

# Metal Film Resistors, Military, MIL-R-10509 Qualified, Precision, Type RN and MIL-PRF-22684 Qualified, Type RL



## FEATURES

- Very low noise (- 40 dB)
- Very low voltage coefficient (5 ppm/V)
- Controlled temperature coefficient
- Flame retardant epoxy coating
- Commercial alternatives to military styles are available with higher power ratings. See CMF Industrial data sheet: [www.vishay.com/doc?31018](http://www.vishay.com/doc?31018)

## STANDARD ELECTRICAL SPECIFICATIONS

| GLOBAL MODEL | MIL STYLE | MIL SPEC. SHEET | POWER RATING<br>$P_{70^{\circ}\text{C}}$<br>W | POWER RATING<br>$P_{125^{\circ}\text{C}}$<br>W | MAX. WORKING VOLTAGE <sup>(1)</sup><br>V | RESISTANCE RANGE<br>$\Omega$<br>MIL-R-10509<br>$\pm 100 \text{ ppm}/^{\circ}\text{C}$<br>(D) | RESISTANCE RANGE<br>$\Omega$<br>MIL-R-10509<br>$\pm 50 \text{ ppm}/^{\circ}\text{C}$<br>(C) | RESISTANCE RANGE<br>$\Omega$<br>MIL-R-10509<br>$\pm 25 \text{ ppm}/^{\circ}\text{C}$<br>(E) | RESISTANCE RANGE<br>$\Omega$<br>MIL-PRF-22684 | TOL. <sup>(3)</sup><br>$\pm \%$ | DIELECTRIC STRENGTH<br>$V_{AC}$ |
|--------------|-----------|-----------------|-----------------------------------------------|------------------------------------------------|------------------------------------------|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|-----------------------------------------------|---------------------------------|---------------------------------|
| CMF50        | RN50      | 08              | -                                             | 0.05                                           | 200                                      | -                                                                                            | 10 to 100K                                                                                  | 10 to 100K                                                                                  | -                                             | 0.1, 0.25, 0.5, 1               | 450                             |
| CMF55        | RN55      | 07              | 0.125                                         | 0.10                                           | 200                                      | 10 to 301K                                                                                   | 49.9 to 100K                                                                                | 49.9 to 100K                                                                                | -                                             | 0.1, 0.25, 0.5, 1               | 450                             |
| CMF60        | RN60      | 01              | 0.25                                          | 0.125                                          | 300                                      | 10 to 1M                                                                                     | 49.9 to 499K                                                                                | 49.9 to 499K                                                                                | -                                             | 0.1, 0.25, 0.5, 1               | 500                             |
| CMF65        | RN65      | 02              | 0.50                                          | 0.25                                           | 350                                      | 10 to 2M                                                                                     | 49.9 to 1M                                                                                  | 49.9 to 1M                                                                                  | -                                             | 0.1, 0.25, 0.5, 1               | 900                             |
| CMF70        | RN70      | 03              | 0.75 <sup>(2)</sup>                           | 0.50                                           | 500                                      | 10 to 2.49M                                                                                  | 24.9 to 1M                                                                                  | 24.9 to 1M                                                                                  | -                                             | 0.1, 0.25, 0.5, 1               | 900                             |
| CMF07        | RL07      | 01              | 0.25                                          | -                                              | 250                                      | -                                                                                            | -                                                                                           | -                                                                                           | 51 to 150K                                    | 2, 5                            | 450                             |
| CMF20        | RL20      | 02              | 0.50                                          | -                                              | 350                                      | -                                                                                            | -                                                                                           | -                                                                                           | 4.3 to 470K                                   | 2, 5                            | 700                             |

## Notes

- (1) Continuous working voltage shall be  $\sqrt{P \times R}$  or maximum working voltage, whichever is less.
- (2) Formerly rated at 1 W and is the direct replacement for RN70 of MIL-R-10509 rev. D.
- (3) Tolerances of  $\pm 0.1 \%$ ,  $\pm 0.25 \%$  and  $\pm 0.5 \%$  are not applicable to characteristic D.

## TECHNICAL SPECIFICATIONS

| PARAMETER                   | UNIT               | CONDITION                                                                                     |
|-----------------------------|--------------------|-----------------------------------------------------------------------------------------------|
| Voltage Coefficient         | ppm/V              | 5 when measured between 10 % and full rated voltage                                           |
| Insulation Resistance       | $\Omega$           | $\geq 10^{10}$ min. dry; $\geq 10^8$ min. after moisture test                                 |
| Operating Temperature Range | $^{\circ}\text{C}$ | - 65/+ 175 (see derating curves for military range)                                           |
| Terminal Strength           | lb                 | 5 pound pull test for RL07/RL20; 2 pound pull test for all others                             |
| Solderability               |                    | Continuous satisfactory coverage when tested in accordance with MIL-R-10509 and MIL-PRF-22684 |



## GLOBAL PART NUMBER INFORMATION

New Global Part Numbering: RN60D3483FR36 (preferred part numbering format)

|                                                                         |          |                                                              |          |                                                                                                                                                            |          |          |                                                                                     |          |          |                                                                                                                                                                                                                       |          |          |                                                                                           |  |  |
|-------------------------------------------------------------------------|----------|--------------------------------------------------------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|-------------------------------------------------------------------------------------|----------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|-------------------------------------------------------------------------------------------|--|--|
| <b>R</b>                                                                | <b>N</b> | <b>6</b>                                                     | <b>0</b> | <b>D</b>                                                                                                                                                   | <b>3</b> | <b>4</b> | <b>8</b>                                                                            | <b>3</b> | <b>F</b> | <b>R</b>                                                                                                                                                                                                              | <b>3</b> | <b>6</b> |                                                                                           |  |  |
| <b>MIL STYLE</b>                                                        |          | <b>CHARACTERISTIC</b>                                        |          | <b>RESISTANCE VALUE</b>                                                                                                                                    |          |          | <b>TOLERANCE CODE</b>                                                               |          |          | <b>PACKAGING</b>                                                                                                                                                                                                      |          |          | <b>SPECIAL</b>                                                                            |  |  |
| <b>RN50</b><br><b>RN55</b><br><b>RN60</b><br><b>RN65</b><br><b>RN70</b> |          | <b>E</b> = 25 ppm<br><b>C</b> = 50 ppm<br><b>D</b> = 100 ppm |          | 3 digit significant figure, followed by a multiplier<br>Use "R" for values < 100 Ω<br><b>10R0</b> = 10 Ω<br><b>2152</b> = 21.5 kΩ<br><b>2494</b> = 2.49 MΩ |          |          | <b>B</b> = ± 0.1 %<br><b>C</b> = ± 0.25 %<br><b>D</b> = ± 0.5 %<br><b>F</b> = ± 1 % |          |          | <b>B14</b> = Tin/lead, bulk<br><b>BSL</b> = Tin/lead, bulk, single lot date code<br><b>R36</b> = Tin/lead, T/R (full)<br><b>RE6</b> = Tin/lead, T/R (1000 pieces)<br><b>RSL</b> = Tin/lead, T/R, single lot date code |          |          | Blank = Standard (Dash number)<br><b>88</b> = Hot solder dip<br><b>143</b> = Non-magnetic |  |  |

Historical Part Number example: RN60D3483F (will continue to be accepted)

|             |                |                  |                |            |
|-------------|----------------|------------------|----------------|------------|
| <b>RN60</b> | <b>D</b>       | <b>3483</b>      | <b>F</b>       | <b>R36</b> |
| MIL STYLE   | CHARACTERISTIC | RESISTANCE VALUE | TOLERANCE CODE | PACKAGING  |

New Global Part Numbering: RL07S471JR36 (preferred part numbering format)

|                            |                       |          |                                                                                                                                                       |          |          |                                      |          |          |                                                                                                                                                                                                                       |          |          |                                                                                           |  |  |
|----------------------------|-----------------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|--------------------------------------|----------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|-------------------------------------------------------------------------------------------|--|--|
| <b>R</b>                   | <b>L</b>              | <b>0</b> | <b>7</b>                                                                                                                                              | <b>S</b> | <b>4</b> | <b>7</b>                             | <b>1</b> | <b>J</b> | <b>R</b>                                                                                                                                                                                                              | <b>3</b> | <b>6</b> |                                                                                           |  |  |
| <b>MIL STYLE</b>           | <b>LEAD MATERIAL</b>  |          | <b>RESISTANCE VALUE</b>                                                                                                                               |          |          | <b>TOLERANCE CODE</b>                |          |          | <b>PACKAGING</b>                                                                                                                                                                                                      |          |          | <b>SPECIAL</b>                                                                            |  |  |
| <b>RL07</b><br><b>RL20</b> | <b>S</b> = Solderable |          | 2 digit significant figure, followed by a multiplier<br>Use "R" for values < 10 Ω<br><b>4R3</b> = 4.3 Ω<br><b>202</b> = 2.0 kΩ<br><b>474</b> = 470 kΩ |          |          | <b>G</b> = ± 2 %<br><b>J</b> = ± 5 % |          |          | <b>B14</b> = Tin/lead, bulk<br><b>BSL</b> = Tin/lead, bulk, single lot date code<br><b>R36</b> = Tin/lead, T/R (full)<br><b>RE6</b> = Tin/lead, T/R (1000 pieces)<br><b>RSL</b> = Tin/lead, T/R, single lot date code |          |          | Blank = Standard (Dash number)<br><b>88</b> = Hot solder dip<br><b>143</b> = Non-magnetic |  |  |

Historical Part Number example: RL07S471J (will continue to be accepted)

|             |               |                  |                |            |
|-------------|---------------|------------------|----------------|------------|
| <b>RL07</b> | <b>S</b>      | <b>471</b>       | <b>J</b>       | <b>R36</b> |
| MIL STYLE   | LEAD MATERIAL | RESISTANCE VALUE | TOLERANCE CODE | PACKAGING  |

## Note

- For additional information on packaging, refer to the Through Hole Resistor Packaging document ([www.vishay.com/doc?31544](http://www.vishay.com/doc?31544)).

## MATERIAL SPECIFICATIONS

|                    |                                                                          |
|--------------------|--------------------------------------------------------------------------|
| <b>Element</b>     | Nickel-chrome alloy                                                      |
| <b>Coating</b>     | Flame retardant epoxy, formulated for superior moisture protection       |
| <b>Core</b>        | Fire-cleaned high purity ceramic                                         |
| <b>Termination</b> | Standard lead material is solder-coated copper. Solderable and weldable. |

## APPLICABLE MIL-SPECS

**MIL-R-10509 and MIL-PRF-22684:** The CMF models meet or exceed the electrical, environmental and dimensional requirements of MIL-R-10509 and MIL-PRF-22684.

**Noise:** Vishay Dale metal film resistors have exceptionally low noise level. Average for standard resistance range is 0.10 μV per V over a decade of frequency, with low and intermediate resistance values typically below 0.05 μV per V.

CAGE CODE: 91637

## ENVIRONMENTAL SPECIFICATIONS

|                   |                                                                                                                                               |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>General</b>    | Environmental performance is shown in the Environmental Performance table. Test methods are those specified in MIL-R-10509 and MIL-PRF-22684. |
| <b>Shelf Life</b> | Resistance shifts due to storage at room temperature are negligible.                                                                          |



Vishay Dale CMF resistors have an operating temperature range of - 65 °C to + 175 °C. They must be derated according to the following curves:

**DERATING****DIMENSIONS** in inches (millimeters)

| VISHAY DALE 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) | 0.244<br>(6.20)                | 0.016 ± 0.002<br>(0.41 ± 0.05) |
| CMF55             | 0.240 ± 0.020<br>(6.10 ± 0.51)  | 0.090 ± 0.008<br>(2.29 ± 0.20) | 0.278<br>(7.06) <sup>(1)</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<br>(10.80)               | 0.025 ± 0.002<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<br>(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<br>(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<br>(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<br>(10.80)               | 0.032 ± 0.002<br>(0.81 ± 0.05) |

**Notes**

<sup>(1)</sup> 0.290" (7.37) for ± 0.25 % and ± 0.1 % resistance tolerances.

<sup>(2)</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.

**MILITARY POWER RATING**

| WATTAGE             | MILITARY QUALIFIED |                          |               |
|---------------------|--------------------|--------------------------|---------------|
|                     | MIL-R-10509        |                          | MIL-PRF-22684 |
|                     | AT + 70 °C<br>(D)  | AT + 125 °C<br>(C and E) | AT + 70 °C    |
| 0.05                | -                  | RN50                     | -             |
| 0.10                | -                  | RN55                     | -             |
| 0.125               | RN55               | RN60                     | -             |
| 0.25                | RN60               | RN65                     | RL07          |
| 0.50                | RN65               | RN70                     | RL20          |
| 0.75 <sup>(3)</sup> | RN70               | -                        | -             |

**Notes**

• Commercial equivalents of military styles are available with higher power ratings. Consult factory.

<sup>(3)</sup> Formerly rated at 1 W and is the direct replacement for RN70 of MIL-R-10509 rev. D.



## MARKING (per MIL-PRF-10509)

Characteristics: D = 100 ppm, C = 50 ppm, E = 25 ppm  
Tolerance: F = 1 %, D = 0.5 %, C = 0.25 %, B = 0.1 %  
Value = Three significant figures and multiplier  
J = JAN (Joint Army - Navy) brand

RN50: (3 lines)

J50D JAN, type, characteristic  
1211 Value  
F137 Tolerance and 3 digit date code

RN55, RN60, RN65, RN70 (4 lines)

DALE Company logo  
0137J 4 digit date code and JAN brand  
RN55D Type and characteristic  
1211F Value and Tolerance

## Note

- RL series are color banded per MIL-PRF-22684.

## PERFORMANCE

| REQUIREMENT                                    | MIL-R-10509               |                     |                     | MIL-PRF-22684       |
|------------------------------------------------|---------------------------|---------------------|---------------------|---------------------|
|                                                | CHARACTERISTIC D          | CHARACTERISTIC C    | CHARACTERISTIC E    |                     |
| MIL Temperature Coefficient                    | + 200 ppm/°C - 500 ppm/°C | ± 50 ppm/°C         | ± 25 ppm/°C         | ± 200 ppm/°C        |
| Applicable Vishay Dale Temperature Coefficient | ± 100 ppm/°C              | ± 50 ppm/°C         | ± 25 ppm/°C         | ± 200 ppm/°C        |
| TEST                                           | MIL <sub>max.</sub>       | MIL <sub>max.</sub> | MIL <sub>max.</sub> | MIL <sub>max.</sub> |
| Thermal Shock                                  | ± 0.50 % $\Delta R$       | ± 0.25 % $\Delta R$ | ± 0.25 % $\Delta R$ | ± 1.00 % $\Delta R$ |
| Short Time Overload                            | ± 0.50 % $\Delta R$       | ± 0.25 % $\Delta R$ | ± 0.25 % $\Delta R$ | ± 0.50 % $\Delta R$ |
| Low Temperature Operation                      | ± 0.50 % $\Delta R$       | ± 0.25 % $\Delta R$ | ± 0.25 % $\Delta R$ | ± 0.50 % $\Delta R$ |
| Moisture Resistance                            | ± 1.50 % $\Delta R$       | ± 0.50 % $\Delta R$ | ± 0.50 % $\Delta R$ | ± 1.50 % $\Delta R$ |
| Shock                                          | ± 0.50 % $\Delta R$       | ± 0.25 % $\Delta R$ | ± 0.25 % $\Delta R$ | ± 0.50 % $\Delta R$ |
| Vibration                                      | ± 0.50 % $\Delta R$       | ± 0.25 % $\Delta R$ | ± 0.25 % $\Delta R$ | ± 0.50 % $\Delta R$ |
| Load Life                                      | ± 1.00 % $\Delta R$       | ± 0.50 % $\Delta R$ | ± 0.50 % $\Delta R$ | ± 2.00 % $\Delta R$ |
| Dielectric Withstanding Voltage                | ± 0.50 % $\Delta R$       | ± 0.25 % $\Delta R$ | ± 0.25 % $\Delta R$ | ± 0.50 % $\Delta R$ |
| Effect of Solder                               | ± 0.50 % $\Delta R$       | ± 0.10 % $\Delta R$ | ± 0.10 % $\Delta R$ | ± 0.50 % $\Delta R$ |



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