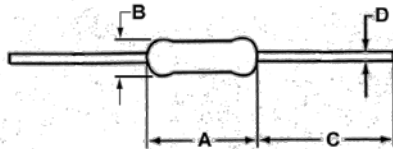


- Features:**
- General purpose resistor ideal for commercial/industrial applications
  - Flame retardant coatings standard
  - Flameproof version available as CFF
  - Panasert available on selected sizes; contact factory
  - Auto sequencing/insertion compatible
  - CFM (mini) ideal choice when size 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



| Electrical Specifications |                             |                             |                          |                                 |  |                               |         |
|---------------------------|-----------------------------|-----------------------------|--------------------------|---------------------------------|--|-------------------------------|---------|
| Type / Code               | Power Rating (Watts) @ 70°C | Maximum Working Voltage (1) | Maximum Overload Voltage | Dielectric Withstanding Voltage | Resistance Temperature Coefficient per Ohmic Range   | Ohmic Range (Ω) and Tolerance |         |
|                           |                             |                             |                          |                                 |  | 2%                            | 5%      |
| CF18                      | 0.125W                      | 250V                        | 500V                     | 350V                            | <div>&lt;10Ω = ±400ppm/°C</div> <div>10Ω to 9.99KΩ = 0 ~ -400ppm/°C</div> <div>10KΩ to 99KΩ = 0 ~ -500ppm/°C</div> <div>100KΩ to 999KΩ = 0 ~ -850ppm/°C</div> <div>1MΩ and above = 0 ~ -1500ppm/°C</div> | 10 - 1M                       | 1 - 22M |
| CF14                      | 0.25W                       | 350V                        | 600V                     | 350V                            |  | 1 - 1M                        |         |
| CF12                      | 0.5W                        | 350V                        | 700V                     | 600V                            |  | 10 - 1M                       |         |
| CF1                       | 1W                          | 500V                        | 1,000V                   | 600V                            |  | 1 - 1M                        | 1 - 10M |
| CF2                       | 2W                          | 500V                        | 1,000V                   | 600V                            |  |                               |         |
| CFM14                     | 0.25W                       | 250V                        | 500V                     | 350V                            |  |                               |         |
| CFM12                     | 0.5W                        | 350V                        | 600V                     | 350V                            |  |                               |         |
| CFM1                      | 1W                          | 600V                        | 1,000V                   | 600V                            |  |                               |         |

(1) Lesser of  $\sqrt{\text{PR}}$  or maximum working voltage.

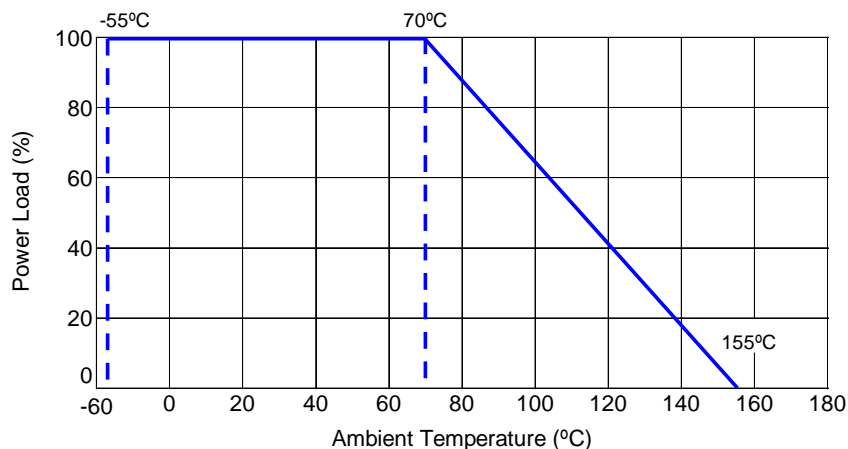


| Mechanical Specifications |                  |                    |                        |                    |        |
|---------------------------|------------------|--------------------|------------------------|--------------------|--------|
| Type / Code               | A<br>Body Length | B<br>Body Diameter | C<br>Lead Length(Bulk) | D<br>Lead Diameter | Unit   |
| CF18                      | 0.130 ± 0.012    | 0.067 ± 0.012      | 1.102 ± 0.118          | 0.018 ± 0.003      | inches |
|                           | 3.30 ± 0.30      | 1.70 ± 0.30        | 28.00 ± 3.00           | 0.45 ± 0.08        | mm     |
| CF14                      | 0.236 ± 0.012    | 0.091 ± 0.012      | 1.102 ± 0.118          | 0.022 ± 0.003      | inches |
|                           | 6.00 ± 0.30      | 2.30 ± 0.30        | 28.00 ± 3.00           | 0.55 ± 0.08        | mm     |
| CF12                      | 0.335 ± 0.039    | 0.106 ± 0.020      | 1.102 ± 0.118          | 0.028 ± 0.002      | inches |
|                           | 8.50 ± 1.00      | 2.70 ± 0.50        | 28.00 ± 3.00           | 0.70 ± 0.05        | mm     |
| CF1                       | 0.433 ± 0.039    | 0.177 ± 0.020      | 1.181 ± 0.118          | 0.028 ± 0.002      | inches |
|                           | 11.00 ± 1.00     | 4.50 ± 0.50        | 30.00 ± 3.00           | 0.70 ± 0.05        | mm     |
| CF2                       | 0.591 ± 0.039    | 0.197 ± 0.020      | 1.339 ± 0.157          | 0.028 ± 0.002      | inches |
|                           | 15.00 ± 1.00     | 5.00 ± 0.50        | 34.00 ± 4.00           | 0.70 ± 0.05        | mm     |
| CFM14                     | 0.130 ± 0.012    | 0.067 ± 0.012      | 1.102 ± 0.118          | 0.018 ± 0.003      | inches |
|                           | 3.30 ± 0.30      | 1.70 ± 0.30        | 28.00 ± 3.00           | 0.45 ± 0.08        | mm     |
| CFM12                     | 0.236 ± 0.012    | 0.091 ± 0.012      | 1.102 ± 0.118          | 0.022 ± 0.003      | inches |
|                           | 6.00 ± 0.30      | 2.30 ± 0.30        | 28.00 ± 3.00           | 0.55 ± 0.08        | mm     |
| CFM1                      | 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     |

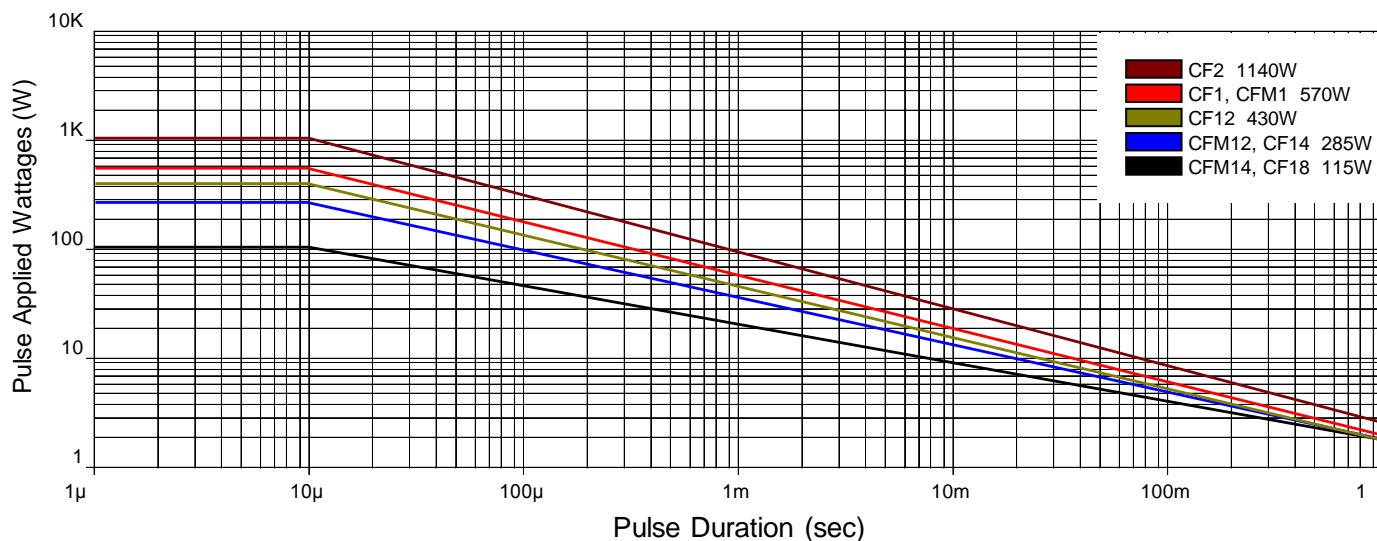
| Performance Characteristics |                                 |                           |                               |                            |   |                               |                            |
|-----------------------------|---------------------------------|---------------------------|-------------------------------|----------------------------|---|-------------------------------|----------------------------|
| Test                        | Standard / Method               | Typical Results           |                               |                            | Test Limits   |                               |                            |
| Current Noise               | MIL-STD 202, Method 308         | 1 $\Omega$ ~ 91K $\Omega$ | 100K $\Omega$ ~ 910K $\Omega$ | 1M $\Omega$ ~ 22M $\Omega$ | 1 $\Omega$ ~ 91K $\Omega$                                   | 100K $\Omega$ ~ 910K $\Omega$ | 1M $\Omega$ ~ 22M $\Omega$ |
|                             |                                 | 0.15 $\mu$ V/V            | 0.32 $\mu$ V/V                | 0.54 $\mu$ V/V             | 0.2 $\mu$ V/V   | 0.4 $\mu$ V/V                 | 0.6 $\mu$ V/V              |
| Short Time Overload         | JIS C5201-1, IEC60115-1, 4.13   | < $\pm$ 0.25%             |                               |                            | $\leq \pm$ (0.75% + 0.05 $\Omega$ )                         |                               |                            |
| Resistance to Solder Heat   | JIS C5201-1, IEC60115-1, 4.18   | < $\pm$ 0.3%              |                               |                            | $\leq \pm$ (0.50% + 0.05 $\Omega$ )                         |                               |                            |
| Rapid Change of Temperature | JIS C5201-1, IEC60115-1, 4.19   | < $\pm$ 0.3%              |                               |                            | $\leq \pm$ (1.00% + 0.05 $\Omega$ )                         |                               |                            |
| Endurance at 70°C           | JIS C5201-1, IEC60115-1, 4.25.1 | < $\pm$ 1.0%              |                               |                            | R<100K $\Omega$ : $\leq \pm$ (2.0% + 0.05 $\Omega$ )        |                               |                            |
|                             |                                 |                           |                               |                            | R $\geq$ 100K $\Omega$ : $\leq \pm$ (3.0% + 0.05 $\Omega$ ) |                               |                            |
| Terminal Strength           | MIL-STD 202, Method 211         | < $\pm$ 0.20%             |                               |                            | $\leq \pm$ (0.50% + 0.05 $\Omega$ )                         |                               |                            |
| Damp Heat (Steady state)    | JIS C5201-1, IEC60115-1, 4.24   | < $\pm$ 1.5%              |                               |                            | R<100K $\Omega$ : $\leq \pm$ (3.0% + 0.05 $\Omega$ )        |                               |                            |
|                             |                                 |                           |                               |                            | R $\geq$ 100K $\Omega$ : $\leq \pm$ (5.0% + 0.05 $\Omega$ ) |                               |                            |

Operating Temperature Range: -55°C to +155°C

### Power Derating Curve:



### Single Pulse Power:



Typical performance for reference only.

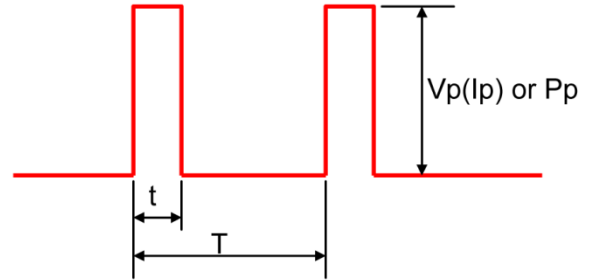
**Repetitive Pulse Data:**

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.

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

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

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



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 by resistors type (refer to below matrix)
- [Vr: Rated Voltage (V), Ir: 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”

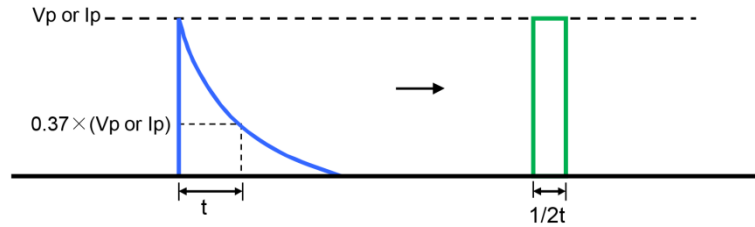
Note 5: Please assure sufficient margin for use period and conditions for “Pulse limiting voltage”

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

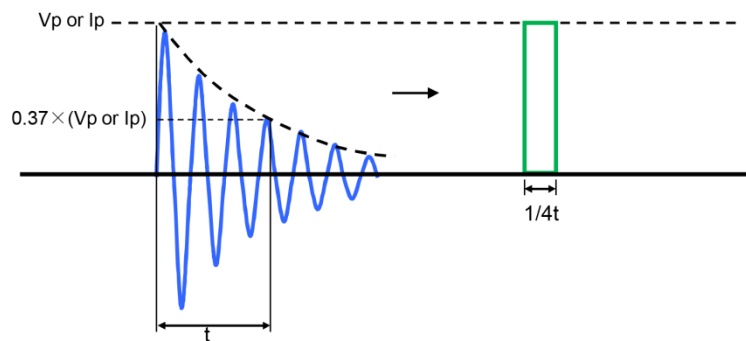
| Coefficient (K) Matrix |     |
|------------------------|-----|
| Resistor Type          | K   |
| RNF, RNMF              | 0.7 |
| CF, CFM, HDM           | 0.8 |
| ASR, SPR, ASRM, SPRM   | 1.0 |
| RSPF, RSPL             | 0.9 |
| RSF, RSMF              | 0.8 |
| FRN                    | 0.6 |

## Waveform Transformation to Square Wave

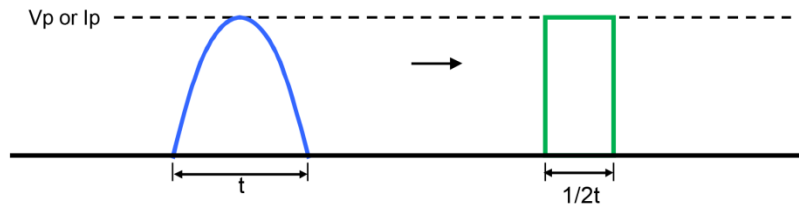
1. Discharge curve wave with time constant " $t$ " → Square wave



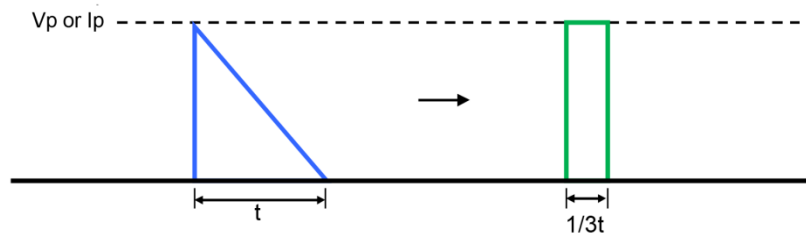
2. Damping oscillation wave with time constant of envelope " $t$ " → Square wave



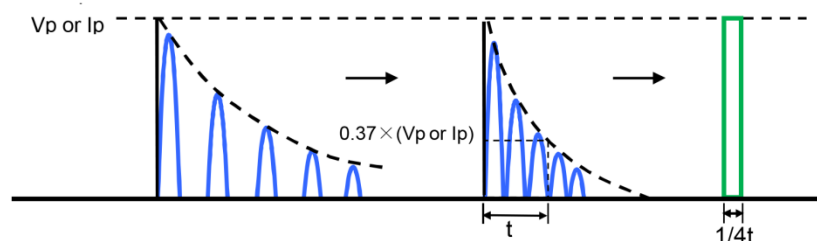
3. Half-wave rectification wave → Square wave



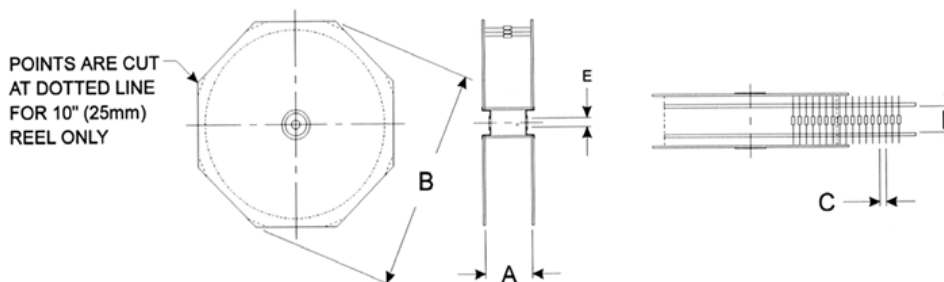
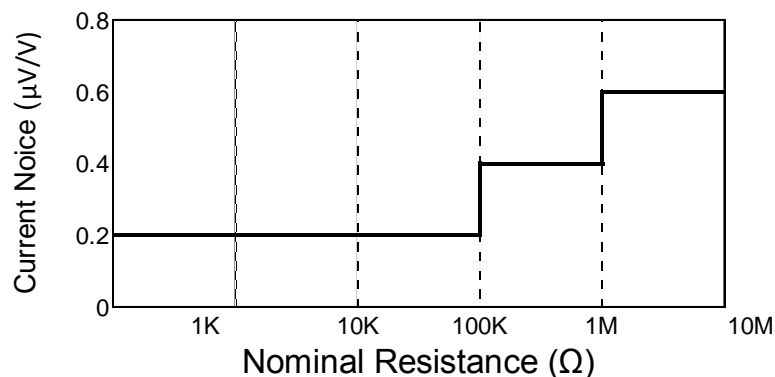
4. Triangular wave → Square wave



5. Special wave → Square wave



Current Noise:



**Lead-Tape Specifications: Reeled in accordance with EIA-296-F**

| Type / Code | Qty per Reel | A max.(1) |       | B max  |        | C             |              | D(2)                   |                      | Tape   |      | Class |
|-------------|--------------|-----------|-------|--------|--------|---------------|--------------|------------------------|----------------------|--------|------|-------|
|             |              | inches    | mm    | inches | mm     | inches        | mm           | inches                 | mm                   | inches | mm   |       |
| CF18, CFM14 | 5,000        | 2.508     | 63.70 | 13.504 | 343.00 | 0.197 ± 0.020 | 5.00 ± 0.50  | 2.063 + 0.079 / -0.039 | 52.40 + 2.00 / -1.00 | 0.250  | 6.35 | I     |
| CF14, CFM12 | 5,000        | 2.638     | 67.00 | 13.504 | 343.00 | 0.197 ± 0.020 | 5.00 ± 0.50  | 2.063 + 0.079 / -0.039 | 52.40 + 2.00 / -1.00 | 0.250  | 6.35 | I     |
| CF12, CFM1  | 5,000        | 2.736     | 69.50 | 13.504 | 343.00 | 0.197 ± 0.020 | 5.00 ± 0.50  | 2.063 + 0.079 / -0.039 | 52.40 + 2.00 / -1.00 | 0.250  | 6.35 | I     |
| CF1         | 2,000        | 2.972     | 75.50 | 13.504 | 343.00 | 0.197 ± 0.020 | 5.00 ± 0.50  | 2.063 + 0.079 / -0.039 | 52.40 + 2.00 / -1.00 | 0.250  | 6.35 | I     |
| CF2         | 1,000        | 3.130     | 79.50 | 13.504 | 343.00 | 0.394 ± 0.020 | 10.00 ± 0.50 | 2.063 + 0.079 / -0.039 | 52.40 + 2.00 / -1.00 | 0.250  | 6.35 | I     |

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)

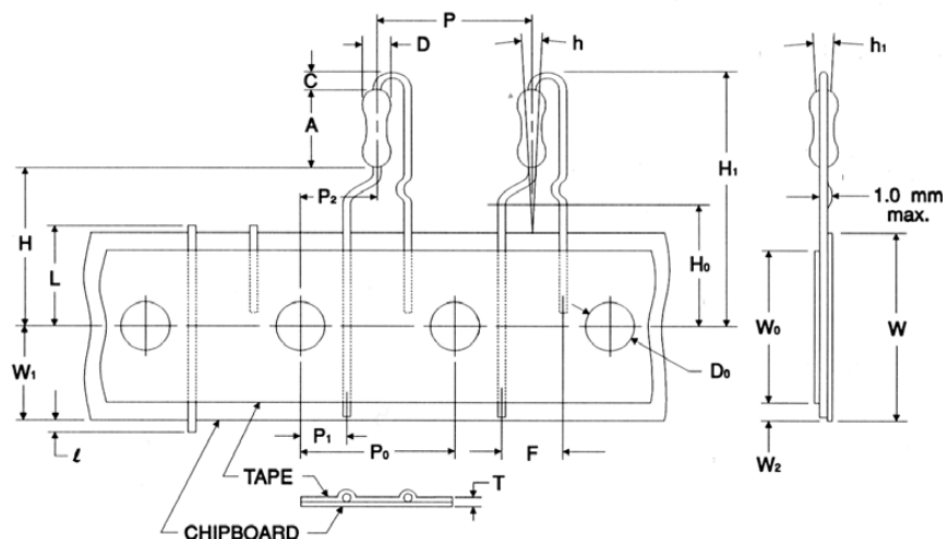
(1) Reference value only. The "A" dimension shall be governed by the overall length of the taped component.

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 26mm narrow spacing is available as option "N" packaging code.

Contact factory for more details.

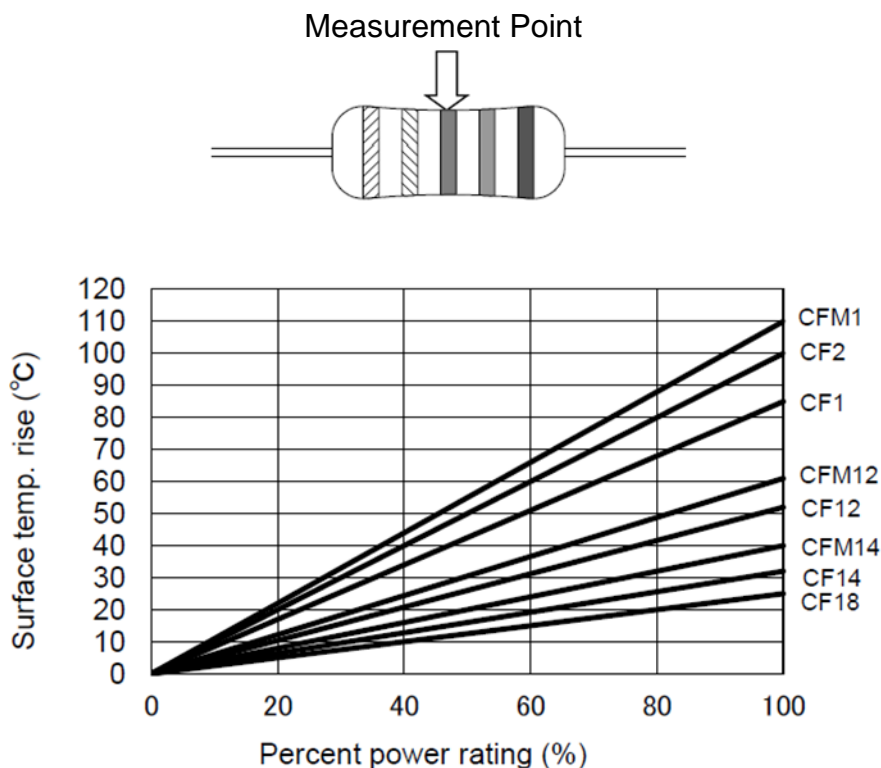
## Radial Lead Taping Specification – Pana-Sert (PCF14)



| 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 <sub>0</sub> | 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 <sub>0</sub> | Height to lead clinch        | 0.630 ± 0.020<br>16.00 ± 0.50       | inches<br>mm |
| H <sub>1</sub> | Height of resistor           | 1.122 max.<br>28.50 max.            | inches<br>mm |
| h              | Resistor alignment           | 0 ± 0.079 (0±5°)<br>0 ± 2.00 (0±5°) | inches<br>mm |
| h <sub>1</sub> | Resistor alignment           | 0 ± 0.079 (0±5°)<br>0 ± 2.00 (0±5°) | inches<br>mm |
| l              | 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              | Resistor pitch(1)                          | 0.500 ± 0.039<br>12.70 ± 1.00                  | inches<br>mm |
| P <sub>0</sub> | Sprocket-hole pitch(1)                     | 0.500 ± 0.012<br>12.70 ± 0.30                  | inches<br>mm |
| P <sub>1</sub> | Sprocket-hole center to lead center        | 0.152 ± 0.028<br>3.85 ± 0.70                   | inches<br>mm |
| P <sub>2</sub> | 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 <sub>0</sub> | Hold-down tape width                       | 0.49 min.<br>12.50 min.                        | inches<br>mm |
| W <sub>1</sub> | Sprocket-hole position                     | 0.354 + 0.030 / -0.020<br>9.00 + 0.75 / -0.50  | inches<br>mm |
| W <sub>2</sub> | Hold-down tape position                    | 0.118 max.<br>3.00 max.                        | inches<br>mm |

Surface Temperature Rise:



## 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 | Size                                | Power Rating | Tolerance | Code | Description | Size  | Quantity | Resistance Value  |
|----------------|-------------------------------------|--------------|-----------|------|-------------|---|----------|---|
| CF             | Standard                            | 18           | 0.125W    | Code | Tol         | CF18, CFM14, CF14, CFM12, CF12, PCF14, PCFM12 | 5,000    | Four characters with the multiplier used as the decimal holder. |
| CFF            | Flameproof                          | 14           | 0.25W     | G    | 2%          | CFM1  | 2,500    |   |
| CFM            | Mini                                | 12           | 0.5W      | J    | 5%          | CF1   | 2,000    |   |
| PCF            | Panasert CF14                       | 1            | 1W        |      |             | CF2   | 1,000    | 10 ohm = 10R0   |
| PCFM           | Panasert CF12                       | 2            | 2W        |      |             |   |          | 10.2 Kohm = 10K2  |
| CFQ            | Tin plating on copper wire          |              |           |      |             |   |          | 1 Mohm = 1M00   |
| CFQM           | Tin plating (mini)                  |              |           |      |             |   |          |   |
| PCFQ           | Tin plating on copper wire Panasert |              |           |      |             |   |          |   |

| Code | Description   | Size  | Quantity |
|------|---------------|---|----------|
| T    | Tape and Reel | CF18, CFM14, CF14, CFM12, CF12, PCF14, PCFM12 | 5,000    |
| A    | Ammo          | CF18, CFM14, CF14, CFM12                      | 5,000    |
| B    | Bulk          | CF18, CFM14, CF14, CFM12                      | 1,000    |