

# Metal Film Resistors, Industrial, Precision



## FEATURES

- Small size - conformal coated
- Flame retardant epoxy coating
- Controlled temperature coefficient
- Excellent high frequency characteristics
- Exceptionally low noise; typically 0.10  $\mu\text{V/V}$
- Low voltage coefficient to  $\pm 5 \text{ ppm/V}$
- Special tolerance and or TC matching available on request
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



RoHS\* COMPLIANT

### Note

\* Lead (Pb)-containing terminations are not RoHS-compliant. Exemptions may apply.

Vishay Dale Model CMF is also available as Military Qualified Styles RN and RL. See appropriate catalog or web page for the MIL-SPEC ratings/attributes. (Except for marking, the Industrial and Military versions are exactly the same. Depending upon stock, military marked parts may be supplied as industrial rated parts).

| STANDARD ELECTRICAL SPECIFICATIONS |                  |   |                            |                            |                            |                             |                             |                             |                             |                             |                             |
|------------------------------------|------------------|---|----------------------------|----------------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| GLOBAL MODEL                       | HISTORICAL MODEL | MAXIMUM WORKING VOLTAGE <sup>(1)</sup><br>V | RESISTANCE RANGE $\Omega$  |                            |                            |                             |                             |                             |                             |                             |                             |
|                                    |                  |   | 0.1 % to 1 %               | 0.1 % to 0.5 %             | 1 % to 5 %                 | 1 %                         | 2 %, 5 %                    | 1 %                         | 2 %, 5 %                    | 1 %                         | 2 %, 5 %                    |
|                                    |                  |   | 25 ppm/ $^{\circ}\text{C}$ | 50 ppm/ $^{\circ}\text{C}$ | 50 ppm/ $^{\circ}\text{C}$ | 100 ppm/ $^{\circ}\text{C}$ | 100 ppm/ $^{\circ}\text{C}$ | 150 ppm/ $^{\circ}\text{C}$ | 150 ppm/ $^{\circ}\text{C}$ | 200 ppm/ $^{\circ}\text{C}$ | 200 ppm/ $^{\circ}\text{C}$ |
| CMF50                              | CMF-50           | 200   | 10 to 2.5M                 | 10 to 2.5M                 | 10 to 2.5M                 | 10 to 2.5M                  | 10 to 2.5M                  | 10 to 22M                   | 10 to 22M                   | 10 to 22M                   | 10 to 22M                   |
| CMF55                              | CMF-55           | 250   | 10 to 2.5M                 | 10 to 2.5M                 | 10 to 5M                   | 1 to 22.1M                  | 1 to 22.1M                  | 0.5 to 50M                  | 0.5 to 50M                  | 0.5 to 50M                  | 0.1 to 50M                  |
| CMF60                              | CMF-60           | 500   | 10 to 2.5M                 | 10 to 2.5M                 | 10 to 10M                  | 1 to 10M                    | 1 to 10M                    | 0.5 to 10M                  | 0.5 to 10M                  | 0.5 to 10M                  | 0.1 to 10M                  |
| CMF65                              | CMF-65           | 500   | 10 to 2.5M                 | 10 to 2.5M                 | 10 to 10M                  | 1 to 15M                    | 1 to 15M                    | 0.5 to 22M                  | 0.5 to 22M                  | 0.5 to 22M                  | 0.1 to 22M                  |
| CMF70                              | CMF-70           | 500   | 10 to 2.5M                 | 10 to 2.5M                 | 10 to 10M                  | 1 to 15M                    | 1 to 15M                    | 1 to 22M                    | 1 to 22M                    | 1 to 22M                    | 1 to 22M                    |
| CMF07                              | CMF-07           | 250   | -                          | -                          | -                          | -                           | 5 to 5M                     | -                           | 1 to 5M                     | -                           | 1 to 5M                     |
| CMF20                              | CMF-20           | 500   | -                          | -                          | -                          | -                           | 5 to 10M                    | -                           | 1 to 10M                    | -                           | 1 to 10M                    |

### Note

<sup>(1)</sup> Continuous working voltage shall be  $\sqrt{P \times R}$  or maximum working voltage, whichever is less

| MAXIMUM COMMERCIAL POWER RATING |         |        |       |        |        |       |       |
|---------------------------------|---------|--------|-------|--------|--------|-------|-------|
| WATTAGE <sup>(2)</sup>          | MODEL   |        |       |        |        |       |       |
|                                 | CMF50   | CMF55  | CMF60 | CMF65  | CMF70  | CMF07 | CMF20 |
| At + 70 $^{\circ}\text{C}$      | 0.25 W  | 0.5 W  | 1 W   | 1 W    | 1 W    | 0.5 W | 1 W   |
| At + 125 $^{\circ}\text{C}$     | 0.125 W | 0.25 W | 0.5 W | 0.75 W | 0.75 W | -     | -     |

### Note

<sup>(2)</sup> See the load life shift due to power and derating table for a summary of the more common combinations of power rating, case size and ambient operating temperature that prevail in various industrial and military resistor specifications. The "performance" table quantifies the load life stability under these combinations.

| GLOBAL PART NUMBER INFORMATION  |   |   |   |  |  |   |   |   |   |   |   |   |   |   |  |  |  |
|---|---|---|---|--|--|---|---|---|---|---|---|---|---|---|--|--|--|
| New Global Part Numbering: CMF55301R00FKRE                                    |   |   |   |  |  |   |   |   |   |   |   |   |   |   |  |  |  |
| C   | M   | F   | 5   | 5  | 3  | 0 | 1 | R | 0 | 0 | F | K | R | E |  |  |  |
| GLOBAL MODEL  | RESISTANCE VALUE  | TOLERANCE CODE  | TEMPERATURE COEFFICIENT <sup>(3)</sup>                                | PACKAGING  | SPECIAL  |   |   |   |   |   |   |   |   |   |  |  |  |
| (See Standard Electrical Specifications table)                                | R = $\Omega$<br>K = k $\Omega$<br>M = M $\Omega$<br>R10000 = 0.1 $\Omega$<br>680K00 = 680 k $\Omega$<br>1M0000 = 1.0 M $\Omega$ | B = $\pm 0.1 \%$<br>C = $\pm 0.25 \%$<br>D = $\pm 0.5 \%$<br>F = $\pm 1 \%$<br>G = $\pm 2 \%$<br>J = $\pm 5 \%$ | E = 25 ppm<br>H = 50 ppm<br>K = 100 ppm<br>L = 150 ppm<br>N = 200 ppm | EK = Lead (Pb)-free, bulk<br>EA = Lead (Pb)-free, T/R (full)<br>EB = Lead (Pb)-free, T/R (1000 pieces)<br>BF = Tin/lead, bulk<br>RE = Tin/lead, T/R (full)<br>R6 = Tin/lead, T/R (1000 pieces) | Blank = Standard (Dash Number) (Up to 3 digits) From 1 to 999 as applicable<br>70 = Color banded, 5 bands ( $\leq 1 \%$ )<br>80 = Color banded, 4 bands ( $\geq 2 \%$ )<br>88 = Hot solder dip |   |   |   |   |   |   |   |   |   |  |  |  |
| Historical Part Number example: CMF-553010FT-1 (will continue to be accepted) |   |   |   |  |  |   |   |   |   |   |   |   |   |   |  |  |  |
| CMF-55  | 3010  | F   | T-1   | R36  |  |   |   |   |   |   |   |   |   |   |  |  |  |
| HISTORICAL MODEL  | RESISTANCE VALUE  | TOLERANCE CODE  | TEMP. COEFFICIENT   | PACKAGING  |  |   |   |   |   |   |   |   |   |   |  |  |  |

### Notes

- <sup>(3)</sup> Tolerances of  $\pm 0.5 \%$  (D),  $\pm 0.25 \%$  (C) and  $\pm 0.1 \%$  (B) are available only in 50 ppm and 25 ppm temperature coefficients.  
 • For additional information on packaging, refer to the Through-Hole Resistor Packaging document ([www.vishay.com/doc?31544](http://www.vishay.com/doc?31544)).

**DIMENSIONS** in inches (millimeters)


| GLOBAL MODEL | A   | B                              | C (Max.)                    | D   |
|--------------|---|--------------------------------|-----------------------------|---|
| CMF50        | 0.150 ± 0.020<br>(3.81 ± 0.51)                | 0.065 ± 0.015<br>(1.65 ± 0.38) | 0.187 (4.75)                | 0.016 ± 0.002<br>(0.41 ± 0.05)                |
| CMF55        | 0.240 ± 0.020 <sup>(4)</sup><br>(6.10 ± 0.51) | 0.090 ± 0.008<br>(2.29 ± 0.20) | 0.278 (7.06) <sup>(3)</sup> | 0.025 ± 0.002<br>(0.64 ± 0.05)                |
| CMF60        | 0.344 ± 0.031<br>(8.74 ± 0.79)                | 0.145 ± 0.015<br>(3.68 ± 0.38) | 0.425 (10.80)               | 0.025 ± 0.002 <sup>(2)</sup><br>(0.64 ± 0.05) |
| CMF65        | 0.562 ± 0.031<br>(14.27 ± 0.79)               | 0.180 ± 0.015<br>(4.57 ± 0.38) | 0.687 (17.45)               | 0.025 ± 0.002<br>(0.64 ± 0.05)                |
| CMF70        | 0.562 ± 0.031<br>(14.27 ± 0.79)               | 0.180 ± 0.015<br>(4.57 ± 0.38) | 0.687 (17.45)               | 0.032 ± 0.002<br>(0.81 ± 0.05)                |
| CMF07        | 0.240 ± 0.020<br>(6.10 ± 0.51)                | 0.090 ± 0.008<br>(2.29 ± 0.20) | 0.278 (7.06)                | 0.025 ± 0.002<br>(0.64 ± 0.05)                |
| CMF20        | 0.375 ± 0.040<br>(9.53 ± 1.02)                | 0.145 ± 0.015<br>(3.68 ± 0.38) | 0.425 (10.80)               | 0.032 ± 0.002<br>(0.81 ± 0.05)                |

**Notes**

- <sup>(1)</sup> Lead length for product in bulk pack. For product supplied in tape and reel, the actual lead length would be based on the body size, tape spacing and lead trim.
- <sup>(2)</sup> Available with 0.032" (0.813 mm) lead [CMF60..95]
- <sup>(3)</sup> 0.290" (7.37 mm) for ± 0.25 % and ± 0.1 % resistance tolerances and values > 1 MΩ
- <sup>(4)</sup> 0.260" ± 0.020" (6.60 mm ± 0.51 mm) for values > 5 MΩ

| TECHNICAL SPECIFICATIONS      |                  |   |       |       |       |       |       |       |
|-------------------------------|------------------|---|-------|-------|-------|-------|-------|-------|
| PARAMETER                     | UNIT             | CMF50   | CMF55 | CMF07 | CMF60 | CMF20 | CMF65 | CMF70 |
| Maximum Working Voltage       | V <sub>≡</sub>   | ≤ 200   | ≤ 250 | ≤ 250 | ≤ 500 | ≤ 500 | ≤ 500 | ≤ 500 |
| Insulation Voltage (1 Min)    | V <sub>eff</sub> | > 500   |       |       |       |       |       |       |
| Voltage Coefficient (Max.)    | ppm/V            | ± 5 (measured between 10 % and full rated voltage)  |       |       |       |       |       |       |
| Dielectric Strength           | V <sub>AC</sub>  | 450   | 450   | 450   | 750   | 750   | 900   | 900   |
| Insulation Resistance         | Ω                | ≥ 10 <sup>11</sup>  |       |       |       |       |       |       |
| Operating Temperature Range   | °C               | - 55 to + 175   |       |       |       |       |       |       |
| Terminal Strength (Pull Test) | lb               | 2   | 2     | 5     | 2     | 5     | 2     | 5     |
| Noise                         | dB               | 0.10 μV/V over a decade of frequency, with low and intermediate resistance values typically below 0.05 μV/V |       |       |       |       |       |       |
| Weight (Max.)                 | g                | 0.12  | 0.20  | 0.20  | 0.50  | 0.60  | 1.00  | 1.10  |

| TEMPERATURE COEFFICIENT CODES |                    |                         |
|-------------------------------|--------------------|-------------------------|
| GLOBAL TC CODE                | HISTORICAL TC CODE | TEMPERATURE COEFFICIENT |
| E                             | T-9                | 25 ppm/°C               |
| H                             | T-2                | 50 ppm/°C               |
| K                             | T-1                | 100 ppm/°C              |
| L                             | T-0                | 150 ppm/°C              |
| N                             | T-00               | 200 ppm/°C              |



**LOAD LIFE SHIFT DUE TO POWER AND DERATING (AT 70 °C AND AT + 125 °C)**

The power rating for the CMF parts is tied to the derating temperature, the heat rise of the parts, and the  $\Delta R$  for the load life performance. When the tables/graphs below are used together they show that when the parts are run at their higher power ratings, the parts will run hotter, which has the potential of causing the resistance of the parts to shift more over the life of the part.

| LOAD LIFE SHIFT VS. POWER RATING |  |             |               |                          |             |             |
|----------------------------------|--|-------------|---------------|--------------------------|-------------|-------------|
| LOAD LIFE                        | MAXIMUM $\Delta R$ (TYPICAL TEST LOTS) |             |               |                          |             |             |
|                                  | $\pm 0.15\%$                           | $\pm 0.5\%$ | $\pm 1.0\%$   | $\pm 0.15\%$             | $\pm 0.5\%$ | $\pm 1.0\%$ |
| MODEL                            | POWER RATING AT + 70 °C                |             |               | POWER RATING AT + 125 °C |             |             |
| CMF50                            | 1/20 W and 1/10 W                      | 1/8 W       | 1/4 W         | 1/20 W                   | 1/10 W      | 1/8 W       |
| CMF55, CMF07                     | 1/10 W and 1/8 W                       | 1/4 W       | 1/2 W         | 1/10 W                   | 1/8 W       | 1/4 W       |
| CMF60, CMF20                     | 1/8 W and 1/4 W                        | 1/2 W       | 3/4 W and 1 W | 1/8 W                    | 1/4 W       | 1/2 W       |
| CMF65                            | 1/4 W and 1/2 W                        | 3/4 W       | 1 W           | 1/4 W                    | 1/2 W       | 3/4 W       |
| CMF70                            | 1/4 W and 1/2 W                        | 3/4 W       | 1 W           | 1/4 W                    | 1/2 W       | 3/4 W       |

CMF resistors have an operating temperature range of - 55 °C to + 175 °C. They must be derated at high ambient temperatures according to the derating curve.



**DERATING**

**THERMAL RESISTANCE**

**Example:**

When a CMF55 part is run at 1/8 W in a 70 °C ambient environment, the resistor will generate enough heat that the surface temperature of the part will reach about 19 °C over the ambient temperature, and over the life of the part this could cause the resistance value to shift up to  $\pm 0.15\%$ .

If the same resistor was instead run at 1/4 W in a 70 °C environment, the element will heat up to about 30 °C over ambient, and over the life of the part the resistance value could shift roughly  $\pm 0.5\%$ .

And if the resistor was run at its maximum power rating of 1/2 W in a 70 °C environment, it will heat up to about 58 °C over ambient, and you could see the resistance value shift roughly  $\pm 1\%$  over the life of the part.

**MATERIAL SPECIFICATIONS**

|                 |                                      |                       |   |
|-----------------|--------------------------------------|-----------------------|---|
| <b>Element:</b> | Vacuum-deposited nickel-chrome alloy | <b>Coating:</b>       | Flame retardant epoxy, formulated for superior moisture protection          |
| <b>Core:</b>    | Fire-cleaned high purity ceramic     | <b>Solderability:</b> | Continuous satisfactory coverage when tested in accordance with MIL-R-10509 |



**SPECIAL MODIFICATIONS**

1. Terminals may be supplied in any commercial material with several type finishes.
2. Special pre-conditioning (power aging, temperature cycling, etc.) to customer specifications.
3. Non-helixed resistors can be supplied for critical high frequency applications.
4. Fusible, flameproof versions available.

| <b>MARKING</b>   |                                |                                       |                   |
|--|--------------------------------|---------------------------------------|-------------------|
| Temperature coefficient: T00 = 200 ppm, T0 = 150 ppm, T1 = 100 ppm, T2 = 50 ppm, T9 = 25 ppm |                                |                                       |                   |
| CMF50: (3 lines)   |                                | CMF55, CMF60, CMF65, CMF70: (4 lines) |                   |
| 3.01   | Value                          | CMF55                                 | Style and size    |
| K 1 %  | Ohm, K or M sign and Tolerance | 49.9 kΩ                               | Value             |
| 1208   | 4-digit date code              | 1 % T2                                | Tolerance and TC  |
|  |                                | 1208                                  | 4-digit date code |

**Note**

- CMF07 and CMF20 parts are marked with color bands, either per MIL-PRF-22684 (with a wide white band) or using commercial color bands. CMFxx..70 and CMFxx..80 parts are marked using commercial color bands.

| <b>PERFORMANCE</b>                           |  |                    |
|--|--|--------------------|
| <b>TEST<br/>(TEST METHODS - MIL-STD-202)</b> | <b>AT + 70 °C</b>  | <b>AT + 125 °C</b> |
|  | <b>MAXIMUM ΔR (TYPICAL TEST LOTS)</b>  |                    |
| Short Time Overload                          | ± 0.05 %   | ± 0.05 %           |
| Low Temperature Operation                    | ± 0.05 %   | ± 0.05 %           |
| Moisture Resistance                          | ± 0.05 %   | ± 0.05 %           |
| Shock  | ± 0.01 %   | ± 0.01 %           |
| Vibration                                    | ± 0.004 %  | ± 0.04 %           |
| Temperature Cycling                          | ± 0.15 %   | ± 0.15 %           |
| Load Life                                    | Varies based on power rating used; see load life shift due to power and derating table |                    |
| Dielectric Withstanding Voltage              | ± 0.01 %   | ± 0.01 %           |
| Effect of Solder                             | ± 0.03 %   | ± 0.03 %           |



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