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

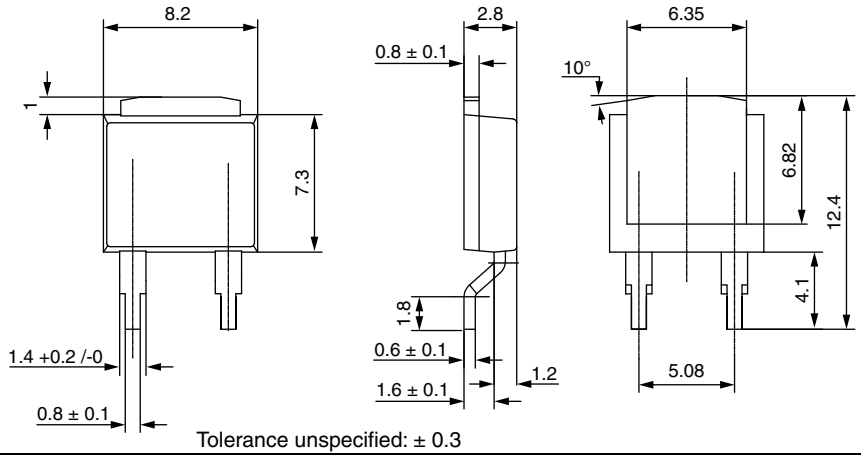
AUTOMOTIVE GRADE

RoHS COMPLIANT

LINKS TO ADDITIONAL RESOURCES

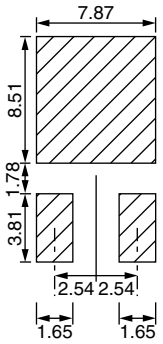
3D Models

DIMENSIONS in millimeters



Tolerance unspecified: ± 0.3

Footprint recommendation for solderable contact area:



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, DTO25)"

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
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	≥ 10^4 MΩ
Inductance	≤ 0.1 µH

DIMENSIONS	
Standard Package	TO-252 style (DPAK)

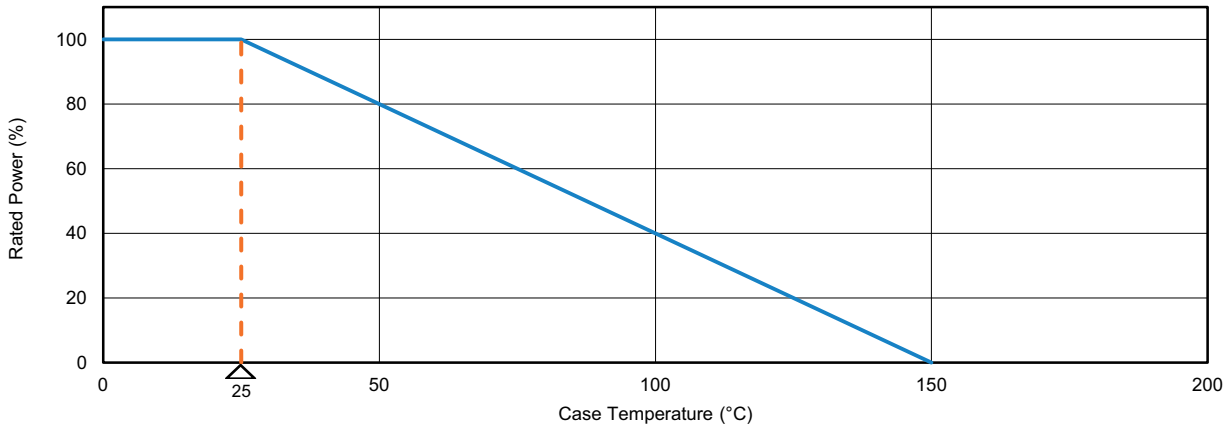
SPECIAL FEATURES			
Resistance Values	≥ 0.016	≥ 0.1	≥ 0.5
Requirement Temperature Coefficient (TCR) (-55 °C +150 °C) IEC 60115-1	± 900 ppm/°C	± 350 ppm/°C	± 150 ppm/°C

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_{AD}	± (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

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: 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:

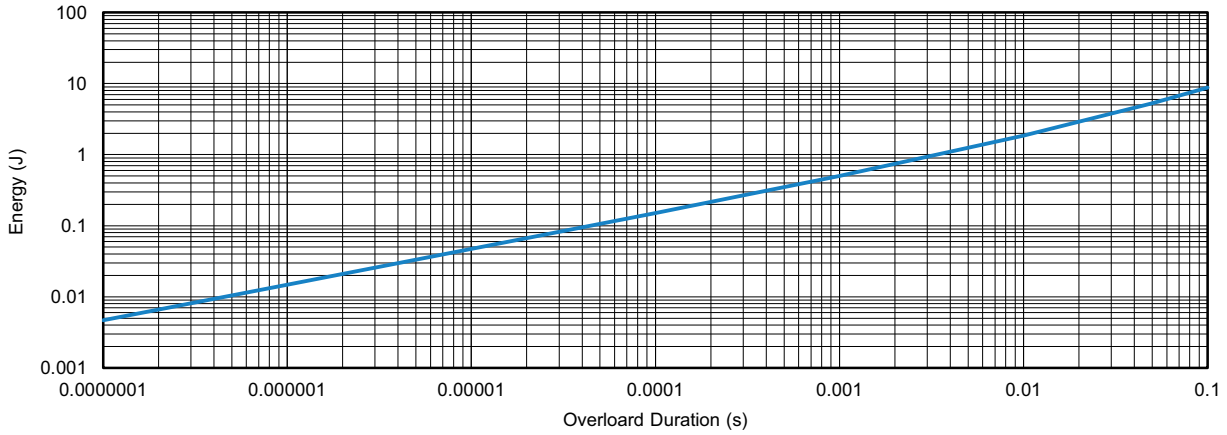
$R_{TH\ (c\ -\ h)} + R_{TH\ (h\ -\ a)}$ for DTO25 power rating 3 W at ambient temperature +25 °C.
Thermal resistance $R_{TH\ (j\ -\ c)}$: 5 °C/W
Considering equation (1) we have:

ΔT = 150 °C - 25 °C = 125 °C
$R_{TH\ (j\ -\ c)} + R_{TH\ (c\ -\ h)} + R_{TH\ (h\ -\ a)} = \Delta T/P = 125/3 = 41.7$ °C/W
$R_{TH\ (c\ -\ h)} + R_{TH\ (h\ -\ a)} = 41.7$ °C/W - 5 °C/W = 36.7 °C/W

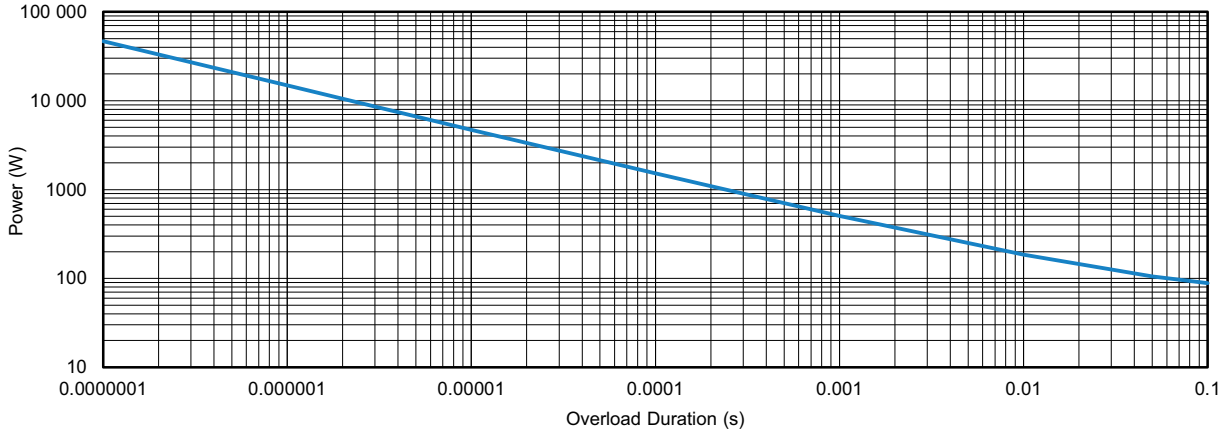
ACCIDENTAL OVERLOAD

In any case the applied voltage must be lower than the maximum overload voltage of U_s = 750 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 (Ω): 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.

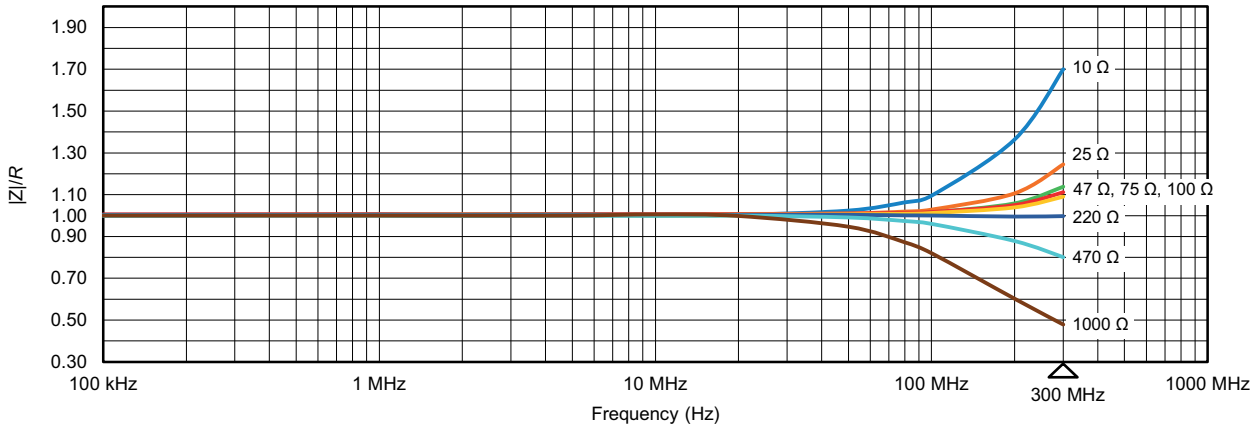
$$E_c = E \times \left(1 + \frac{P_a}{P_r}\right)$$

with:

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

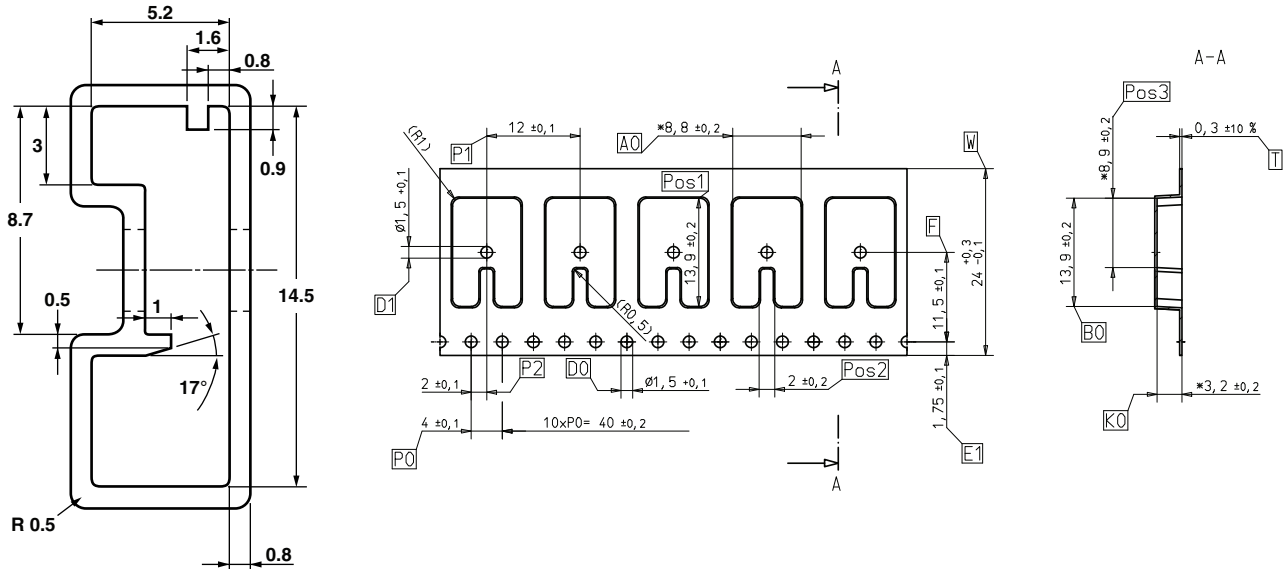
The energy calculated must be less than that allowed by the graph and the average power dissipated (P_a) must not exceed the continuous power of resistor.

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

DTO	025	C	100 kΩ	± 1 %	XXX	e3
MODEL	STYLE	CONNECTIONS	RESISTANCE VALUE	TOLERANCE	CUSTOM DESIGN	LEAD (Pb)-FREE
				F = ± 1 % G = ± 2 % J = ± 5 % K = ± 10 %	Optional on request: shape, etc	

SAP PART NUMBERING GUIDELINES

D	T	O	0	2	5	C	1	0	0	0	2	F	R	E	3

GLOBAL MODEL	SIZE	LEADS	OHMIC VALUE	TOLERANCE	PACKAGING	LEAD (Pb)-FREE / PACKAGING
DTO	**025**	**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. **48R70** = 48.7 Ω **48701** = 48 700 Ω **10002** = 100 000 Ω **R0100** = 0.01 Ω **R6800** = 0.68 Ω **27000** = 2700 Ω = 2.7 kΩ	**F** = 1 % **G** = 2 % **J** = 5 % **K** = 10 %	**R** = reel 500 pieces **T** = tube 50 pieces	**E3** = standard packaging reel 500 or tube 50 and lead (Pb)-free (pure tin) **15** = 1000 pcs. reel and lead (Pb)-free (pure tin)

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