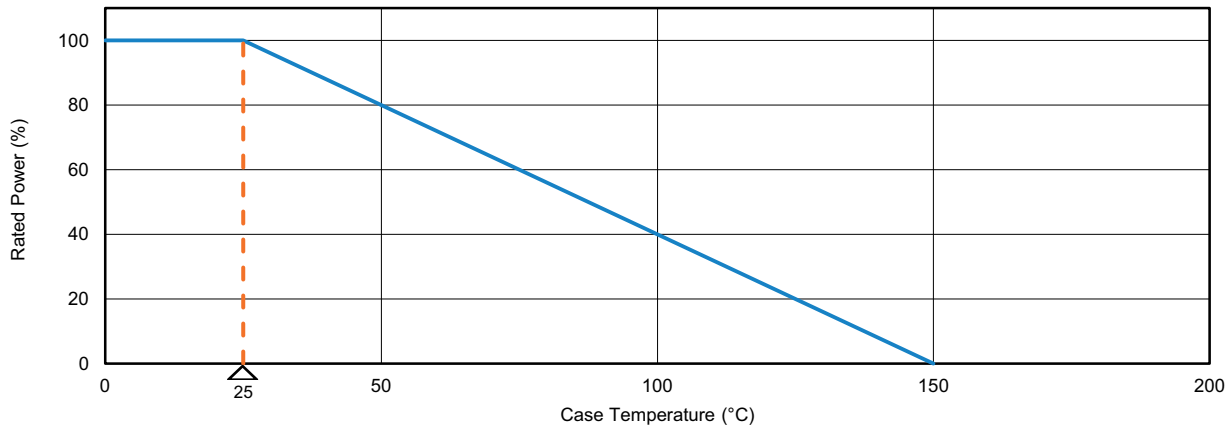
SPECIAL FEATURES			
Resistance Values	≥ 0.016	≥ 0.1	≥ 0.5
Requirement Temperature Coefficient (TCR) (-55 °C +150 °C) IEC 60115-1	± 900 ppm/°C	± 350 ppm/°C	± 150 ppm/°C

PERFORMANCE		
TESTS	CONDITIONS	REQUIREMENTS
Momentary Overload	IEC 60115-1 §4.13 1.6 Pr 5 s US < 1.5 UL	± (0.25 % + 0.005 Ω)
Load Life	IEC 60115-1 1000 h, 90/30 Pr at +25 °C	± (0.5 % + 0.005 Ω)
High Temperature Exposure	AEC-Q200 rev. D conditions: MIL-STD-202 method 108 1000 h, +175 °C, unpowered	± (0.5 % + 0.005 Ω)
Temperature Cycling	AEC-Q200 rev. D conditions: pre-conditioning 3 reflows according JESTD020D JESD22 method JA-104 1000 cycles, (-55 °C to +125 °C) dwell time 15 min	± (0.5 % + 0.005 Ω)
Biased Humidity	AEC-Q200 rev. D conditions: MIL-STD-202 method 103 1000 h, 85 °C, 85 % RH	± (0.5 % + 0.005 Ω)
Operational Life	AEC-Q200 rev. D conditions: pre-conditioning 3 reflows according JESTD020D MIL-STD-202 method 108 1000 h, 90/30, powered, +125 °C	± (0.5 % + 0.005 Ω)
ESD Human Body Model	AEC-Q200 rev. D conditions: AEC-Q200-002 25 kV <sub>AD</sub>	± (0.5 % + 0.005 Ω)
Vibration	AEC-Q200 rev. D conditions: MIL-STD-202 method 204 20 g's for 20 min, 12 cycles test from 10 Hz to 2000 Hz	± (0.2 % + 0.005 Ω)
Mechanical Shock	AEC-Q200 rev. D conditions: MIL-STD-202 method 213 100 g's, 6 ms, 3.75 m/s 3 shocks/direction	± (0.2 % + 0.005 Ω)
Board Flex	AEC-Q200 rev. D conditions: AEC-Q200-005 bending 2 mm, 60 s	± (0.25 % + 0.01 Ω)
Terminal Strength	AEC-Q200 rev. D conditions: AEC-Q200-006 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 MIL-STD-202 method 210 Solder bath method: 270 °C / 10 s	± (0.5 % + 0.005 Ω)
Moisture Sensitivity Level (MSL)	IPC / JEDEC® J-STD-020C 85 °C / 85 % RH / 168 h	Level: 1 + 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 150 °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: 5 °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 DTO25 power rating 3 W at ambient temperature +25 °C.

Thermal resistance  $R_{TH(j-c)}$ : 5 °C/W

Considering equation (1) we have:

$$\Delta T = 150 \text{ °C} - 25 \text{ °C} = 125 \text{ °C}$$

$$R_{TH(j-c)} + R_{TH(c-h)} + R_{TH(h-a)} = \Delta T / P = 125 / 3 = 41.7 \text{ °C/W}$$

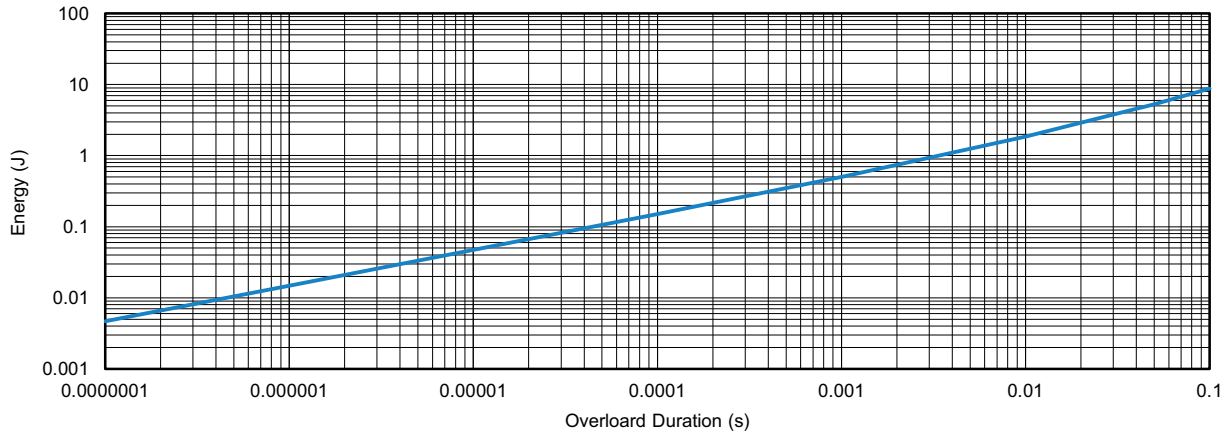
$$R_{TH(c-h)} + R_{TH(h-a)} = 41.7 \text{ °C/W} - 5 \text{ °C/W} = 36.7 \text{ °C/W}$$

## ACCIDENTAL OVERLOAD

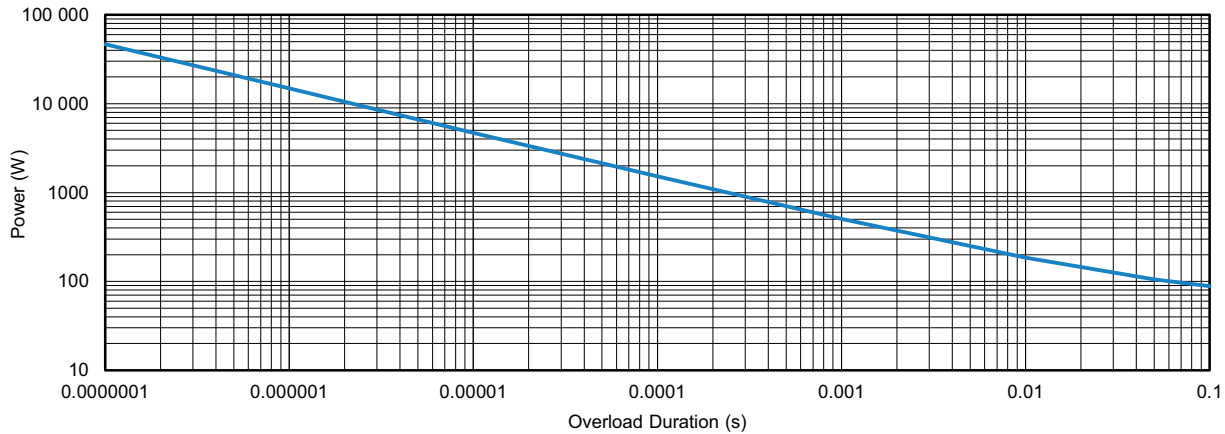
In any case the applied voltage must be lower than the maximum overload voltage of  $U_s = 750 \text{ V}$ . The values indicated on the graph below are applicable to resistors onto a board.



**ENERGY CURVE** at 25 °C



**POWER CURVE** at 25 °C



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.

Repetitive or Superimposed Pulses:

The following formula is used to calculate the “equivalent” energy of a repetitive pulse or the “equivalent energy” of a pulse on a resistor that is already dissipating power.

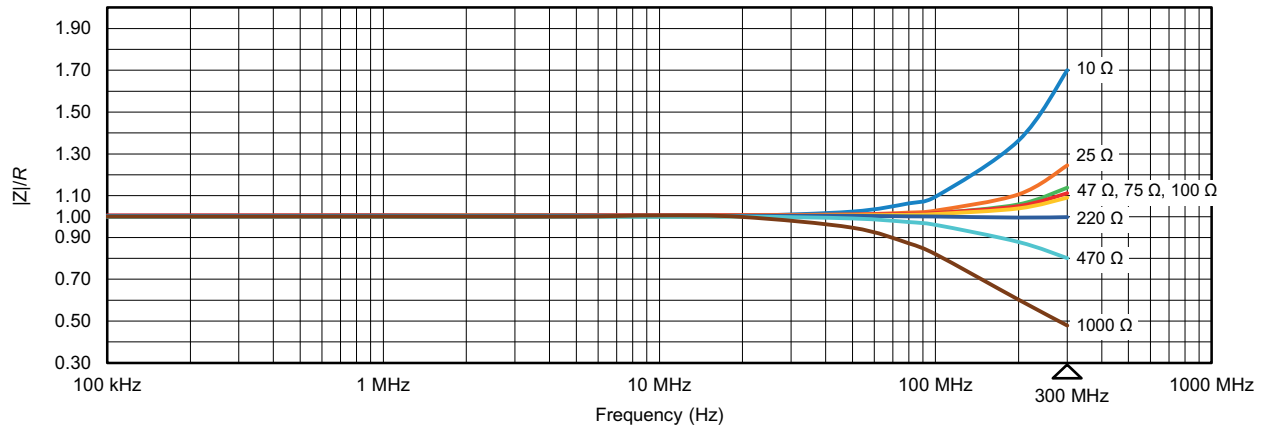
$$E_c = E \times \left(1 + \frac{P_a}{P_r}\right)$$

with:

- $E_c$  (J): equivalent pulse energy
- $E$  (J): known pulse energy
- $P_r$ : resistor power rating
- $P_a$ : mean power being dissipated

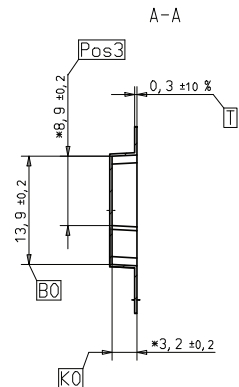
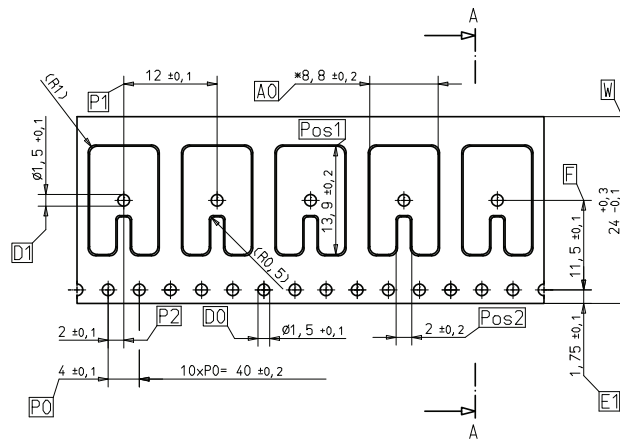
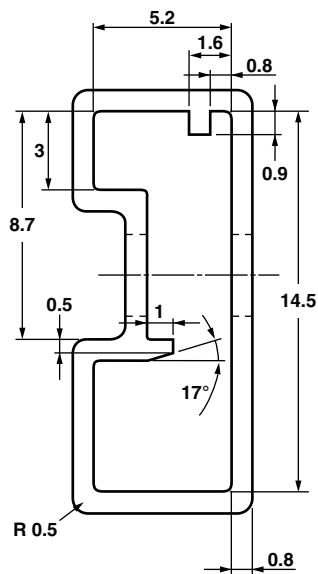
The energy calculated must be less than that allowed by the graph and the average power dissipated ( $P_a$ ) must not exceed the continuous power of resistor.

**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

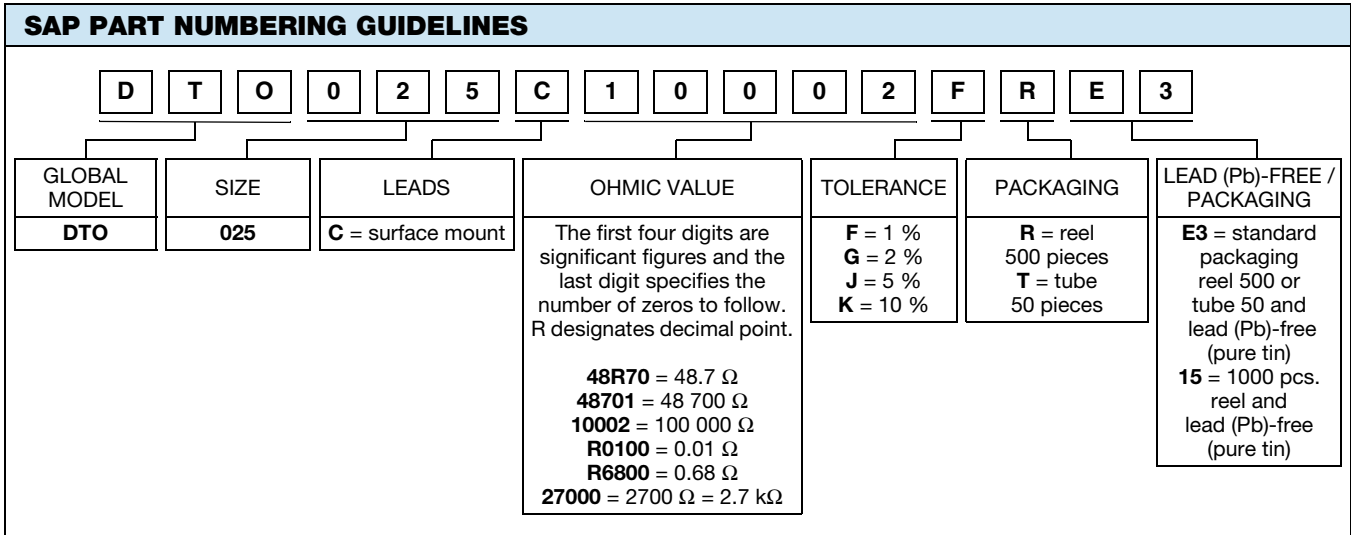


**MARKING**

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



ORDERING INFORMATION						
<b>DTO</b>	<b>025</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 % G = ± 2 % J = ± 5 % K = ± 10 %	Optional on request: shape, etc	





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