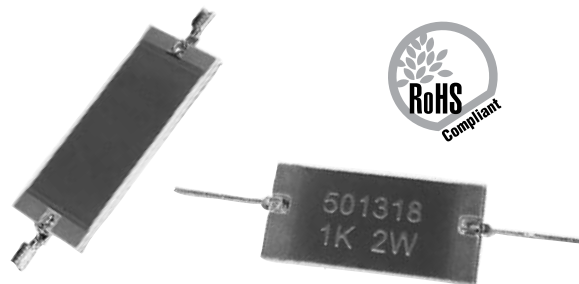


# TFS Series

Surge Capable  
Thick Film Non Inductive



## FEATURES

- Appropriate for medical surge protection applications
- Ideal to replace standard carbon composition resistors
- Custom dimensions, values, tolerances and characteristics available

The TFS Series has been specifically developed to absorb large amounts of energy by efficient use of its compact mass. Ideal for medical surge protection applications, these thick film resistors offer non-inductive performance in an axial package.

Uses include power supply conversion, electron microscopes, X-ray systems, high-resolution CRT displays, and geophysical instrument related products.

## SERIES SPECIFICATIONS

| Type | U (KV) | Energy* (J) | Power (W) |
|------|--------|-------------|-----------|
| TFSA | 3      | 6           | 0.5       |
| TFSB | 3.5    | 9           | 0.5       |
| TFSC | 4      | 11          | 0.75      |
| TFSD | 7      | 33          | 1         |
| TFSE | 7      | 44          | 1.5       |
| TFSF | 11     | 55          | 2         |

\*Published energy rating is for 10ms pulse. For shorter pulses energy rating has to be derated according to Max. Individual Pulse Rating chart and Single Pulse Energy Rating considerations.

## CHARACTERISTICS

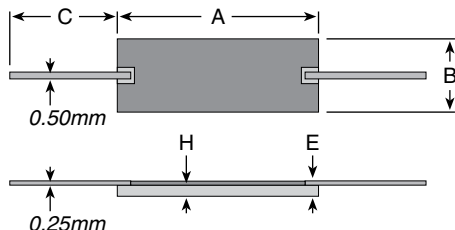
|                                |                                   |
|--------------------------------|-----------------------------------|
| <b>Resistive Element</b>       | Thick Film                        |
| <b>Encapsulation</b>           | Screen Printed Glass              |
| <b>Resistance Value</b>        | 100Ω up to 100KΩ                  |
| <b>Temperature Coefficient</b> | 100ppm/°C                         |
| <b>Tolerance</b>               | 1%, 2%, 5%, 10%                   |
| <b>Operating Temperature</b>   | -55°C to +200°C                   |
| <b>Test</b>                    | VDE 0750 (Pulse Duration 10 msec) |

### Notes

- Momentary overload capability is 5 times rated power for 1 second or 2 times rated power for 5 seconds. Always verify designs with pulse and surge conditions through thorough testing of the design at maximum operating temperature and maximum pulse loading (or some margin above maximum pulse loading).
- Damage to the resistor by excessive pulse loading is generally indicated by an increasing resistance of the resistor.
- Energy ratings are based on single pulses (at least 1 minute between pulses).
- For multiple pulse applications the energy pulse rating should be reduced and the average power should not exceed the nominal power rating of the selected model.
- See Single Pulse Energy section for more information

## DIMENSIONS

mm



| Type | Watts | A  | B    | C  | H   | E   |
|------|-------|----|------|----|-----|-----|
| TFSA | 0.5   | 9  | 5.5  | 10 | 0.7 | 1.1 |
| TFSB | 0.5   | 11 | 5.5  | 10 | 0.7 | 1.1 |
| TFSC | 0.75  | 13 | 5.5  | 10 | 0.7 | 1.1 |
| TFSD | 1     | 21 | 8    | 10 | 0.9 | 1.3 |
| TFSE | 1.5   | 21 | 10.5 | 10 | 0.9 | 1.3 |
| TFSF | 2     | 26 | 10.5 | 10 | 0.9 | 1.3 |

(continued)

# TFS Series

## Surge Capable Thick Film Non Inductive

### SINGLE PULSE ENERGY RATING

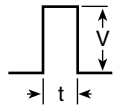
Although Ohmite's TFS Series resistors have been specially designed and developed to absorb much more energy than standard resistors, pulses and transients require special consideration since they cause an instantaneous temperature rise in the resistor film. This application note can guide you through these considerations.

For applications with transients, pulses or surges the following must be considered:

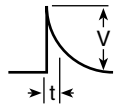
1. Do not exceed the normal rated operating voltage of the device.
2. Using the figure at right, estimate the energy ( $E_a$ ) and the pulse duration ( $t_a$ ) for a single pulse in your application.
3. Calculate the energy ratio in percent ( $E_r$ ) between the nominal energy rating of the model you have chosen (see table) and the single pulse energy in your application ( $E_a$  from step 2) using the formula:

$$E_r = \frac{E_a}{E_{\text{nominal}}} \times 100$$

4. Refer to the Pulse Chart. On this chart find the point where the energy ratio ( $E_r$ ), found at step 3, and time ( $t_a$ ) coincide. Qualify that this point falls below the maximum pulse energy curve. If the point is above the curve a bigger model should be chosen.

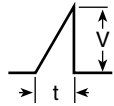


$$E = \frac{V^2 t}{R}$$

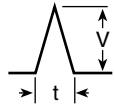


$$E = \frac{1}{2} CV^2$$

$$t = RC$$



$$E = \frac{V^2 t}{3R}$$



$$E = \frac{V^2 t}{3R}$$

E = Energy (joules)  
t = Time (seconds)  
V = Voltage (volts)  
R = Resistance (ohms)  
C = Capacitance (farads)

### Example

A  $1\mu\text{F}$  capacitor is charged to 3.5kV and model TFSC, 1KOhm has been selected. Model TFSC is rated for 4kV, so the peak voltage of 3.5kV is acceptable.

$$E_a = \frac{1}{2} CV^2 = 6.1\text{J}$$

$$t_a = RC = 1\text{ms}$$

$$E_r = \frac{6.1\text{J}}{11\text{J}} \times 100 = 55\%$$

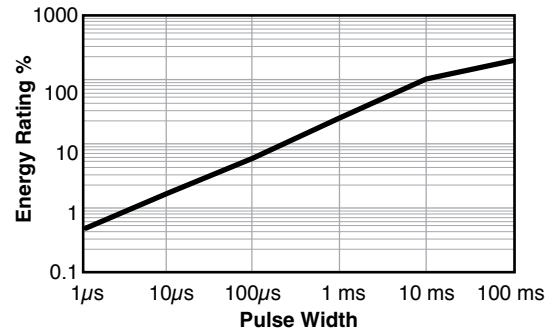
According to the pulse chart, an energy ratio of 55% for a pulse

width of 1ms falls well above the energy curve. The limit is actually located around 25-30%. Model TFSC cannot be used for this application.

A bigger model should be chosen, for example TFSD. Model TFSD, 1KOhm, can be used for this application because we have an energy ratio  $E_r$  of 18%, which is below the energy curve.

$$E_r = \frac{6.1\text{J}}{33\text{J}} \times 100 = 18\%$$

### Maximum Individual Pulse Rating



### ORDERING INFORMATION

RoHS Compliant

**T F S A 1 0 0 K J E**

| Series | Energy Rating<br>joules | Ohm Value<br>Example:<br>100R = 100Ω<br>2K40 = 2400Ω | Tolerance<br>F = 1%<br>G = 2%<br>J = 5%<br>K = 10% |
|--------|-------------------------|--|--|
| A = 6  | D = 33                  | 100R = 100Ω  | G = 2%   |
| B = 9  | E = 44                  | 2K40 = 2400Ω   | J = 5%   |
| C = 11 | F = 55                  |  | K = 10%  |

### Standard Part Numbers for TFS Series

| Ohms    | Tol. | 6 Joules<br>0.5 Watts | 9 Joules<br>0.5 Watts | 11 Joules<br>0.75 Watts | 33 Joules<br>1 Watts | 44 Joules<br>1.5 Watts | 55 Joules<br>2 Watts |
|---------|------|-----------------------|-----------------------|-------------------------|----------------------|------------------------|----------------------|
| 100     | 1%   | TFSA100RFE            |                       |                         |                      |                        |                      |
| 100     | 5%   |                       | TFSB100RJE            |                         | TFSD100RJE           |                        | TFSF100RJE           |
| 220     | 1%   | TFSA220RFE            |                       |                         |                      |                        |                      |
| 270     | 5%   | TFSA270RJE            |                       | TFSC270RJE              | TFSD270RJE           |                        | TFSF270RJE           |
| 470     | 1%   | TFSA470RFE            |                       |                         |                      |                        |                      |
| 470     | 5%   |                       | TFSB470RJE            |                         |                      | TFSE470RJE             |                      |
| 680     | 5%   | TFSA680RJE            |                       | TFSC680RJE              |                      | TFSE680RJE             | TFSF680RJE           |
| 750     | 5%   |                       | TFSB750RJE            |                         | TFSD750RJE           |                        | TFSF750RJE           |
| 1,000   | 1%   | TFSA1K00FE            |                       |                         |                      |                        |                      |
| 1,000   | 5%   | TFSA1K00JE            | TFSB1K00JE            | TFSC1K00JE              | TFSD1K00JE           | TFSE1K00JE             | TFSF1K00JE           |
| 1,500   | 5%   | TFSA1K50JE            |                       | TFSC1K50JE              | TFSD1K50JE           |                        | TFSF1K50JE           |
| 2,200   | 1%   | TFSA2K20FE            |                       |                         |                      |                        |                      |
| 2,700   | 5%   |                       | TFSB2K70JE            |                         |                      | TFSE2K70JE             |                      |
| 4,700   | 1%   | TFSA4K70FE            |                       |                         |                      |                        |                      |
| 4,700   | 5%   | TFSA4K70JE            |                       | TFSC4K70JE              | TFSD4K70JE           |                        |                      |
| 4,990   | 1%   | TFSA4K99FE            |                       |                         |                      |                        |                      |
| 5,000   | 5%   | TFSA75K0JE            |                       |                         |                      |                        |                      |
| 6,800   | 5%   |                       | TFSB6K80JE            |                         |                      | TFSE6K80JE             |                      |
| 10,000  | 1%   | TFSA10K0FE            |                       |                         |                      |                        |                      |
| 10,000  | 5%   | TFSA10K0JE            | TFSB10K0JE            | TFSC10K0JE              | TFSD10K0JE           |                        | TFSF10K0JE           |
| 16,000  | 5%   |                       |                       |                         |                      |                        | TFSF16K0JE           |
| 20,000  | 1%   | TFSA20K0FE            |                       |                         |                      |                        | TFSF20K0JE           |
| 20,000  | 5%   |                       | TFSB20K0JE            |                         | TFSD20K0JE           |                        |                      |
| 22,000  | 1%   | TFSA22K0FE            |                       |                         |                      |                        |                      |
| 27,000  | 5%   | TFSA27K0JE            |                       | TFSC27K0JE              |                      | TFSE27K0JE             |                      |
| 47,000  | 1%   | TFSA47K0FE            |                       |                         |                      |                        |                      |
| 50,000  | 5%   | TFSA50K0JE            |                       |                         |                      |                        | TFSF51K0JE           |
| 51,000  | 5%   |                       | TFSB51K0JE            | TFSC51K0JE              | TFSD51K0JE           |                        |                      |
| 75,000  | 5%   |                       |                       |                         |                      | TFSE75K0JE             |                      |
| 100,000 | 1%   | TFSA100KFE            |                       |                         |                      |                        |                      |
| 100,000 | 5%   |                       | TFSB100KJE            | TFSC100KJE              | TFSD100KJE           |                        | TFSF100KJE           |