

**Features:**

- General purpose resistor ideal for commercial/industrial applications
- Flame retardant coatings standard
- Flameproof version available as CFF and CFFM
- Panasert available on selected sizes - contact Stackpole
- Auto sequencing/insertion compatible
- CFM (mini) ideal choice when size constraints apply
- Cut and formed product is available on select sizes - contact Stackpole
- Standard lead wire for CF and CFM is copper plated steel, with 100% tin over plate
- 100% tin plate on copper wire is available as type CFQ and CFQM
- 100% RoHS compliant and lead free without exemption
- Halogen free
- REACH compliant



Electrical Specifications - CF								
Type/Code	Size	Power Rating (W) @ 70°C	Maximum Working Voltage (V) <sup>(1)</sup>	Maximum Overload Voltage (V)	Dielectric Withstanding Voltage (V)	TCR (ppm/°C) per Ohmic Range	Ohmic Range (Ω) and Tolerance	
							2%	5%
CF, CFQ	18	0.125	250	500	350	< 10 Ω = ±400 ppm/°C 10 Ω to 9.99K Ω = 0 ~ -400 ppm/°C 10 K Ω to 99K Ω = 0 ~ -500 ppm/°C 100 K Ω to 999K Ω = 0 ~ -850 ppm/°C 1M Ω and above = 0 ~ -1500 ppm/°C	10 - 1M	1 - 22M
CF, CFQ, PCF	14	0.25	350	600	350		1 - 1M	1 - 22M
CF, CFQ	12	0.5	350	700	600		10 - 1M	1 - 22M
CF, CFQ	1	1	500	1000	600		1 - 1M	1 - 10M
CF, CFQ	2	2	500	1000	600		1 - 1M	1 - 10M

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

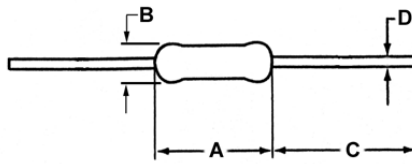
Electrical Specifications - CFM								
Type/Code	Size	Power Rating (W) @ 70°C	Maximum Working Voltage (V) <sup>(1)</sup>	Maximum Overload Voltage (V)	Dielectric Withstanding Voltage (V)	TCR (ppm/°C) per Ohmic Range	Ohmic Range (Ω) and Tolerance	
							2%	5%
CFM, CFQM	14	0.25	250	500	350	< 10 Ω = ±400 ppm/°C 10 Ω to 9.99K Ω = 0 ~ -400 ppm/°C 10 K Ω to 99K Ω = 0 ~ -500 ppm/°C 100 K Ω to 999K Ω = 0 ~ -850 ppm/°C 1M Ω and above = 0 ~ -1500 ppm/°C	1 - 1M	1 - 10M
CFM, CFQM, PCFM	12	0.5	350	600	350		1 - 1M	1 - 10M
CFM, CFQM	1	1	600	1000	600		1 - 1M	1 - 10M
CFM, CFQM	2	2	600	1000	600		1 - 1M	1 - 10M

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

Electrical Specifications – CFF/CFM								
Type/Code	Size	Power Rating (W) @ 70°C	Maximum Working Voltage (V) <sup>(1)</sup>	Maximum Overload Voltage (V)	Dielectric Withstanding Voltage (V)	TCR (ppm/°C) per Ohmic Range	Ohmic Range (Ω) and Tolerance	
							2%, 5%	
CFF	18	0.166	200	400	300	< 10 Ω = ±400 ppm/°C 10 Ω to 9.99K Ω = 0 ~ -400 ppm/°C 10 K Ω to 99K Ω = 0 ~ -500 ppm/°C 100 K Ω to 999K Ω = 0 ~ -850 ppm/°C 1M Ω and above = 0 ~ -1500 ppm/°C	1 - 2.2M	
	14	0.25	300	600	500		1 - 5.1M	
	12	0.5	350	700	500			
CFFM	14	0.25	250	500	300		1 - 2.2M	
	12	0.5	300	600	500			

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

**Mechanical Specifications**



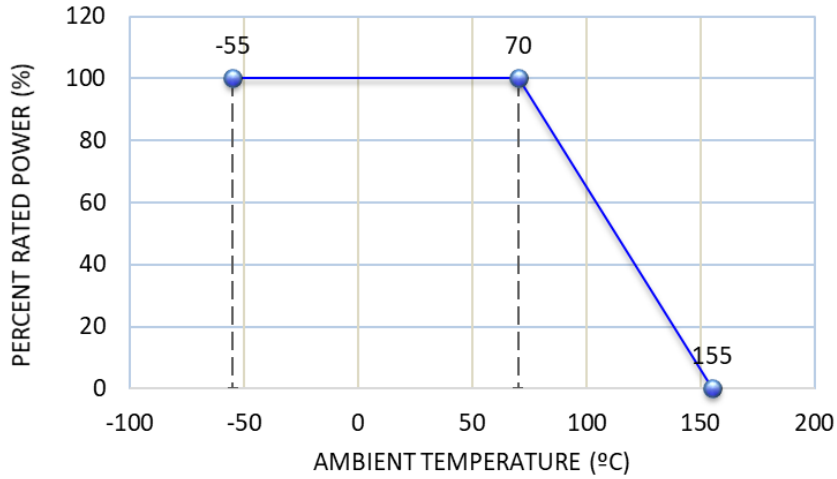
Type/Code	Size	A Body Length	B Body Diameter	C Lead Length (Bulk)	D - Lead Diameter	Unit
CF	18	0.130 ± 0.012	0.067 ± 0.012	1.102 ± 0.118 28.00 ± 3.00	0.016 ± 0.003	inches
CFQ		3.30 ± 0.30	1.70 ± 0.30		0.40 ± 0.08	mm
CFF	18	0.126 ± 0.008	0.073 ± 0.008		0.018 ± 0.002	inches
		3.20 ± 0.20	1.85 ± 0.20		0.45 ± 0.05	mm
CF, CFF, CFQ, PCF	14	0.236 ± 0.012	0.091 ± 0.012		0.022 ± 0.003	inches
		6.00 ± 0.30	2.30 ± 0.30		0.55 ± 0.08	mm
CFFM		0.126 ± 0.008	0.073 ± 0.008		0.018 ± 0.002	inches
		3.20 ± 0.20	1.85 ± 0.20		0.45 ± 0.05	mm
CFM		0.130 ± 0.012	0.067 ± 0.012		0.016 ± 0.003	inches
		3.30 ± 0.30	1.70 ± 0.30		0.40 ± 0.08	mm
CFQM					0.018 ± 0.003	inches
					0.45 ± 0.08	mm
CF	12	0.335 ± 0.039	0.106 ± 0.020	0.022 ± 0.003	inches	
CFF, CFQ		8.50 ± 1.00	2.70 ± 0.50	0.55 ± 0.08	mm	
				0.028 ± 0.004	inches	
CFM, CFQM, CFFM		0.236 ± 0.012	0.091 ± 0.012	0.70 ± 0.10	mm	
		6.00 ± 0.30	2.30 ± 0.30	0.022 ± 0.003	inches	
				0.55 ± 0.08	mm	
CF, CFQ	1	0.433 ± 0.039	0.177 ± 0.020	1.181 ± 0.118	0.031 ± 0.004	inches
		11.00 ± 1.00	4.50 ± 0.50	30.00 ± 3.00	0.80 ± 0.10	mm
CFM, CFQM		0.354 ± 0.020	0.138 ± 0.020	1.102 ± 0.118	0.028 ± 0.002	inches
		9.00 ± 0.50	3.50 ± 0.50	28.00 ± 3.00	0.70 ± 0.05	mm
CF, CFQ	2	0.591 ± 0.039	0.197 ± 0.020	1.339 ± 0.157	0.031 ± 0.004	inches
		15.00 ± 1.00	5.00 ± 0.50	34.00 ± 4.00	0.80 ± 0.10	mm

**Performance Characteristics**

Test	Test Method	Typical Result			Test Limit		
		1Ω ~ 91KΩ	100KΩ ~ 910KΩ	1MΩ ~ 22MΩ	1Ω ~ 91KΩ	100KΩ ~ 910KΩ	1MΩ ~ 22MΩ
Current Noise	MIL-STD 202, Method 308	0.15μ V/V	0.32μ V/V	0.54μ V/V	0.2μ V/V	0.4μ V/V	0.6μ V/V
Short Time Overload	JIS C5201-1, IEC60115-1, 4.13	< ± 0.25%			≤ ± (0.75% + 0.05Ω)		
Resistance to Soldering Heat	JIS C5201-1, IEC60115-1, 4.18	< ± 0.3%			≤ ± (0.5% + 0.05Ω)		
Rapid Change of Temperature	JIS C5201-1, IEC60115-1, 4.19	< ± 0.3%			≤ ± (1% + 0.05Ω)		
Endurance at 70°C	JIS C5201-1, IEC60115-1, 4.25.1	< ± 1%			R < 100KΩ: ≤ ± (2% + 0.05Ω) R ≥ 100KΩ: ≤ ± (3% + 0.05Ω)		
Terminal Strength	MIL-STD 202, Method 211	< ± 0.2%			≤ ± (0.5% + 0.05Ω)		
Damp Heat (Steady state)	JIS C5201-1, IEC60115-1, 4.24	< ± 1.5%			R < 100KΩ: ≤ ± (3% + 0.05Ω) R ≥ 100KΩ: ≤ ± (5% + 0.05Ω)		

Operating temperature range is -55°C to +155°C

**Power Derating Curve:**



**Recommended Solder Profiles**

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**

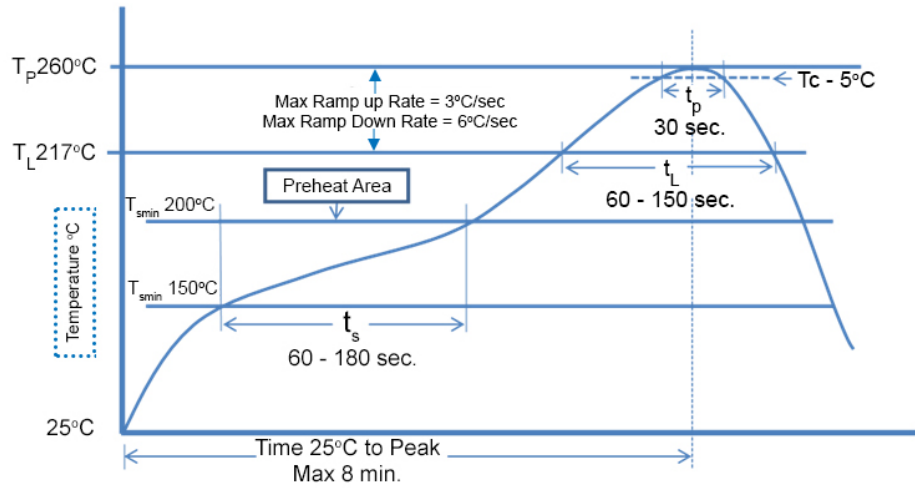
Soldering iron recommended temperatures: 330°C to 350°C with minimum duration.  
Maximum number of reflow cycles: 3.

Wave Soldering – 100% Matte Tin / RoHS Compliant Terminations			
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

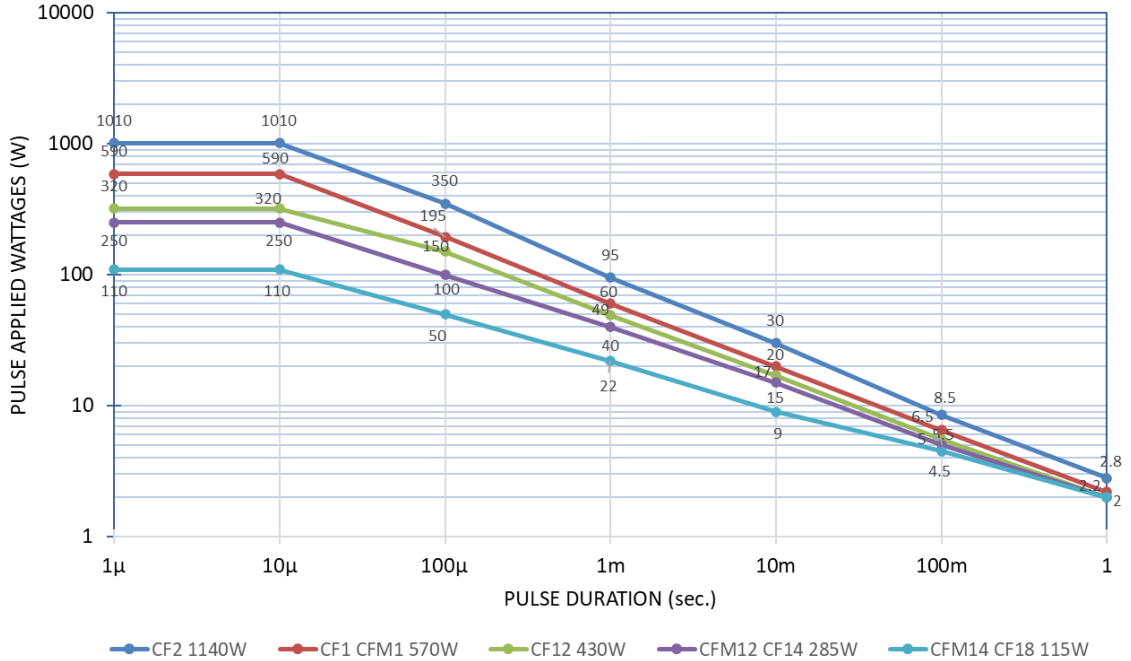
Temperature Diff. = Defference between final preheat stage and soldering stage.

Convection IR Reflow – 100% Matte Tin / RoHS Compliant Terminations			
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	*

**Recommended Lead Free Resistor Reflow Profile**



**Single Pulse Power:**



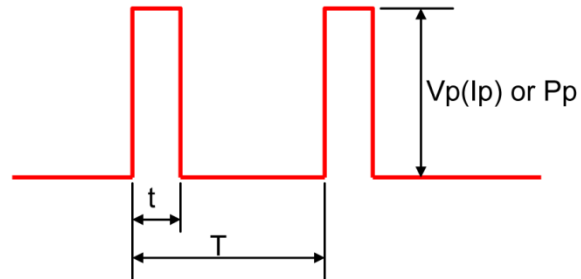
## Repetitive Pulse Information

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: 0.8  
 $[V_r$ : 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  $V_p$  ( $I_p$ ,  $P_p$ ).

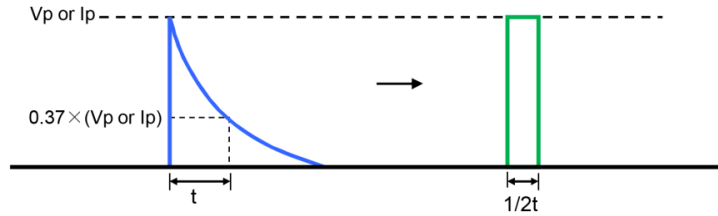
Note 4: Pulse limiting voltage (Current, Wattage) is applied at less than ambient temperature. If ambient temperature is more than the rated temperature (70°C), please decrease power rating according to “Power Derating Curve”.

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

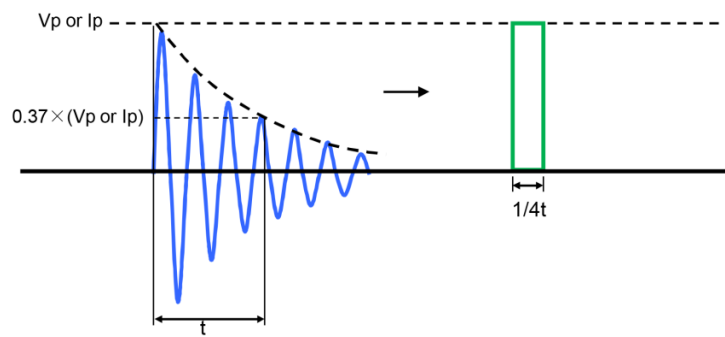
Note 6: If the pulse waveform is not square wave, please judge after transform the waveform into square wave according to the “Waveform Transformation to Square Wave”.

Waveform Transformation to Square Wave

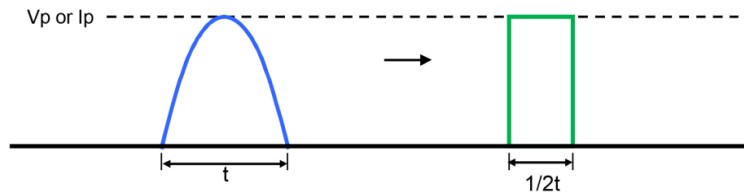
1. Discharge curve wave with time constant "t" → Square wave



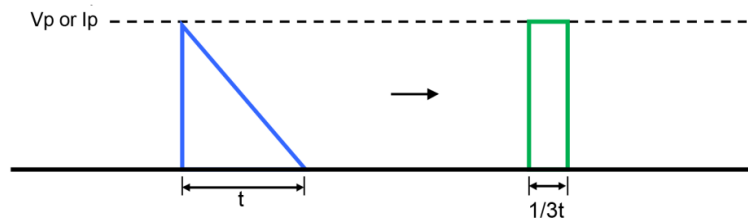
2. Damping oscillation wave with time constant of envelope "t" → Square wave



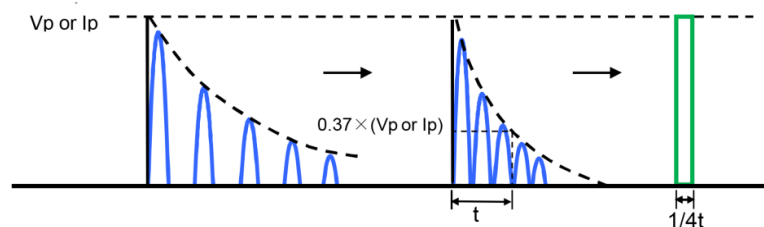
3. Half-wave rectification wave → Square wave



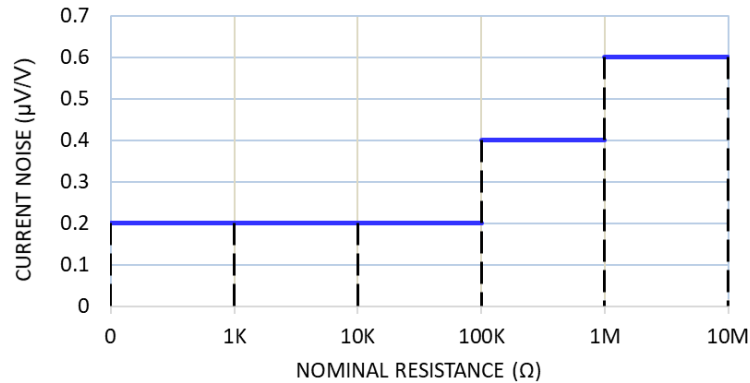
4. Triangular wave → Square wave



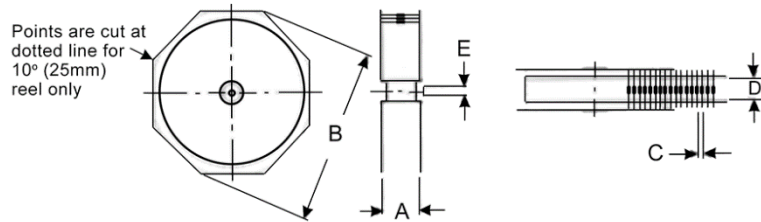
5. Special wave → Square wave



**Current Noise:**



**Reel Packaging Specifications**



Type/Code	Size	Class	Tape	A Max <sup>(1)</sup>	B Max	C	D <sup>(2)</sup>	Unit
CF, CFQ	18	I	0.250 6.35	2.508 63.70	13.504 343.00	0.197 ± 0.020 5.00 ± 0.50	2.063 ± 0.079 52.40 ± 2.00	inches mm
CFF	18			2.508 63.70				inches mm
CF, CFQ, CFF	14			2.638 67.00				inches mm
	12			2.736 69.50				inches mm
CF, CFQ	1			2.972 75.50				inches mm
	2			3.130 79.50				inches mm
CFM, CFQM, CFFM	14			2.508 63.70				inches mm
	12			2.638 67.00				inches mm
CFM, CFQM	1			2.736 69.50				inches mm

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

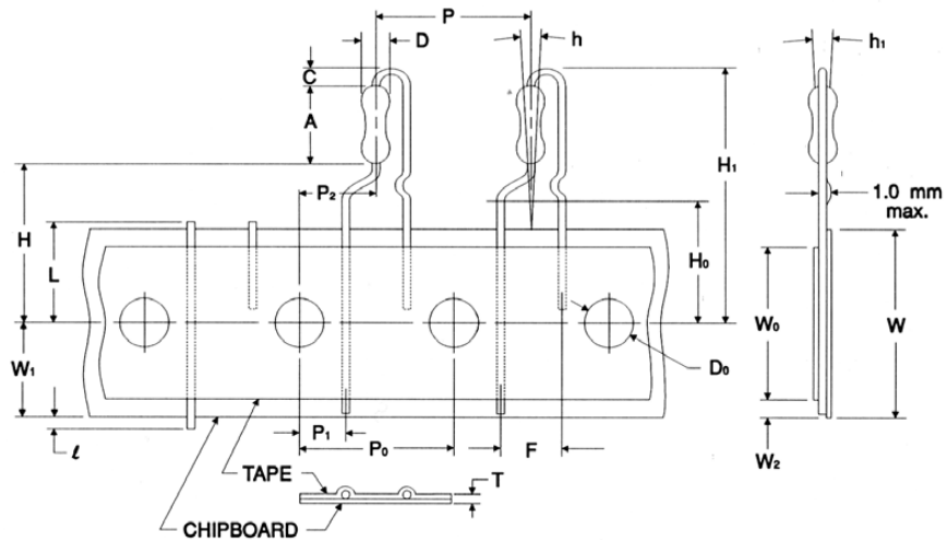
Range of diameters is from 0.547 inches (13.90 mm) to 1.500 inches (38.10 mm).

(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. Contact Stackpole for more details.

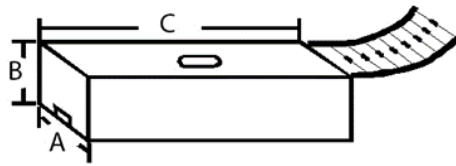
**Radial Lead Taping Specifications (Pana-Sert PCF14)**



Symbol	Description	PANA-SERT	Unit	Symbol	Description	PANA-SERT	Unit
A	Resistor body length	0.256 ± 0.020 6.50 ± 0.50	inches mm	L	Cutout Length (1)	0.433 max. 11.00 max.	inches mm
C	Height of bending	0.098 ± 0.020 2.50 ± 0.50	inches mm	P	Resistor pitch (1)	0.500 ± 0.039 12.70 ± 1.00	inches mm
D	Resistor body diameter	0.091 ± 0.008 2.30 ± 0.20	inches mm	P <sub>0</sub>	Sprocket-hole pitch (1)	0.500 ± 0.012 12.70 ± 0.30	inches mm
D <sub>0</sub>	Sprocket-hole diameter	0.157 ± 0.012 4.00 ± 0.30	inches mm	P <sub>1</sub>	Sprocket-hole center to lead center	0.152 ± 0.028 3.85 ± 0.70	inches mm
F	Resistor lead spacing	0.197 ± 0.039 5.00 ± 1.00	inches mm	P <sub>2</sub>	Sprocket-hole center to resistor center (1)	0.250 ± 0.051 6.35 ± 1.30	inches mm
H	Height to bottom of resistor	0.748 ± 0.039 19.00 ± 1.00	inches mm	T	Thickness (chipboard and tape)	0.028 ± 0.008 0.70 ± 0.20	inches mm
H <sub>0</sub>	Height to lead clinch	0.630 ± 0.020 16.00 ± 0.50	inches mm	W	Chipboard width (1)	0.709 + 0.039 / -0.020 18.00 + 1.00 / -0.50	inches mm
H <sub>1</sub>	Height of resistor	1.122 max. 28.50 max.	inches mm	W <sub>0</sub>	Hold-down tape width	0.49 min. 12.50 min.	inches mm
h	Resistor alignment	0 ± 0.079 (0 ± 5°) 0 ± 2.00 (0 ± 5°)	inches mm	W <sub>1</sub>	Sprocket-hole position	0.354 + 0.030 / -0.020 9.00 + 0.75 / -0.50	inches mm
h <sub>1</sub>	Resistor alignment	0 ± 0.079 (0 ± 5°) 0 ± 2.00 (0 ± 5°)	inches mm	W <sub>2</sub>	Hold-down tape position	0.118 max. 3.00 max.	inches mm
l	Lead protrusion	0.079 max. 2.00 max.	inches mm				



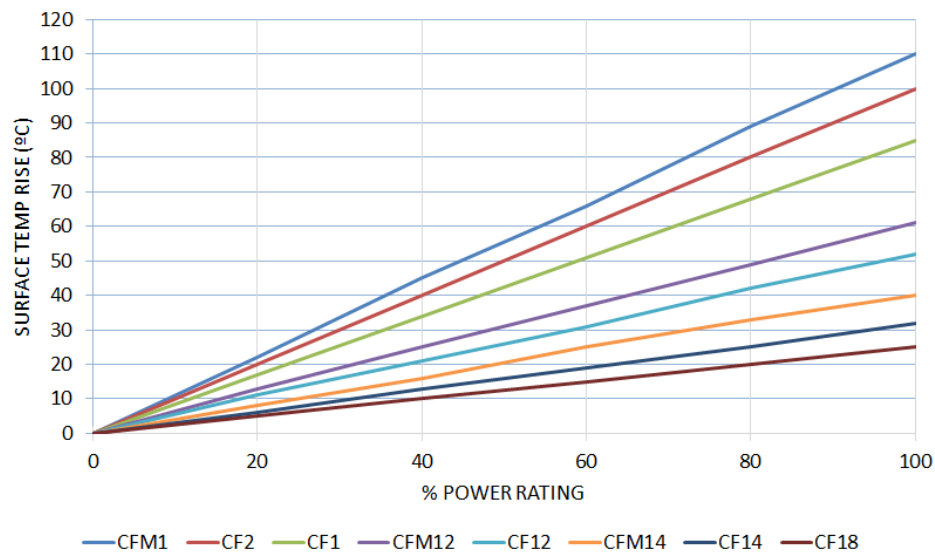
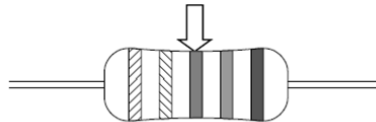
**Ammo Packaging Specifications**



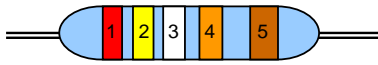
Type/Code	Size	A	B	C	Unit
CF, CFQ	16	2.953 ± 0.079 75.00 ± 2.00	2.756 ± 0.118 70.00 ± 3.00	10.039 ± 0.197 255.00 ± 5.00	inches mm
CF, CFQ	14		3.937 ± 0.118 100.00 ± 3.00		inches mm
CF, CFQ	12		2.756 ± 0.118 70.00 ± 3.00		inches mm
CFQ	2		3.543 ± 0.118 90.00 ± 3.00		inches mm
CFM, CFQM	14		2.756 ± 0.118 70.00 ± 3.00		inches mm
CFM, CFQM	12		3.937 ± 0.118 100.00 ± 3.00		inches mm
CFQ, CFQM	1		2.953 ± 0.118 75.00 ± 3.00		inches mm

**Surface Temperature Rise**

Measurement Point



**Standard Color Codes**



**PRECISION** - Have three significant-figure bands, a multiplier band and a tolerance band. Tolerances 1% or less.

**GENERAL PURPOSE** - Have two significant-figure bands, a multiplier band and a tolerance band. Tolerances 2% or greater.

Color Band Description		
Band	Precision	General Purpose
1st Band	Nominal	Nominal
2nd Band	Nominal	Nominal
3rd Band	Nominal	Multiplier
4th Band	Multiplier	Tolerance
5th Band	Tolerance	-

	Black
	Brown
	Red
	Orange
	Yellow
	Green
	Blue
	Violet
	Gray
	White
	Silver
	Gold

	Nominal	Multiplier	Tolerance (%)
Black	0	1	-
Brown	1	10	1
Red	2	100	2
Orange	3	1 K	-
Yellow	4	10 K	-
Green	5	100 K	0.5
Blue	6	1000 K	0.25
Violet	7	-	0.1
Gray	8	-	-
White	9	0.001	-
Silver	-	0.01	10
Gold	-	0.1	5

**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)
CF	Carbon Film Leaded Resistor	Axial	YES	100% Matte Sn	Jan-04 (Taiwan, China)	04/01
CFM	Mini-Carbon Film Leaded Resistor	Axial	YES	100% Matte Sn	Jan-04 (Taiwan, China)	04/01

**“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.

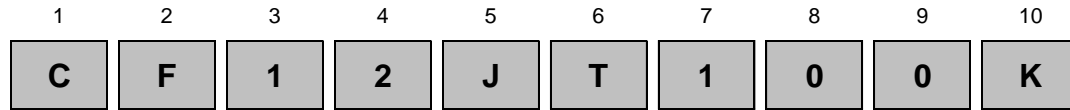
**Compliance to “REACH”**

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**



Product Series		Power Rating		Tolerance		Packaging				Resistance Value
Code	Description	Code	W	Code	Tol	Code	Description	Product Code	Qty	
CF	Standard	18	0.125	G	2%	T	Tape and Reel	CF18, CFQ18, CFF18	5000	Four characters with the multiplier used as the decimal holder.  10 ohm = 10R0 10.2 Kohm = 10K2 1 Mohm = 1M00
CFM	Mini	CFF18	0.166	J	5%			CF14, CFM14, CFF14, CFFM14		
CFF	Flameproof	14	0.25			CFQ14, CFQM14, PCF14				
CFFM	Flameproof (mini)	12	0.5			CF12, CFM12, CFF12, CFFM12				
PCF	Panasert CF14	1	1			A	Ammo	CFQ12, CFQM12, PCFM12	2500	
PCFM	Panasert CFM12	2	2					CFM1, CFQM1	2000	
CFQ	Tin plating on copper wire							CF1, CFQ1	1000	
CFQM	Tin plating (mini)							CF2, CFQ2	1000	
PCFQ	Tin plating on copper wire Panasert							CF18, CFQ18, CFF18	5000	
								CF14, CFF14, CFFM14, CFM14	2000	
								CFQ14, CFQM14		
								CFM12, CFFM12, CFQM12	1000	
								CF12, CFF12, CFQ12, PCFM12		
								CF1, CFM1, CFQ1, CFQM1	1000	
								PCF14		
								CF2	1000	
						B <sup>(*)</sup>	Bulk	All Sizes	1000	

(\*) Bulk packaging may be subject to 25Kpc MOQ