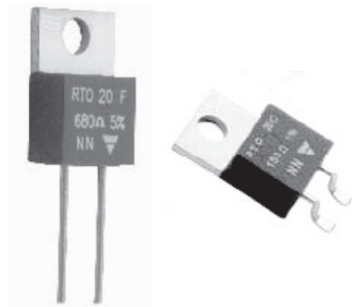


## Power Resistors Thick Film Technology



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

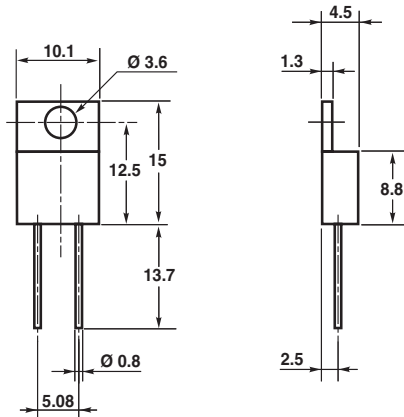


Two versions of this thick film resistor are available:

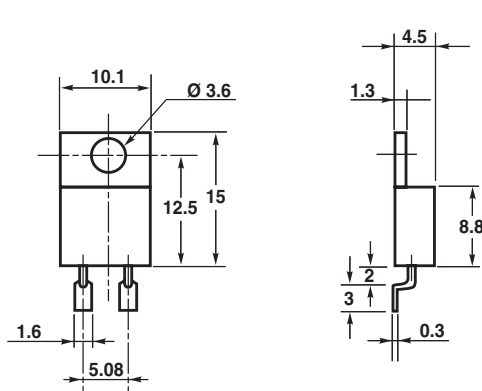
- A radial leaded version for PCB mounting
- A flat lead version for surface mounting

### DIMENSIONS in millimeters

RTO 20F - LEADED



RTO 20C - FOR SURFACE MOUNTING



• Tolerance unless otherwise specified: ± 0.4 mm

• 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.

### MECHANICAL SPECIFICATIONS

|                              |                |
|------------------------------|----------------|
| <b>Mechanical Protection</b> | Insulated case |
| <b>Resistive Element</b>     | Thick Film     |
| <b>Connections</b>           | Tinned copper  |
| <b>Weight</b>                | 2.2 g max.     |

### DIMENSIONS

|                         |                          |
|-------------------------|--------------------------|
| <b>Standard Package</b> | TO 220<br>Insulated case |
|-------------------------|--------------------------|

### ENVIRONMENTAL SPECIFICATIONS

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

### ELECTRICAL SPECIFICATIONS

|   |  |
|---|--|
| <b>Resistance Range</b>                                     | 0.010 Ω to 550 kΩ serie E24  |
| <b>Tolerances (Standard)</b>                                | ± 1 % to ± 10 %  |
| <b>Dissipation and Associated:</b>                          | Onto a heatsink  |
| <b>Thermal Resistance and Nominal Power</b>                 | 20 W at + 25 °C<br>$R_{TH(j-c)}$ : 6.5 °C/W<br>free air:<br>2 W at + 25 °C |
| <b>Temperature Coefficient Standard (- 55 °C; + 150 °C)</b> | See Performance table<br>± 150 ppm/°C                                      |
| <b>Limiting Element Voltage <math>U_L</math></b>            | 250 V  |
| <b>Dielectric Strength MIL STD 202</b>                      | 2000 $V_{RMS}$ - 1 min - 10 mA max.<br>(between terminals<br>and heatsink) |
| <b>Insulation Resistance</b>                                | ≥ 10 <sup>6</sup> MΩ   |
| <b>Inductance</b>   | ≤ 0.1 μH   |
| <b>Critical Resistance</b>                                  | 3.12 kΩ  |



| PERFORMANCE               |   |                      |
|---------------------------|---|----------------------|
| TESTS                     | CONDITIONS  | REQUIREMENTS         |
| Momentary Overload        | EN 60115-1<br>2 Pr 5 s for R < 2 Ω<br>1.6 Pr 5 s for R ≥ 2 Ω<br>Us < 1.5 UL | ± (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 R.H. 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)  |

| SPECIAL FEATURES  |                 |              |              |              |
|---|-----------------|--------------|--------------|--------------|
| 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 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:

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

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)

$R_{TH(c-a)}$ : Thermal resistance value measured between outer side of the resistor and room temperature. It is the thermal resistance of the heatsink itself (type, shape) and the quality of the fastening device.

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:

$$\Delta T = 155 \text{ °C} - 25 \text{ °C} = 130 \text{ °C}$$

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

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

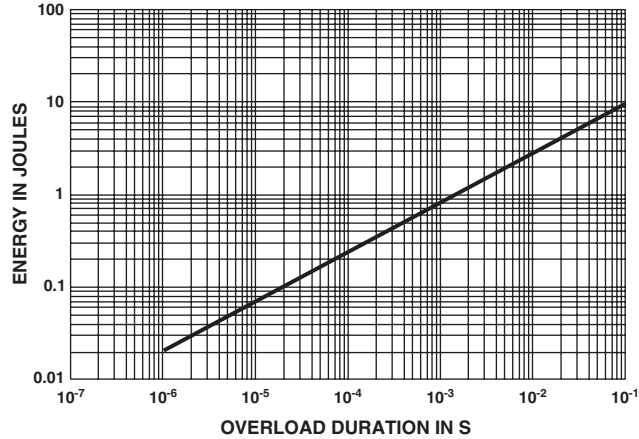


**OVERLOADS**

In any case the applied voltage must be lower than the maximum overload voltage of 375 V.

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

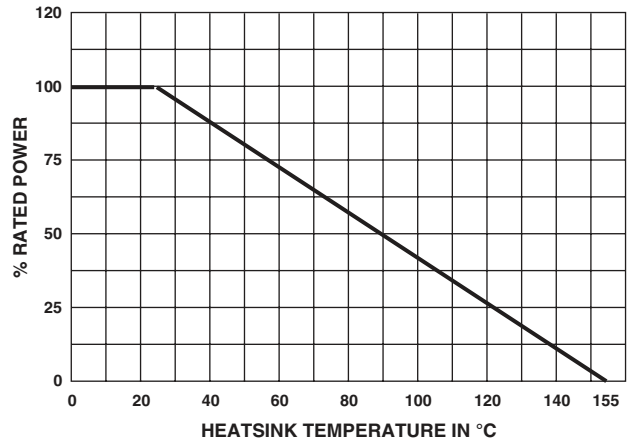
**ENERGY CURVE**



**POWER RATING CHART**

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).



**MARKING**

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

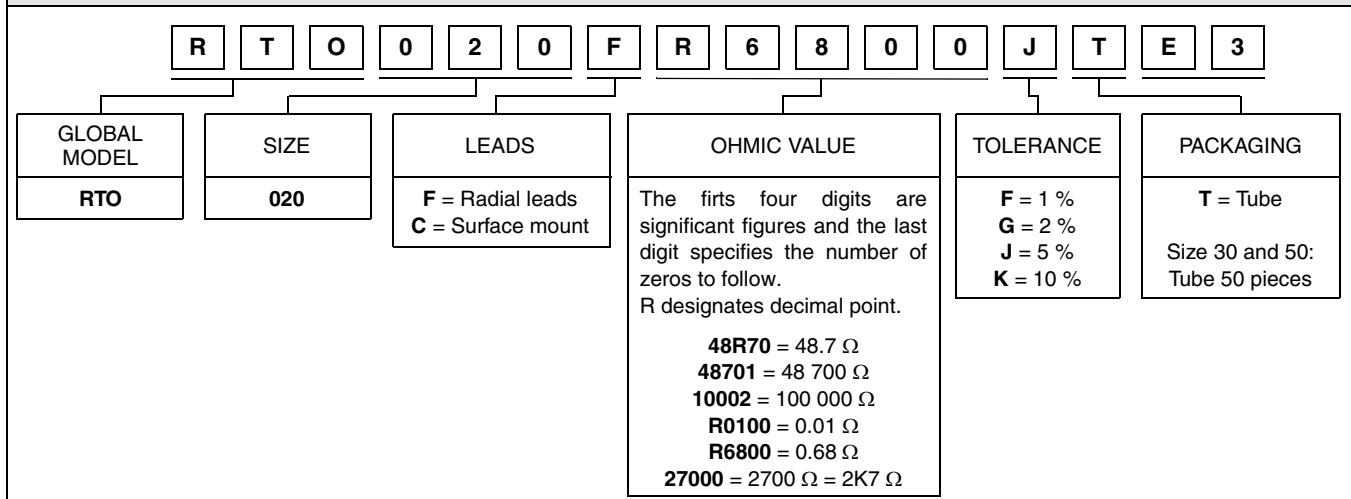
**PACKAGING**

Tube of 50 units

**ORDERING INFORMATION**

|            |                                     |             |                  |                                   |   |             |                |
|------------|-------------------------------------|-------------|------------------|-----------------------------------|---|-------------|----------------|
| <b>RTO</b> | <b>20</b>                           | <b>F</b>    | <b>U68</b>       | <b>5 %</b>                        | <b>xxx</b>  | <b>TU50</b> | <b>e3</b>      |
| 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<br>on request:<br>special TCR,<br>shape etc. |             |                |

**GLOBAL PART NUMBER INFORMATION**





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