

**Features:**

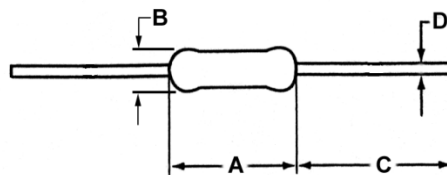
- Coating meets UL 94V-0
- Designed for constant current to provide overload protection
- Consistent performance and reliability
- Cut and formed product is available on select sizes, contact Stackpole for details
- 100% RoHS compliant and lead free without exemption
- Halogen free
- REACH compliant



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**



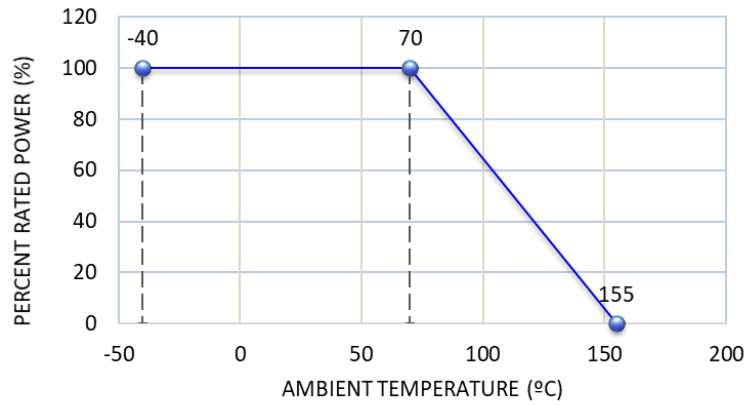
Type / Code	A Body Length	B Body Diameter	C Lead Length (Bulk)	D Lead Diameter	Unit
FRN16	0.126 +0.008 / -0	0.073 ± 0.006	1.102 ± 0.118	0.018 ± 0.002	inches
	3.20 +0.20 / -0	1.85 ± 0.15	28.00 ± 3.00	0.45 ± 0.05	mm
FRN14	0.236 ± 0.020	0.091 ± 0.008	1.102 ± 0.118	0.022 ± 0.002	inches
	6.00 ± 0.50	2.30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

**Performance Characteristics**

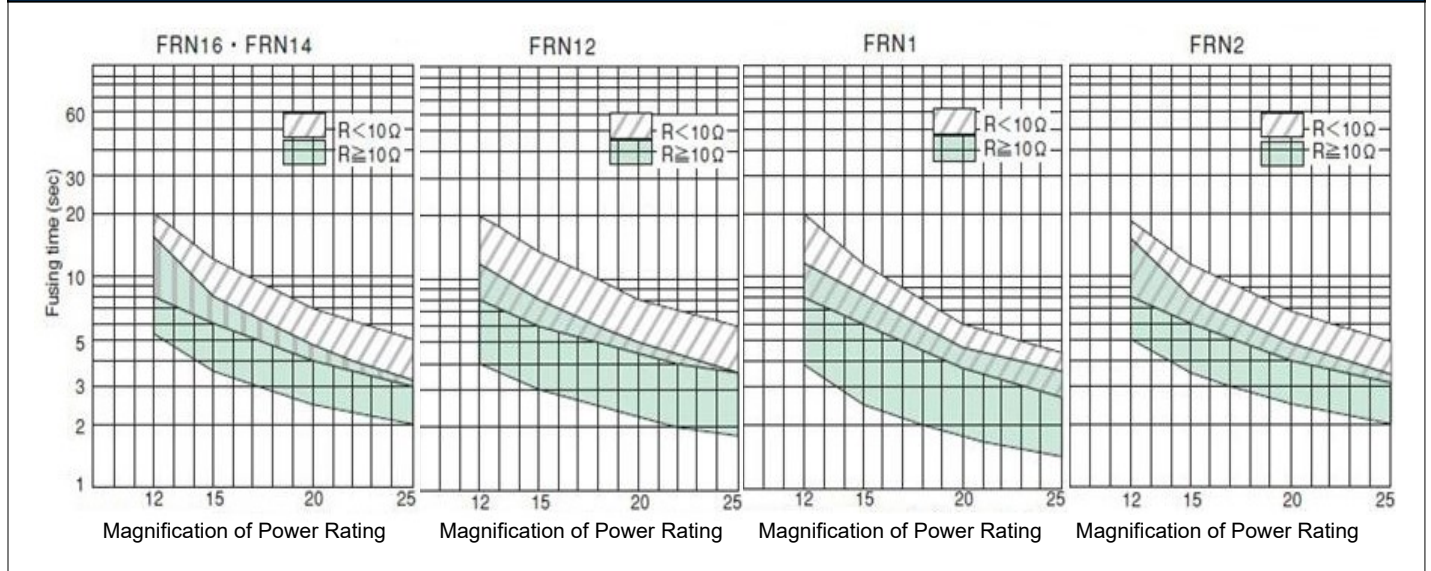
Test	Test Result
Moisture Resistance	± 5%
Thermal Shock	± 1%
Load Life @ 70°C - 1000 hours	± 5%
Resistance to Soldering Heat	± 1%
Short Time Overload	± 2%

Operating temperature range is -40°C to +155°C

Power Derating Curve:



Fusing Curves



### Repetitive Pulse Information

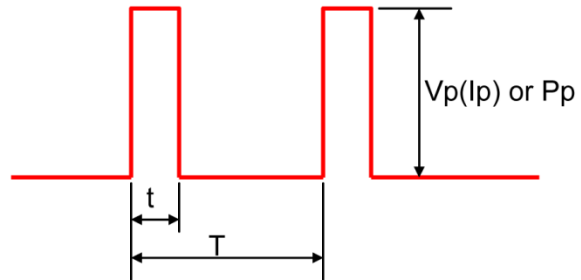
If repetitive pulses are applied to resistors, pulse wave form must be less than “Pulse limiting voltage”, “Pulse limiting current” or “Pulse limiting wattage” calculated by the formula below.

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

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

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

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  $V_p$  ( $I_p$ ,  $P_p$ ).

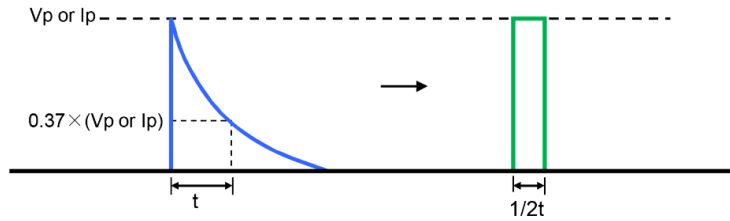
Note 4: Pulse limiting voltage (Current, Wattage) is applied at less than rated ambient temperature. If ambient temperature is more than the rated temperature (70°C), please decrease power rating according to “Power Derating Curve”.

Note 5: Please assure sufficient margin for use period and conditions for “Pulse limiting voltage”.

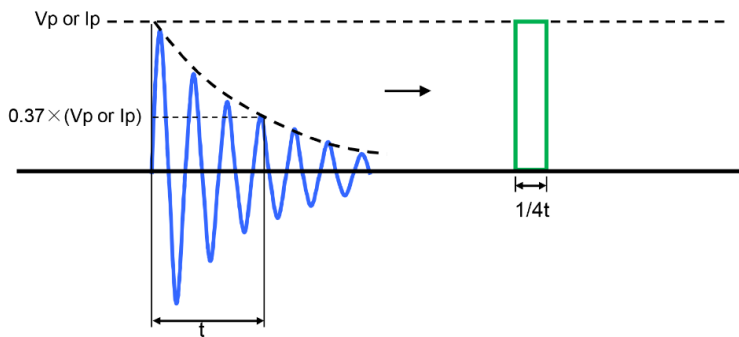
Note 6: If the pulse waveform is not square wave, please judge after transform the waveform into square wave according to “Waveform Transformation to Square Wave” information.

Waveform Transformation to Square Wave

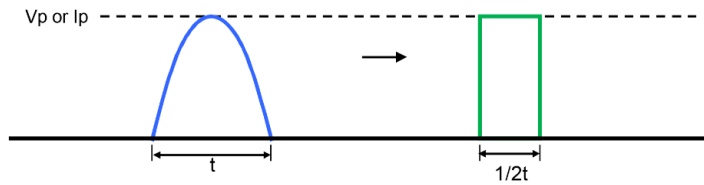
1. Discharge curve wave with time constant "t" → Square wave



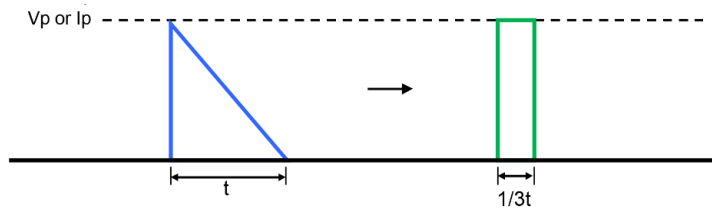
2. Damping oscillation wave with time constant of envelope "t" → Square wave



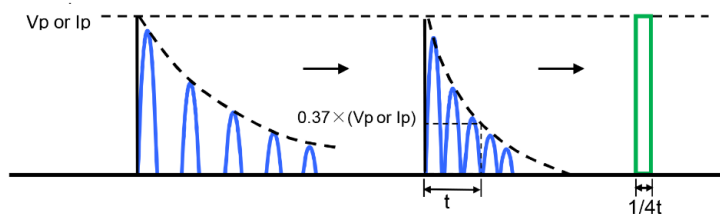
3. Half-wave rectification wave → Square wave



4. Triangular wave → Square wave



5. Special wave → Square wave



### Recommended Solder Profile

This information is intended as a reference for solder profiles for Stackpole resistive components. These profiles should be compatible with most soldering processes. These are only recommendations. Actual numbers will depend on board density, geometry, packages used, etc., especially those cells labeled with “\*”.

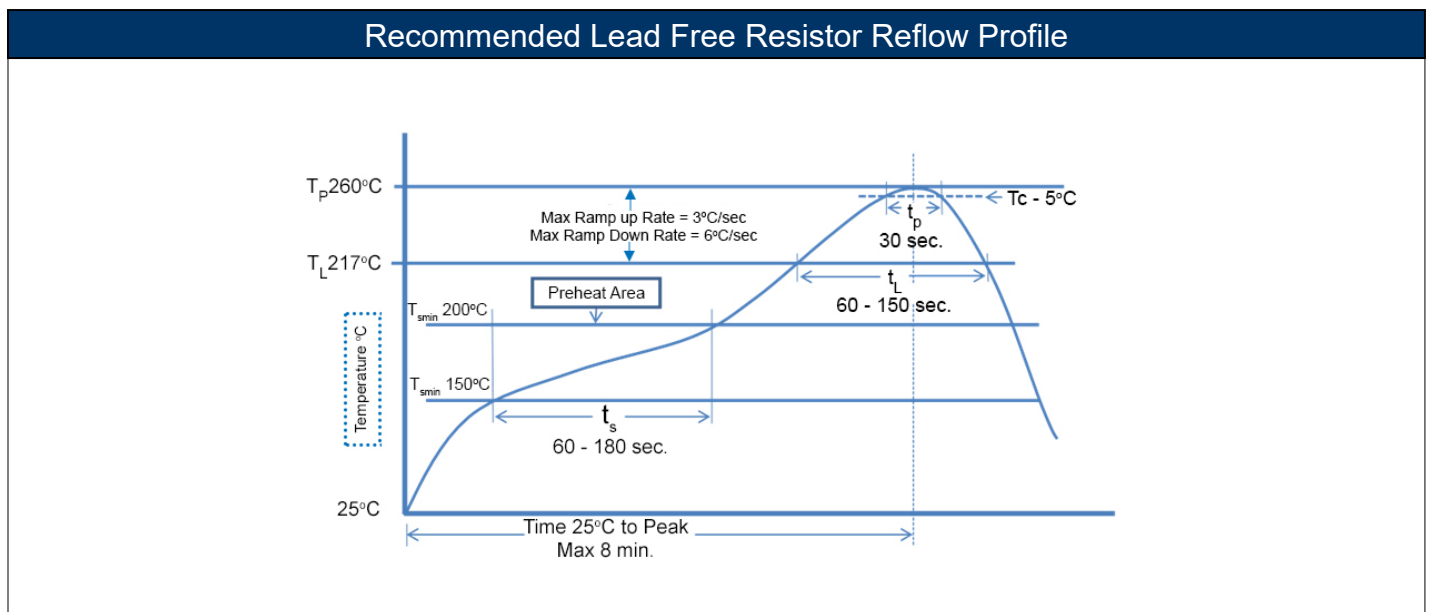
### 100% Matte Tin / RoHS Compliant Terminations

Soldering iron recommended temperatures: 330°C to 350°C with minimum duration.  
Maximum number of reflow cycles: 3.

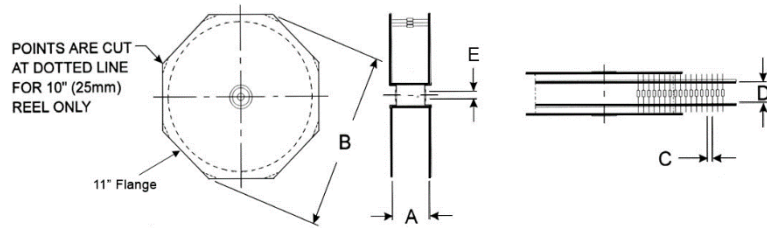
Wave Soldering			
Description	Maximum	Recommended	Minimum
Preheat Time	80 seconds	70 seconds	60 seconds
Temperature Diff.	140°C	120°C	100°C
Solder Temp.	260°C	250°C	240°C
Dwell Time at Max.	10 seconds	5 seconds	*
Ramp DN (°C/sec)	N/A	N/A	N/A

Temperature Diff. = Difference between final preheat stage and soldering stage.

Convection IR Reflow			
Description	Maximum	Recommended	Minimum
Ramp Up (°C/sec)	3°C/sec	2°C/sec	*
Dwell Time > 217°C	150 seconds	90 seconds	60 seconds
Solder Temp.	260°C	245°C	*
Dwell Time at Max.	30 seconds	15 seconds	10 seconds
Ramp DN (°C/sec)	6°C/sec	3°C/sec	*



**Packaging Specifications**



Series	A max <sup>(1)</sup>	B max	C	D <sup>(2)</sup>	Tape	Unit
FRN16	2.618	13.504	0.197 ± 0.020	2.063 ± 0.079	0.250	inches
	66.50	343.00	5.00 ± 0.50	52.40 ± 2.00	6.35	mm
FRN14	2.508	13.504	0.197 ± 0.020	2.063 ± 0.079	0.250	inches
	63.70	343.00	5.00 ± 0.50	52.40 ± 2.00	6.35	mm
FRN12	2.618	13.504	0.197 ± 0.020	2.063 ± 0.079	0.250	inches
	66.50	343.00	5.00 ± 0.50	52.40 ± 2.00	6.35	mm
FRN1	2.421	13.504	0.197 ± 0.020	2.063 ± 0.079	0.250	inches
	61.50	343.00	5.00 ± 0.50	52.40 ± 2.00	6.35	mm
FRN2	3.917	13.504	0.394 ± 0.020	2.500 ± 0.079	0.250	inches
	99.50	343.00	10.00 ± 0.50	63.50 ± 2.00	6.35	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. A 26 mm narrow spacing is available as option "N" packaging code.

**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 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

