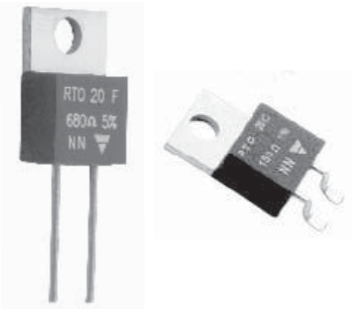
# 20 W Power Resistor, Thick Film Technology, TO-220




The well known TO-220 package is compact and easy to mount.

## FEATURES

- 20 W at 25 °C heatsink mounted
- High power dissipation to size ratio
- Wide resistance range from 0.01 Ω to 550 kΩ
- Negligible inductance
- Easy mounting
- TO-220 package: Compact and easy to mount
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

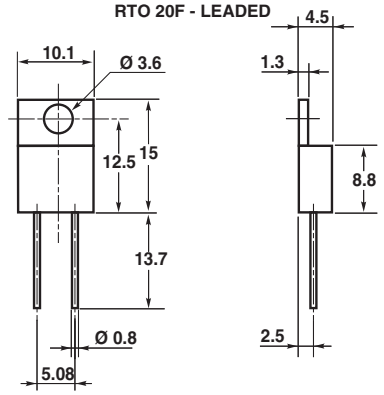
RoHS COMPLIANT

Two versions of this thick film resistor are available:

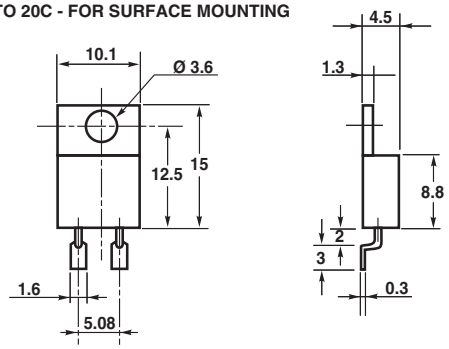
- A radial leaded version for PCB mounting
- A flat lead version for surface mounting

## DIMENSIONS in millimeters

RTO 20F - LEADED




RTO 20C - FOR SURFACE MOUNTING




• Only for RTO 20 version C = during surface mount soldering temperature profile must not cause the metal tab of this device to exceed 220 °C.

**Note**

- Tolerances unless stated: ± 0.4 mm

## 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 |
|---|---|---|---|---|---|---|---|
| RTO 20 | TO-220 | 0.010 to 550K (1) | 20 | 500 | 1, 2, 5, 10 | 150 | 12.5K |

**Note**

(1) E24 series

## MECHANICAL SPECIFICATIONS

| | |
|---|---|
| **Mechanical Protection** | Insulated case |
| **Resistive Element** | Thick film |
| **Substrate** | Alumina onto base of nickel coated copper |
| **Connections** | Tinned copper |
| **Weight** | 2.2 g max. |

## ENVIRONMENTAL SPECIFICATIONS

| | |
|---|---|
| **Temperature Range** | -55 °C to 155 °C |
| **Climatic Category** | 55/155/56 |
| **Sealing** | Sealed container, solder immersion |
| **Flammability** | IEC 60695-11-5<br>2 applications 30 s<br>separated by 60 s |

**Note**

- Not compatible with RoHS reflow profile.

## TECHNICAL SPECIFICATIONS

| | |
|---|---|
| **Dissipation and Associated** | Onto a heatsink |
| **Thermal Resistance and Nominal Power** | 20 W at + 25 °C<br>$R_{TH\ (j-c)}$: 6.5 °C/W<br>Free air:<br>2 W at +25 °C |
| **Dielectric Strength MIL STD 202** | 2000 $V_{RMS}$ - 1 min - 10 mA max.<br>(between terminals and heatsink) |
| **Insulation Resistance** | ≥ $10^6$ MΩ |
| **Inductance** | ≤ 0.1 µH |

## DIMENSIONS

| | |
|---|---|
| **Standard Package** | TO-220 insulated case |

| PERFORMANCE | | |
|---|---|---|
| **TESTS** | **CONDITIONS** | **REQUIREMENTS** |
| **Momentary Overload** | EN 60115-1<br>2 Pr 5 s for $R < 2\ \Omega$<br>1.6 Pr 5 s for $R \geq 2\ \Omega$<br>$U_S < 1.5\ U_L$ | ± (0.25 % + 0.005 Ω) |
| **Rapid Temperature Change** | EN 60115-1/60068-2-14<br>5 cycles<br>-55 °C to +155 °C | ± (0.5 % + 0.005 Ω) |
| **Load Life** | EN 60115-1<br>1000 h Pr at +25 °C | ± (1 % + 0.005 Ω) |
| **Humidity (Steady State)** | EN 60115-1<br>56 days RH 95 % | ± (0.5 % + 0.005 Ω) |
| **High Temperature Exposure** | NF EN 140 000<br>1000 h - 40 % Pr at +100 °C | ± (0.5 % + 0.005 Ω) |
| **Vibration** | MIL STD 202, Method 204 C Test D | ± (0.2 % + 0.005 Ω) |
| **Terminal Strength** | MIL STD 202, Method 211 Test A1 | ± (0.2 % + 0.005 Ω) |
| **Shock** | IEC 60115-1<br>IEC 60068-2-27<br>Saw tooth: 100 *g*/6 ms | ± (0.5 % + 0.005 Ω) |

| RESISTANCE VALUE IN RELATION TO TOLERANCE AND TCR | | | | |
|---|---|---|---|---|
| **Resistance Values** | ≥ 0.01 | ≥ 0.015 | ≥ 0.1 | ≥ 0.5 |
| **Tolerances** | ± 1 % at ± 10 % | | | |
| **Typical Temperature Coefficient Range (-55 °C to +155 °C)** | ± 900 ppm/°C | ± 700 ppm/°C | ± 250 ppm/°C | ± 150 ppm/°C |

**Note**

- For very low ohmic values, TCR for information.

## CHOICE OF THE HEATSINK

The user must choose the board according to the working conditions of the component (power, room temperature). Maximum working temperature must not exceed 155 °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: Special Features table.

$R_{TH\ (c\ -\ h)}$: Thermal resistance value measured between outer side of the resistor and upper side of the heatsink. This is the thermal resistance of the interface (grease, thermal pad), and the quality of the fastening device.

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

**Example:**

$R_{TH\ (c\ -\ a)}$ for RTO 20 power rating 10 W at ambient temperature +25 °C

Thermal resistance $R_{TH\ (j\ -\ c)}$: 6.5 °C/W

Considering equation (1) we have:

$\Delta T = 155\ °C - 25\ °C = 130\ °C$

$R_{TH\ (j\ -\ c)} + R_{TH\ (c\ -\ h)} + R_{TH\ (h\ -\ a)} = \frac{\Delta T}{P} = \frac{130}{10} = 13\ °C/W$

$R_{TH\ (c\ -\ h)} + R_{TH\ (h\ -\ a)} = 13\ °C/W - 6.5\ °C/W = 6.5\ °C/W$

## OVERLOADS

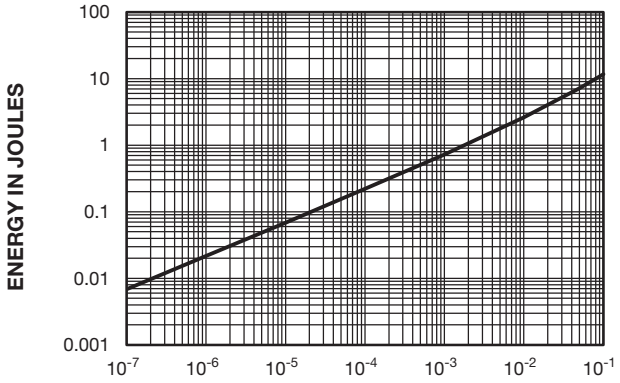
In any case the applied voltage must be lower than the maximum overload voltage of 750 V.

The values indicated on the graph below are applicable to resistors in air or mounted onto a heatsink.

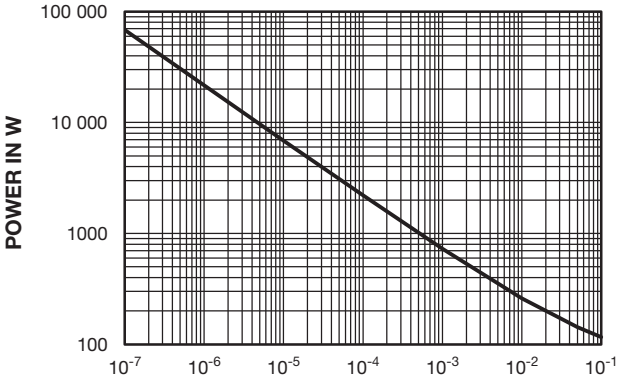
## MARKING

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

## ENERGY CURVE



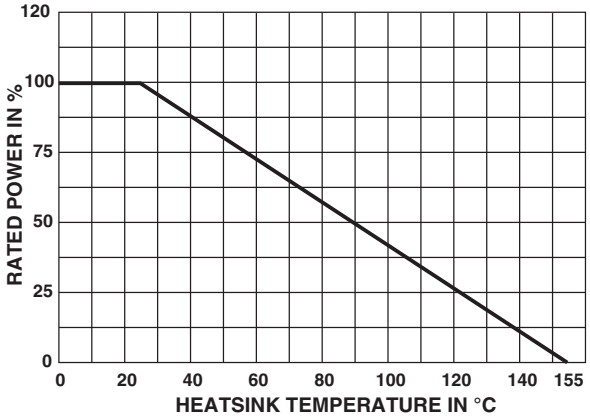

## POWER CURVE




## POWER RATING

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

To improve the thermal conductivity, surfaces in contact should be coated with a silicone grease and the torque applied on the screw for tightening should be around 1 Nm. Spring clip can also be used to mount the component on an heatsink (ex: Kunze, clip KU4-498).




| PACKAGING |
| --- |
| Tube of 50 units |

## ORDERING INFORMATION

| RTO | 20 | F | U68 | 5 % | xxx | TU50 | e3 |
|---|---|---|---|---|---|---|---|
| MODEL | STYLE | CONNECTIONS | RESISTANCE VALUE | TOLERANCE | CUSTOM DESIGN | PACKAGING | LEAD (Pb)-FREE |
| | | **F**: Radial leads<br>**C**: Surface mount | | ± 1 %<br>± 2 %<br>± 5 %<br>± 10 % | Optional on request: Special TCR, shape etc. | | |

## GLOBAL PART NUMBER INFORMATION

| R | T | O | 0 | 2 | 0 | F | R | 6 | 8 | 0 | 0 | J | T | E | 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| GLOBAL MODEL | STYLE | DIELECTRIC | OHMIC VALUE | TOLERANCE | PACKAGING |
|---|---|---|---|---|---|
| **RTO** | **020** | **F** = Radial leads<br>**C** = Surface mount | The first four digits are significant figures and the last digit specifies the number of zeros to follow.<br>R designates decimal point.<br><br>**48R70** = 48.7 Ω<br>**48701** = 48 700 Ω<br>**10002** = 100 000 Ω<br>**R0100** = 0.01 Ω<br>**R6800** = 0.68 Ω<br>**27000** = 2700 Ω = 2.7 kΩ | **F** = 1 %<br>**G** = 2 %<br>**J** = 5 %<br>**K** = 10 % | **T** = Tube<br><br>Size 30 and 50: Tube 50 pieces |

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