

**Features:**

- Coating meets UL 94V-0
- Designed for constant current to provide overload protection
- Consistent performance and reliability
- Cut and formed product is available on select sizes, contact Stackpole for details
- RoHS compliant, REACH compliant, lead free, and halogen free



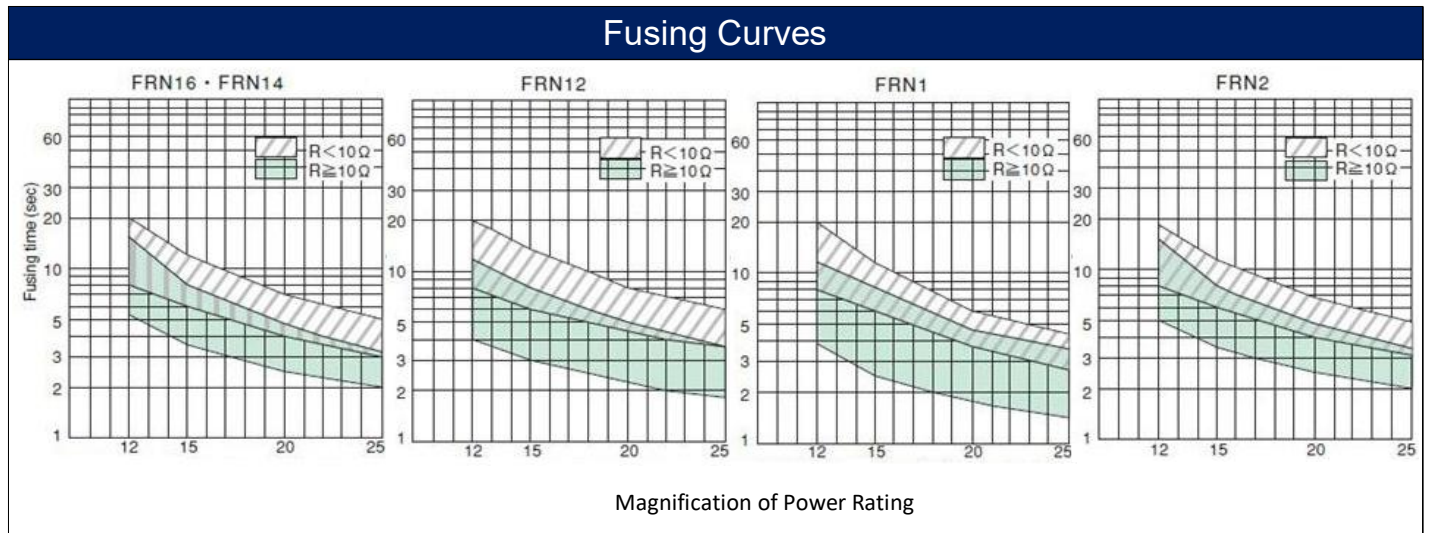
| Electrical Specifications |                         |                                            |                              |              |                                  |
|---------------------------|-------------------------|--------------------------------------------|------------------------------|--------------|----------------------------------|
| Type/Code                 | Power Rating (W) @ 70°C | Maximum Working Voltage (V) <sup>(1)</sup> | Maximum Overload Voltage (V) | TCR (ppm/°C) | Ohmic Range (Ω) and Tolerance 5% |
| FRN16                     | 0.166                   | 150                                        | 200                          | ± 350        | 0.56 - 10K                       |
| FRN14                     | 0.25                    | 200                                        | 300                          | ± 350        | 0.22 - 10K                       |
| FRN12                     | 0.5                     | 250                                        | 400                          | ± 350        | 0.47 - 10K                       |
| FRN1                      | 1                       | 300                                        | 600                          | ± 350        | 0.47 - 10K                       |
| FRN2                      | 2                       | 300                                        | 600                          | ± 350        | 1 - 3K                           |

(1) Lesser of  $\sqrt{P \cdot R}$  or maximum working voltage

| Mechanical Specifications |                                      |                              |                               |                              |              |
|---------------------------|--------------------------------------|------------------------------|-------------------------------|------------------------------|--------------|
|                           |                                      |                              |                               |                              |              |
| Type/Code                 | A<br>Body Length                     | B<br>Body Diameter           | C<br>Lead Length (Bulk)       | D<br>Lead Diameter           | Unit         |
| FRN16                     | 0.126 +0.008 / -0<br>3.20 +0.20 / -0 | 0.073 ± 0.006<br>1.85 ± 0.15 | 1.102 ± 0.118<br>28.00 ± 3.00 | 0.018 ± 0.002<br>0.45 ± 0.05 | inches<br>mm |
| FRN14                     | 0.236 ± 0.020<br>6.00 ± 0.50         | 0.091 ± 0.008<br>2.30 ± 0.20 | 1.102 ± 0.118<br>28.00 ± 3.00 | 0.022 ± 0.002<br>0.55 ± 0.05 | inches<br>mm |
| FRN12                     | 0.354 ± 0.039<br>9.00 ± 1.00         | 0.118 ± 0.020<br>3.00 ± 0.50 | 1.102 ± 0.118<br>28.00 ± 3.00 | 0.028 ± 0.002<br>0.70 ± 0.05 | inches<br>mm |
| FRN1                      | 0.433 ± 0.039<br>11.00 ± 1.00        | 0.157 ± 0.020<br>4.00 ± 0.50 | 1.102 ± 0.118<br>28.00 ± 3.00 | 0.031 ± 0.002<br>0.80 ± 0.05 | inches<br>mm |
| FRN2                      | 0.591 ± 0.039<br>15.00 ± 1.00        | 0.217 ± 0.039<br>5.50 ± 1.00 | 1.378 ± 0.118<br>35.00 ± 3.00 | 0.031 ± 0.002<br>0.80 ± 0.05 | inches<br>mm |

| Performance Characteristics   |             |
|-------------------------------|-------------|
| Test                          | Test Result |
| Moisture Resistance           | ± 5%        |
| Thermal Shock                 | ± 1%        |
| Load Life @ 70°C - 1000 hours | ± 5%        |
| Resistance to Soldering Heat  | ± 1%        |
| Short Time Overload           | ± 2%        |

Operating temperature range is -40 to +155°C



### Repetitive Pulse Information:

If repetitive pulses are applied to resistors, pulse wave form must be less than “pulse limiting voltage”, “pulse limiting current” or “pulse limiting wattage” calculated by the formula below.

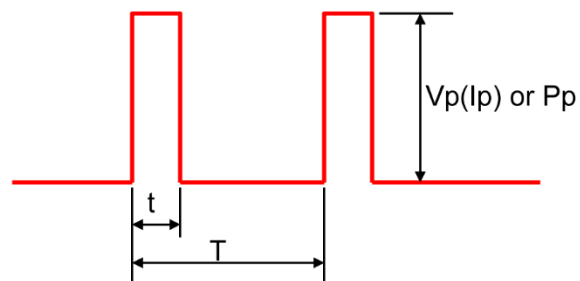
$$V_p = K \sqrt{P \times R \times T/t}$$

$$I_p = K \sqrt{P/R \times T/t}$$

$$P_p = K^2 \times P \times T/t$$

Where:

|           |                                               |
|-----------|-----------------------------------------------|
| $V_p$ :   | Pulse limiting voltage (V)                    |
| $I_p$ :   | Pulse limiting current (A)                    |
| $P_p$ :   | Pulse limiting wattage (W)                    |
| $P$ :     | Power rating (W)                              |
| $R$ :     | Nominal resistance (ohm)                      |
| $T$ :     | Repetitive period (sec)                       |
| $t$ :     | Pulse duration (sec)                          |
| $K$ :     | Coefficient: 0.6                              |
| [ $V_r$ : | Rated Voltage (V), $I_r$ : Rated Current (A)] |



Note 1: If  $T > 10 \rightarrow T = 10$  (sec),  $T/t > 1000 \rightarrow T/t = 1000$

Note 2: If  $T > 10$  and  $T/t > 1000$ , “Pulse Limiting power (Single pulse) is applied

Note 3: If  $V_p < V_r$  ( $I_p < I_r$  or  $P_p < P$ ),  $V_r$  ( $I_r$ ,  $P$ ) is  $V_p$  ( $I_p$ ,  $P_p$ )

Note 4: Pulse limiting voltage (current, wattage) is applied at less than rated ambient temperature.

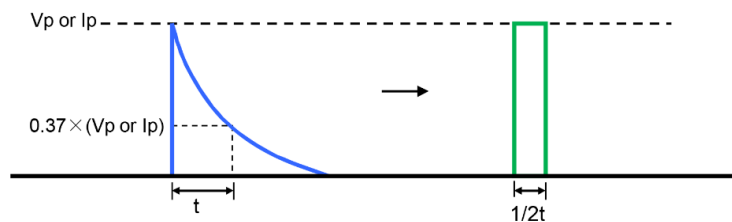
If ambient temperature is more than the rated temperature (70 °C), decrease power rating according to “Power Derating Curve”

Note 5: Assure sufficient margin for use period and conditions for “pulse limiting voltage”

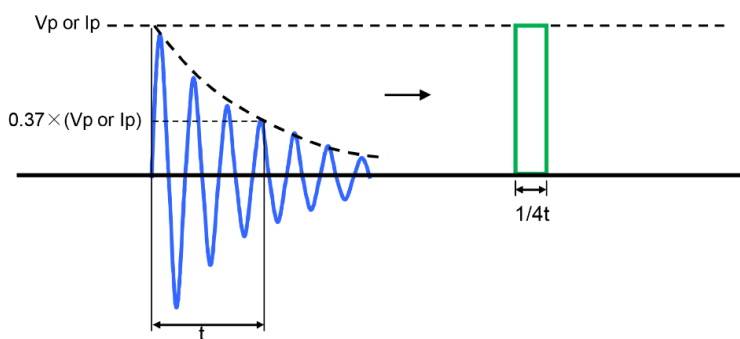
Note 6: If the pulse waveform is not square wave, judge after transform the waveform into square wave according to the “Waveform Transformation to Square Wave”.

## Waveform Transformation to Square Wave

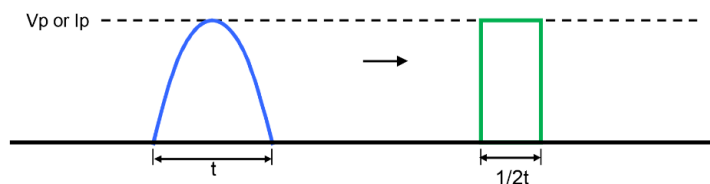
1. Discharge curve wave with time constant " $t$ " → Square wave



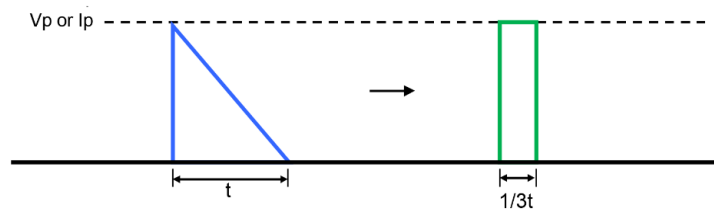
2. Damping oscillation wave with time constant of envelope " $t$ " → Square wave



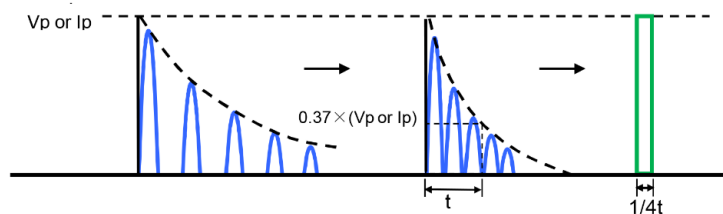
3. Half-wave rectification wave → Square wave



4. Triangular wave → Square wave



5. Special wave → Square wave



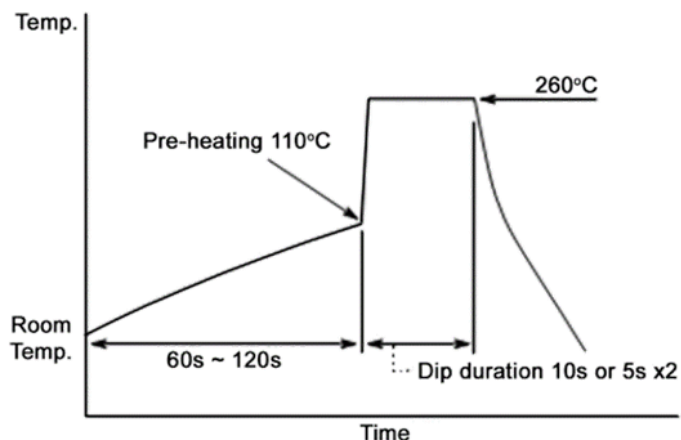
## Recommended Soldering Condition

### Flow Soldering:

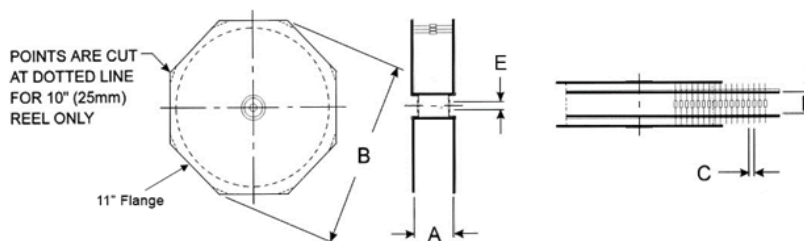
- Pre-heating: 110°C MAX
- Peak temperature/duration: 260°C within 10 seconds (1<sup>st</sup>, 2<sup>nd</sup> wave total)
- Temperature profile (see chart on the right)

### Iron Soldering:

- 380°C, 5 seconds, once/terminal



## Reel Specifications



| Series | A max <sup>(1)</sup> | B max            | C                             | D <sup>(2)</sup>              | Tape          | Unit         |
|--------|----------------------|------------------|-------------------------------|-------------------------------|---------------|--------------|
| FRN16  | 2.618<br>66.50       | 13.504<br>343.00 | 0.197 ± 0.020<br>5.00 ± 0.50  | 2.063 ± 0.079<br>52.40 ± 2.00 | 0.250<br>6.35 | inches<br>mm |
| FRN14  | 2.508<br>63.70       | 13.504<br>343.00 | 0.197 ± 0.020<br>5.00 ± 0.50  | 2.063 ± 0.079<br>52.40 ± 2.00 | 0.250<br>6.35 | inches<br>mm |
| FRN12  | 2.618<br>66.50       | 13.504<br>343.00 | 0.197 ± 0.020<br>5.00 ± 0.50  | 2.063 ± 0.079<br>52.40 ± 2.00 | 0.250<br>6.35 | inches<br>mm |
| FRN1   | 2.421<br>61.50       | 13.504<br>343.00 | 0.197 ± 0.020<br>5.00 ± 0.50  | 2.063 ± 0.079<br>52.40 ± 2.00 | 0.250<br>6.35 | inches<br>mm |
| FRN2   | 3.917<br>99.50       | 13.504<br>343.00 | 0.394 ± 0.020<br>10.00 ± 0.50 | 2.500 ± 0.079<br>63.50 ± 2.00 | 0.250<br>6.35 | inches<br>mm |

Dimension "E": This is a non-critical dimension that does not have a tolerance in the standard.

Range of diameters is from 0.547 inches (13.90 mm) to 1.500 inches (38.10 mm).

(1) Reference value only. The "A" dimension shall be governed by the overall length of the taped component.

The distance between flanges shall be 0.059 inches (1.50 mm) to 0.315 (8.00 mm) greater than the overall component.

(2) The given dimension "D" expresses the standard width spacing.

## RoHS Compliance

Stackpole Electronics has joined the worldwide effort to reduce the amount of lead in electronic components and to meet the various regulatory requirements now prevalent, such as the European Union's directive regarding "Restrictions on Hazardous Substances" (RoHS 3). As part of this ongoing program, we periodically update this document with the status regarding the availability of our compliant components. All our standard part numbers are compliant to EU Directive 2011/65/EU of the European Parliament as amended by Directive (EU) 2015/863/EU as regards the list of restricted substances.

| RoHS Compliance Status  |                              |                            |                                |                                   |                                                    |                                       |
|-------------------------|------------------------------|----------------------------|--------------------------------|-----------------------------------|----------------------------------------------------|---------------------------------------|
| Standard Product Series | Description                  | Package / Termination Type | Standard Series RoHS Compliant | Lead-Free Termination Composition | Lead-Free Mfg. Effective Date (Std Product Series) | Lead-Free Effective Date Code (YY/WW) |
| FRN                     | Axial Leaded Fusing Resistor | Axial                      | YES                            | 99.3/0.7 Sn/Cu                    | Apr-05                                             | 05/14                                 |

### "Conflict Metals" Commitment

We at Stackpole Electronics, Inc. are joined with our industry in opposing the use of metals mined in the "conflict region" of the eastern Democratic Republic of the Congo (DRC) in our products. Recognizing that the supply chain for metals used in the electronics industry is very complex, we work closely with our own suppliers to verify to the extent possible that the materials and products we supply do not contain metals sourced from this conflict region. As such, we are in compliance with the requirements of Dodd-Frank Act regarding Conflict Minerals.

### Compliance to "REACH"

We certify that all passive components supplied by Stackpole Electronics, Inc. are SVHC (Substances of Very High Concern) free and compliant with the requirements of EU Directive 1907/2006/EC, "The Registration, Evaluation, Authorization and Restriction of Chemicals", otherwise referred to as REACH. Contact us for the complete list of REACH Substance Candidate List.

### Environmental Policy

It is the policy of Stackpole Electronics, Inc. (SEI) to protect the environment in all localities in which we operate. We continually strive to improve our effect on the environment. We observe all applicable laws and regulations regarding the protection of our environment and all requests related to the environment to which we have agreed. We are committed to the prevention of all forms of pollution.

## How to Order

| F              |                   | R            |       | N         |     | 1     |           | 2             |                            | J        |                                                                                                          | T |  | 4 |  | R |  | 7 |  | 0 |  |
|----------------|-------------------|--------------|-------|-----------|-----|-------|-----------|---------------|----------------------------|----------|----------------------------------------------------------------------------------------------------------|---|--|---|--|---|--|---|--|---|--|
| Product Series |                   | Power Rating |       | Tolerance |     |       | Packaging |               |                            |          | Resistance Value                                                                                         |   |  |   |  |   |  |   |  |   |  |
|                |                   |              |       |           |     |       |           |               |                            |          |                                                                                                          |   |  |   |  |   |  |   |  |   |  |
| Code           | Description       | Code         | W     | Code      | Tol | Value | Code      | Description   | Product Code               | Quantity | Four characters with the multiplier used as the decimal holder.<br><br>0.47 ohm = R470<br>10 Kohm = 10K0 |   |  |   |  |   |  |   |  |   |  |
| FRN            | Fusing Metal Film | 16           | 0.166 | J         | 5%  | E24   | T         | Tape and Reel | FRN16, FRN14               | 5000     |                                                                                                          |   |  |   |  |   |  |   |  |   |  |
|                |                   | 14           | 0.25  |           |     |       |           |               | FRN12, FRN1                | 2500     |                                                                                                          |   |  |   |  |   |  |   |  |   |  |
|                |                   | 12           | 0.5   |           |     |       |           |               | FRN2                       | 1000     |                                                                                                          |   |  |   |  |   |  |   |  |   |  |
|                |                   | 1            | 1     |           |     |       | A         | Ammo          | FRN16                      | 5000     |                                                                                                          |   |  |   |  |   |  |   |  |   |  |
|                |                   | 2            | 2     |           |     |       |           |               | FRN14, FRN12               | 2000     |                                                                                                          |   |  |   |  |   |  |   |  |   |  |
|                |                   |              |       |           |     |       |           |               | FRN1                       | 1000     |                                                                                                          |   |  |   |  |   |  |   |  |   |  |
|                |                   |              |       |           |     |       |           |               | FRN2                       | 500      |                                                                                                          |   |  |   |  |   |  |   |  |   |  |
|                |                   |              |       |           |     |       | B         | Bulk          | FRN16                      | 2000     |                                                                                                          |   |  |   |  |   |  |   |  |   |  |
|                |                   |              |       |           |     |       |           |               | FRN14, FRN12<br>FRN1, FRN2 | 1000     |                                                                                                          |   |  |   |  |   |  |   |  |   |  |