## Features:

- General purpose resistor ideal for commercial/industrial applications
- Flame retardant coatings standard
- Flameproof version available as CFF
- Panasert available on selected sizes - contact factory
- Auto sequencing/insertion compatible
- CFM (mini) ideal choice when size constraints apply
- Cut and formed product is available on select sizes - contact factory
- Standard lead wire for CF / CFM is copper plated steel, with 100% tin over plate
- 100% tin plate on copper wire is available as type CFQ / CFQM
- RoHS compliant, lead free and halogen free

## Electrical Specifications - CF

| Type / Code | Power Rating (W) @ 70ºC | Maximum Working Voltage (V) (1) | Maximum Overload Voltage (V) | Dielectric Withstanding Voltage (V) | TCR (ppm/ºC) per Ohmic Range | Ohmic Range (Ω) and Tolerance | |
|---|---|---|---|---|---|---|---|
| | | | | | | 2% | 5% |
| CF18 | 0.125 | 250 | 500 | 350 | < 10 Ω = ±400 ppm/ºC | 10 - 1 M | 1 - 22 M |
| CF14 | 0.25 | 350 | 600 | 350 | 10 Ω to 9.99K Ω = 0 ~ -400 ppm/ºC | 1 - 1 M | 1 - 22 M |
| CF12 | 0.5 | 350 | 700 | 600 | 10 K Ω to 99K Ω = 0 ~ -500 ppm/ºC | 10 - 1 M | 1 - 22 M |
| CF1 | 1 | 500 | 1000 | 600 | 100 K Ω to 999K Ω = 0 ~ -850 ppm/ºC | 1 - 1 M | 1 - 10 M |
| CF2 | 2 | 500 | 1000 | 600 | 1M Ω and above = 0 ~ -1500 ppm/ºC | 1 - 1 M | 1 - 10 M |

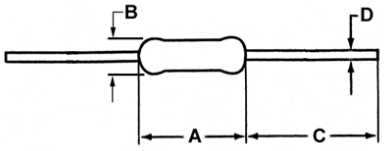
(1) Lesser of √P*R or maximum working voltage.

## Electrical Specifications - CFM

| Type / Code | Power Rating (W) @ 70ºC | Maximum Working Voltage (V) | Maximum Overload Voltage (V) | Dielectric Withstanding Voltage (V) | TCR (ppm/ºC) per Ohmic Range | Ohmic Range (Ω) and Tolerance | |
|---|---|---|---|---|---|---|---|
| | | | | | | 2% | 5% |
| CFM14 | 0.25 | 250 | 500 | 350 | < 10 Ω = ±400 ppm/ºC<br>10 Ω to 9.99K Ω = 0 ~ -400 ppm/ºC | 1 - 1 M | 1 - 10 M |
| CFM12 | 0.5 | 350 | 600 | 350 | 10 K Ω to 99K Ω = 0 ~ -500 ppm/ºC | 1 - 1 M | 1 - 10 M |
| CFM1 | 1 | 600 | 1000 | 600 | 100 K Ω to 999K Ω = 0 ~ -850 ppm/ºC<br>1M Ω and above = 0 ~ -1500 ppm/ºC | 1 - 1 M | 1 - 10 M |

(1) Lesser of √P*R or maximum working voltage.

## Mechanical Specifications – CF / CFQ




| Type / Code | A Body Length | B Body Diameter | C Lead Length (Bulk) | D - Lead Diameter CF / CFM | D - Lead Diameter CFQ / CFQM | Unit |
|---|---|---|---|---|---|---|
| CF18 / CFQ18 | 0.130 ± 0.012 | 0.067 ± 0.012 | 1.102 ± 0.118 | 0.016 ± 0.003 | 0.018 ± 0.003 | inches |
| | 3.30 ± 0.30 | 1.70 ± 0.30 | 28.00 ± 3.00 | 0.40 ± 0.08 | 0.45 ± 0.08 | mm |
| CF14 / CFQ14 | 0.236 ± 0.012 | 0.091 ± 0.012 | 1.102 ± 0.118 | 0.022 ± 0.003 | 0.022 ± 0.003 | inches |
| | 6.00 ± 0.30 | 2.30 ± 0.30 | 28.00 ± 3.00 | 0.55 ± 0.08 | 0.55 ± 0.08 | mm |
| CF12 / CFQ12 | 0.335 ± 0.039 | 0.106 ± 0.020 | 1.102 ± 0.118 | 0.022 ± 0.003 | 0.028 ± 0.004 | inches |
| | 8.50 ± 1.00 | 2.70 ± 0.50 | 28.00 ± 3.00 | 0.55 ± 0.08 | 0.70 ± 0.10 | mm |
| CF1 / CFQ1 | 0.433 ± 0.039 | 0.177 ± 0.020 | 1.181 ± 0.118 | 0.031 ± 0.004 | 0.031 ± 0.004 | inches |
| | 11.00 ± 1.00 | 4.50 ± 0.50 | 30.00 ± 3.00 | 0.80 ± 0.10 | 0.80 ± 0.10 | mm |
| CF2 / CFQ2 | 0.591 ± 0.039 | 0.197 ± 0.020 | 1.339 ± 0.157 | 0.031 ± 0.004 | 0.031 ± 0.004 | inches |
| | 15.00 ± 1.00 | 5.00 ± 0.50 | 34.00 ± 4.00 | 0.80 ± 0.10 | 0.80 ± 0.10 | mm |

## Mechanical Specifications – CFM / CFQM

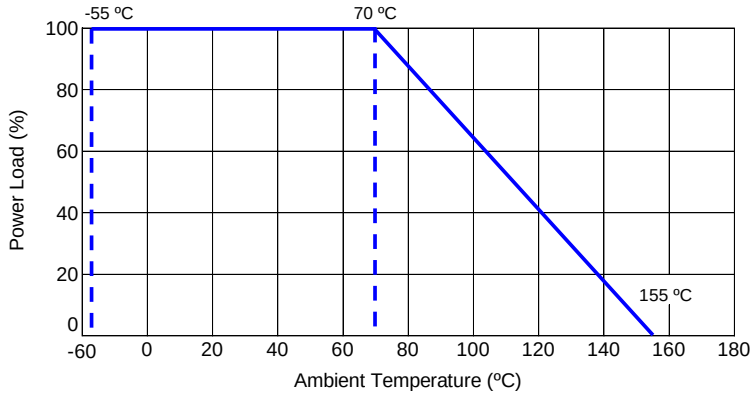
| Type / Code | A<br>Body Length | B<br>Body Diameter | C<br>Lead Length (Bulk) | D - Lead Diameter<br>CF / CFM | D - Lead Diameter<br>CFQ / CFQM | Unit |
|---|---|---|---|---|---|---|
| CFM14 / CFQM14 | 0.130 ± 0.012<br>3.30 ± 0.30 | 0.067 ± 0.012<br>1.70 ± 0.30 | 1.102 ± 0.118<br>28.00 ± 3.00 | 0.016 ± 0.003<br>0.40 ± 0.08 | 0.018 ± 0.003<br>0.45 ± 0.08 | inches<br>mm |
| CFM12 / CFQM12 | 0.236 ± 0.012<br>6.00 ± 0.30 | 0.091 ± 0.012<br>2.30 ± 0.30 | 1.102 ± 0.118<br>28.00 ± 3.00 | 0.022 ± 0.003<br>0.55 ± 0.08 | 0.022 ± 0.003<br>0.55 ± 0.08 | inches<br>mm |
| CFM1 / CFQM1 | 0.354 ± 0.020<br>9.00 ± 0.50 | 0.138 ± 0.020<br>3.50 ± 0.50 | 1.102 ± 0.118<br>28.00 ± 3.00 | 0.028 ± 0.002<br>0.70 ± 0.05 | 0.028 ± 0.002<br>0.70 ± 0.05 | inches<br>mm |

## Performance Characteristics

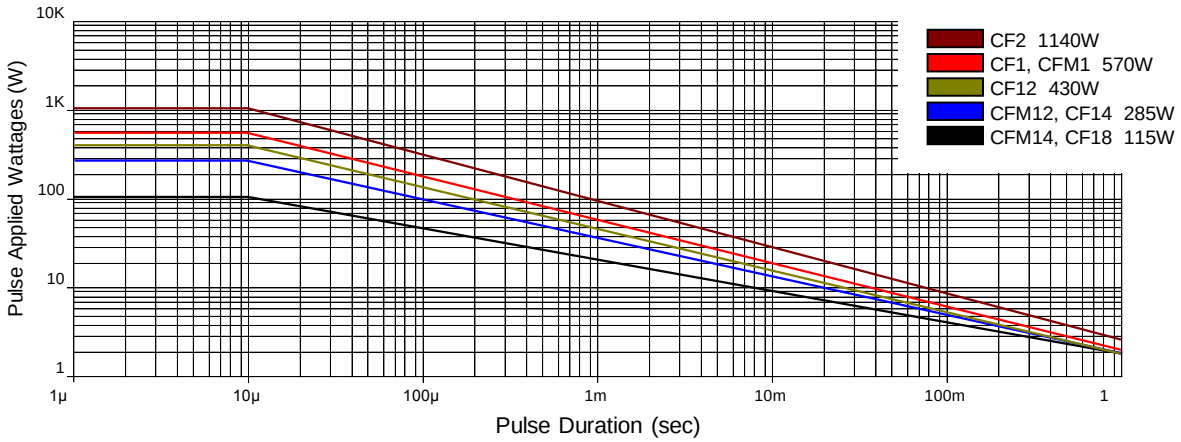
| Test | Test Method | Typical Result | | | Test Limit | | |
|---|---|---|---|---|---|---|---|
| Current Noise | MIL-STD 202, Method 308 | 1 Ω ~ 91K Ω | 100K Ω ~ 910K Ω | 1M Ω ~ 22M Ω | 1 Ω ~ 91K Ω | 100K Ω ~ 910K Ω | 1M Ω ~ 22M Ω |
| | | 0.15µ V/V | 0.32µ V/V | 0.54µ V/V | 0.2µ V/V | 0.4µ V/V | 0.6µ V/V |
| Short Time Overload | JIS C5201-1, IEC60115-1, 4.13 | < ± 0.25% | | | ≤ ± (0.75% + 0.05 Ω) | | |
| Resistance to Solder Heat | JIS C5201-1, IEC60115-1, 4.18 | < ± 0.3% | | | ≤ ± (0.50% + 0.05 Ω) | | |
| Rapid Change of Temperature | JIS C5201-1, IEC60115-1, 4.19 | < ± 0.3% | | | ≤ ± (1.00% + 0.05 Ω) | | |
| Endurance at 70 °C | JIS C5201-1, IEC60115-1, 4.25.1 | < ± 1% | | | R < 100K Ω: ≤ ± (2.0% + 0.05 Ω) | | |
| Terminal Strength | MIL-STD 202, Method 211 | < ± 0.2% | | | ≤ ± (0.50% + 0.05 Ω) | | |
| Damp Heat (Steady state) | JIS C5201-1, IEC60115-1, 4.24 | < ± 1.5% | | | R < 100K Ω: ≤ ± (3.0% + 0.05 Ω) | | |

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

### Power Derating Curve:




### Single Pulse Power:




Typical performance for reference only.

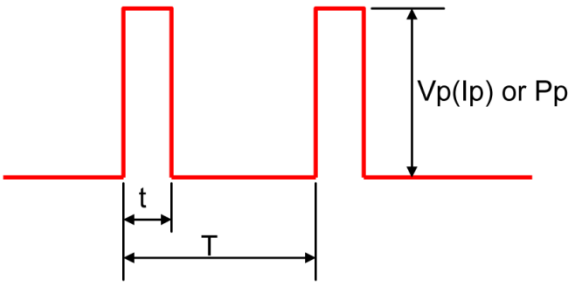
Repetitive Pulse Data:

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.

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

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

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

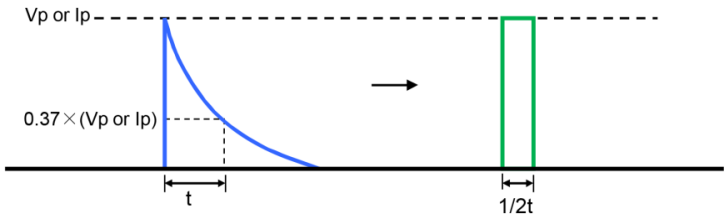



Where: Vp: Pulse limiting voltage (V)
Ip: Pulse limiting current (A)
Pp: Pulse limiting wattage (W)
P: Power rating (W)
R: Nominal resistance (ohm)
T: Repetitive period (sec.)
t: Pulse duration (sec.)
K: Coefficient: 0.8
[Vr: Rated Voltage (V), Ir: Rated Current (A)]

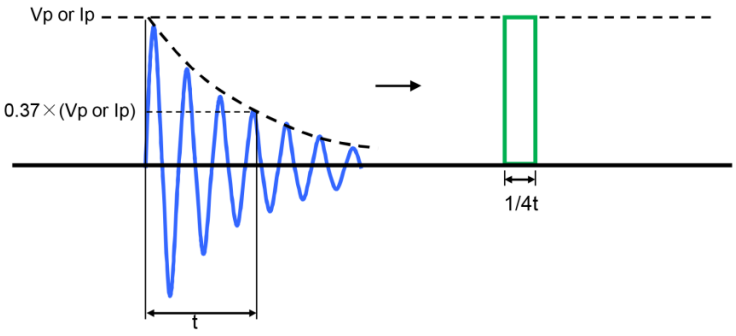
Note 1: If T > 10 → T = 10 (sec.), T / t > 1000 → T / t = 1000
Note 2: If T > 10 and T / t > 1000, “Pulse Limiting power (single pulse) is applied
Note 3: If Vp < Vr (Ip < Ir or Pp < P), Vr (Ir, P) is Vp (Ip, Pp)
Note 4: Pulse limiting voltage (Current, Wattage) is applied at less than rated ambient 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 the “Waveform Transformation to Square Wave”.

## Waveform Transformation to Square Wave

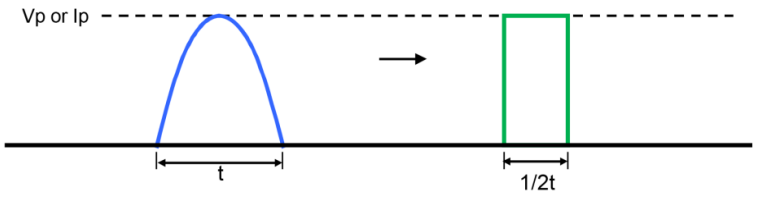
1. Discharge curve wave with time constant “t” → Square wave



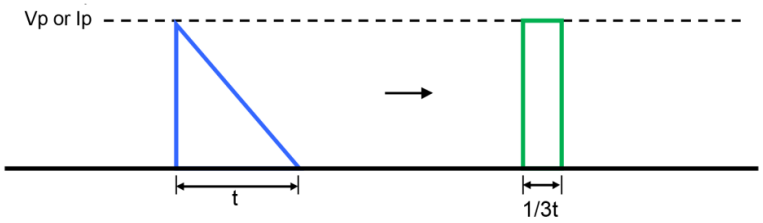
2. Damping oscillation wave with time constant of envelope “t” → Square wave



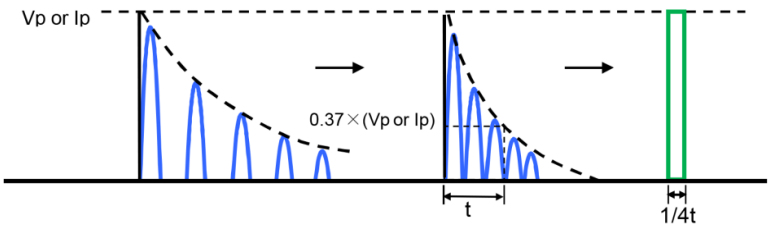

3. Half-wave rectification wave → Square wave



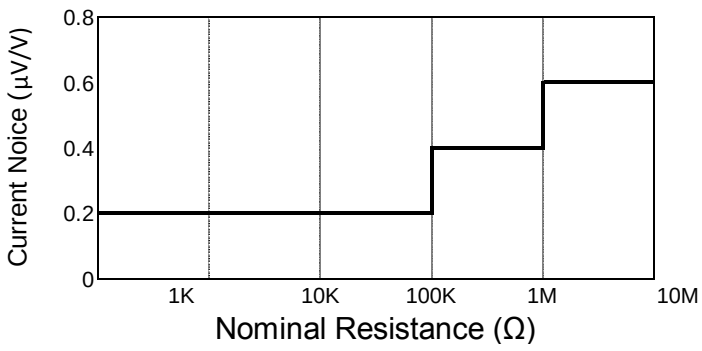

4. Triangular wave → Square wave



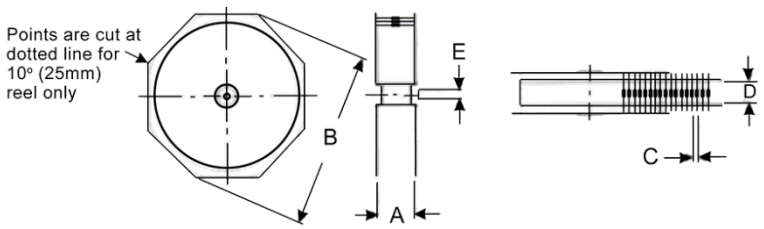

5. Special wave → Square wave




Current Noise:



## Packaging Specifications



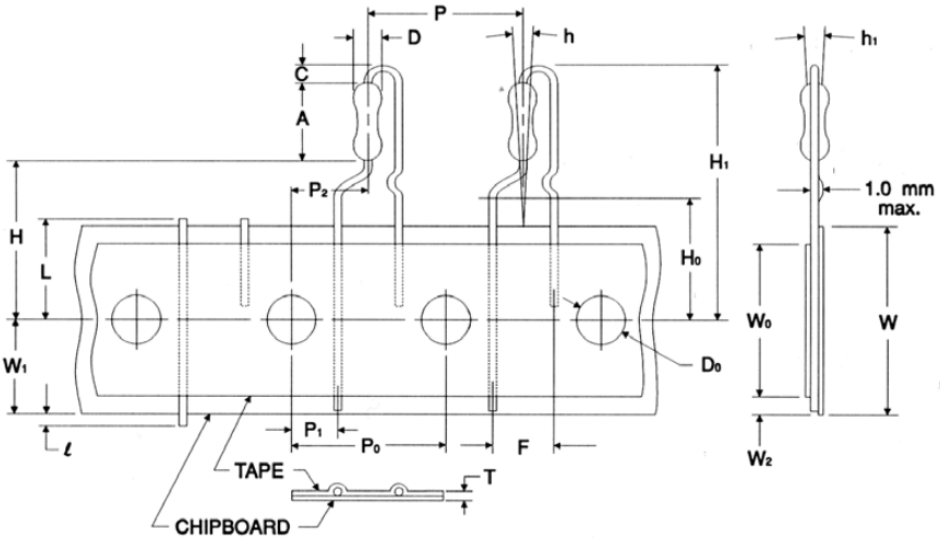

| Type / Code | Class | Tape | A Max (1). | B Max | C | D (2) | Unit |
|---|---|---|---|---|---|---|---|
| CF18 / CFQ18 | I | 0.250<br>6.35 | 2.508<br>63.70 | 13.504<br>343.00 | 0.197 ± 0.020<br>5.00 ± 0.50 | 2.063 ± 0.079<br>52.40 ± 2.00 | inches<br>mm |
| CF14 / CFQ14 | I | 0.250<br>6.35 | 2.638<br>67.00 | 13.504<br>343.00 | 0.197 ± 0.020<br>5.00 ± 0.50 | 2.063 ± 0.079<br>52.40 ± 2.00 | inches<br>mm |
| CF12 / CFQ12 | I | 0.250<br>6.35 | 2.736<br>69.50 | 13.504<br>343.00 | 0.197 ± 0.020<br>5.00 ± 0.50 | 2.063 ± 0.079<br>52.40 ± 2.00 | inches<br>mm |
| CF1 / CFQ1 | I | 0.250<br>6.35 | 2.972<br>75.50 | 13.504<br>343.00 | 0.197 ± 0.020<br>5.00 ± 0.50 | 2.063 ± 0.079<br>52.40 ± 2.00 | inches<br>mm |
| CF2 / CFQ2 | I | 0.250<br>6.35 | 3.130<br>79.50 | 13.504<br>343.00 | 0.394 ± 0.020<br>10.00 ± 0.50 | 2.063 ± 0.079<br>52.40 ± 2.00 | inches<br>mm |
| CFM14 / CFQM14 | I | 0.250<br>6.35 | 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 | inches<br>mm |
| CFM12 / CFQM12 | I | 0.250<br>6.35 | 2.638<br>67.00 | 13.504<br>343.00 | 0.197 ± 0.020<br>5.00 ± 0.50 | 2.063 ± 0.079<br>52.40 ± 2.00 | inches<br>mm |
| CFM1 / CFQM1 | I | 0.250<br>6.35 | 2.736<br>69.50 | 13.504<br>343.00 | 0.197 ± 0.020<br>5.00 ± 0.50 | 2.063 ± 0.079<br>52.40 ± 2.00 | 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. A 26 mm narrow spacing is available as option "N" packaging code.
Contact factory for more details.

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

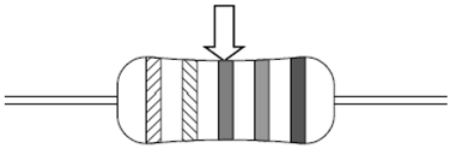


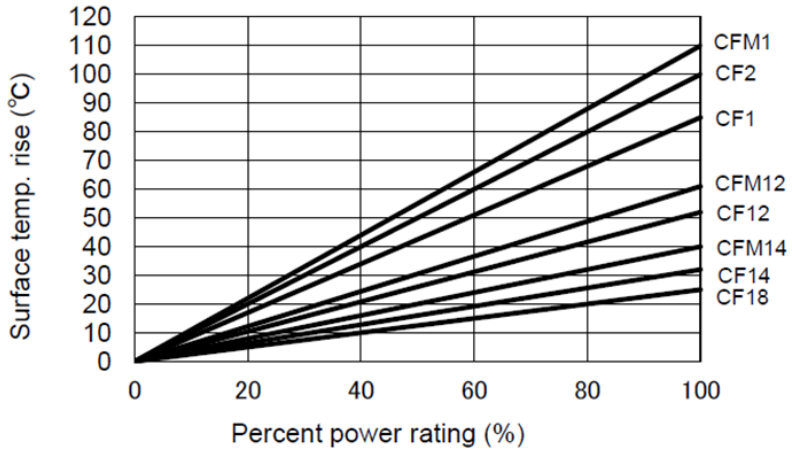
| Symbol | Description | PANA-SERT | Unit |
|---|---|---|---|
| A | Resistor body length | 0.256 ± 0.020<br>6.50 ± 0.50 | inches<br>mm |
| C | Height of bending | 0.098 ± 0.020<br>2.50 ± 0.50 | inches<br>mm |
| D | Resistor body diameter | 0.091 ± 0.008<br>2.30 ± 0.20 | inches<br>mm |
| $D_0$ | Sprocket-hole diameter | 0.157 ± 0.012<br>4.00 ± 0.30 | inches<br>mm |
| F | Resistor lead spacing | 0.197 ± 0.039<br>5.00 ± 1.00 | inches<br>mm |
| H | Height to bottom of resistor | 0.748 ± 0.039<br>19.00 ± 1.00 | inches<br>mm |
| $H_0$ | Height to lead clinch | 0.630 ± 0.020<br>16.00 ± 0.50 | inches<br>mm |
| $H_1$ | Height of resistor | 1.122 max.<br>28.50 max. | inches<br>mm |
| h | Resistor alignment | 0 ± 0.079 (0 ± 5º)<br>0 ± 2.00 (0 ± 5º) | inches<br>mm |
| $h_1$ | Resistor alignment | 0 ± 0.079 (0 ± 5º)<br>0 ± 2.00 (0 ± 5º) | inches<br>mm |
| I | Lead protrusion | 0.079 max.<br>2.00 max. | inches<br>mm |

| Symbol | Description | PANA-SERT | Unit |
|---|---|---|---|
| L | Cutout Length(1) | 0.433 max.<br>11.00 max. | inches<br>mm |
| P | Resitor pitch(1) | 0.500 ± 0.039<br>12.70 ± 1.00 | inches<br>mm |
| $P_0$ | Sprocket-hole pitch(1) | 0.500 ± 0.012<br>12.70 ± 0.30 | inches<br>mm |
| $P_1$ | Sprocket-hole center to lead center | 0.152 ± 0.028<br>3.85 ± 0.70 | inches<br>mm |
| $P_2$ | Sprocket-hole center to resistor center(1) | 0.250 ± 0.051<br>6.35 ± 1.30 | inches<br>mm |
| T | Thickness (chipboard and tape) | 0.028 ± 0.008<br>0.70 ± 0.20 | inches<br>mm |
| W | Chipboard width(1) | 0.709 + 0.039 / -0.020<br>18.00 + 1.00 / -0.50 | inches<br>mm |
| $W_0$ | Hold-down tape width | 0.49 min.<br>12.50 min. | inches<br>mm |
| $W_1$ | Sprocket-hole position | 0.354 + 0.030 / -0.020<br>9.00 + 0.75 / -0.50 | inches<br>mm |
| $W_2$ | Hold-down tape position | 0.118 max.<br>3.00 max. | inches<br>mm |

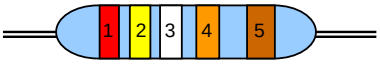
## Surface Temperature Rise

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 | - |

| | 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

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| **C** | **F** | **1** | **2** | **J** | **T** | **1** | **0** | **0** | **K** |

| Product Series | |
|---|---|
| Code | Description |
| CF | Standard |
| CFF | Flameproof |
| CFM | Mini |
| PCF | Panasert CF14 |
| PCFM | Panasert CF12 |
| CFQ | Tin plating on copper wire |
| CFQM | Tin plating (mini) |
| PCFQ | Tin plating on copper wire Panasert |

| Power Rating | |
|---|---|
| Code | W |
| 18 | 0.125 |
| 14 | 0.25 |
| 12 | 0.5 |
| 1 | 1 |
| 2 | 2 |

| Tolerance | |
|---|---|
| Code | Tol |
| G | 2% |
| J | 5% |

| Packaging | | | |
|---|---|---|---|
| Code | Description | Product Code | Quantity |
| T | Tape and Reel | CF18, CFQ18, CFM14, CFQM14, CF14, CFQ14, CFM12, CFQM12, CF12, CFQ12, PCF14, PCFM12 | 5000 |
| | | CFM1/CFQM1 | 2500 |
| | | CF1/CFQ1 | 2000 |
| | | CF2/CFQ2 | 1000 |
| A | Ammo | CF18, CFQ18, CFM14, CFQM14, CF14, CFQ14, CFM12, CFQM12 | 5000 |
| | | CF12, CFQ12, CFM1, CFQM1, PCF14, PCFM12, CF1, CFQ1 | 2000 |
| | | CF2 | 1000 |
| B(*) | Bulk | All Sizes | 1000 |

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

| Resistance Value |
|---|
| Four characters with the multiplier used as the decimal holder. |
| 10 ohm = 10R0 |
| 10.2 Kohm = 10K2 |
| 1 Mohm = 1M00 |