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## Surface Mount Power Resistor Thick Film Technology

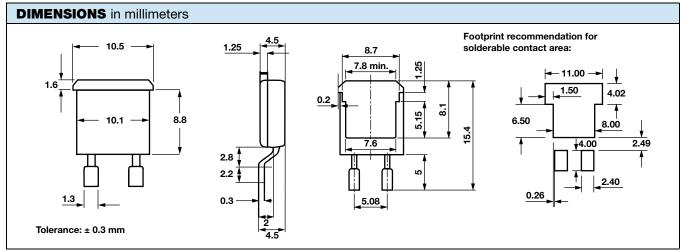


#### **LINKS TO ADDITIONAL RESOURCES**



#### **FEATURES**

- AEC-Q200 qualified
- 20 W at 25 °C case temperature
- Surface mounted resistor TO-263 (D<sup>2</sup>PAK) style package
- Wide resistance range from 0.01  $\Omega$  to 550 k $\Omega$
- Non inductive
- Resistor isolated from metal tab
- Solder reflow secure at 270 °C/10 s
- Material categorization: for definitions of compliance please see <a href="https://www.vishav.com/doc?99912">www.vishav.com/doc?99912</a>



#### Notes

- For the assembly on board, we recommend the lead (Pb)-free thermal profile as per J-STD-020C
- Power dissipation is 3.1 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

STANDARD ELECTRICAL SPECIFICATIONS							
MODEL	SIZE	$\begin{array}{c} \textbf{RESISTANCE} \\ \textbf{RANGE} \\ \Omega \end{array}$	RATED POWER  P <sub>25 °C</sub> W	LIMITING ELEMENT VOLTAGE <i>U</i> L V	TOLERANCE ± %	TEMPERATURE COEFFICIENT ± ppm/°C	$\begin{array}{c} \textbf{CRITICAL} \\ \textbf{RESISTANCE} \\ \Omega \end{array}$
D2TO20	TO-263	0.01 to 550K	20	500	1, 2, 5, 10	150, 250, 700, 1100	12.5K

MECHANICAL SPECIFICATIONS			
Mechanical Protection Molded			
Resistive Element	Thick film		
Substrate	Alumina		
Connections	Tinned copper		
Weight	2.2 g max.		

ENVIRONMENTAL SPECIFICATIONS				
Temperature Range	-55 °C to +155 °C			
	IEC 60695-11-5			
Flammability	Application time: $t_a = 10 \text{ s}$ Burning duration: $t_b < 30 \text{ s}$			

TECHNICAL SPECIFICATIONS				
Power Rating and	20 W at 25 °C			
Thermal Resistance	(case temperature)			
of the Component	R <sub>TH (j - c)</sub> : 6.5 °C/W			
Temperature Coefficient	See Special Feature table			
Standard	± 150 ppm/°C			
Dielectric Strength	2000 V <sub>RMS</sub> - 1 min - 10 mA max.			
IEC 60115-1	(between terminals and board)			
Insulation Resistance	$\geq 10^4 \ \text{M}\Omega$			
Inductance	≤ 0.1 µH			

DIMENSIONS			
Standard Package	TO-263 style (D <sup>2</sup> PAK)		

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# Vishay Sfernice

SPECIAL FEATURES				
Resistance Values	≥ 0.010	≥ 0.045	≥ 0.1	≥ 0.5
Tolerances	± 1 % at ± 10 %			
Requirement Temperature Coefficient (TCR) (-55 °C +150 °C) IEC 60115-1	± 1100 ppm/°C	± 700 ppm/°C	± 250 ppm/°C	± 150 ppm/°C

PERFORMANCE				
TESTS	CONDITIONS	REQUIREMENTS		
Momentary Overload	IEC 60115-1 §4.13 2 Pr 5 s for $R < 2 \Omega$ 1.5 Pr 5 s for $R \ge 2 \Omega$ US < 1.5 UL	± (0.25 % + 0.005 Ω)		
Load Life	IEC 60115-1 1000 h, 90/30 Pr at +25 °C	$\pm (0.5 \% + 0.005 \Omega)$		
High Temperature Exposure	AEC-Q200 rev. D conditions: MIL-STD-202 method 108 1000 h, +175 °C, unpowered	$\pm (0.25 \% + 0.005 \Omega)$		
Temperature Cycling	Pre-conditioning 3 reflows according JESTD020D IEC 60068-2-14 test Na 1000 cycles, -55 °C/+175 °C Dwell time - 15 min	$\pm (0.5 \% + 0.005 \Omega)$		
Moisture Resistance	AEC-Q200 rev. D conditions: MIL-STD-202 method 106 10 cycles, 24 h, unpowered	± (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 2000 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 5 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	IEC 60115-1 IEC 60068-2-58 Solder bath method: 270 °C/10 s	± (0.5 % + 0.005 Ω)			
Moisture Sensitivity Level (MSL)	IPC/JEDEC <sup>®</sup> J-STD-020C 85 °C / 85 % RH / 168 h	Level: 1 + pass requirements of TCR overload and dielectric strength after MSL			



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#### **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:

$$P = \frac{\Delta T}{R_{TH (j-c)} + R_{TH (c-h)} + R_{TH (h-a)}}$$
(1)

P: expressed in W

ΔT: difference between maximum working temperature and room temperature or fluid cooling temperature

R<sub>TH (j - c)</sub>: thermal resistance value measured between resistive layer and outer side of the resistor. It is the thermal resistance of the component: 6.5 °C/W.

R<sub>TH (c - h)</sub>: 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<sub>TH (h - a)</sub>: thermal resistance of the board.

#### **Example:**

 $R_{TH (c-h)} + R_{TH (h-a)}$  for D2TO20 power rating 2.5 W at ambient temperature +25 °C.

Thermal resistance R<sub>TH (i - c)</sub>: 6.5 °C/W

Considering equation (1) we have:

$$\Delta T = 155 \, ^{\circ}\text{C} - 25 \, ^{\circ}\text{C} = 130 \, ^{\circ}\text{C}$$

$$R_{TH (j-c)} + R_{TH (c-h)} + R_{TH (h-a)} = \Delta T/P = 130/2.5 = 52 \text{ °C/W}$$

$$R_{TH (c - h)} + R_{TH (h - a)} = 52 \text{ °C/W} - 6.5 \text{ °C/W} = 45.5 \text{ °C/W}$$

#### 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 energyP (W): pulse powert (s): pulse durationU (V): pulse voltage

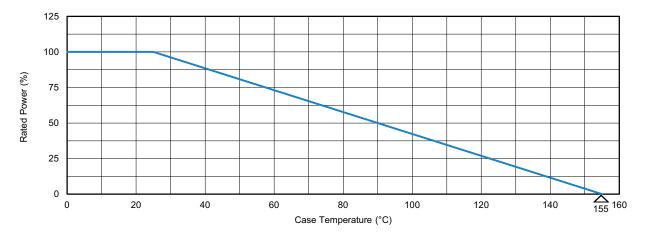
 $R(\Omega)$ : resistor

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



#### **POWER RATING**

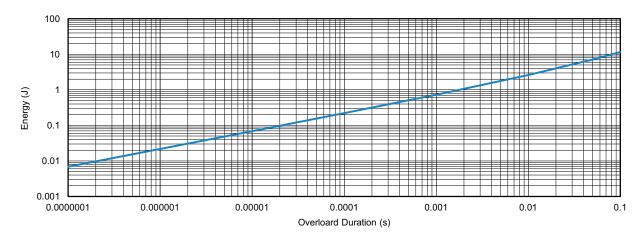
The temperature of the case should be maintained within the limits specified.



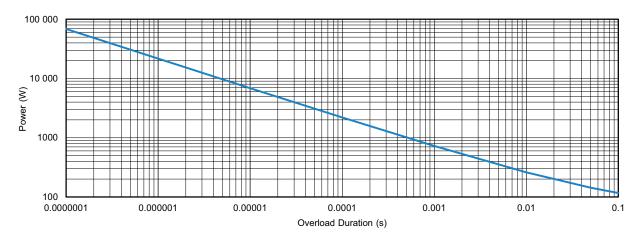
#### **OVERLOADS**

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 board.

#### **ENERGY CURVE**

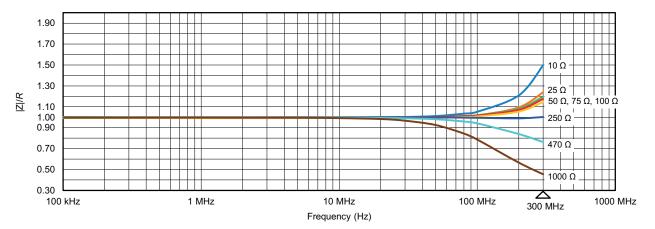


#### **POWER CURVE**





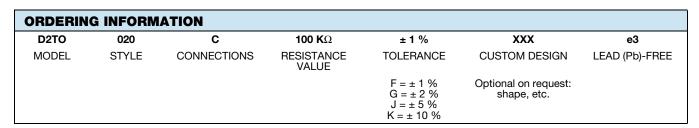
#### **IMPEDANCE CURVE** 10 $\Omega$ to 1 k $\Omega$ from 100 kHz to 300 MHz

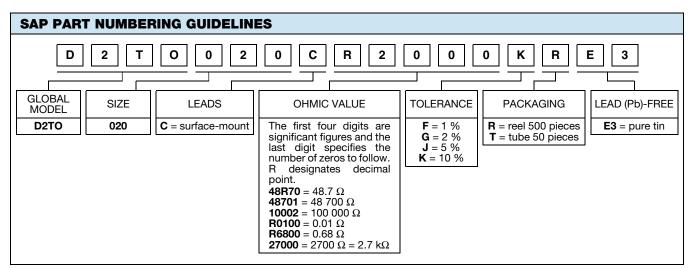


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#### **MARKING**

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







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