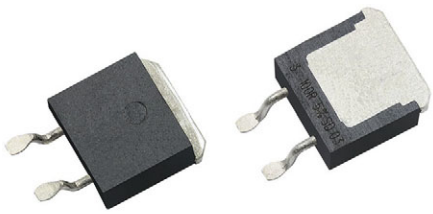
Top Side Cooling Mount Power Resistor Thick Film Technology



LINKS TO ADDITIONAL RESOURCES

3D Models

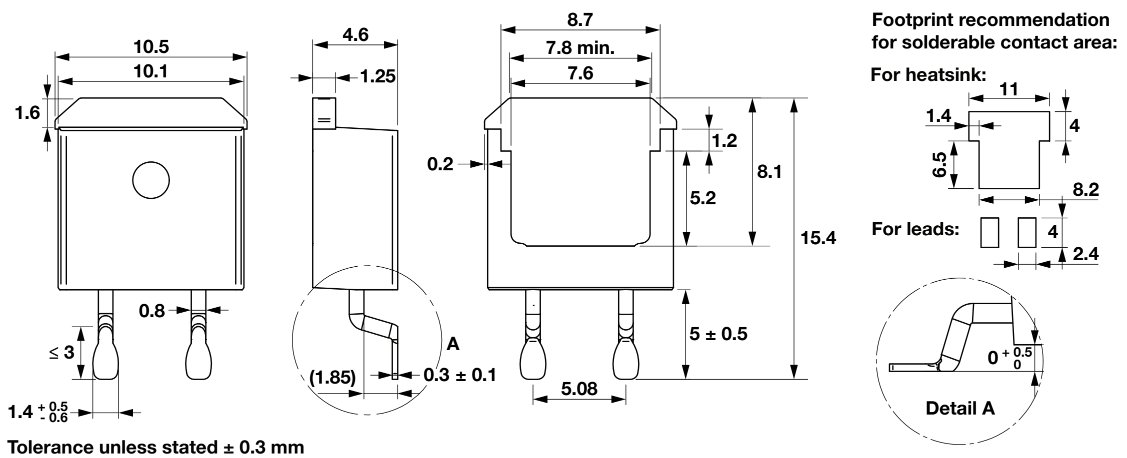
FEATURES

- **AEC-Q200 qualified**
- 35 W at 25 °C case temperature
- Surface mounted resistor - TO-263 (D^2PAK) style package
- Top side cooling mount with reverse leads
- Wide resistance range from 0.01 Ω to 550 kΩ
- Non inductive
- Resistor isolated from metal tab
- Solder reflow secure at 270 °C/10 s
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

AUTOMOTIVE GRADE

RoHS COMPLIANT

DIMENSIONS in millimeters



Tolerance unless stated ± 0.3 mm

Notes

- For the assembly on board, we recommend the lead (Pb)-free thermal profile as per J-STD-020C
- Planarity measurement according to JEDEC® TO-263D

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
D2TO35S	TO-263	0.01 to 550K	35	500	1, 2, 5, 10	150, 250, 700, 1100	7.14K

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 +175 °C
Flammability	IEC 60695-11-5 Application time: t_a = 10 s Burning duration: t_b < 30 s

TECHNICAL SPECIFICATIONS

Power Rating and Thermal Resistance of the Component	35 W at 25 °C (case temperature) $R_{TH\,(j-c)}$: 4.28 °C/W
Temperature Coefficient	See Special Feature table
Standard	± 150 ppm/°C
Dielectric Strength IEC 60115-1	2000 V_{RMS} - 1 min - 10 mA max. (between terminals and board)
Insulation Resistance	≥ 10^4 MΩ
Inductance	≤ 0.1 µH

DIMENSIONS

Standard Package	TO-263 style (D^2PAK)

SPECIAL FEATURES				
Resistance Values	≥ 0.010 Ω	≥ 0.045 Ω	≥ 0.1 Ω	≥ 0.5 Ω
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 1.7 Pr 5 s for $R < 2\ \Omega$ 1.4 Pr 5 s for $R \geq 2\ \Omega$ 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. E conditions: MIL-STD-202 method 108 1000 h, +175 °C, unpowered	± (0.25 % + 0.005 Ω)
Temperature Cycling	AEC-Q200 rev. E conditions: pre-conditioning 3 reflows according JESTD020D JESD22 method JA-104 1000 cycles, (-55 °C to +155 °C) dwell time 15 min	± (0.5 % + 0.01 Ω)
Humidity Bias	AEC-Q200 rev. E conditions: MIL-STD-202 method 103 1000 h, 85 °C, 85 % RH	± (0.5 % + 0.005 Ω)
High Temperature Operating Life	AEC-Q200 rev. E conditions: pre-conditioning 3 reflows according JESTD020D MIL-STD-202 method 108 1000 h, 90/30, powered, +25 °C	± (0.5 % + 0.005 Ω)
ESD Human Body Model	AEC-Q200 rev. E conditions: AEC-Q200-002 25 kV_{AD}	± (0.5 % + 0.005 Ω)
Vibration	AEC-Q200 rev. E 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. E 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. E conditions: AEC-Q200-005 bending 2 mm, 60 s	± (0.25 % + 0.01 Ω)
Terminal Strength	AEC-Q200 rev. E 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 J-STD-020C 85 °C / 85 % RH / 168 h	Level: 1 + pass requirements of TCR overload and dielectric strength after MSL

CHOICE OF THE HEATSINK

The user must choose the heatsink 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

ΔT: difference between maximum working temperature and room temperature or fluid cooling 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 heatsink. This is the thermal resistance of the interface (solder layer, thermal grease).

$R_{TH\ (h-a)}$: thermal resistance of the heatsink.

Example:

$R_{TH\ (c-h)} + R_{TH\ (h-a)}$ for D2TO35S power rating 10 W at ambient temperature +25 °C.

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

Considering equation [(1)] we have:

ΔT = 175 °C - 25 °C = 150 °C

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

$R_{TH\ (c-h)} + R_{TH\ (h-a)}$ = 15 °C/W - 4.28 °C/W = 10.72 °C/W

	CONFIGURATION 1	CONFIGURATION 2	CONFIGURATION 3	CONFIGURATION 4
Power dissipation (W)	10	12	15	32
T° resistive element (°C)	175	175	175	175
$R_{TH\ (j-c)}$ max. (°C/W)	4.28	4.28	4.28	4.28
$R_{TH\ (c-h)} + R_{TH\ (h-a)}$ (°C/W)	10.72	8.22	5.72	0.72
Fluid T° (°C)	25 (air)	25 (air)	25 (air)	15 (water)

Configuration 1: part is clipped on an air cooling heatsink (50 mm x 37.5 mm x 6 mm) utilizing thermal grease Bluesil Past 340 from BlueStar silicones.

Configuration 2: part is glued on FR4 HTG and mounted on an air cooling heatsink (45 mm x 30 mm x 50 mm) utilizing thermal grease Bluesil Past 340 from BlueStar silicones.

Configuration 3: part is glued on FR4 HTG and mounted on an air cooling heatsink (80 mm x 48 mm x 73 mm) utilizing thermal grease Bluesil Past 340 from BlueStar silicones.

Configuration 4: part is glued on FR4 HTG and mounted on a water cooling heatsink (304 mm x 95.3 mm x 8 mm) utilizing thermal grease Bluesil Past 340 from BlueStar silicones.

Mounting Recommendation

For optimum thermal management when mounting resistors on a PCB, the resistor should be firmly bonded to the PCB by its molded part and the leads soldered to the PCB's tin-plated pads. The back side of the resistor should be in contact with an air- or water-cooled heatsink, using thermal grease to improve thermal conductivity. This configuration improves heat dissipation thanks to an efficient heatsink.

To ensure a secure bond during assembly, apply a drop of glue to the molded part of the resistor before soldering the wires to the PCB. Loctite 3609 Epoxy has been evaluated and shown to perform excellently in terminal strength, vibration, and shock.

To ensure long-term reliability and prevent damage to the mounted component, no mechanical force (pushing, pulling, or bending) can be applied to the component or its leads during handling, assembly, or operation. It is strongly recommended that the component remains free of any mechanical constraints once mounted.

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

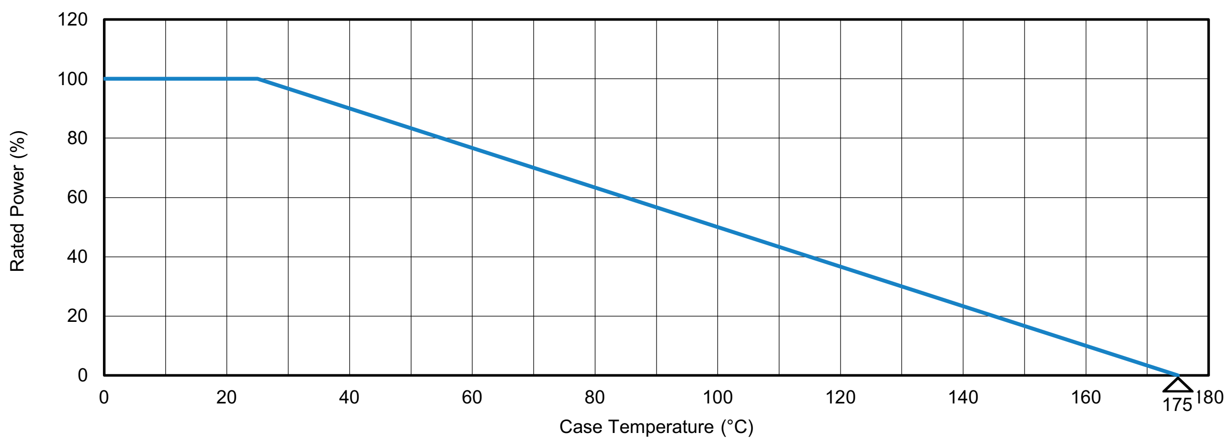
U (V): pulse voltage

R (Ω): resistor

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

POWER RATING

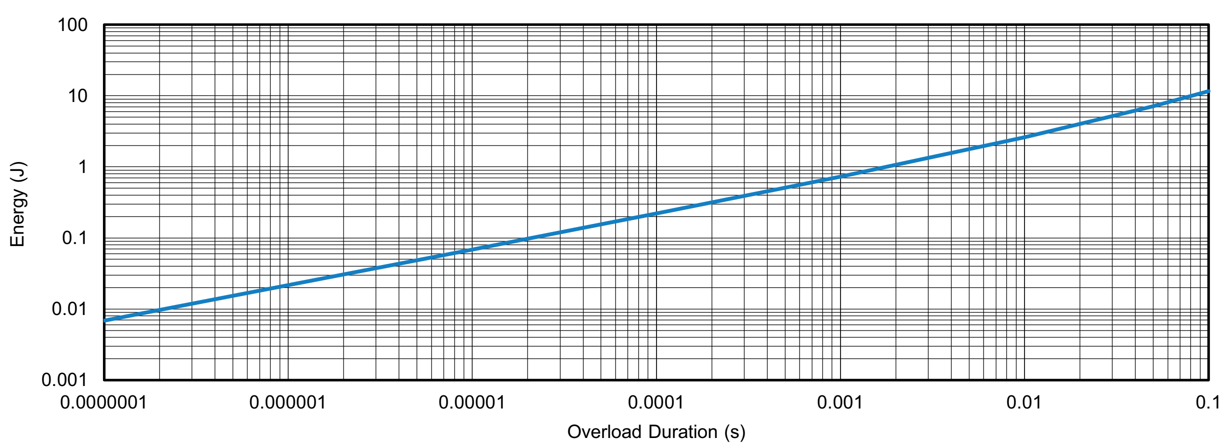
The temperature of the case should be maintained within the limits specified.



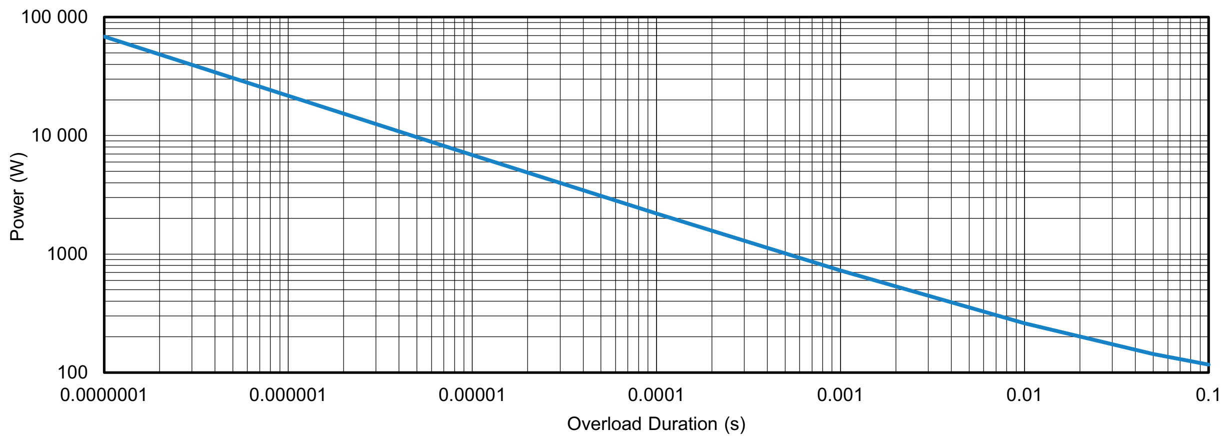
OVERLOADS

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.

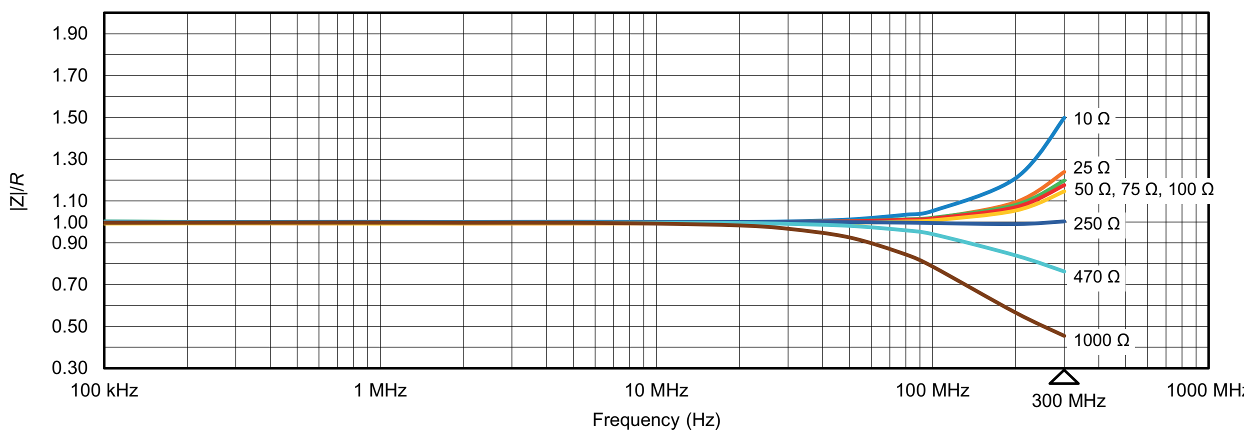
ENERGY CURVE



POWER CURVE

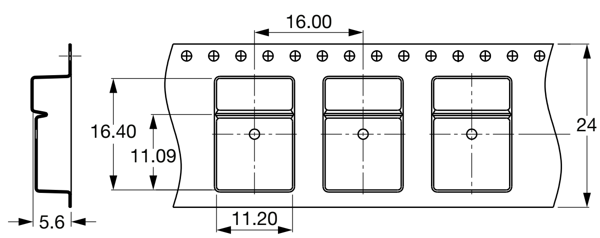


IMPEDANCE CURVE 10 Ω to 1 kΩ from 100 kHz to 300 MHz



PACKAGING

- Reel
- Tube
- Tape dimensions (mm) for reel:



MARKING

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

ORDERING INFORMATION

D2TO	35	S	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	2	T	O	0	3	5	S	R	2	0	0	0	K	R	E	3

GLOBAL MODEL	SIZE	LEADS	OHMIC VALUE	TOLERANCE	PACKAGING	LEAD (Pb)-FREE
D2TO	**035**	**S** = reverse leads	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** = pure tin

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