

# LEADED RESISTORS 2011





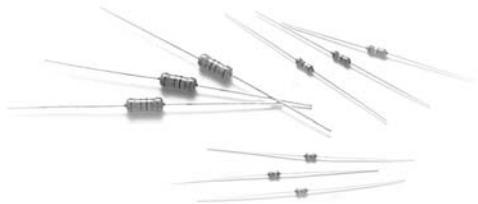


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## Metal Film Resistors

# General Type

## Normal & Miniature Style [ MFR Series ]



### INTRODUCTION

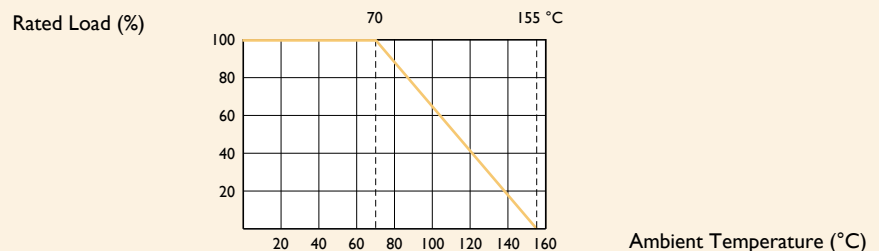
The MFR Series Metal Film Resistors are manufactured using a vacuum sputtering system to deposit multiple layers of mixed metal alloys and passivative materials onto a carefully treated high grade ceramic substrate. After a helical groove has been cut in the resistive layer, tinned connecting leads of electrolytic copper are welded to the end-caps. The resistors are coated with layers of blue color lacquer.

### FEATURES

|                      |                                                                                                                                                        |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Power Rating         | 1/6W, 1/4W, 1/2W, 1W, 2W, 3W                                                                                                                           |
| Resistance Tolerance | $\pm 0.5\%$ , $\pm 1\%$ , $\pm 5\%$                                                                                                                    |
| T.C.R.               | $\pm 15\text{ppm}/^{\circ}\text{C}$ , $\pm 25\text{ppm}/^{\circ}\text{C}$ , $\pm 50\text{ppm}/^{\circ}\text{C}$ , $\pm 100\text{ppm}/^{\circ}\text{C}$ |

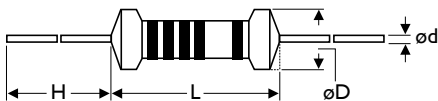
### DERATING CURVE

For resistors operated in ambient temperatures above  $70^{\circ}\text{C}$ , power rating must be derated in accordance with the curve below.



### DIMENSIONS

Unit: mm



| STYLE  |           | DIMENSION      |               |              |                 |
|--------|-----------|----------------|---------------|--------------|-----------------|
| Normal | Miniature | L              | øD            | H            | ød              |
| MFR-12 | MFR25S    | $3.4 \pm 0.3$  | $1.9 \pm 0.2$ | $28 \pm 2.0$ | $0.45 \pm 0.05$ |
| MFR-25 | MFR50S    | $6.3 \pm 0.5$  | $2.4 \pm 0.2$ | $28 \pm 2.0$ | $0.55 \pm 0.05$ |
| MFR-50 | MFR1WS    | $9.0 \pm 0.5$  | $3.3 \pm 0.3$ | $26 \pm 2.0$ | $0.55 \pm 0.05$ |
| MFR100 | MFR2WS    | $11.5 \pm 1.0$ | $4.5 \pm 0.5$ | $35 \pm 2.0$ | $0.8 \pm 0.05$  |
| MFR200 | MFR3WS    | $15.5 \pm 1.0$ | $5.0 \pm 0.5$ | $33 \pm 2.0$ | $0.8 \pm 0.05$  |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                    | MFR-12                                                                                                                                         | MFR25S | MFR-25 | MFR50S | MFR-50 | MFRIWS | MFRI00 | MFR2WS | MFR200 | MFR3WS |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Power Rating at 70°C     | 1/6W                                                                                                                                           | 1/4W   |        | 1/2W   |        | 1W     |        | 2W     |        | 3W     |
| Maximum Working Voltage  | 200V                                                                                                                                           |        | 250V   | 300V   | 350V   | 400V   | 500V   |        |        |        |
| Maximum Overload Voltage | 400V                                                                                                                                           |        | 500V   | 600V   | 700V   | 800V   | 1,000V |        |        |        |
| Voltage Proof            | 300V                                                                                                                                           | 400V   | 500V   |        |        | 700V   | 1,000V |        |        |        |
| Resistance Range         | 1 $\Omega$ - 10M $\Omega$ & 0 $\Omega$ for E24 & E96 series value                                                                              |        |        |        |        |        |        |        |        |        |
| Operating Temp. Range    | -55°C to +155°C                                                                                                                                |        |        |        |        |        |        |        |        |        |
| Temperature Coefficient  | $\pm 15\text{ppm}/^\circ\text{C}$ , $\pm 25\text{ppm}/^\circ\text{C}$ , $\pm 50\text{ppm}/^\circ\text{C}$ , $\pm 100\text{ppm}/^\circ\text{C}$ |        |        |        |        |        |        |        |        |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST              | TEST METHOD      |                                                                                                       | APPRAISE                                  |
|-------------------------------|------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                                             | $\pm 0.25\% + 0.05 \Omega$                |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                                          | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                                       | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                                | $> 10,000\text{M} \Omega$                 |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm 5^\circ\text{C}$ for 3 $\pm 0.5$ Sec.                                                        | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm 0.5$ Min. with ultrasonic                                                              | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                                        | $\geq 2.5\text{kg}$ (24.5N)               |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                                   | $\pm 1.0\% + 0.05 \Omega$                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm 2^\circ\text{C}$ , 90-95% RH for 56 days, loaded with 0.1 times RCWV                          | $\pm 1.5\% + 0.05 \Omega$                 |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm 2^\circ\text{C}$ at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                              | $\pm 1.5\% + 0.05 \Omega$                 |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles)               | $\pm 0.75\% + 0.05 \Omega$                |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm 3^\circ\text{C}$ for 10 $\pm 1$ Sec., immersed to a point 3 $\pm 0.5\text{mm}$ from the body | $\pm 0.25\% + 0.05 \Omega$                |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Metal Film Resistors

# Precision Type

## Normal & Miniature Style [ MFP Series ]



### INTRODUCTION

The MFP Series Metal Film Precision Resistors are manufactured using a vacuum sputtering system to deposit multiple layers of mixed metal alloys and passivative materials onto a carefully treated high grade ceramic substrate. After a helical groove has been cut in the resistive layer, tinned connecting leads of electrolytic copper are welded to the end-caps. The resistors are coated with layers of blue color lacquer. Ultra high precision resistors, ultra high stability, ultra low temperature coefficient.

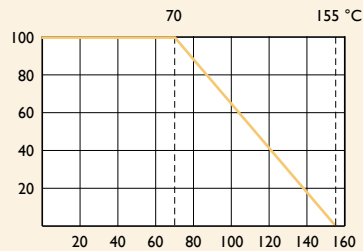
### FEATURES

|                      |                                                        |
|----------------------|--------------------------------------------------------|
| Power Rating         | 1/6W, 1/4W, 0.4W, 1/2W, 0.6W, 1W, 2W, 3W               |
| Resistance Tolerance | ±0.1%, ±0.25%, (±0.02%, ±0.05% on request)             |
| T.C.R.               | ±15ppm/°C, ±25ppm/°C, (±5ppm/°C, ±10ppm/°C on request) |

### DERATING CURVE

For resistors operated in ambient temperatures above 70°C, power rating must be derated in accordance with the curve below.

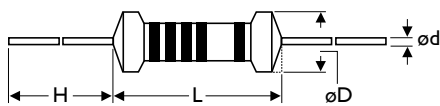
Rated Load (%)



Ambient Temperature (°C)

### DIMENSIONS

Unit: mm



#### STYLE

#### DIMENSION

| Normal | Miniature | L        | øD      | H      | ød        |
|--------|-----------|----------|---------|--------|-----------|
| MFP-12 | MFP25S    | 3.4±0.3  | 1.9±0.2 | 28±2.0 | 0.45±0.05 |
| MFP204 | -         | 3.4±0.3  | 1.9±0.2 | 28±2.0 | 0.45±0.05 |
| MFP-25 | MFP50S    | 6.3±0.5  | 2.4±0.2 | 28±2.0 | 0.55±0.05 |
| MFP207 | -         | 6.3±0.5  | 2.4±0.2 | 28±2.0 | 0.55±0.05 |
| MFP-50 | MFP1WS    | 9.0±0.5  | 3.3±0.3 | 26±2.0 | 0.55±0.05 |
| MFP100 | MFP2WS    | 11.5±1.0 | 4.5±0.5 | 35±2.0 | 0.8±0.05  |
| MFP200 | MFP3WS    | 15.5±1.0 | 5.0±0.5 | 33±2.0 | 0.8±0.05  |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                    | MFP-12                                                                | MFP25S | MFP204 | MFP-25 | MFP50S | MFP207 | MFP-50 | MFPIWS | MFPI00 | MFP2WS | MFP200 | MFP3WS |
|--------------------------|-----------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Power Rating at 70°C     | 1/6W                                                                  | 1/4W   | 0.4W   | 1/4W   | 1/2W   | 0.6W   | 1/2W   | 1W     |        | 2W     |        | 3W     |
| Maximum Working Voltage  | 150V                                                                  | 200V   |        | 250V   |        |        | 350V   | 400V   | 500V   |        |        |        |
| Maximum Overload Voltage | 300V                                                                  | 400V   |        | 500V   | 600V   |        | 700V   | 800V   | 1,000V |        |        |        |
| Voltage Proof            | 300V                                                                  |        |        | 500V   |        |        |        | 700V   | 1,000V |        |        |        |
| Resistance Range         | 10 $\Omega$ - 1 M $\Omega$ for E192 series value                      |        |        |        |        |        |        |        |        |        |        |        |
| Operating Temp. Range    | -55°C to +155°C                                                       |        |        |        |        |        |        |        |        |        |        |        |
| Temperature Coefficient  | $\pm 15\text{ppm}/^\circ\text{C}$ , $\pm 25\text{ppm}/^\circ\text{C}$ |        |        |        |        |        |        |        |        |        |        |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

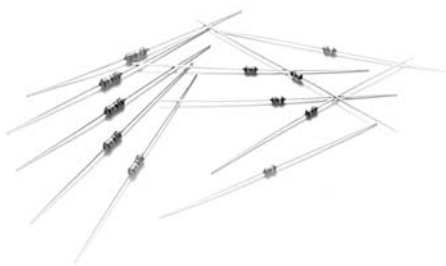
| PERFORMANCE TEST              | TEST METHOD      |                                                                                                       | APPRAISE                                  |
|-------------------------------|------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                                             | $\pm 0.25\% + 0.05 \Omega$                |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                                          | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                                       | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                                | $> 10,000\text{M} \Omega$                 |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm 5^\circ\text{C}$ for 3 $\pm 0.5$ Sec.                                                        | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm 0.5$ Min. with ultrasonic                                                              | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                                        | $\geq 2.5\text{kg}$ (24.5N)               |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                                   | $\pm 1.0\% + 0.05 \Omega$                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm 2^\circ\text{C}$ , 90-95% RH for 56 days, loaded with 0.1 times RCWV                          | $\pm 1.5\% + 0.05 \Omega$                 |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm 2^\circ\text{C}$ at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                              | $\pm 1.5\% + 0.05 \Omega$                 |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles)               | $\pm 0.75\% + 0.05 \Omega$                |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm 3^\circ\text{C}$ for 10 $\pm 1$ Sec., immersed to a point 3 $\pm 0.5\text{mm}$ from the body | $\pm 0.25\% + 0.05 \Omega$                |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Metal Film Resistors

# Professional Type

## Miniature Style [ MF0 Series ]



### INTRODUCTION

The MF0 Series Metal Film Professional Resistors are manufactured using a vacuum sputtering system to deposit multiple layers of mixed metal alloys and passivative materials onto a carefully treated high grade ceramic substrate. After a helical groove has been cut in the resistive layer; tinned connecting leads of electrolytic copper are welded to the end-caps. The resistors are coated with layers of blue color lacquer.

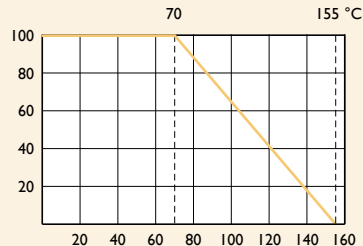
### FEATURES

|                      |                                     |
|----------------------|-------------------------------------|
| Power Rating         | 0.4W, 0.6W                          |
| Resistance Tolerance | $\pm 0.5\%$ , $\pm 1\%$ , $\pm 5\%$ |
| T.C.R.               | $\pm 50\text{ppm}/^{\circ}\text{C}$ |

### DERATING CURVE

For resistors operated in ambient temperatures above  $70^{\circ}\text{C}$ , power rating must be derated in accordance with the curve below.

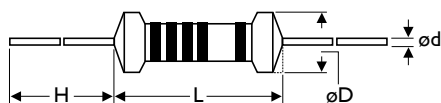
Rated Load (%)



Ambient Temperature ( $^{\circ}\text{C}$ )

### DIMENSIONS

Unit: mm



| STYLE     | DIMENSION     |               |              |                 |
|-----------|---------------|---------------|--------------|-----------------|
| Miniature | L             | øD            | H            | ød              |
| MF0204    | $3.4 \pm 0.3$ | $1.9 \pm 0.2$ | $28 \pm 2.0$ | $0.45 \pm 0.05$ |
| MF0207    | $6.3 \pm 0.5$ | $2.4 \pm 0.2$ | $28 \pm 2.0$ | $0.55 \pm 0.05$ |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                    | MF0204                                                            | MF0207 |
|--------------------------|-------------------------------------------------------------------|--------|
| Power Rating at 70°C     | 0.4W                                                              | 0.6W   |
| Maximum Working Voltage  | 250V                                                              | 350V   |
| Maximum Overload Voltage | 500V                                                              | 700V   |
| Voltage Proof            | 300V                                                              | 500V   |
| Resistance Range         | 1 $\Omega$ - 10M $\Omega$ & 0 $\Omega$ for E24 & E96 series value |        |
| Operating Temp. Range    | -55°C to +155°C                                                   |        |
| Temperature Coefficient  | $\pm 50$ ppm/°C                                                   |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST              | TEST METHOD      |                                                                                         | APPRAISE                                  |
|-------------------------------|------------------|-----------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                               | $\pm 0.25\% + 0.05 \Omega$                |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                            | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                         | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                  | $> 10,000M \Omega$                        |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm 5$ °C for 3 $\pm 0.5$ Sec.                                                     | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm 0.5$ Min. with ultrasonic                                                | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                          | $\geq 2.5$ kg (24.5N)                     |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                     | $\pm 1.0\% + 0.05 \Omega$                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm 2$ °C, 90-95% RH for 56 days, loaded with 0.1 times RCWV                        | $\pm 1.5\% + 0.05 \Omega$                 |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm 2$ °C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                           | $\pm 1.5\% + 0.05 \Omega$                 |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles) | $\pm 0.75\% + 0.05 \Omega$                |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm 3$ °C for 10 $\pm 1$ Sec., immersed to a point 3 $\pm 0.5$ mm from the body    | $\pm 0.25\% + 0.05 \Omega$                |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Metal Film Resistors

# Flame-Proof Type

## Normal & Miniature Style [ FMF Series ]



### INTRODUCTION

The FMF Series Metal Film Flame-Proof Resistors are manufactured using a vacuum sputtering system to deposit multiple layers of mixed metal alloys and passivative materials onto a carefully treated high grade ceramic substrate. After a helical groove has been cut in the resistive layer; tinned connecting leads of electrolytic copper are welded to the end-caps. The resistors are coated with layers of gray color lacquer.

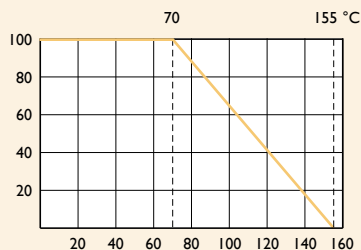
### FEATURES

|                                        |                        |
|----------------------------------------|------------------------|
| Power Rating                           | 1/4W, 1/2W, 1W, 2W, 3W |
| Resistance Tolerance                   | ±1%                    |
| T.C.R.                                 | ±50ppm/°C, ±100ppm/°C  |
| Flameproof Multi-layer Coating Meets   | UL-94V-0               |
| Flameproof Feature Meets Overload Test | UL-1412                |

### DERATING CURVE

For resistors operated in ambient temperatures above 70°C, power rating must be derated in accordance with the curve below.

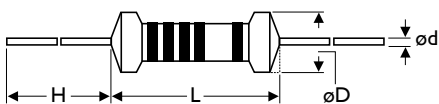
Rated Load (%)



Ambient Temperature (°C)

### DIMENSIONS

Unit: mm



#### STYLE

#### DIMENSION

| Normal | Miniature | L        | øD      | H      | ød        |
|--------|-----------|----------|---------|--------|-----------|
| FMF-25 | FMF50S    | 6.3±0.5  | 2.4±0.2 | 28±2.0 | 0.55±0.05 |
| FMF-50 | FMF1WS    | 9.0±0.5  | 3.3±0.3 | 26±2.0 | 0.55±0.05 |
| FMF100 | FMF2WS    | 11.5±1.0 | 4.5±0.5 | 35±2.0 | 0.8±0.05  |
| FMF200 | FMF3WS    | 15.5±1.0 | 5.0±0.5 | 33±2.0 | 0.8±0.05  |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                    | FMF-25                                                                 | FMF50S | FMF-50 | FMFIWS | FMFI00 | FMF2WS | FMF200 | FMF3WS |
|--------------------------|------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|
| Power Rating at 70°C     | 1/4W                                                                   | 1/2W   |        | 1W     |        | 2W     |        | 3W     |
| Maximum Working Voltage  | 250V                                                                   | 300V   | 350V   | 400V   | 500V   |        |        |        |
| Maximum Overload Voltage | 500V                                                                   | 600V   | 700V   | 800V   | 1,000V |        |        |        |
| Voltage Proof            | 400V                                                                   |        | 500V   | 600V   | 750V   |        |        |        |
| Resistance Range         | 1 $\Omega$ - 10M $\Omega$ & 0 $\Omega$ for E24 & E96 series value      |        |        |        |        |        |        |        |
| Operating Temp. Range    | -55°C to +155°C                                                        |        |        |        |        |        |        |        |
| Temperature Coefficient  | $\pm 50\text{ppm}/^\circ\text{C}$ , $\pm 100\text{ppm}/^\circ\text{C}$ |        |        |        |        |        |        |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

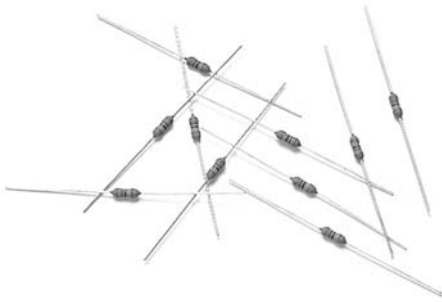
| PERFORMANCE TEST              | TEST METHOD      |                                                                                                       | APPRAISE                                  |
|-------------------------------|------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                                             | $\pm 0.25\% + 0.05 \Omega$                |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                                          | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                                       | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                                | $> 1,000\text{M} \Omega$                  |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm 5^\circ\text{C}$ for 3 $\pm 0.5$ Sec.                                                        | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm 0.5$ Min. with ultrasonic                                                              | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                                        | $\geq 2.5\text{kg}$ (24.5N)               |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                                   | $\pm 1.0\% + 0.05 \Omega$                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm 2^\circ\text{C}$ , 90-95% RH for 56 days, loaded with 0.1 times RCWV                          | $\pm 1.5\% + 0.05 \Omega$                 |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm 2^\circ\text{C}$ at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                              | $\pm 1.5\% + 0.05 \Omega$                 |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles)               | $\pm 0.75\% + 0.05 \Omega$                |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm 3^\circ\text{C}$ for 10 $\pm 1$ Sec., immersed to a point 3 $\pm 0.5\text{mm}$ from the body | $\pm 0.25\% + 0.05 \Omega$                |
| Accidental Overload Test      | IEC 60115-1 4.26 | 4 times RCWV for 1 Min.                                                                               | No evidence of flaming or arcing          |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Metal Film Resistors

# Professional & Flame-Proof Type

## Miniature Style [ FM0 Series ]



### INTRODUCTION

The FM0 Series Metal Film Professional & Flame-Proof Resistors are manufactured using a vacuum sputtering system to deposit multiple layers of mixed metal alloys and passive materials onto a carefully treated high grade ceramic substrate. After a helical groove has been cut in the resistive layer; tinned connecting leads of electrolytic copper are welded to the end-caps. The resistors are coated with layers of light green color lacquer.

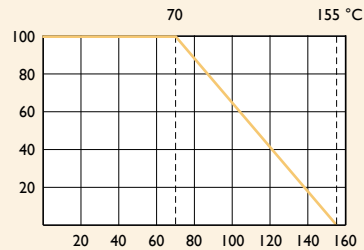
### FEATURES

|                                        |                                     |
|----------------------------------------|-------------------------------------|
| Power Rating                           | 0.4W, 0.6W                          |
| Resistance Tolerance                   | $\pm 1\%$ , $\pm 5\%$               |
| T.C.R.                                 | $\pm 50\text{ppm}/^{\circ}\text{C}$ |
| Flameproof Multi-layer Coating Meets   | UL-94V-0                            |
| Flameproof Feature Meets Overload Test | UL-1412                             |

### DERATING CURVE

For resistors operated in ambient temperatures above  $70^{\circ}\text{C}$ , power rating must be derated in accordance with the curve below.

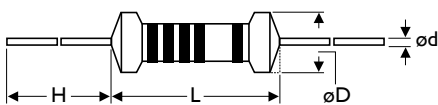
Rated Load (%)



Ambient Temperature ( $^{\circ}\text{C}$ )

### DIMENSIONS

Unit: mm



| STYLE     | DIMENSION     |               |              |                 |
|-----------|---------------|---------------|--------------|-----------------|
| Miniature | L             | $\phi D$      | H            | $\phi d$        |
| FM0204    | $3.4 \pm 0.3$ | $1.9 \pm 0.2$ | $28 \pm 2.0$ | $0.45 \pm 0.05$ |
| FM0207    | $6.3 \pm 0.5$ | $2.4 \pm 0.2$ | $28 \pm 2.0$ | $0.55 \pm 0.05$ |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                    | FM0204                                                            | FM0207 |
|--------------------------|-------------------------------------------------------------------|--------|
| Power Rating at 70°C     | 0.4W                                                              | 0.6W   |
| Maximum Working Voltage  | 200V                                                              | 300V   |
| Maximum Overload Voltage | 400V                                                              | 600V   |
| Voltage Proof            | 300V                                                              | 500V   |
| Resistance Range         | 1 $\Omega$ - 10M $\Omega$ & 0 $\Omega$ for E24 & E96 series value |        |
| Operating Temp. Range    | -55°C to +155°C                                                   |        |
| Temperature Coefficient  | $\pm 50$ ppm/°C                                                   |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

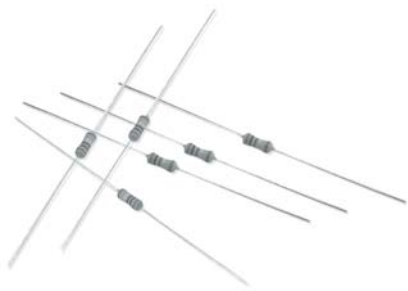
| PERFORMANCE TEST              | TEST METHOD      |                                                                                         | APPRAISE                                  |
|-------------------------------|------------------|-----------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                               | $\pm 0.25\% + 0.05 \Omega$                |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                            | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                         | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                  | $> 1,000M \Omega$                         |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm 5$ °C for 3 $\pm 0.5$ Sec.                                                     | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm 0.5$ Min. with ultrasonic                                                | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                          | $\geq 2.5$ kg (24.5N)                     |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                     | $\pm 1.0\% + 0.05 \Omega$                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm 2$ °C, 90-95% RH for 56 days, loaded with 0.1 times RCWV                        | $\pm 1.5\% + 0.05 \Omega$                 |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm 2$ °C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                           | $\pm 1.5\% + 0.05 \Omega$                 |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles) | $\pm 0.75\% + 0.05 \Omega$                |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm 3$ °C for 10 $\pm 1$ Sec., immersed to a point 3 $\pm 0.5$ mm from the body    | $\pm 0.25\% + 0.05 \Omega$                |
| Accidental Overload Test      | IEC 60115-1 4.26 | 4 times RCWV for 1 Min.                                                                 | No evidence of flaming or arcing          |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Metal Film Resistors

# High Power Type

## Ultra Miniature Style [ FMP Series ]



### INTRODUCTION

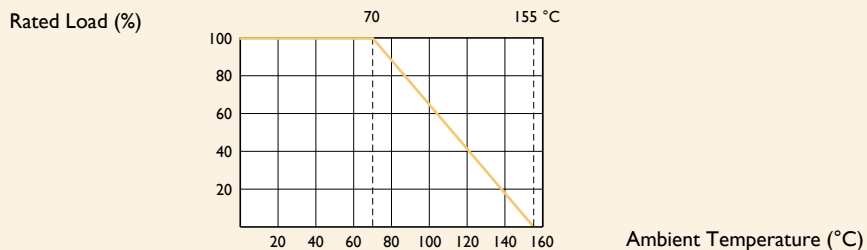
The FMP Series Metal Film High Power Resistors are manufactured using a vacuum sputtering system to deposit multiple layers of mixed metal alloys and passivative materials onto a carefully treated high grade ceramic substrate. After a helical groove has been cut in the resistive layer; tinned connecting leads of electrolytic copper are welded to the end-caps. The resistors are coated with layers of pink color lacquer.

### FEATURES

|                                        |                      |
|----------------------------------------|----------------------|
| Power Rating                           | 1/2W, 1W, 2W, 3W, 4W |
| Resistance Tolerance                   | ±1%, ±5%             |
| T.C.R.                                 | ±100ppm/°C           |
| Flameproof Multi-layer Coating Meets   | UL-94V-0             |
| Flameproof Feature Meets Overload Test | UL-1412              |

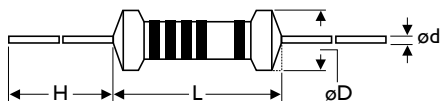
### DERATING CURVE

For resistors operated in ambient temperatures above 70°C, power rating must be derated in accordance with the curve below.



### DIMENSIONS

Unit: mm



| STYLE           | DIMENSION |         |        |           |
|-----------------|-----------|---------|--------|-----------|
| Ultra Miniature | L         | øD      | H      | ød        |
| FMP-50          | 3.4±0.3   | 1.9±0.2 | 28±2.0 | 0.45±0.05 |
| FMP100          | 6.3±0.5   | 2.4±0.2 | 28±2.0 | 0.55±0.05 |
| FMP200          | 9.0±0.5   | 3.9±0.3 | 26±2.0 | 0.55±0.05 |
| FMP3WS          | 11.5±1.0  | 4.5±0.5 | 35±2.0 | 0.8±0.05  |
| FMP300          | 15.5±1.0  | 5.0±0.5 | 33±2.0 | 0.8±0.05  |
| FMP4WV          | 17.0±1.0  | 7.5±0.5 | 32±2.0 | 0.8±0.05  |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                    | FMP-50                                                            | FMP100 | FMP200 | FMP3WS | FMP300 | FMP4WV |
|--------------------------|-------------------------------------------------------------------|--------|--------|--------|--------|--------|
| Power Rating at 70°C     | 1/2W                                                              | 1W     | 2W     | 3W     |        | 4W     |
| Maximum Working Voltage  | 200V                                                              | 350V   | 500V   |        | 750V   |        |
| Maximum Overload Voltage | 400V                                                              | 600V   | 700V   |        | 1,000V |        |
| Voltage Proof            | 300V                                                              | 500V   |        |        | 750V   |        |
| Resistance Range         | 1 $\Omega$ - 10M $\Omega$ & 0 $\Omega$ for E24 & E96 series value |        |        |        |        |        |
| Operating Temp. Range    | -55°C to +155°C                                                   |        |        |        |        |        |
| Temperature Coefficient  | $\pm 100\text{ppm}/^\circ\text{C}$                                |        |        |        |        |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

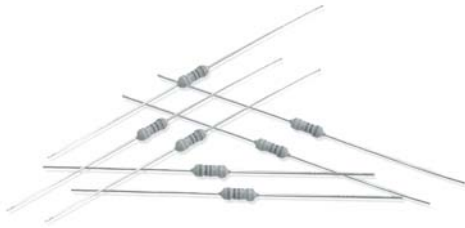
| PERFORMANCE TEST              | TEST METHOD      |                                                                                                       | APPRAISE                                  |
|-------------------------------|------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                                             | $\pm 0.5\% + 0.05 \Omega$                 |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                                          | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                                       | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                                | $> 1,000\text{M} \Omega$                  |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm 5^\circ\text{C}$ for 3 $\pm 0.5$ Sec.                                                        | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm 0.5$ Min. with ultrasonic                                                              | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                                        | $\geq 2.5\text{kg}$ (24.5N)               |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                                   | $\pm 1.0\% + 0.05 \Omega$                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm 2^\circ\text{C}$ , 90-95% RH for 56 days, loaded with 0.1 times RCWV                          | $\pm 2.0\% + 0.05 \Omega$                 |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm 2^\circ\text{C}$ at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                              | $\pm 2.0\% + 0.05 \Omega$                 |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles)               | $\pm 1.0\% + 0.05 \Omega$                 |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm 3^\circ\text{C}$ for 10 $\pm 1$ Sec., immersed to a point 3 $\pm 0.5\text{mm}$ from the body | $\pm 0.25\% + 0.05 \Omega$                |
| Accidental Overload Test      | IEC 60115-1 4.26 | 4 times RCWV for 1 Min.                                                                               | No evidence of flaming or arcing          |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Metal Film Resistors

# Fusible & Flame-Proof Type

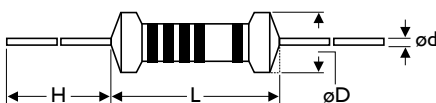
## Normal & Miniature Style [ FRM Series ]



### INTRODUCTION

The FRM Series Metal Film Fusible & Flame-Proof Resistors are manufactured using a vacuum sputtering system to deposit multiple layers of mixed metal alloys and passive materials onto a carefully treated high grade ceramic substrate. After a helical groove has been cut in the resistive layer, tinned connecting leads of electrolytic copper are welded to the end-caps. The resistors are coated with layers of gray color lacquer for normal size & pink color lacquer for miniature size. Overload protection without risk of fire. Wide range of overload currents.

### DIMENSIONS



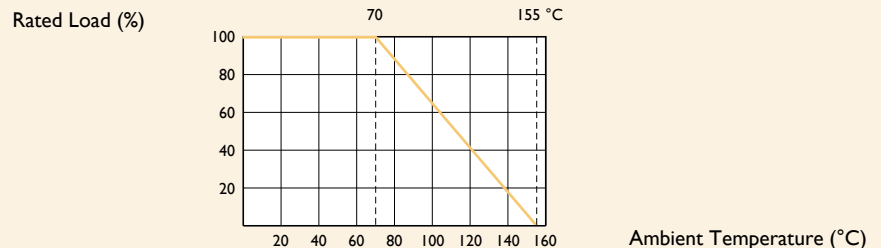
5th color code: white

### FEATURES

|                                        |                        |
|----------------------------------------|------------------------|
| Power Rating                           | 1/4W, 1/2W, 1W, 2W, 3W |
| Resistance Tolerance                   | ±2%, ±5%               |
| T.C.R.                                 | ±200ppm/°C             |
| Flameproof Multi-layer Coating Meets   | UL-94V-0               |
| Flameproof Feature Meets Overload Test | UL-1412                |

### DERATING CURVE

For resistors operated in ambient temperatures above 70°C, power rating must be derated in accordance with the curve below.



### FUSING CHARACTERISTICS

$R \leq 2.0 \Omega$  Fusing time within 60 seconds at 36 times of rated power

$R \geq 2.2 \Omega$  Fusing time within 60 seconds at 25 times of rated power

Fusing residual resistive value at least 100 times rated resistance

Unit: mm

| STYLE  |           | DIMENSION |         |        |           |
|--------|-----------|-----------|---------|--------|-----------|
| Normal | Miniature | L         | øD      | H      | ød        |
| FRM-25 | FRM50S    | 6.3±0.5   | 2.4±0.2 | 28±2.0 | 0.55±0.05 |
| FRM-50 | FRM1WS    | 9.0±0.5   | 3.3±0.3 | 26±2.0 | 0.55±0.05 |
| FRM100 | FRM2WS    | 11.5±1.0  | 4.5±0.5 | 35±2.0 | 0.8±0.05  |
| FRM200 | FRM3WS    | 15.5±1.0  | 5.0±0.5 | 33±2.0 | 0.8±0.05  |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                    | FRM-25                                                                                                                          | FRM50S | FRM-50 | FRMIWS | FRMI00 | FRM2WS | FRM200 | FRM3WS |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|
| Power Rating at 70°C     | 1/4W                                                                                                                            | 1/2W   |        | 1W     |        | 2W     |        | 3W     |
| Maximum Working Voltage  | 200V                                                                                                                            |        | 250V   |        | 300V   |        | 350V   |        |
| Maximum Overload Voltage | 400V                                                                                                                            |        | 500V   |        | 600V   |        | 700V   |        |
| Voltage Proof            | 250V                                                                                                                            |        |        |        | 350V   |        |        |        |
| Resistance Range         | 4.7 $\Omega$ - 560 $\Omega$ ( $\pm 2\%$ ) for E24 series value & 2.2 $\Omega$ - 560 $\Omega$ ( $\pm 5\%$ ) for E24 series value |        |        |        |        |        |        |        |
| Operating Temp. Range    | -55°C to +155°C                                                                                                                 |        |        |        |        |        |        |        |
| Temperature Coefficient  | $\pm 200$ ppm/°C                                                                                                                |        |        |        |        |        |        |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

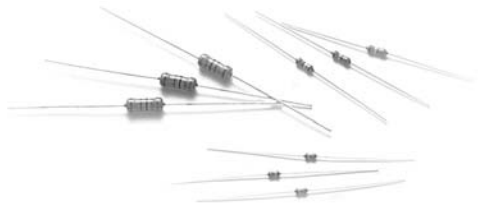
| PERFORMANCE TEST              | TEST METHOD      |                                                                                         | APPRAISE                                  |
|-------------------------------|------------------|-----------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                               | $\pm 2.0\% + 0.05 \Omega$                 |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                            | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                         | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                  | $> 100M \Omega$                           |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm 5$ °C for 3 $\pm 0.5$ Sec.                                                     | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm 0.5$ Min. with ultrasonic                                                | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                          | $\geq 2.5$ kg (24.5N)                     |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                     | $\pm 1.0\% + 0.05 \Omega$                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm 2$ °C, 90-95% RH for 56 days, loaded with 0.1 times RCWV                        | $\pm 5.0\% + 0.05 \Omega$                 |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm 2$ °C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                           | $\pm 5.0\% + 0.05 \Omega$                 |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles) | $\pm 2.0\% + 0.05 \Omega$                 |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm 3$ °C for 10 $\pm 1$ Sec., immersed to a point 3 $\pm 0.5$ mm from the body    | $\pm 1.0\% + 0.05 \Omega$                 |
| Accidental Overload Test      | IEC 60115-1 4.26 | 4 times RCWV for 1 Min.                                                                 | No evidence of flaming or arcing          |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Metal Film Resistors

# Biased Humidity Type

## Normal & Miniature Style [ MFN Series ]



### INTRODUCTION

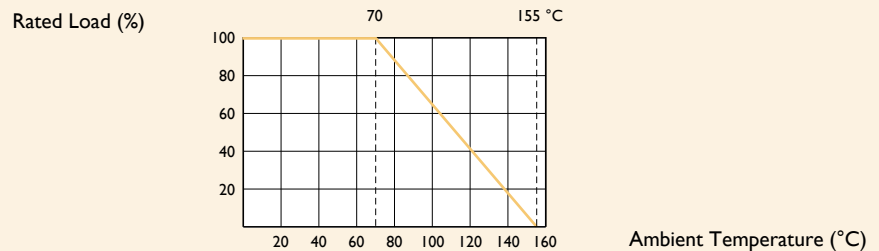
The MFN Series Metal Film Biased Humidity Resistors are manufactured using a vacuum sputtering system to deposit multiple layers of mixed metal alloys and passivative materials onto a carefully treated high grade ceramic substrate. After a helical groove has been cut in the resistive layer; tinned connecting leads of electrolytic copper are welded to the end-caps. The resistors are coated with a specialized blue lacquer. Its processes and controls ensure the product is impervious to moisture.

### FEATURES

|                      |                                                                                                                                                |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Power Rating         | 1/6W, 1/4W, 1/2W, 1W, 2W, 3W                                                                                                                   |
| Resistance Tolerance | $\pm 0.5\%$ , $\pm 1\%$                                                                                                                        |
| T.C.R.               | $\pm 15\text{ppm}/^\circ\text{C}$ , $\pm 25\text{ppm}/^\circ\text{C}$ , $\pm 50\text{ppm}/^\circ\text{C}$ , $\pm 100\text{ppm}/^\circ\text{C}$ |

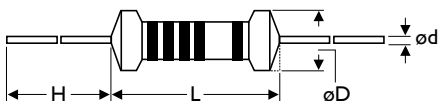
### DERATING CURVE

For resistors operated in ambient temperatures above  $70^\circ\text{C}$ , power rating must be derated in accordance with the curve below.



### DIMENSIONS

Unit: mm



| STYLE  |           | DIMENSION      |               |              |                 |
|--------|-----------|----------------|---------------|--------------|-----------------|
| Normal | Miniature | L              | øD            | H            | ød              |
| MFN-12 | MFN25S    | $3.4 \pm 0.3$  | $1.9 \pm 0.2$ | $28 \pm 2.0$ | $0.45 \pm 0.05$ |
| MFN-25 | MFN50S    | $6.3 \pm 0.5$  | $2.4 \pm 0.2$ | $28 \pm 2.0$ | $0.55 \pm 0.05$ |
| MFN-50 | MFN1WS    | $9.0 \pm 0.5$  | $3.3 \pm 0.3$ | $26 \pm 2.0$ | $0.55 \pm 0.05$ |
| MFN100 | MFN2WS    | $11.5 \pm 1.0$ | $4.5 \pm 0.5$ | $35 \pm 2.0$ | $0.8 \pm 0.05$  |
| MFN200 | MFN3WS    | $15.5 \pm 1.0$ | $5.0 \pm 0.5$ | $33 \pm 2.0$ | $0.8 \pm 0.05$  |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                    | MFN-12                                                                                                                                         | MFN25S | MFN-25 | MFN50S | MFN-50 | MFNIWS | MFN100 | MFN2WS | MFN200 | MFN3WS |
|--------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Power Rating at 70°C     | 1/6W                                                                                                                                           | 1/4W   |        | 1/2W   |        | 1W     |        | 2W     |        | 3W     |
| Maximum Working Voltage  | 200V                                                                                                                                           |        | 250V   | 300V   | 350V   | 400V   | 500V   |        |        |        |
| Maximum Overload Voltage | 400V                                                                                                                                           |        | 500V   | 600V   | 700V   | 800V   | 1,000V |        |        |        |
| Voltage Proof            | 300V                                                                                                                                           | 400V   | 500V   |        |        | 700V   | 1,000V |        |        |        |
| Resistance Range         | 1 $\Omega$ - 10M $\Omega$ & 0 $\Omega$ for E24 & E96 series value                                                                              |        |        |        |        |        |        |        |        |        |
| Operating Temp. Range    | -55°C to +155°C                                                                                                                                |        |        |        |        |        |        |        |        |        |
| Temperature Coefficient  | $\pm 15\text{ppm}/^\circ\text{C}$ , $\pm 25\text{ppm}/^\circ\text{C}$ , $\pm 50\text{ppm}/^\circ\text{C}$ , $\pm 100\text{ppm}/^\circ\text{C}$ |        |        |        |        |        |        |        |        |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST              | TEST METHOD      |                                                                                                       | APPRAISE                                  |
|-------------------------------|------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                                             | $\pm 0.25\% + 0.05 \Omega$                |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                                          | No breakdown or flashover                 |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                                       | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                                | > 10,000M                                 |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm 5^\circ\text{C}$ for 3 $\pm 0.5$ Sec.                                                        | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm 0.5$ Min. with ultrasonic                                                              | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                                        | $\geq 2.5\text{kg}$ (24.5N)               |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                                   | $\pm 1.0\% + 0.05 \Omega$                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm 2^\circ\text{C}$ , 90-95% RH for 56 days, loaded with 0.1 times RCWV                          | $\pm 1.5\% + 0.05 \Omega$                 |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm 2^\circ\text{C}$ at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                              | $\pm 1.5\% + 0.05 \Omega$                 |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles)               | $\pm 0.75\% + 0.05 \Omega$                |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm 3^\circ\text{C}$ for 10 $\pm 1$ Sec., immersed to a point 3 $\pm 0.5\text{mm}$ from the body | $\pm 0.25\% + 0.05 \Omega$                |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Metal Film Resistors

# HID Lamps Type

## Normal Style [ HTM Series ]



### INTRODUCTION

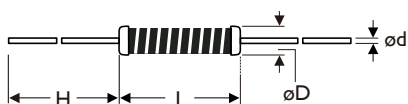
The HTM Series Metal Film Resistors are manufactured using a vacuum sputtering system to deposit multiple layers of mixed metal alloys onto a carefully treated high grade ceramic substrate. After a helical groove has been cut in the resistive layer, steel copper plated wires are welded to the end-caps. The resistor is not coated. This is a special product for HID lamps, providing high power within a small package and saving space.

### FEATURES

|                      |            |
|----------------------|------------|
| Power Rating         | 2W, 2.5W   |
| Resistance Tolerance | ±5%        |
| T.C.R.               | ±250ppm/°C |

### DIMENSIONS

Unit: mm



| STYLE  | DIMENSION |           |        |          |
|--------|-----------|-----------|--------|----------|
| Normal | L         | øD        | H      | ød       |
| HTM200 | 8.5±0.3   | 3.5±0.2   | 26±2.0 | 0.8±0.05 |
| HTM250 | 15.5±0.3  | Max. 3.55 | 33±2.0 | 0.8±0.05 |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                   | HTM200                                          | HTM250 |
|-------------------------|-------------------------------------------------|--------|
| Power Rating at 70°C    | 2W                                              | 2.5W   |
| Maximum Working Voltage | 500V                                            | 750V   |
| Resistance Range        | 2K $\Omega$ - 68K $\Omega$ for E24 series value |        |
| Temperature Coefficient | $\pm 250\text{ppm}/^\circ\text{C}$              |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

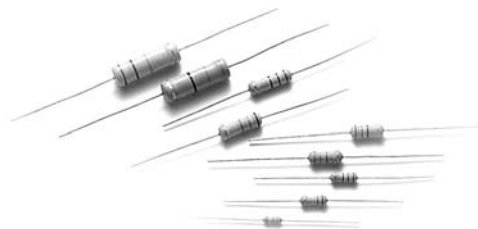
| PERFORMANCE TEST           | TEST METHOD      |                                                                                         | APPRAISE                           |
|----------------------------|------------------|-----------------------------------------------------------------------------------------|------------------------------------|
| Short Time Overload        | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                               | $\pm 0.25\% + 0.05 \Omega$         |
| Temperature Coefficient    | IEC 60115-1 4.8  | -55°C to +155°C                                                                         | $\pm 250\text{ppm}/^\circ\text{C}$ |
| Robustness of Terminations | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                          | $\geq 4\text{kg}$ (39.2N)          |
| Periodic-pulse Overload    | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                     | $\pm 1.0\% + 0.05 \Omega$          |
| Endurance at 70°C          | IEC 60115-1 4.25 | 70 $\pm 2^\circ\text{C}$ at RCWV for 1,000 Hr; (1.5 Hr. on, 0.5 Hr. off)                | $\pm 1.5\% + 0.05 \Omega$          |
| Temperature Cycling        | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles) | $\pm 0.75\% + 0.05 \Omega$         |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Metal Oxide Film Resistors

# Flame-Proof Type

## Normal & Miniature Style [ RSF Series ]



### INTRODUCTION

The RSF Series Metal Oxide Film Flame-Proof Resistors offer excellent performance in applications where stability and uniformity of characteristics are desired. They provide lower cost alternatives to Carbon Composition Resistors and General Purpose Metal Films. Metal Oxides also can replace many low power General Purpose wirewound applications, saving both money and time, with shorter delivery cycles. The normal style & the miniature style of RSF series are coated with layers of gray and pink colors flame-proof lacquer respectively.

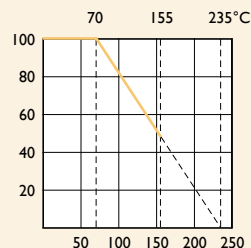
### FEATURES

|                                        |                            |
|----------------------------------------|----------------------------|
| Power Rating                           | 1/4W, 1/2W, 1W, 2W, 3W, 5W |
| Resistance Tolerance                   | ±2%, ±5%                   |
| T.C.R.                                 | ±300ppm/°C                 |
| Flameproof Multi-layer Coating Meets   | UL-94V-0                   |
| Flameproof Feature Meets Overload Test | UL-1412                    |

### DERATING CURVE

For resistors operated in ambient temperatures above 70°C, power rating must be derated in accordance with the curve below.

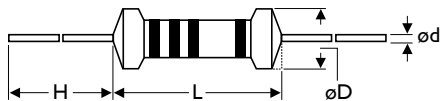
Rated Load (%)



Ambient Temperature (°C)

### DIMENSIONS

Unit: mm



| STYLE  |           | DIMENSION |         |        |           |
|--------|-----------|-----------|---------|--------|-----------|
| Normal | Miniature | L         | øD      | H      | ød        |
| RSF-25 | RSF50S    | 6.3±0.5   | 2.4±0.2 | 28±2.0 | 0.55±0.05 |
| RSF-50 | RSF1WS    | 9.0±0.5   | 3.3±0.3 | 26±2.0 | 0.55±0.05 |
| RSF100 | RSF2WS    | 11.5±1.0  | 4.5±0.5 | 35±2.0 | 0.8±0.05  |
| RSF200 | RSF3WS    | 15.5±1.0  | 5.0±0.5 | 33±2.0 | 0.8±0.05  |
| RSF3WM | RSF5SS    | 17.5±1.0  | 6.5±1.0 | 32±2.0 | 0.8±0.05  |
| RSF300 | RSF5WS    | 24.5±1.0  | 8.5±1.0 | 38±2.0 | 0.8±0.05  |
| RSF500 | -         | 24.5±1.0  | 8.5±1.0 | 38±2.0 | 0.8±0.05  |

Note: RSF1WS (for MB Type) ød = 0.8±0.05mm

## ELECTRICAL CHARACTERISTICS

### NORMAL STYLE

| STYLE                    | RSF-25                                                     | RSF-50 | RSF100 | RSF200 | RSF3WM | RSF300 | RSF500 |
|--------------------------|------------------------------------------------------------|--------|--------|--------|--------|--------|--------|
| Power Rating at 70°C     | 1/4W                                                       | 1/2W   | 1W     | 2W     | 3W     |        | 5W     |
| Maximum Working Voltage  | 200V                                                       | 250V   | 350V   |        | 450V   | 500V   | 750V   |
| Maximum Overload Voltage | 300V                                                       | 400V   | 600V   |        | 700V   | 800V   | 1,000V |
| Voltage Proof            | 250V                                                       | 350V   | 500V   |        | 600V   | 700V   | 750V   |
| Resistance Range         | 1 $\Omega$ - 1M $\Omega$ & 0 $\Omega$ for E24 series value |        |        |        |        |        |        |
| Operating Temp. Range    | -55°C to +235°C                                            |        |        |        |        |        |        |
| Temperature Coefficient  | $\pm 300$ ppm/°C                                           |        |        |        |        |        |        |

### MINIATURE STYLE

| STYLE                    | RSF50S                                                     | RSFIWS | RSF2WS | RSF3WS | RSF5SS | RSF5WS |
|--------------------------|------------------------------------------------------------|--------|--------|--------|--------|--------|
| Power Rating at 70°C     | 1/2W                                                       | 1W     | 2W     | 3W     | 5W     |        |
| Maximum Working Voltage  | 250V                                                       | 300V   | 350V   |        | 500V   | 700V   |
| Maximum Overload Voltage | 400V                                                       | 500V   | 600V   |        | 800V   | 900V   |
| Voltage Proof            | 350V                                                       | 400V   | 500V   |        | 700V   | 700V   |
| Resistance Range         | 1 $\Omega$ - 1M $\Omega$ & 0 $\Omega$ for E24 series value |        |        |        |        |        |
| Operating Temp. Range    | -55°C to +235°C                                            |        |        |        |        |        |
| Temperature Coefficient  | $\pm 300$ ppm/°C                                           |        |        |        |        |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

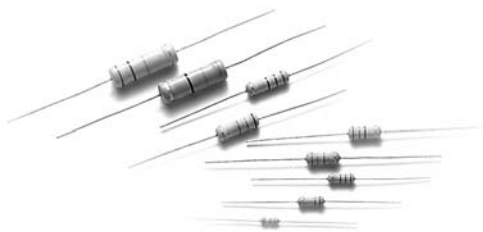
| PERFORMANCE TEST              | TEST METHOD      |                                                                                         | APPRAISE                                                                                    |
|-------------------------------|------------------|-----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                               | $\pm 1.0\% + 0.05 \Omega$ for normal style<br>$\pm 2.0\% + 0.05 \Omega$ for miniature style |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                            | By type                                                                                     |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                         | By type                                                                                     |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                  | >1,000M $\Omega$                                                                            |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm 5$ °C for 3 $\pm 0.5$ Sec.                                                     | 95% Min. coverage                                                                           |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm 0.5$ Min. with ultrasonic                                                | No deterioration of coatings and markings                                                   |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                          | $\geq 2.5$ kg (24.5N)                                                                       |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                     | $\pm 2.0\% + 0.05 \Omega$                                                                   |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm 2$ °C, 90-95% RH for 56 days, loaded with 0.1 times RCWV                        | $\pm 5.0\% + 0.05 \Omega$                                                                   |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm 2$ °C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                           | $\pm 5.0\% + 0.05 \Omega$                                                                   |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles) | $\pm 1.0\% + 0.05 \Omega$                                                                   |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm 3$ °C for 10 $\pm 1$ Sec., immersed to a point 3 $\pm 0.5$ mm from the body    | $\pm 1.0\% + 0.05 \Omega$                                                                   |
| Accidental Overload Test      | IEC 60115-1 4.26 | 4 times RCWV for 1 Min.                                                                 | No evidence of flaming or arcing                                                            |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Metal Oxide Film Resistors

# Low-Inductive & Flame-Proof Type

## Normal & Miniature Style [ LIR Series ]



### INTRODUCTION

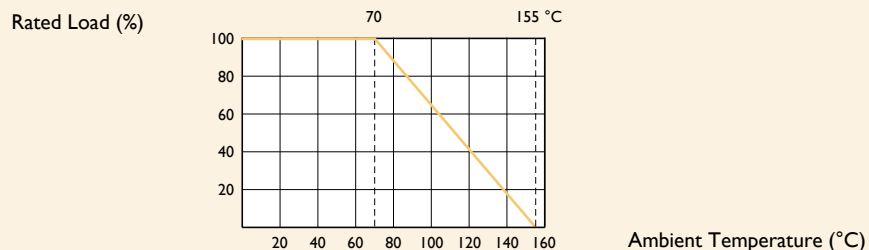
The LIR Series Metal Oxide Film Low-Inductive & Flame-Proof Resistors offer excellent performance in applications where stability and uniformity of characteristics are desired. They provide lower cost alternatives to Carbon Composition Resistors and General Purpose Metal Films. Metal Oxides also can replace many low power General Purpose wirewound applications, saving both money and time, with shorter delivery cycles. The normal style & the miniature style of LIR series are coated with layers of gray and pink colors flame-proof lacquer respectively.

### FEATURES

|                                        |                    |
|----------------------------------------|--------------------|
| Power Rating                           | 1/4W, 1/2W, 1W, 2W |
| Resistance Tolerance                   | ±5%, ±10%          |
| T.C.R.                                 | ±300ppm/°C         |
| Flameproof Multi-layer Coating Meets   | UL-94V-0           |
| Flameproof Feature Meets Overload Test | UL-1412            |

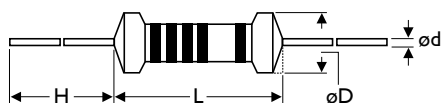
### DERATING CURVE

For resistors operated in ambient temperatures above 70°C, power rating must be derated in accordance with the curve below.



### DIMENSIONS

Unit: mm



5th color code: blue

| STYLE  |           | DIMENSION |         |        |           |
|--------|-----------|-----------|---------|--------|-----------|
| Normal | Miniature | L         | øD      | H      | ød        |
| LIR-25 | LIR50S    | 6.3±0.5   | 2.4±0.2 | 28±2.0 | 0.55±0.05 |
| LIR-50 | LIR1WS    | 9.0±0.5   | 3.3±0.3 | 26±2.0 | 0.55±0.05 |
| LIR100 | LIR2WS    | 11.5±1.0  | 4.5±0.5 | 35±2.0 | 0.8±0.05  |
| LIR200 | LIR3WS    | 15.5±1.0  | 5.0±0.5 | 33±2.0 | 0.8±0.05  |

Note: LIR1WS ( for MB Type ) ød 0.8±0.0 mm

## ELECTRICAL CHARACTERISTICS

### NORMAL STYLE

| STYLE                    | LIR-25                                                           | LIR-50 | LIR100 | LIR200 |
|--------------------------|------------------------------------------------------------------|--------|--------|--------|
| Power Rating at 70°C     | 1/4W                                                             | 1/2W   | 1W     | 2W     |
| Maximum Working Voltage  | 200V                                                             | 250V   | 350V   |        |
| Maximum Overload Voltage | 300V                                                             | 400V   | 600V   |        |
| Voltage Proof            | 250V                                                             | 350V   | 500V   |        |
| Resistance Range         | 1 $\Omega$ - 100K $\Omega$ & 0 $\Omega$ for E24 resistance value |        |        |        |
| Operating Temp. Range    | -55°C to +155°C                                                  |        |        |        |
| Temperature Coefficient  | $\pm 300\text{ppm}/^\circ\text{C}$                               |        |        |        |

### MINIATURE STYLE

| STYLE                    | LIR50S                                                           | LIR1WS | LIR2WS | LIR3WS |
|--------------------------|------------------------------------------------------------------|--------|--------|--------|
| Power Rating at 70°C     | 1/2W                                                             | 1W     | 2W     | 3W     |
| Maximum Working Voltage  | 250V                                                             | 300V   | 350V   |        |
| Maximum Overload Voltage | 400V                                                             | 500V   | 600V   |        |
| Voltage Proof            | 350V                                                             | 400V   | 500V   |        |
| Resistance Range         | 1 $\Omega$ - 100K $\Omega$ & 0 $\Omega$ for E24 resistance value |        |        |        |
| Operating Temp. Range    | -55°C to +155°C                                                  |        |        |        |
| Temperature Coefficient  | $\pm 300\text{ppm}/^\circ\text{C}$                               |        |        |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST              | TEST METHOD      |                                                                                                       | APPRAISE                                                                                |
|-------------------------------|------------------|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                                             | $\pm 1.0\%+0.05 \Omega$ for normal style<br>$\pm 2.0\%+0.05 \Omega$ for miniature style |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                                          | By type                                                                                 |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                                       | By type                                                                                 |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                                | >1,000M $\Omega$                                                                        |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm 5^\circ\text{C}$ for 3 $\pm 0.5$ Sec.                                                        | 95% Min. coverage                                                                       |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm 0.5$ Min. with ultrasonic                                                              | No deterioration of coatings and markings                                               |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                                        | $\geq 2.5\text{kg}$ (24.5N)                                                             |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                                   | $\pm 2.0\%+0.05 \Omega$                                                                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm 2^\circ\text{C}$ , 90-95% RH for 56 days, loaded with 0.1 times RCWV                          | $\pm 5.0\%+0.05 \Omega$                                                                 |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm 2^\circ\text{C}$ at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                              | $\pm 5.0\%+0.05 \Omega$                                                                 |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles)               | $\pm 1.0\%+0.05 \Omega$                                                                 |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm 3^\circ\text{C}$ for 10 $\pm 1$ Sec., immersed to a point 3 $\pm 0.5\text{mm}$ from the body | $\pm 1.0\%+0.05 \Omega$                                                                 |
| Accidental Overload Test      | IEC 60115-1 4.26 | 4 times RCWV for 1 Min.                                                                               | No evidence of flaming or arcing                                                        |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Melf Metal Film Resistors

# General Type

## Normal & Miniature Style [ MMF Series ]



### INTRODUCTION

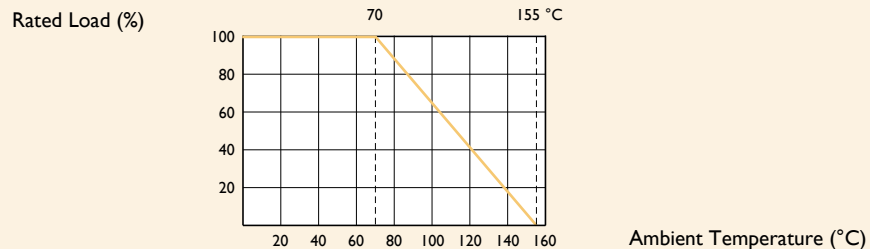
The MMF Series Melf Metal Film Resistors are manufactured using a vacuum sputtering system to deposit multiple layers of mixed metal alloys and passivative materials onto a carefully treated high grade ceramic substrate. After a helical groove has been cut in the resistive layer, SMD enabled structure. The resistors are coated with layers of blue color lacquer.

### FEATURES

|                      |                                                         |
|----------------------|---------------------------------------------------------|
| Power Rating         | 1/6W, 1/4W, 0.4W, 1/2W, 0.6W, 1W                        |
| Resistance Tolerance | ±0.1%, ±0.25%, ±0.5%, ±1%, ±2%, ±5%                     |
| T.C.R.               | ±15ppm/°C, ±25ppm/°C, ±50ppm/°C, ±100ppm/°C, ±200ppm/°C |

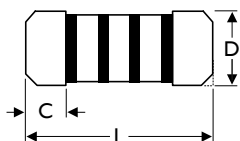
### DERATING CURVE

For resistors operated in ambient temperatures above 70°C, power rating must be derated in accordance with the curve below.



### DIMENSIONS

Unit: mm



| STYLE  |                 | DIMENSION |           |        |
|--------|-----------------|-----------|-----------|--------|
| Normal | Miniature       | L         | D         | C Min. |
| MMF-12 | MMF25S / MMF204 | 3.50±0.2  | 1.40±0.15 | 0.5    |
| MMF-25 | MMF50S / MMF207 | 5.90±0.2  | 2.20±0.1  | 0.5    |
| MMF-50 | MMF1WS          | 8.50±0.2  | 3.20±0.2  | 0.5    |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                    | MMF-12                                                                                                                                                                              | MMF25S | MMF204 | MMF-25 | MMF50S | MMF207 | MMF-50 | MMFIWS |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|
| Power Rating at 70°C     | 1/6W                                                                                                                                                                                | 1/4W   | 0.4W   | 1/4W   | 1/2W   | 0.6W   | 1/2W   | 1W     |
| Maximum Working Voltage  | 150V                                                                                                                                                                                | 200V   |        | 250V   |        |        | 350V   |        |
| Maximum Overload Voltage | 300V                                                                                                                                                                                | 400V   |        | 500V   |        |        | 700V   |        |
| Voltage Proof            | 300V                                                                                                                                                                                |        |        | 500V   |        |        | 700V   |        |
| Resistance Range         | 1 $\Omega$ - 1M $\Omega$ & 0 $\Omega$ for E24 & E96 series value, 100 $\Omega$ - 100K $\Omega$ for E192 series value                                                                |        |        |        |        |        |        |        |
| Operating Temp. Range    | -55°C to +155°C                                                                                                                                                                     |        |        |        |        |        |        |        |
| Temperature Coefficient  | $\pm 15\text{ppm}/^\circ\text{C}$ , $\pm 25\text{ppm}/^\circ\text{C}$ , $\pm 50\text{ppm}/^\circ\text{C}$ , $\pm 100\text{ppm}/^\circ\text{C}$ , $\pm 200\text{ppm}/^\circ\text{C}$ |        |        |        |        |        |        |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST              | TEST METHOD      |                                                                                                       | APPRAISE                                  |
|-------------------------------|------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                                             | $\pm 0.5\% + 0.05 \Omega$                 |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                                          | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                                       | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                                | $> 10,000M \Omega$                        |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm 5^\circ\text{C}$ for 3 $\pm 0.5$ Sec.                                                        | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm 0.5$ Min. with ultrasonic                                                              | No deterioration of coatings and markings |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                                   | $\pm 1.0\% + 0.05 \Omega$                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm 2^\circ\text{C}$ , 90-95% RH for 56 days, loaded with 0.1 times RCWV                          | $\pm 2.0\% + 0.1 \Omega$                  |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm 2^\circ\text{C}$ at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                              | $\pm 2.0\% + 0.1 \Omega$                  |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles)               | $\pm 0.75\% + 0.05 \Omega$                |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm 3^\circ\text{C}$ for 10 $\pm 1$ Sec., immersed to a point 3 $\pm 0.5\text{mm}$ from the body | $\pm 0.5\% + 0.05 \Omega$                 |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Melf Metal Film Resistors

# High Power Type

## Ultra Miniature Style [ MMP Series ]



### INTRODUCTION

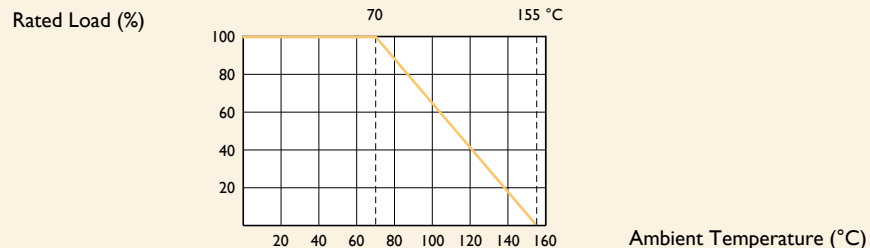
The MMP Series Melf Metal Film High Power Resistors are manufactured using a vacuum sputtering system to deposit multiple layers of mixed metal alloys and passivative materials onto a carefully treated high grade ceramic substrate. After a helical groove has been cut in the resistive layer, SMD enabled structure and high power in small packages. The resistors are coated with layers of lacquer.

### FEATURES

|                      |                                                                                                                   |
|----------------------|-------------------------------------------------------------------------------------------------------------------|
| Power Rating         | 1W, 2W                                                                                                            |
| Resistance Tolerance | $\pm 1\%$ , $\pm 2\%$ , $\pm 5\%$                                                                                 |
| T.C.R.               | $\pm 50\text{ppm}/^{\circ}\text{C}$ , $\pm 100\text{ppm}/^{\circ}\text{C}$ , $\pm 200\text{ppm}/^{\circ}\text{C}$ |

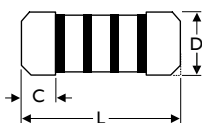
### DERATING CURVE

For resistors operated in ambient temperatures above  $70^{\circ}\text{C}$ , power rating must be derated in accordance with the curve below.



### DIMENSIONS

Unit: mm



| STYLE           | DIMENSION     |               |        |
|-----------------|---------------|---------------|--------|
| Ultra Miniature | L             | D             | C Min. |
| MMP100          | $5.9 \pm 0.2$ | $2.2 \pm 0.1$ | 0.5    |
| MMP200          | $8.5 \pm 0.2$ | $3.2 \pm 0.2$ | 0.5    |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                    | MMP100                                                                                                      | MMP200 |
|--------------------------|-------------------------------------------------------------------------------------------------------------|--------|
| Power Rating at 70°C     | 1W                                                                                                          | 2W     |
| Maximum Working Voltage  | 350V                                                                                                        |        |
| Maximum Overload Voltage | 700V                                                                                                        |        |
| Voltage Proof            | 500V                                                                                                        |        |
| Resistance Range         | 1 $\Omega$ - 1M $\Omega$ & 0 $\Omega$ for E24 & E96 series value                                            |        |
| Operating Temp. Range    | -55°C to +155°C                                                                                             |        |
| Temperature Coefficient  | $\pm 50\text{ppm}/^\circ\text{C}$ , $\pm 100\text{ppm}/^\circ\text{C}$ , $\pm 200\text{ppm}/^\circ\text{C}$ |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST              | TEST METHOD      |                                                                                                       | APPRAISE                                  |
|-------------------------------|------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                                             | $\pm 0.5\% + 0.05 \Omega$                 |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                                          | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                                       | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                                | $> 10,000\text{M} \Omega$                 |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm 5^\circ\text{C}$ for 3 $\pm 0.5$ Sec.                                                        | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm 0.5$ Min. with ultrasonic                                                              | No deterioration of coatings and markings |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                                   | $\pm 1.0\% + 0.05 \Omega$                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm 2^\circ\text{C}$ , 90-95% RH for 56 days, loaded with 0.1 times RCWV                          | $\pm 2.0\% + 0.1 \Omega$                  |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm 2^\circ\text{C}$ at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                              | $\pm 2.0\% + 0.1 \Omega$                  |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles)               | $\pm 0.75\% + 0.05 \Omega$                |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm 3^\circ\text{C}$ for 10 $\pm 1$ Sec., immersed to a point 3 $\pm 0.5\text{mm}$ from the body | $\pm 0.5\% + 0.05 \Omega$                 |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Carbon Film Resistors

# General Type

## Normal & Miniature Style [ CFR Series ]



### INTRODUCTION

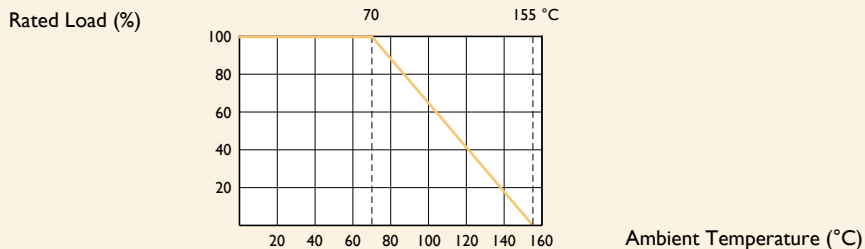
The CFR Series Carbon Film Resistors are manufactured by coating a homogeneous film of pure carbon on high grade ceramic rods. After a helical groove has been cut in the resistive layer, tinned connecting leads of electrolytic copper are welded to the end-caps. The resistors are coated with layers of tan color lacquer.

### FEATURES

|                      |                              |
|----------------------|------------------------------|
| Power Rating         | 1/6W, 1/4W, 1/2W, 1W, 2W, 3W |
| Resistance Tolerance | ±2%, ±5%                     |
| T.C.R.               | see Table I                  |

### DERATING CURVE

For resistors operated in ambient temperatures above 70°C, power rating must be derated in accordance with the curve below.

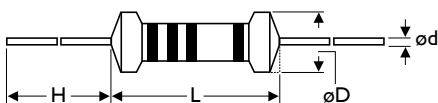


### TABLE I TEMPERATURE COEFFICIENT

| STYLE                                             | MAX. VALUE OF TEMP. COEFFICIENT PPM/°C |               |              |
|---------------------------------------------------|----------------------------------------|---------------|--------------|
|                                                   | under 100K Ω                           | 100K Ω - 1M Ω | 1M Ω - 10M Ω |
| CFR100, CFR200, CFR2WS, CFR3WS                    | ±350                                   | -500          | -1,500       |
| CFR-12, CFR-25, CFR-50,<br>CFR25S, CFR50S, CFR1WS | +350 / -500                            | -700          | -1,500       |

### DIMENSIONS

Unit: mm



| STYLE  |           | DIMENSION |         |        |           |
|--------|-----------|-----------|---------|--------|-----------|
| Normal | Miniature | L         | øD      | H      | ød        |
| CFR-12 | CFR25S    | 3.4±0.3   | 1.9±0.2 | 28±2.0 | 0.45±0.05 |
| CFR-25 | CFR50S    | 6.3±0.5   | 2.4±0.2 | 28±2.0 | 0.55±0.05 |
| CFR-50 | CFR1WS    | 9.0±0.5   | 3.3±0.3 | 26±2.0 | 0.55±0.05 |
| CFR100 | CFR2WS    | 11.5±1.0  | 4.5±0.5 | 35±2.0 | 0.8±0.05  |
| CFR200 | CFR3WS    | 15.5±1.0  | 5.0±0.5 | 33±2.0 | 0.8±0.05  |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                    | CFR-I2                                                      | CFR25S | CFR-25 | CFR50S | CFR-50 | CFRIWS | CFRI00 | CFR2WS | CFR200 | CFR3WS |
|--------------------------|-------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Power Rating at 70°C     | 1/6W                                                        | 1/4W   |        | 1/2W   |        | 1W     |        | 2W     |        | 3W     |
| Maximum Working Voltage  | 150V                                                        | 200V   | 250V   | 300V   | 350V   | 400V   | 500V   |        |        |        |
| Maximum Overload Voltage | 300V                                                        | 400V   | 500V   | 600V   | 700V   | 800V   | 1,000V |        |        |        |
| Voltage Proof            | 300V                                                        | 400V   | 500V   |        |        | 700V   | 1,000V |        |        |        |
| Resistance Range         | 1 $\Omega$ - 10M $\Omega$ & 0 $\Omega$ for E24 series value |        |        |        |        |        |        |        |        |        |
| Operating Temp. Range    | -55°C to +155°C                                             |        |        |        |        |        |        |        |        |        |
| Temperature Coefficient  | see Table I                                                 |        |        |        |        |        |        |        |        |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST              | TEST METHOD      |                                                                                                       | APPRAISE                                  |
|-------------------------------|------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                                             | $\pm 0.75\% + 0.05 \Omega$                |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                                          | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                                       | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                                | $> 1,000M \Omega$                         |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm 5^\circ\text{C}$ for 3 $\pm 0.5$ Sec.                                                        | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm 0.5$ Min. with ultrasonic                                                              | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                                        | $\geq 2.5\text{kg}$ (24.5N)               |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                                   | $\pm 1.0\% + 0.05 \Omega$                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm 2^\circ\text{C}$ , 90-95% RH for 56 days, loaded with 0.1 times RCWV                          | $\pm 3.0\% + 0.05 \Omega$                 |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm 2^\circ\text{C}$ at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                              | $\pm 3.0\% + 0.05 \Omega$                 |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles)               | $\pm 1.0\% + 0.05 \Omega$                 |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm 3^\circ\text{C}$ for 10 $\pm 1$ Sec., immersed to a point 3 $\pm 0.5\text{mm}$ from the body | $\pm 1.0\% + 0.05 \Omega$                 |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Carbon Film Resistors

# Professional Type

## Miniature Style [ CF0 Series ]



### INTRODUCTION

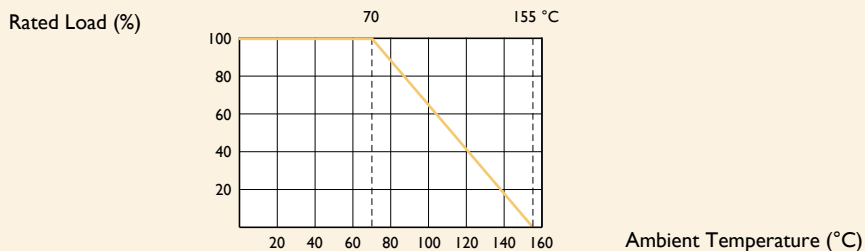
The CF0 Series Carbon Film Professional Resistors are manufactured by coating a homogeneous film of pure carbon on high grade ceramic rods. After a helical groove has been cut in the resistive layer, tinned connecting leads of electrolytic copper are welded to the end-caps. The resistors are coated with layers of tan color lacquer.

### FEATURES

|                      |             |
|----------------------|-------------|
| Power Rating         | 0.4W, 0.6W  |
| Resistance Tolerance | ±2%, ±5%    |
| T.C.R.               | see Table I |

### DERATING CURVE

For resistors operated in ambient temperatures above 70°C, power rating must be derated in accordance with the curve below.

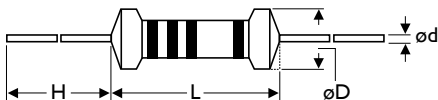


### TABLE I TEMPERATURE COEFFICIENT

| STYLE          | MAX. VALUE OF TEMP. COEFFICIENT PPM/°C |                             |                            |
|----------------|----------------------------------------|-----------------------------|----------------------------|
|                | under 100K $\Omega$                    | 100K $\Omega$ - 1M $\Omega$ | 1M $\Omega$ - 10M $\Omega$ |
| CF0204, CF0207 | +350 / -500                            | -700                        | -1,500                     |

### DIMENSIONS

Unit: mm



| STYLE     | DIMENSION |          |        |           |
|-----------|-----------|----------|--------|-----------|
| Miniature | L         | $\phi D$ | H      | $\phi d$  |
| CF0204    | 3.4±0.3   | 1.9±0.2  | 28±2.0 | 0.45±0.05 |
| CF0207    | 6.3±0.5   | 2.4±0.2  | 28±2.0 | 0.55±0.05 |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                    | CF0204                                                      | CF0207 |
|--------------------------|-------------------------------------------------------------|--------|
| Power Rating at 70°C     | 0.4W                                                        | 0.6W   |
| Maximum Working Voltage  | 200V                                                        | 300V   |
| Maximum Overload Voltage | 400V                                                        | 600V   |
| Voltage Proof            | 300V                                                        | 500V   |
| Resistance Range         | 1 $\Omega$ - 10M $\Omega$ & 0 $\Omega$ for E24 series value |        |
| Operating Temp. Range    | -55°C to +155°C                                             |        |
| Temperature Coefficient  | see Table I                                                 |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

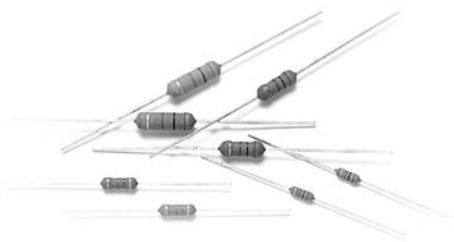
| PERFORMANCE TEST              | TEST METHOD      |                                                                                         | APPRAISE                                  |
|-------------------------------|------------------|-----------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                               | $\pm 0.75\% + 0.05 \Omega$                |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                            | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                         | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                  | $> 1,000M \Omega$                         |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm$ 5°C for 3 $\pm$ 0.5 Sec.                                                      | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm$ 0.5 Min. with ultrasonic                                                | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                          | $\geq 2.5\text{kg}$ (24.5N)               |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                     | $\pm 1.0\% + 0.05 \Omega$                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm$ 2°C, 90-95% RH for 56 days, loaded with 0.1 times RCWV                         | $\pm 3.0\% + 0.05 \Omega$                 |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm$ 2°C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                            | $\pm 3.0\% + 0.05 \Omega$                 |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles) | $\pm 1.0\% + 0.05 \Omega$                 |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm$ 3°C for 10 $\pm$ 1 Sec., immersed to a point 3 $\pm$ 0.5mm from the body      | $\pm 1.0\% + 0.05 \Omega$                 |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Carbon Film Resistors

# Flame-Proof Type

## Normal & Miniature Style [ FCR Series ]



### INTRODUCTION

The FCR Series Carbon Film Flame-Proof Resistors are manufactured by coating a homogeneous film of pure carbon on high grade ceramic rods. After a helical groove has been cut in the resistive layer, tinned connecting leads of electrolytic copper are welded to the end-caps. The resistors are coated with layers of gray color lacquer.

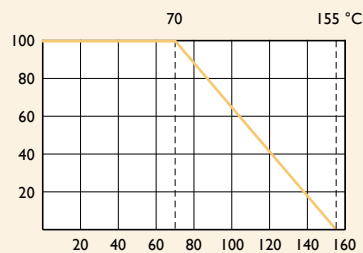
### FEATURES

|                                        |                        |
|----------------------------------------|------------------------|
| Power Rating                           | 1/4W, 1/2W, 1W, 2W, 3W |
| Resistance Tolerance                   | ±2%, ±5%               |
| T.C.R.                                 | see Table I            |
| Flameproof Multi-layer Coating Meets   | UL-94V-0               |
| Flameproof Feature Meets Overload Test | UL-1412                |

### DERATING CURVE

For resistors operated in ambient temperatures above 70°C, power rating must be derated in accordance with the curve below.

Rated Load (%)



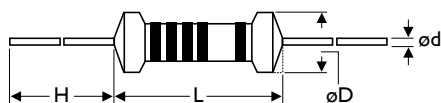
Ambient Temperature (°C)

### TABLE I TEMPERATURE COEFFICIENT

| STYLE                          | MAX. VALUE OF TEMP. COEFFICIENT PPM/°C |               |              |
|--------------------------------|----------------------------------------|---------------|--------------|
|                                | under 100K Ω                           | 100K Ω - 1M Ω | 1M Ω - 10M Ω |
| FCR100, FCR200, FCR2WS, FCR3WS | ±350                                   | -500          | -1,500       |
| FCR-25, FCR-50, FCR50S, FCR1WS | +350 / -500                            | -700          | -1,500       |

### DIMENSIONS

Unit: mm



5th color code: black

| STYLE  |           | DIMENSION |         |        |           |
|--------|-----------|-----------|---------|--------|-----------|
| Normal | Miniature | L         | øD      | H      | ød        |
| FCR-25 | FCR50S    | 6.3±0.5   | 2.4±0.2 | 28±2.0 | 0.55±0.05 |
| FCR-50 | FCR1WS    | 9.0±0.5   | 3.3±0.3 | 26±2.0 | 0.55±0.05 |
| FCR100 | FCR2WS    | 11.5±1.0  | 4.5±0.5 | 35±2.0 | 0.8±0.05  |
| FCR200 | FCR3WS    | 15.5±1.0  | 5.0±0.5 | 33±2.0 | 0.8±0.05  |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                    | FCR-25                                                      | FCR50S | FCR-50 | FCRIWS | FCRI00 | FCR2WS | FCR200 | FCR3WS |
|--------------------------|-------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|
| Power Rating at 70°C     | 1/4W                                                        | 1/2W   |        | 1W     |        | 2W     |        | 3W     |
| Maximum Working Voltage  | 250V                                                        | 300V   | 350V   | 400V   | 500V   |        |        |        |
| Maximum Overload Voltage | 500V                                                        | 600V   | 700V   | 800V   | 1,000V |        |        |        |
| Voltage Proof            | 400V                                                        |        | 500V   | 600V   | 750V   |        |        |        |
| Resistance Range         | 1 $\Omega$ - 10M $\Omega$ & 0 $\Omega$ for E24 series value |        |        |        |        |        |        |        |
| Operating Temp. Range    | -55°C to +155°C                                             |        |        |        |        |        |        |        |
| Temperature Coefficient  | see Table I                                                 |        |        |        |        |        |        |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

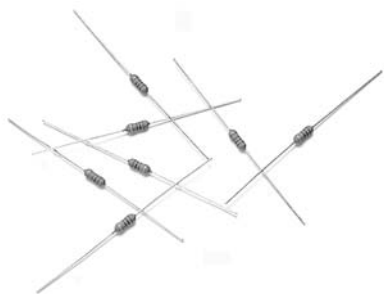
| PERFORMANCE TEST              | TEST METHOD      |                                                                                         | APPRAISE                                  |
|-------------------------------|------------------|-----------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                               | $\pm 0.75\% + 0.05 \Omega$                |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                            | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                         | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                  | $> 1,000M \Omega$                         |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm$ 5°C for 3 $\pm$ 0.5 Sec.                                                      | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm$ 0.5 Min. with ultrasonic                                                | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                          | $\geq 2.5\text{kg}$ (24.5N)               |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                     | $\pm 1.0\% + 0.05 \Omega$                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm$ 2°C, 90-95% RH for 56 days, loaded with 0.1 times RCWV                         | $\pm 3.0\% + 0.05 \Omega$                 |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm$ 2°C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                            | $\pm 3.0\% + 0.05 \Omega$                 |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles) | $\pm 1.0\% + 0.05 \Omega$                 |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm$ 3°C for 10 $\pm$ 1 Sec., immersed to a point 3 $\pm$ 0.5mm from the body      | $\pm 1.0\% + 0.05 \Omega$                 |
| Accidental Overload Test      | IEC 60115-1 4.26 | 4 times RCWV for 1 Min.                                                                 | No evidence of flaming or arcing          |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Carbon Film Resistors

# Professional & Flame-Proof Type

## Miniature Style [ FC0 Series ]



### INTRODUCTION

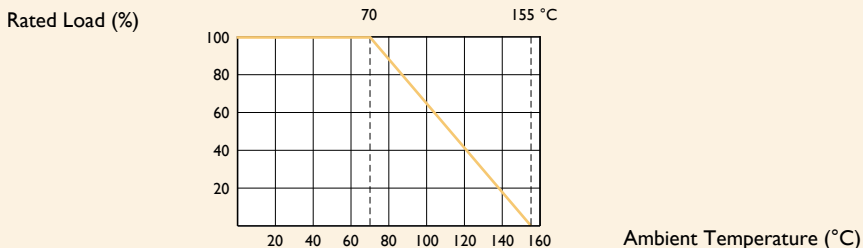
The FC0 Series Carbon Film Professional & Flame-Proof Resistors are manufactured by coating a homogeneous film of pure carbon on high grade ceramic rods. After a helical groove has been cut in the resistive layer, tinned connecting leads of electrolytic copper are welded to the end-caps. The resistors are coated with layers of green color lacquer.

### FEATURES

|                                        |                       |
|----------------------------------------|-----------------------|
| Power Rating                           | 0.4W, 0.6W            |
| Resistance Tolerance                   | $\pm 2\%$ , $\pm 5\%$ |
| T.C.R.                                 | see Table I           |
| Flameproof Multi-layer Coating Meets   | UL-94V-0              |
| Flameproof Feature Meets Overload Test | UL-1412               |

### DERATING CURVE

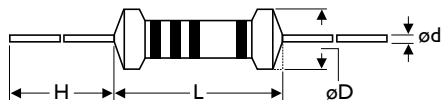
For resistors operated in ambient temperatures above 70°C, power rating must be derated in accordance with the curve below.



### TABLE I TEMPERATURE COEFFICIENT

| STYLE          | MAX. VALUE OF TEMP. COEFFICIENT PPM/°C |                             |                            |
|----------------|----------------------------------------|-----------------------------|----------------------------|
|                | under 100K $\Omega$                    | 100K $\Omega$ - 1M $\Omega$ | 1M $\Omega$ - 10M $\Omega$ |
| FC0204, FC0207 | +300 / -500                            | -700                        | -1,500                     |

### DIMENSIONS



Unit: mm

| STYLE     | DIMENSION     |               |              |                 |
|-----------|---------------|---------------|--------------|-----------------|
| Miniature | L             | øD            | H            | ød              |
| FC0204    | 3.4 $\pm$ 0.3 | 1.9 $\pm$ 0.2 | 28 $\pm$ 2.0 | 0.45 $\pm$ 0.05 |
| FC0207    | 6.3 $\pm$ 0.5 | 2.4 $\pm$ 0.2 | 28 $\pm$ 2.0 | 0.55 $\pm$ 0.05 |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                    | FC0204                                                      | FC0207 |
|--------------------------|-------------------------------------------------------------|--------|
| Power Rating at 70°C     | 0.4W                                                        | 0.6W   |
| Maximum Working Voltage  | 200V                                                        | 300V   |
| Maximum Overload Voltage | 400V                                                        | 600V   |
| Voltage Proof            | 300V                                                        | 500V   |
| Resistance Range         | 1 $\Omega$ - 10M $\Omega$ & 0 $\Omega$ for E24 series value |        |
| Operating Temp. Range    | -55°C to +155°C                                             |        |
| Temperature Coefficient  | see Table I                                                 |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

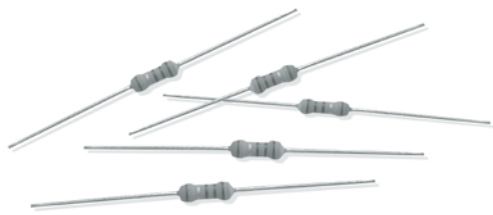
| PERFORMANCE TEST              | TEST METHOD      |                                                                                         | APPRAISE                                  |
|-------------------------------|------------------|-----------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                               | $\pm 0.75\% + 0.05 \Omega$                |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                            | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                         | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                  | >1,000M $\Omega$                          |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm$ 5°C for 3 $\pm$ 0.5 Sec.                                                      | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm$ 0.5 Min. with ultrasonic                                                | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                          | $\geq 2.5\text{kg}$ (24.5N)               |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                     | $\pm 1.0\% + 0.05 \Omega$                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm$ 2°C, 90-95% RH for 56 days, loaded with 0.1 times RCWV                         | $\pm 3.0\% + 0.05 \Omega$                 |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm$ 2°C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                            | $\pm 3.0\% + 0.05 \Omega$                 |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles) | $\pm 1.0\% + 0.05 \Omega$                 |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm$ 3°C for 10 $\pm$ 1 Sec., immersed to a point 3 $\pm$ 0.5mm from the body      | $\pm 1.0\% + 0.05 \Omega$                 |
| Accidental Overload Test      | IEC 60115-1 4.26 | 4 times RCWV for 1 Min.                                                                 | No evidence of flaming or arcing          |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Carbon Film Resistors

# Non-Inductive & Flame-Proof Type

## Normal & Miniature Style [ NCR Series ]



### INTRODUCTION

The NCR Series Carbon Film Non-Inductive & Flame-Proof Resistors are manufactured by coating a homogeneous film of pure carbon on high grade ceramic rods. Tinned connecting leads of electrolytic copper are welded to the end-caps. The inductance is  $< 1 \mu\text{H}$ .

The resistors are coated with layers of gray color lacquer for normal size & pink color lacquer for miniature size.

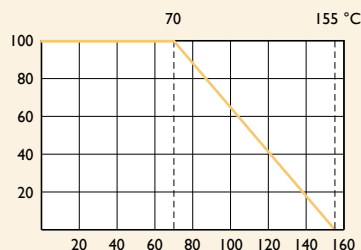
### FEATURES

|                                        |                        |
|----------------------------------------|------------------------|
| Power Rating                           | 1/4W, 1/2W, 1W, 2W, 3W |
| Resistance Tolerance                   | $\pm 5\%$ , $\pm 10\%$ |
| T.C.R.                                 | see Table I            |
| Flameproof Multi-layer Coating Meets   | UL-94V-0               |
| Flameproof Feature Meets Overload Test | UL-1412                |

### DERATING CURVE

For resistors operated in ambient temperatures above  $70^\circ\text{C}$ , power rating must be derated in accordance with the curve below.

Rated Load (%)



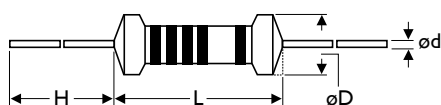
Ambient Temperature ( $^\circ\text{C}$ )

### TABLE I TEMPERATURE COEFFICIENT

| VALUE RANGE                      | MAX. VALUE OF TEMP. COEFFICIENT PPM/ $^\circ\text{C}$ |
|----------------------------------|-------------------------------------------------------|
| Under $5\text{K } \Omega$        | -500                                                  |
| $5\text{K} - 10\text{K } \Omega$ | -800                                                  |

### DIMENSIONS

Unit: mm



5th color code: green

| STYLE  |           | DIMENSION      |               |              |                 |
|--------|-----------|----------------|---------------|--------------|-----------------|
| Normal | Miniature | L              | øD            | H            | ød              |
| NCR-25 | NCR50S    | $6.3 \pm 0.5$  | $2.4 \pm 0.2$ | $28 \pm 2.0$ | $0.55 \pm 0.05$ |
| NCR-50 | NCR1WS    | $9.0 \pm 0.5$  | $3.3 \pm 0.3$ | $26 \pm 2.0$ | $0.55 \pm 0.05$ |
| NCR100 | NCR2WS    | $11.5 \pm 1.0$ | $4.5 \pm 0.5$ | $35 \pm 2.0$ | $0.8 \pm 0.05$  |
| NCR200 | NCR3WS    | $15.5 \pm 1.0$ | $5.0 \pm 0.5$ | $33 \pm 2.0$ | $0.8 \pm 0.05$  |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                    | NCR-25                             | NCR50S | NCR-50 | NCRIWS | NCR100 | NCR2WS | NCR200 | NCR3WS |
|--------------------------|------------------------------------|--------|--------|--------|--------|--------|--------|--------|
| Power Rating at 70°C     | 1/4W                               | 1/2W   |        | 1W     |        | 2W     |        | 3W     |
| Maximum Working Voltage  | 250V                               | 300V   | 350V   | 400V   | 500V   |        |        |        |
| Maximum Overload Voltage | 500V                               | 600V   | 700V   | 800V   | 1,000V |        |        |        |
| Voltage Proof            | 500V                               |        | 700V   |        | 1,000V |        |        |        |
| Resistance Range         | 2.2 Ω - 10K Ω for E24 series value |        |        |        |        |        |        |        |
| Operating Temp. Range    | -55°C to +155°C                    |        |        |        |        |        |        |        |
| Temperature Coefficient  | see Table I                        |        |        |        |        |        |        |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST              | TEST METHOD      |                                                                  | APPRAISE                                                           |
|-------------------------------|------------------|------------------------------------------------------------------|--------------------------------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                        | ±0.75%+0.05 Ω for normal style<br>±2.0%+0.05 Ω for miniature style |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                     | By type                                                            |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                  | By type                                                            |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                           | >1,000M Ω                                                          |
| Solderability                 | IEC 60115-1 4.17 | 235±5°C for 3±0.5 Sec.                                           | 95% Min. coverage                                                  |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5±0.5 Min. with ultrasonic                               | No deterioration of coatings and markings                          |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads   | ≥2.5kg (24.5N)                                                     |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)              | ±1.0%+0.05 Ω                                                       |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40±2°C, 90-95% RH for 56 days, loaded with 0.1 times RCWV        | ±3.0%+0.05 Ω                                                       |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70±2°C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)           | ±3.0%+0.05 Ω                                                       |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C ⇄ Room Temp. ⇄ +155°C ⇄ Room Temp. (5 cycles)              | ±1.0%+0.05 Ω                                                       |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260±3°C for 10±1 Sec., immersed to a point 3±0.5mm from the body | ±1.0%+0.05 Ω                                                       |
| Accidental Overload Test      | IEC 60115-1 4.26 | 4 times RCWV for 1 Min.                                          | No evidence of flaming or arcing                                   |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Carbon Film Resistors

# Biased Humidity Type

## Normal & Miniature Style [ CFN Series ]



### INTRODUCTION

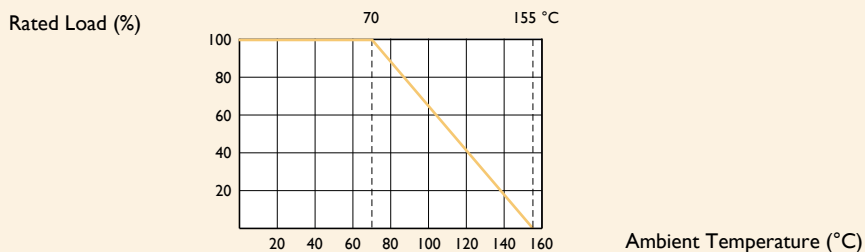
The CFN Series Carbon Film Biased Humidity Resistors are manufactured by coating a homogeneous film of pure carbon on high grade ceramic rods. After a helical groove has been cut in the resistive layer, tinned connecting leads of electrolytic copper are welded to the end-caps. The resistors are coated with a specialized tan lacquer. Its processes and controls ensure the product is impervious to moisture.

### FEATURES

|                      |                              |
|----------------------|------------------------------|
| Power Rating         | 1/6W, 1/4W, 1/2W, 1W, 2W, 3W |
| Resistance Tolerance | ±2%, ±5%                     |
| T.C.R.               | see Table I                  |

### DERATING CURVE

For resistors operated in ambient temperatures above 70°C, power rating must be derated in accordance with the curve below.

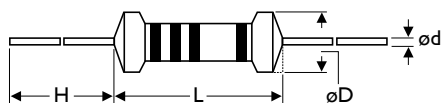


### TABLE I TEMPERATURE COEFFICIENT

| STYLE                                          | MAX. VALUE OF TEMP. COEFFICIENT PPM/°C |               |              |
|------------------------------------------------|----------------------------------------|---------------|--------------|
|                                                | under 100K Ω                           | 100K Ω - 1M Ω | 1M Ω - 10M Ω |
| CFN100, CFN200, CFN2WS, CFN3WS                 | ±350                                   | -500          | -1,500       |
| CFN-12, CFN-25, CFN-50, CFN25S, CFN50S, CFN1WS | +350 / -500                            | -700          | -1,500       |

Unit: mm

### DIMENSIONS



| STYLE  |           | DIMENSION |         |        |           |
|--------|-----------|-----------|---------|--------|-----------|
| Normal | Miniature | L         | øD      | H      | ød        |
| CFN-12 | CFN25S    | 3.4±0.3   | 1.9±0.2 | 28±2.0 | 0.45±0.05 |
| CFN-25 | CFN50S    | 6.3±0.5   | 2.4±0.2 | 28±2.0 | 0.55±0.05 |
| CFN-50 | CFN1WS    | 9.0±0.5   | 3.3±0.3 | 26±2.0 | 0.55±0.05 |
| CFN100 | CFN2WS    | 11.5±1.0  | 4.5±0.5 | 35±2.0 | 0.8±0.05  |
| CFN200 | CFN3WS    | 15.5±1.0  | 5.0±0.5 | 33±2.0 | 0.8±0.05  |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                    | CFN-12                                                      | CFN25S | CFN-25 | CFN50S | CFN-50 | CFNIWS | CFN100 | CFN2WS | CFN200 | CFN3WS |
|--------------------------|-------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Power Rating at 70°C     | 1/6W                                                        | 1/4W   |        | 1/2W   |        | 1W     |        | 2W     |        | 3W     |
| Maximum Working Voltage  | 150V                                                        | 200V   | 250V   | 300V   | 350V   | 400V   | 500V   |        |        |        |
| Maximum Overload Voltage | 300V                                                        | 400V   | 500V   | 600V   | 700V   | 800V   | 1,000V |        |        |        |
| Voltage Proof            | 300V                                                        | 400V   | 500V   |        |        | 700V   | 1,000V |        |        |        |
| Resistance Range         | 1 $\Omega$ - 10M $\Omega$ & 0 $\Omega$ for E24 series value |        |        |        |        |        |        |        |        |        |
| Operating Temp. Range    | -55°C to +155°C                                             |        |        |        |        |        |        |        |        |        |
| Temperature Coefficient  | see Table I                                                 |        |        |        |        |        |        |        |        |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST              | TEST METHOD      |                                                                                                       | APPRAISE                                  |
|-------------------------------|------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                                             | $\pm 0.75\% + 0.05 \Omega$                |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                                          | No breakdown or flashover                 |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                                       | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                                | >1,000M                                   |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm 5^\circ\text{C}$ for 3 $\pm 0.5$ Sec.                                                        | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm 0.5$ Min. with ultrasonic                                                              | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                                        | $\geq 2.5\text{kg}$ (24.5N)               |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                                   | $\pm 1.0\% + 0.05 \Omega$                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm 2^\circ\text{C}$ , 90-95% RH for 56 days, loaded with 0.1 times RCWV                          | $\pm 3\% + 0.05 \Omega$                   |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm 2^\circ\text{C}$ at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                              | $\pm 3\% + 0.05 \Omega$                   |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles)               | $\pm 1\% + 0.05 \Omega$                   |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm 3^\circ\text{C}$ for 10 $\pm 1$ Sec., immersed to a point 3 $\pm 0.5\text{mm}$ from the body | $\pm 1\% + 0.05 \Omega$                   |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Melf Carbon Film Resistors

# General Type

## Normal & Miniature Style [ MCF Series ]



### INTRODUCTION

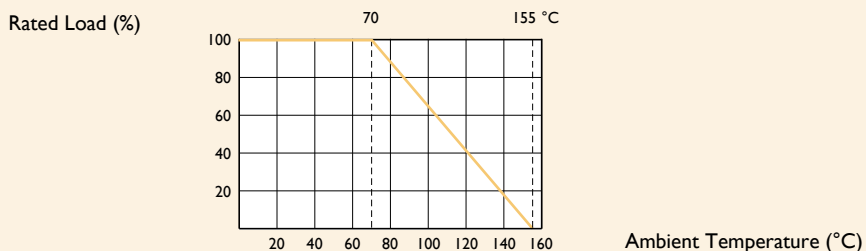
The MCF Series Melf Carbon Film Resistors are manufactured by coating a homogeneous film of pure carbon on high grade ceramic rods. After a helical groove has been cut in the resistive layer, tinned connecting leads of electrolytic copper are welded to the end-caps. SMD enabled structure. The resistors are coated with layers of lacquer.

### FEATURES

|                      |                                  |
|----------------------|----------------------------------|
| Power Rating         | 1/6W, 1/4W, 0.4W, 1/2W, 0.6W, 1W |
| Resistance Tolerance | ±2%, ±5%                         |
| T.C.R.               | see Table I                      |

### DERATING CURVE

For resistors operated in ambient temperatures above 70°C, power rating must be derated in accordance with the curve below.

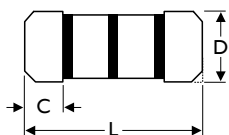


### TABLE I TEMPERATURE COEFFICIENT

| STYLE                                     | MAX. VALUE OF TEMP. COEFFICIENT PPM/°C |                      |                      |                     |
|-------------------------------------------|----------------------------------------|----------------------|----------------------|---------------------|
| MCF-12, MCF25S, MCF204                    | <b>under 1K Ω</b>                      | <b>1K1 Ω -47K Ω</b>  | <b>51K Ω -470K Ω</b> | <b>510K Ω -1M Ω</b> |
|                                           | 0 to -350                              | 0 to -600            | 0 to -1,000          | 0 to -1,500         |
| MCF-25, MCF50S, MCF207,<br>MCF-50, MCF1WS | <b>under 10K Ω</b>                     | <b>11K Ω -150K Ω</b> | <b>160K Ω -2M2 Ω</b> |                     |
|                                           | 0 to -350                              | 0 to -600            | 0 to -1,000          |                     |

### DIMENSIONS

Unit: mm



| STYLE  |                 | DIMENSION |           |        |
|--------|-----------------|-----------|-----------|--------|
| Normal | Miniature       | L         | D         | C Min. |
| MCF-12 | MCF25S / MCF204 | 3.50±0.2  | 1.40±0.15 | 0.5    |
| MCF-25 | MCF50S / MCF207 | 5.90±0.2  | 2.20±0.1  | 0.5    |
| MCF-50 | MCF1WS          | 8.50±0.2  | 3.20±0.2  | 0.5    |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                    | MCF-12                                 | MCF25S | MCF204 | MCF-25 | MCF50S | MCF207 | MCF-50 | MCFIWS |
|--------------------------|----------------------------------------|--------|--------|--------|--------|--------|--------|--------|
| Power Rating at 70°C     | 1/6W                                   | 1/4W   | 0.4W   | 1/4W   | 1/2W   | 0.6W   | 1/2W   | 1W     |
| Maximum Working Voltage  | 200V                                   | 250V   |        | 300V   |        |        | 350V   |        |
| Maximum Overload Voltage | 400V                                   | 500V   |        | 600V   |        |        | 700V   |        |
| Voltage Proof            | 200V                                   |        |        | 500V   |        |        | 700V   |        |
| Resistance Range         | 10 Ω - 1M Ω & 0 Ω for E24 series value |        |        |        |        |        |        |        |
| Operating Temp. Range    | -55°C to +155°C                        |        |        |        |        |        |        |        |
| Temperature Coefficient  | see Table I                            |        |        |        |        |        |        |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST              | TEST METHOD      |                                                                  | APPRAISE                                  |
|-------------------------------|------------------|------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                        | ±1.0%+0.05 Ω                              |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                     | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                  | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                           | >10,000M Ω                                |
| Solderability                 | IEC 60115-1 4.17 | 235±5°C for 3±0.5 Sec.                                           | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5±0.5 Min. with ultrasonic                               | No deterioration of coatings and markings |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)              | ±1.0%+0.05 Ω                              |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40±2°C, 90-95% RH for 56 days, loaded with 0.1 times RCWV        | ±5.0%+0.1 Ω                               |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70±2°C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)           | ±3.0%+0.1 Ω                               |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C ⇄ Room Temp. ⇄ +155°C ⇄ Room Temp. (5 cycles)              | ±0.75%+0.05 Ω                             |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260±3°C for 10±1 Sec., immersed to a point 3±0.5mm from the body | ±1.0%+0.05 Ω                              |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Melf Carbon Film Resistors

# High Power Type

## Ultra Miniature Style [ MCP Series ]



### INTRODUCTION

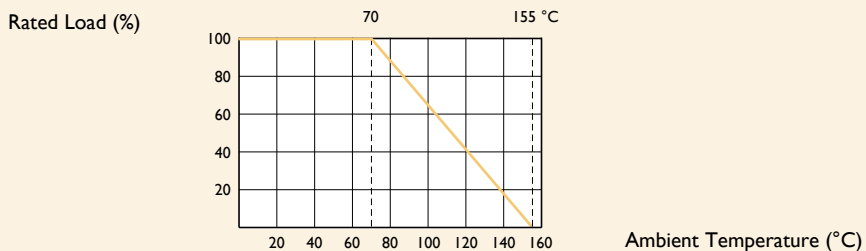
The MCP Series Melf Carbon Film High Power Resistors are manufactured by coating a homogeneous film of pure carbon on high grade ceramic rods. After a helical groove has been cut in the resistive layer, tinned connecting leads of electrolytic copper are welded to the end-caps. SMD enabled structure and high power in small packages. The resistors are coated with layers of lacquer.

### FEATURES

|                      |             |
|----------------------|-------------|
| Power Rating         | 1W, 2W      |
| Resistance Tolerance | ±2%, ±5%    |
| T.C.R.               | see Table I |

### DERATING CURVE

For resistors operated in ambient temperatures above 70°C, power rating must be derated in accordance with the curve below.

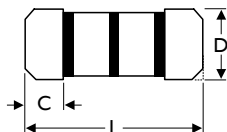


### TABLE I TEMPERATURE COEFFICIENT

| STYLE          | MAX. VALUE OF TEMP. COEFFICIENT PPM/°C |               |               |
|----------------|----------------------------------------|---------------|---------------|
|                | under 10K Ω                            | 11K Ω -150K Ω | 160K Ω -2M2 Ω |
| MCP100, MCP200 | 0 to -350                              | 0 to -600     | 0 to -1,000   |

### DIMENSIONS

Unit: mm



| STYLE           | DIMENSION |         |        |
|-----------------|-----------|---------|--------|
| Ultra Miniature | L         | D       | C Min. |
| MCP100          | 5.9±0.2   | 2.2±0.1 | 0.5    |
| MCP200          | 8.5±0.2   | 3.2±0.2 | 0.5    |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                    | MCP100                                                           | MCP200 |
|--------------------------|------------------------------------------------------------------|--------|
| Power Rating at 70°C     | 1W                                                               | 2W     |
| Maximum Working Voltage  | 350V                                                             |        |
| Maximum Overload Voltage | 700V                                                             |        |
| Voltage Proof            | 500V                                                             |        |
| Resistance Range         | 1 $\Omega$ - 1M $\Omega$ & 0 $\Omega$ for E24 & E96 series value |        |
| Operating Temp. Range    | -55°C to +155°C                                                  |        |
| Temperature Coefficient  | See Table I                                                      |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

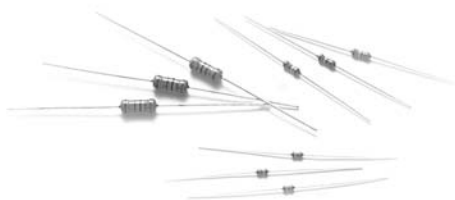
| PERFORMANCE TEST              | TEST METHOD      |                                                                                         | APPRAISE                                  |
|-------------------------------|------------------|-----------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                               | $\pm 1.0\% + 0.05 \Omega$                 |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                            | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                         | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                  | >10,000M $\Omega$                         |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm$ 5°C for 3 $\pm$ 0.5 Sec.                                                      | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm$ 0.5 Min. with ultrasonic                                                | No deterioration of coatings and markings |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                     | $\pm 1.0\% + 0.05 \Omega$                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm$ 2°C, 90-95% RH for 56 days, loaded with 0.1 times RCWV                         | $\pm 5.0\% + 0.1 \Omega$                  |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm$ 2°C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                            | $\pm 3.0\% + 0.1 \Omega$                  |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles) | $\pm 0.75\% + 0.05 \Omega$                |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm$ 3°C for 10 $\pm$ 1 Sec., immersed to a point 3 $\pm$ 0.5mm from the body      | $\pm 1.0\% + 0.05 \Omega$                 |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Metal Glazed Film Resistors

# High Voltage & High Ohmic Type

## Normal & Miniature Style [ HHV Series ]



### INTRODUCTION

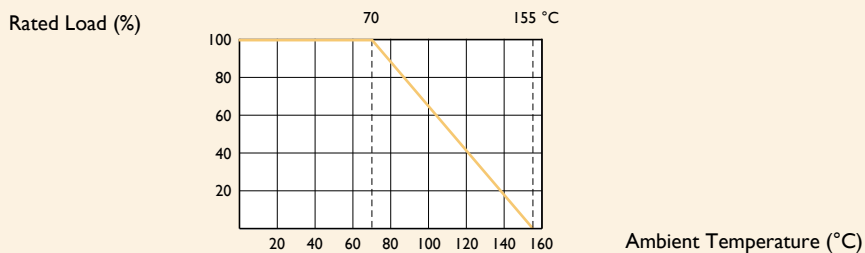
The HHV Series High Voltage & High Ohmic Resistors are made of metal glaze film, with tinned connecting leads of electrolytic copper welded to the end of caps. The resistors are coated with layers of pink color lacquer.

### FEATURES

|                                        |                                      |
|----------------------------------------|--------------------------------------|
| Power Rating                           | 1/4W, 1/2W, 1W, 2W, 3W               |
| Resistance Tolerance                   | $\pm 1\%$ , $\pm 5\%$                |
| T.C.R.                                 | $\pm 200\text{ppm}/^{\circ}\text{C}$ |
| Flameproof Multi-layer Coating Meets   | UL-94V-0                             |
| Flameproof Feature Meets Overload Test | UL-1412                              |

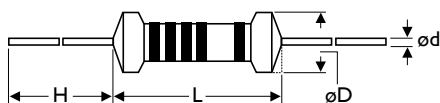
### DERATING CURVE

For resistors operated in ambient temperatures above  $70^{\circ}\text{C}$ , power rating must be derated in accordance with the curve below.



### DIMENSIONS

Unit: mm



5th color code: yellow

| STYLE  |           | DIMENSION      |               |              |                 |
|--------|-----------|----------------|---------------|--------------|-----------------|
| Normal | Miniature | L              | $\phi D$      | H            | $\phi d$        |
| HHV-25 | HHV50S    | $6.3 \pm 0.5$  | $2.4 \pm 0.2$ | $28 \pm 2.0$ | $0.55 \pm 0.05$ |
| HHV-50 | HHV1SS    | $9.0 \pm 0.5$  | $3.3 \pm 0.3$ | $26 \pm 2.0$ | $0.55 \pm 0.05$ |
| HHV1WS | HHV2SS    | $11.5 \pm 1.0$ | $4.5 \pm 0.5$ | $35 \pm 2.0$ | $0.8 \pm 0.05$  |
| HHV2WS | HHV3SS    | $15.5 \pm 1.0$ | $5.0 \pm 0.5$ | $33 \pm 2.0$ | $0.8 \pm 0.05$  |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                         | HHV-25                                                  | HHV50S | HHV-50 | HHVISS | HHVIWS  | HHV2SS | HHV2WS  | HHV3SS |
|-------------------------------|---------------------------------------------------------|--------|--------|--------|---------|--------|---------|--------|
| Power Rating at 70°C          | 1/4W                                                    | 1/2W   |        | 1W     |         | 2W     |         | 3W     |
| Maximum Working Voltage (DC)  | 1,600V                                                  |        | 3,500V |        | 5,000V  |        | 7,000V  |        |
| Maximum Overload Voltage (DC) | 3,000V                                                  |        | 7,000V |        | 10,000V |        | 14,000V |        |
| Voltage Proof                 | 300V                                                    |        | 500V   |        | 600V    |        |         |        |
| Resistance Range              | 100K $\Omega$ - 68M $\Omega$ for E24 & E96 series value |        |        |        |         |        |         |        |
| Operating Temp. Range         | -55°C to +155°C                                         |        |        |        |         |        |         |        |
| Temperature Coefficient       | $\pm 200\text{pm}/^\circ\text{C}$                       |        |        |        |         |        |         |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

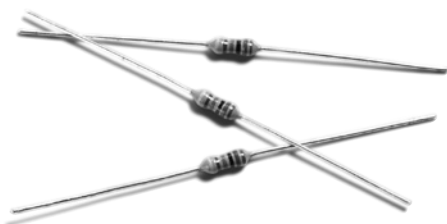
| PERFORMANCE TEST              | TEST METHOD      |                                                                                                       | APPRAISE                                  |
|-------------------------------|------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                                             | $\pm 2.0\% + 0.05 \Omega$                 |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                                          | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                                       | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                                | $> 10,000\text{M} \Omega$                 |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm 5^\circ\text{C}$ for 3 $\pm 0.5$ Sec.                                                        | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm 0.5$ Min. with ultrasonic                                                              | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                                        | $\geq 2.5\text{kg}$ (24.5N)               |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                                   | $\pm 1.0\% + 0.05 \Omega$                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm 2^\circ\text{C}$ , 90-95% RH for 56 days, loaded with 0.1 times RCWV                          | $\pm 5.0\% + 0.05 \Omega$                 |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm 2^\circ\text{C}$ at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                              | $\pm 5.0\% + 0.05 \Omega$                 |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles)               | $\pm 1.0\% + 0.05 \Omega$                 |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm 3^\circ\text{C}$ for 10 $\pm 1$ Sec., immersed to a point 3 $\pm 0.5\text{mm}$ from the body | $\pm 1.0\% + 0.05 \Omega$                 |
| Accidental Overload Test      | IEC 60115-1 4.26 | 4 times RCWV for 1 Min.                                                                               | No evidence of flaming or arcing          |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Pulse-Loading Resistors

# Anti-Pulse Type

## Normal & Miniature Style [ APR Series ]



### INTRODUCTION

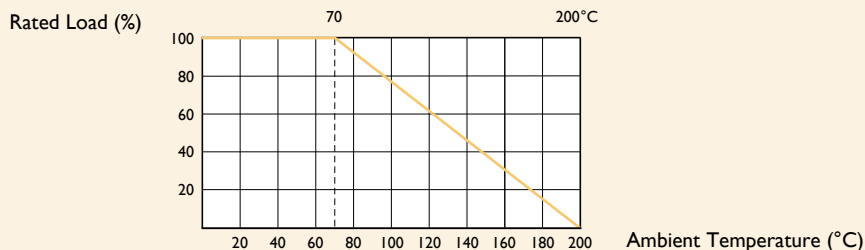
The APR Series Pulse-Loading Resistors have excellent capability in withstanding pulse; tinned connecting leads of electrolytic copper are welded to the end-caps. The resistors are coated with layers of gray color lacquer. The 5th color band is yellow to represent APR series.

### FEATURES

|                                        |                                      |
|----------------------------------------|--------------------------------------|
| Power Rating                           | 1/4W, 1/2W, 1W, 2W, 3W               |
| Resistance Tolerance                   | 5%                                   |
| T.C.R.                                 | $\pm 300\text{ppm}/^{\circ}\text{C}$ |
| Flameproof Multi-layer Coating Meets   | UL-94V-0                             |
| Flameproof Feature Meets Overload Test | UL-1412                              |

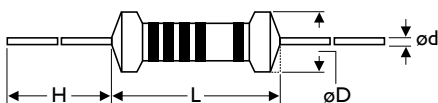
### DERATING CURVE

For resistors operated in ambient temperatures above 70°C, power rating must be derated in accordance with the curve below.



### DIMENSIONS

Unit: mm



5th color code: yellow

| STYLE  |           | DIMENSION |         |        |           |
|--------|-----------|-----------|---------|--------|-----------|
| Normal | Miniature | L         | øD      | H      | ød        |
| APR-25 | APR50S    | 6.3±0.5   | 2.4±0.2 | 28±2.0 | 0.55±0.05 |
| APR-50 | APR1WS    | 9.0±0.5   | 3.3±0.3 | 26±2.0 | 0.55±0.05 |
| APR100 | APR2WS    | 11.5±1.0  | 4.5±0.5 | 35±2.0 | 0.80±0.05 |
| APR200 | APR3WS    | 15.5±1.0  | 5.0±0.5 | 33±2.0 | 0.80±0.05 |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                    | APR-25                                                       | APR50S | APR-50 | APRIWS | APRI00 | APR2WS | APR200 | APR3WS |
|--------------------------|--------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|
| Power Rating at 70°C     | 1/4W                                                         | 1/2W   |        | 1W     |        | 2W     |        | 3W     |
| Maximum Working Voltage  | 250V                                                         | 350V   |        | 400V   | 500V   |        |        |        |
| Maximum Overload Voltage | 500V                                                         | 600V   | 700V   | 800V   | 1,000V |        |        |        |
| Voltage Proof            | 400V                                                         |        | 500V   | 600V   | 750V   |        |        |        |
| Resistance Range         | 1 $\Omega$ - 100K $\Omega$ & 0 $\Omega$ for E24 series value |        |        |        |        |        |        |        |
| Operating Temp. Range    | -55°C to +200°C                                              |        |        |        |        |        |        |        |
| Temperature Coefficient  | $\pm 300$ ppm/°C                                             |        |        |        |        |        |        |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST              | TEST METHOD      |                                                                                         | APPRAISE                                  |
|-------------------------------|------------------|-----------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                               | $\pm 0.75\% + 0.05 \Omega$                |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                            | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                         | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                  | >10,000M                                  |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm$ 5°C for 3 $\pm$ 0.5 Sec.                                                      | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm$ 0.5 Min. with ultrasonic                                                | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                          | $\geq 2.5$ kg (24.5N)                     |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                     | $\pm 1.0\% + 0.05 \Omega$                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm$ 2°C, 90-95% RH for 56 days, loaded with 0.1 times RCWV                         | $\pm 3.0\% + 0.05 \Omega$                 |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm$ 2°C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                            | $\pm 3.0\% + 0.05 \Omega$                 |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles) | $\pm 1.0\% + 0.05 \Omega$                 |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm$ 3°C for 10 $\pm$ 1 Sec., immersed to a point 3 $\pm$ 0.5mm from the body      | $\pm 1.0\% + 0.05 \Omega$                 |
| Accidental Overload Test      | IEC 60115-1 4.26 | 4 times RCWV for 1 Min.                                                                 | No evidence of flaming or arcing          |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Zero Ohm Resistors

Coating Type  
Normal Style [ ZOR Series ]

## INTRODUCTION

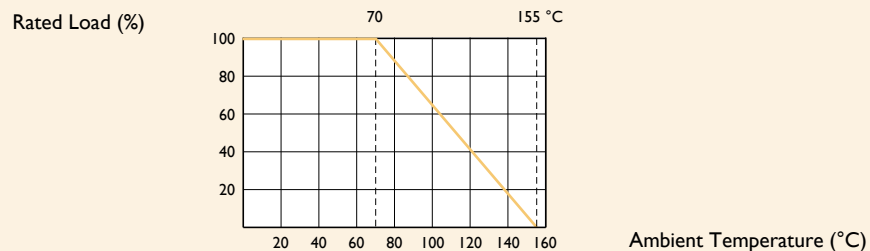
- Similar to a 1/4W resistor (1/6W size also available)
- Ideal for automatic insertion or Cut and Form
- Available in Tape/Reel, Tape/Box and Bulk
- Products meet EU-RoHS requirements

## SPECIFICATIONS

|                                      |                                                                                                    |                  |
|--------------------------------------|----------------------------------------------------------------------------------------------------|------------------|
| Power Rating                         | 1/6W, 1/4W                                                                                         |                  |
| Maximum Resistance                   | 20m $\Omega$ or less                                                                               |                  |
| Min. Insulation Resistance           | Dry                                                                                                | 10,000M $\Omega$ |
|                                      | Wet                                                                                                | 100M $\Omega$    |
| Min. Dielectric Withstanding Voltage | Atmospheric                                                                                        | 500V RMS         |
|                                      | Reduced                                                                                            | 325V RMS         |
| Insulation Flammability              | Resistor insulation is self extinguishing within 10 Sec. after externally applied flame is removed |                  |
| Current Rating                       | 2.5 AMPS at 70°C for 1/4W                                                                          |                  |
|                                      | 1.5 AMPS at 70°C for 1/6W                                                                          |                  |

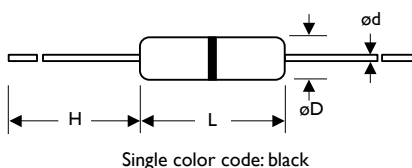
## DERATING CURVE

For resistors operated in ambient temperatures above 70°C, power rating must be derated in accordance with the curve below.



## DIMENSIONS

Unit: mm



| STYLE  | DIMENSION |         |        |           |
|--------|-----------|---------|--------|-----------|
| Normal | L         | øD      | H      | ød        |
| ZOR-12 | 3.3±0.4   | 1.8±0.3 | 28±2.0 | 0.45±0.05 |
| ZOR-25 | 6.3±0.5   | 2.3±0.3 | 28±2.0 | 0.55±0.05 |

# Tinned-Copper Wire Type

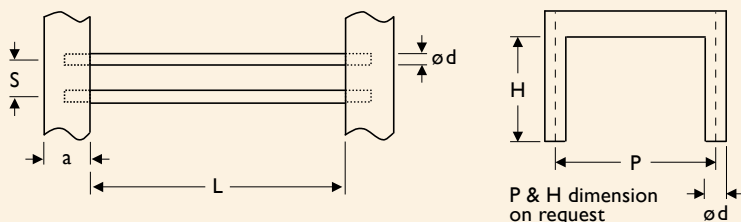
## Normal Style [ JPW Series ]

## Jumper Wires

### SPECIFICATIONS

|                         |                                        |                  |          |
|-------------------------|----------------------------------------|------------------|----------|
| Material of Jumper Wire | Soft copper wire with tin plating      |                  |          |
| Wire Diameter           | ø0.5, ø0.6, ø0.7, ø0.8, ø1.0 (±0.05mm) |                  |          |
| Tension Strength        | CNS 8938 within 28kg/mm²               |                  |          |
| Extension Rate          | CNS 8938 ø0.5 to ø0.6mm                | over 24%         |          |
|                         | CNS 8938 ø0.7 to ø1.0mm                | over 26%         |          |
| Conductivity            | ø0.5mm                                 | Minimum 94%      |          |
|                         | ø0.6 to ø1.0mm                         | Minimum 96%      |          |
| Twisting Strength       | CNS 8938 ø0.5mm                        | Load 250g        | 3 cycles |
|                         | CNS 8938 ø0.6 to ø0.8mm                | Load 500g        | 3 cycles |
|                         | CNS 8938 ø1.0mm                        | Load 1.0kg       | 3 cycles |
| Solderability           | 235±5°C, 3±0.5 Sec. coverage 95%       |                  |          |
| Element of Plating      | Tin Minimum 99.9%                      |                  |          |
| Thickness of Plating    | 4±1 µm                                 |                  |          |
| Current Rating          | ø0.5mm                                 | 6 AMPS at 70°C   |          |
|                         | ø0.6mm                                 | 7.5 AMPS at 70°C |          |
|                         | ø0.7mm                                 | 8.5 AMPS at 70°C |          |
|                         | ø0.8mm                                 | 10 AMPS at 70°C  |          |
|                         | ø1.0mm                                 | 15 AMPS at 70°C  |          |
| Appearance              | Smooth and shining                     |                  |          |

### DIMENSIONS



### INTRODUCTION

Jumper wires or crossovers, as they are sometimes called, are basically interconnection devices between points on a PC Board. Generally they are used for the following reasons:

- Inability to connect two points on a PC Board due to other circuit paths which must be crossed over
- An After-the-Fact design change that requires new point connections
- Circuit tuning by changing point connections

Jumper wires offers a quick simple solution to these problems. They are especially suited for automatic machine insertion on lead tape, and are available in all packaging styles, including pre-cut and formed leads, for manual insertion.

- Products meet EU-RoHS requirements

Unit: mm

| STYLE  | DIMENSION     |               |              |              |
|--------|---------------|---------------|--------------|--------------|
| Normal | $\phi d$      | L             | S            | a            |
| JPW-05 | $0.5\pm 0.05$ |               |              |              |
| JPW-06 | $0.6\pm 0.05$ | $26.0\pm 1.0$ |              |              |
| JPW-07 | $0.7\pm 0.05$ | $52.4\pm 1.0$ | $5.0\pm 0.1$ | $6.0\pm 0.5$ |
| JPW-08 | $0.8\pm 0.05$ | $73.0\pm 1.5$ |              |              |
| JPW-10 | $1.0\pm 0.05$ |               |              |              |

## Low Ohmic Wire Resistors

# Alloy-Wire Type

## Normal Style [ MCW Series ]



### FEATURES

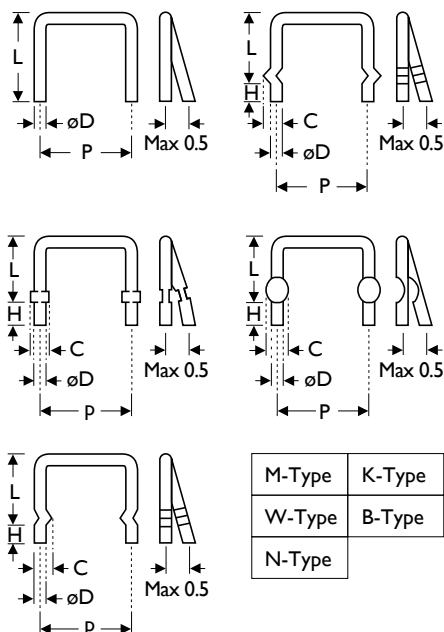
|                      |                                                                                                                   |
|----------------------|-------------------------------------------------------------------------------------------------------------------|
| Material             | Manganese-copper, Nickel-copper; others upon request                                                              |
| Resistance Tolerance | $\pm 2\%$ , $\pm 5\%$                                                                                             |
| T.C.R.               | $\pm 50\text{ppm}/^{\circ}\text{C}$ , $\pm 100\text{ppm}/^{\circ}\text{C}$ , $\pm 200\text{ppm}/^{\circ}\text{C}$ |

### INTRODUCTION

- The Low Ohmic Alloy-Wire Resistors are suitable for high power current detection, it is non-inductive type
- Low Ohmic Wire Resistors meet EU-RoHS requirements

### DIMENSIONS

Unit: mm



| STYLE  | DIMENSION      |               |               |                                                   |
|--------|----------------|---------------|---------------|---------------------------------------------------|
| Normal | $\phi D$       | C             | H             | P, L                                              |
| MCW-06 | $0.6 \pm 0.02$ | $0.9 \pm 0.1$ | $3.0 \pm 0.5$ | P & L could be designed by customer's requirement |
| MCW-08 | $0.8 \pm 0.02$ | $1.1 \pm 0.1$ | $3.0 \pm 0.5$ |                                                   |
| MCW-10 | $1.0 \pm 0.02$ | $1.3 \pm 0.1$ | $3.0 \pm 0.5$ |                                                   |
| MCW-12 | $1.2 \pm 0.02$ | $1.5 \pm 0.1$ | $3.0 \pm 0.5$ |                                                   |
| MCW-14 | $1.4 \pm 0.02$ | $1.7 \pm 0.1$ | $3.0 \pm 0.5$ |                                                   |
| MCW-16 | $1.6 \pm 0.02$ | $1.9 \pm 0.2$ | $3.0 \pm 0.5$ |                                                   |
| MCW-18 | $1.8 \pm 0.02$ | $2.2 \pm 0.2$ | $3.0 \pm 0.5$ |                                                   |
| MCW-20 | $2.0 \pm 0.02$ | $2.5 \pm 0.2$ | $3.0 \pm 0.5$ |                                                   |
| MCW-26 | $2.6 \pm 0.02$ | $3.2 \pm 0.2$ | $3.0 \pm 0.5$ |                                                   |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                   | MCW-06                                                                                                      | MCW-08 | MCW-10 | MCW-12 | MCW-14 | MCW-16 | MCW-18 | MCW-20 | MCW-26 |
|-------------------------|-------------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Maximum Current Rating  | 3A                                                                                                          | 4.5A   | 5.5A   | 7.0A   | 8.0A   | 9.5A   | 11A    | 12A    | 18A    |
| Resistance Range        | 0.0014 $\Omega$ - 0.078 $\Omega$                                                                            |        |        |        |        |        |        |        |        |
| Operating Temp. Range   | -55°C to +125°C                                                                                             |        |        |        |        |        |        |        |        |
| Temperature Coefficient | $\pm 50\text{ppm}/^\circ\text{C}$ , $\pm 100\text{ppm}/^\circ\text{C}$ , $\pm 200\text{ppm}/^\circ\text{C}$ |        |        |        |        |        |        |        |        |

Note: Below or over this resistance value is available on request

## ENVIRONMENTAL CHARACTERISTICS

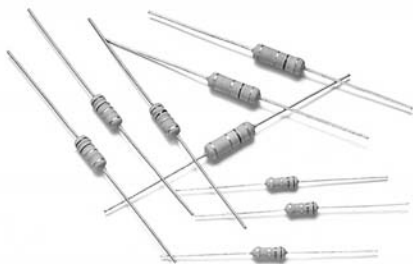
| PERFORMANCE TEST             | TEST METHOD      |                                                                                                       | APPRAISE          |
|------------------------------|------------------|-------------------------------------------------------------------------------------------------------|-------------------|
| Short Time Overload          | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                                             | $\pm 2\%$         |
| Temperature Coefficient      | IEC 60115-1 4.8  | -55°C to +125°C                                                                                       | By type           |
| Solderability                | IEC 60115-1 4.17 | 235 $\pm 5^\circ\text{C}$ for 3 $\pm 0.5$ Sec.                                                        | 95% Min. coverage |
| Damp Heat Steady State       | IEC 60115-1 4.24 | 40 $\pm 2^\circ\text{C}$ , 90-95% RH for 56 days, loaded with 0.1 times RCWV                          | $\pm 2.0\%$       |
| Endurance at 70°C            | IEC 60115-1 4.25 | 70 $\pm 2^\circ\text{C}$ at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                              | $\pm 3.0\%$       |
| Temperature Cycling          | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles)               | $\pm 1.0\%$       |
| Resistance to Soldering Heat | IEC 60115-1 4.18 | 260 $\pm 3^\circ\text{C}$ for 10 $\pm 1$ Sec., immersed to a point 3 $\pm 0.5\text{mm}$ from the body | $\pm 1.0\%$       |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Wirewound Resistors

# Flame-Proof Type

## Normal & Miniature Style [ KNP Series ]



### INTRODUCTION

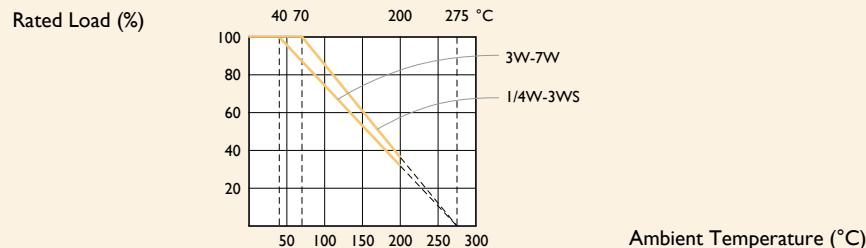
The resistor element is a resistive wire which is wound in a single layer on a ceramic rod, with tinned connecting wires of electrolytic copper welded to the end-caps. The ends of the resistive wire and the leads are connected to the caps by welding. The resistors are coated with layers of green color flame-proof lacquer.

### FEATURES

|                                        |                                    |
|----------------------------------------|------------------------------------|
| Power Rating                           | 1/4W, 1/2W, 1W, 2W, 3W, 4W, 5W, 7W |
| Resistance Tolerance                   | ±1%, ±5%                           |
| T.C.R.                                 | ±300ppm/°C                         |
| Flameproof Multi-layer Coating Meets   | UL-94V-0                           |
| Flameproof Feature Meets Overload Test | UL-1412                            |

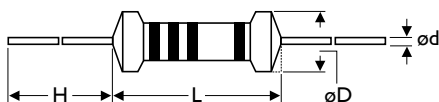
### DERATING CURVE

For resistors operated in ambient temperatures above 40°C, power rating must be derated in accordance with the curve below.



### DIMENSIONS

Unit: mm



| STYLE  |           | DIMENSION |         |        |           |
|--------|-----------|-----------|---------|--------|-----------|
| Normal | Miniature | L         | øD      | H      | ød        |
| KNP-25 | NP50S     | 6.3±0.5   | 2.4±0.2 | 28±2.0 | 0.55±0.05 |
| KNP-50 | KNP1WS    | 9.0±0.5   | 3.3±0.3 | 26±2.0 | 0.55±0.05 |
| KNP100 | KNP2WS    | 11.5±1.0  | 4.5±0.5 | 35±2.0 | 0.8±0.05  |
| KNP200 | KNP3WS    | 15.5±1.0  | 5.0±0.5 | 33±2.0 | 0.8±0.05  |
| KNP300 | KNP5WS    | 17.5±1.0  | 6.5±0.5 | 32±2.0 | 0.8±0.05  |
| KNP400 |           |           |         |        |           |
| KNP500 | KNP7WS    | 24.5±1.0  | 8.0±0.5 | 38±2.0 | 0.8±0.05  |
| KNP700 | -         | 24.5±1.0  | 8.0±0.5 | 38±2.0 | 0.8±0.05  |

Note: KNP1WS ( for MB Type ) ød = 0.8±0.05 mm

## ELECTRICAL CHARACTERISTICS

### NORMAL STYLE

| STYLE                   | KNP-25          | KNP-50         | KNP100           | KNP200           | KNP300          | KNP400 | KNP500          | KNP700 |
|-------------------------|-----------------|----------------|------------------|------------------|-----------------|--------|-----------------|--------|
| Power Rating at 40°C    |                 |                |                  |                  | 3W              | 4W     | 5W              | 7W     |
| Power Rating at 70°C    | 1/4W            | 1/2W           | 1W               | 2W               |                 |        |                 |        |
| Voltage Proof           | 250V            | 300V           | 400V             |                  |                 |        |                 |        |
| Resistance Range (±1%)  | 0.22 Ω - 150 Ω  | 0.1 Ω - 800 Ω  | 0.1 Ω - 1.8K Ω   | 0.1 Ω - 2.8K Ω   | 0.1 Ω - 7.5K Ω  |        | 0.1 Ω - 6.5K Ω  |        |
| Resistance Range (±5%)  | 0.05 Ω - 200 Ω  | 0.03 Ω - 800 Ω | 0.015 Ω - 2.2K Ω | 0.015 Ω - 2.8K Ω | 0.02 Ω - 7.5K Ω |        | 0.03 Ω - 6.8K Ω |        |
| Operating Temp. Range   | -40°C to +200°C |                |                  |                  |                 |        |                 |        |
| Temperature Coefficient | ±300ppm/°C      |                |                  |                  |                 |        |                 |        |

Note: Special value is available on request

### MINIATURE STYLE

| STYLE                   | KNP50S          | KNPIWS         | KNP2WS           | KNP3WS           | KNP5WS          | KNP7WS          |
|-------------------------|-----------------|----------------|------------------|------------------|-----------------|-----------------|
| Power Rating at 40°C    |                 |                |                  |                  | 5W              | 7W              |
| Power Rating at 70°C    | 1/2W            | 1W             | 2W               | 3W               |                 |                 |
| Voltage Proof           | 200V            | 300V           | 400V             |                  |                 |                 |
| Resistance Range (±1%)  | 0.22 Ω - 150 Ω  | 0.1 Ω - 800 Ω  | 0.1 Ω - 1.8K Ω   | 0.1 Ω - 2.8K Ω   | 0.1 Ω - 7.5K Ω  | 0.1 Ω - 6.5K Ω  |
| Resistance Range (±5%)  | 0.05 Ω - 200 Ω  | 0.03 Ω - 800 Ω | 0.015 Ω - 2.2K Ω | 0.015 Ω - 2.8K Ω | 0.02 Ω - 7.5K Ω | 0.03 Ω - 6.8K Ω |
| Operating Temp. Range   | -40°C to +200°C |                |                  |                  |                 |                 |
| Temperature Coefficient | ±300ppm/°C      |                |                  |                  |                 |                 |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

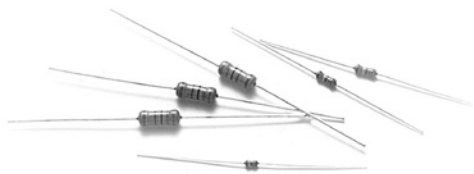
| PERFORMANCE TEST              | TEST METHOD      |                                                                  | APPRAISE                                  |
|-------------------------------|------------------|------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 10 times rated power for 5 Sec.                                  | ±2.0%+0.05 Ω                              |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                     | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                  | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                           | >100M Ω                                   |
| Solderability                 | IEC 60115-1 4.17 | 235±5°C for 3±0.5 Sec                                            | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5±0.5 Min. with ultrasonic                               | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads   | ≥2.5kg (24.5N)                            |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40±2°C, 90-95% RH for 56 days, loaded with 0.1 times RCWV        | ±5.0%+0.05 Ω                              |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70±2°C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)           | ±5.0%+0.05 Ω                              |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C ⇄ Room Temp. ⇄ +155°C ⇄ Room Temp. (5 cycles)              | ±1.0%+0.05 Ω                              |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260±3°C for 10±1 Sec., immersed to a point 3±0.5mm from the body | ±1.0%+0.05 Ω                              |
| Accidental Overload Test      | IEC 60115-1 4.26 | 4 times RCWV for 1 Min.                                          | No evidence of flaming or arcing          |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Wirewound Resistors

# Flame-Proof & Non-Inductive Type

## Normal & Miniature Style [ NKN Series ]



### INTRODUCTION

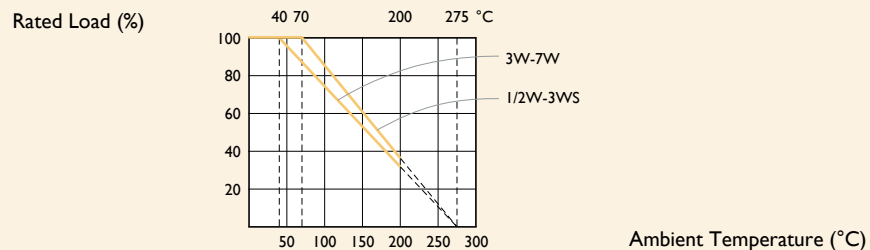
The resistor element is a resistive wire which is wound in a single layer on a ceramic rod, with tinned connecting wires of electrolytic copper welded to the end-caps. The ends of the resistive wire and the leads are connected to the caps by welding. The resistors are coated with layers of green color flame-proof lacquer. The 5th color band is black to represent NKN series.

### FEATURES

|                                        |                              |
|----------------------------------------|------------------------------|
| Power Rating                           | 1/2W, 1W, 2W, 3W, 4W, 5W, 7W |
| Resistance Tolerance                   | ±5%                          |
| T.C.R.                                 | ±300ppm/°C                   |
| Flameproof Multi-layer Coating Meets   | UL-94V-0                     |
| Flameproof Feature Meets Overload Test | UL-1412                      |

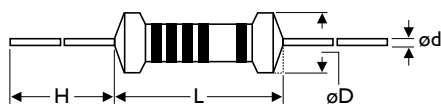
### DERATING CURVE

For resistors operated in ambient temperatures above 40°C, power rating must be derated in accordance with the curve below.



### DIMENSIONS

Unit: mm



5th color code: black

| STYLE  |           | DIMENSION |         |        |           |
|--------|-----------|-----------|---------|--------|-----------|
| Normal | Miniature | L         | øD      | H      | ød        |
| NKN-50 | NKN1WS    | 9.0±0.5   | 3.3±0.3 | 26±2.0 | 0.55±0.05 |
| NKN100 | NKN2WS    | 11.5±1.0  | 4.5±0.5 | 35±2.0 | 0.8±0.05  |
| NKN200 | NKN3WS    | 15.5±1.0  | 5.0±0.5 | 33±2.0 | 0.8±0.05  |
| NKN300 |           |           |         |        |           |
| NKN400 | NKN5WS    | 17.5±1.0  | 6.5±0.5 | 32±2.0 | 0.8±0.05  |
| NKN500 | NKN7WS    | 24.5±1.0  | 8.0±0.5 | 38±2.0 | 0.8±0.05  |

## ELECTRICAL CHARACTERISTICS

### NORMAL STYLE

| STYLE                   | NKN-50          | NKN100        | NKN200        | NKN300        | NKN400 | NKN500         |
|-------------------------|-----------------|---------------|---------------|---------------|--------|----------------|
| Power Rating at 40°C    |                 |               |               | 3W            | 4W     | 5W             |
| Power Rating at 70°C    | 1/2W            | 1W            | 2W            |               |        |                |
| Voltage Proof           | 250V            | 400V          |               |               |        |                |
| Resistance Range        | 0.08 Ω - 15 Ω   | 0.05 Ω - 40 Ω | 0.03 Ω - 90 Ω | 0.1 Ω - 120 Ω |        | 0.18 Ω - 220 Ω |
| Operating Temp. Range   | -40°C to +200°C |               |               |               |        |                |
| Temperature Coefficient | ±300ppm/°C      |               |               |               |        |                |

Note: Special value is available on request

### MINIATURE STYLE

| STYLE                   | NKNIWS           | NKN2WS        | NKN3WS        | NKN5WS        | NKN7WS         |
|-------------------------|------------------|---------------|---------------|---------------|----------------|
| Power Rating at 40°C    |                  |               |               | 5W            | 7W             |
| Power Rating at 70°C    | 1W               | 2W            | 3W            |               |                |
| Voltage Proof           | 250V             | 400V          |               |               |                |
| Resistance Range        | 0.08 Ω - 15 Ω    | 0.05 Ω - 40 Ω | 0.03 Ω - 90 Ω | 0.1 Ω - 120 Ω | 0.18 Ω - 220 Ω |
| Operating Temp. Range   | - 40°C to +200°C |               |               |               |                |
| Temperature Coefficient | ±300ppm/°C       |               |               |               |                |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

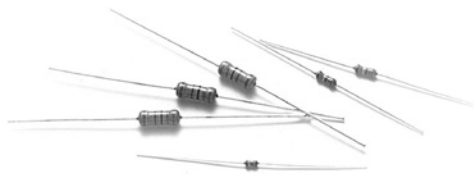
| PERFORMANCE TEST              | TEST METHOD      |                                                                  | APPRAISE                                  |
|-------------------------------|------------------|------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 10 times rated power for 5 Sec.                                  | ±2.0%+0.05 Ω                              |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                     | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                  | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                           | >100M Ω                                   |
| Solderability                 | IEC 60115-1 4.17 | 235±5°C for 3±0.5 Sec.                                           | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5±0.5 Min. with ultrasonic                               | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads   | ≥2.5kg (24.5N)                            |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40±2°C, 90-95% RH for 56 days, loaded with 0.1 times RCWV        | ±5.0%+0.05 Ω                              |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70±2°C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)           | ±5.0%+0.05 Ω                              |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C ⇄ Room Temp. ⇄ +155°C ⇄ Room Temp. (5 cycles)              | ±1.0%+0.05 Ω                              |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260±3°C for 10±1 Sec., immersed to a point 3±0.5mm from the body | ±1.0%+0.05 Ω                              |
| Accidental Overload Test      | IEC 60115-1 4.26 | 4 times RCWV for 1 Min.                                          | No evidence of flaming or arcing          |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Wirewound Resistors

# Fusible & Flame-Proof Type

## Normal & Miniature Style [ FKN Series ]



### INTRODUCTION

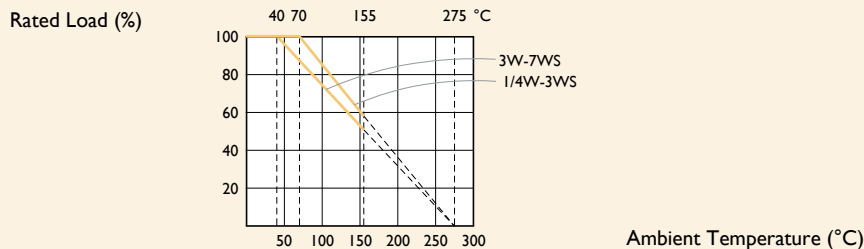
The resistor element is a resistive wire which is wound in a single layer on a ceramic rod, with tinned connecting wires of electrolytic copper welded to the end-caps. The ends of the resistive wire and the leads are connected to the caps by welding. The resistors are coated with layers of green color flame-proof lacquer. Overload protection without risk of fire. Wide range of overload currents.

### FEATURES

|                                        |                                    |
|----------------------------------------|------------------------------------|
| Power Rating                           | 1/4W, 1/2W, 1W, 2W, 3W, 4W, 5W, 7W |
| Resistance Tolerance                   | ±1%, ±5%                           |
| T.C.R.                                 | ±350ppm/°C                         |
| Flameproof Multi-layer Coating Meets   | UL-94V-0                           |
| Flameproof Feature Meets Overload Test | UL-1412                            |

### DERATING CURVE

For resistors operated in ambient temperatures above 40°C, power rating must be derated in accordance with the curve below.



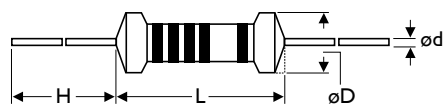
### FUSING CHARACTERISTICS

$R \leq 2.0 \Omega$  Fusing time within 60 seconds at 36 times of rated power

$R > 2.0 \Omega$  Fusing time within 60 seconds at 25 times of rated power

Fusing residual resistive value at least 100 times rated resistance

### DIMENSIONS



5th color code: white

Unit: mm

| STYLE  | DIMENSION |          |         |        |           |
|--------|-----------|----------|---------|--------|-----------|
| Normal | Miniature | L        | øD      | H      | ød        |
| FKN-25 | FKN50S    | 6.3±0.5  | 2.4±0.2 | 28±2.0 | 0.55±0.05 |
| FKN-50 | FKN1WS    | 9.0±0.5  | 3.3±0.3 | 26±2.0 | 0.55±0.05 |
| FKN100 | FKN2WS    | 11.5±1.0 | 4.5±0.5 | 35±2.0 | 0.8±0.05  |
| FKN200 | FKN3WS    | 15.5±1.0 | 5.0±0.5 | 33±2.0 | 0.8±0.05  |
| FKN300 | FKN5WS    | 17.5±1.0 | 6.5±0.5 | 32±2.0 | 0.8±0.05  |
| FKN400 |           |          |         |        |           |
| FKN500 | FKN7WS    | 24.5±1.0 | 8.0±0.5 | 38±2.0 | 0.8±0.05  |

Note: FKN1WS ( for MB Type ) ød = 0.8±0.05 mm

## ELECTRICAL CHARACTERISTICS

### NORMAL STYLE

| STYLE                   | FKN-25          | FKN-50       | FKN100        | FKN200         | FKN300         | FKN400 | FKN500      |
|-------------------------|-----------------|--------------|---------------|----------------|----------------|--------|-------------|
| Power Rating at 40°C    |                 |              |               |                | 3W             | 4W     | 5W          |
| Power Rating at 70°C    | 1/4W            | 1/2W         | 1W            | 2W             |                |        |             |
| Voltage Proof           | 200V            | 300V         |               |                |                |        |             |
| Resistance Range (±1%)  |                 |              | 0.5 Ω - 100 Ω | 0.47 Ω - 150 Ω | 0.56 Ω - 330 Ω |        | 1 Ω - 620 Ω |
| Resistance Range (±5%)  | 2.5 Ω - 22 Ω    | 0.5 Ω - 47 Ω | 0.5 Ω - 100 Ω | 0.47 Ω - 150 Ω | 0.56 Ω - 330 Ω |        | 1 Ω - 620 Ω |
| Operating Temp. Range   | -40°C to +155°C |              |               |                |                |        |             |
| Temperature Coefficient | ±350ppm/°C      |              |               |                |                |        |             |

Note: Special value is available on request

### MINIATURE STYLE

| STYLE                   | FKN50S          | FKNIWS        | FKN2WS         | FKN3WS         | FKN5WS         | FKN7WS      |
|-------------------------|-----------------|---------------|----------------|----------------|----------------|-------------|
| Power Rating at 40°C    |                 |               |                |                | 5W             | 7W          |
| Power Rating at 70°C    | 1/2W            | 1W            | 2W             | 3W             |                |             |
| Voltage Proof           | 200V            | 300V          |                |                |                |             |
| Resistance Range (±1%)  |                 | 0.47 Ω - 62 Ω | 0.47 Ω - 150 Ω | 0.47 Ω - 240 Ω | 0.56 Ω - 330 Ω | 1 Ω - 620 Ω |
| Resistance Range (±5%)  | 2.5 Ω - 22 Ω    | 0.47 Ω - 62 Ω | 0.47 Ω - 150 Ω | 0.47 Ω - 240 Ω | 0.56 Ω - 330 Ω | 1 Ω - 620 Ω |
| Operating Temp. Range   | -40°C to +155°C |               |                |                |                |             |
| Temperature Coefficient | ±350ppm/°C      |               |                |                |                |             |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

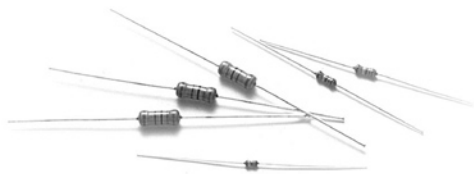
| PERFORMANCE TEST              | TEST METHOD      |                                                                  | APPRAISE                                  |
|-------------------------------|------------------|------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 10 times rated power for 5 Sec.                                  | ±2.0%+0.05 Ω                              |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                     | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                  | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                           | >100M Ω                                   |
| Solderability                 | IEC 60115-1 4.17 | 235±5°C for 3±0.5 Sec.                                           | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5±0.5 Min. with ultrasonic                               | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads   | ≥2.5kg (24.5N)                            |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40±2°C, 90-95% RH for 56 days, loaded with 0.1 times RCWV        | ±5.0%+0.05 Ω                              |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70±2°C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)           | ±5.0%+0.05 Ω                              |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C ⇄ Room Temp. ⇄ +155°C ⇄ Room Temp. (5 cycles)              | ±1.0%+0.05 Ω                              |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260±3°C for 10±1 Sec., immersed to a point 3±0.5mm from the body | ±1.0%+0.05 Ω                              |
| Accidental Overload Test      | IEC 60115-1 4.26 | 4 times RCWV for 1 Min.                                          | No evidence of flaming or arcing          |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Wirewound Resistors

# High Power Type

## Ultra Miniature Style [ PNP Series ]



### INTRODUCTION

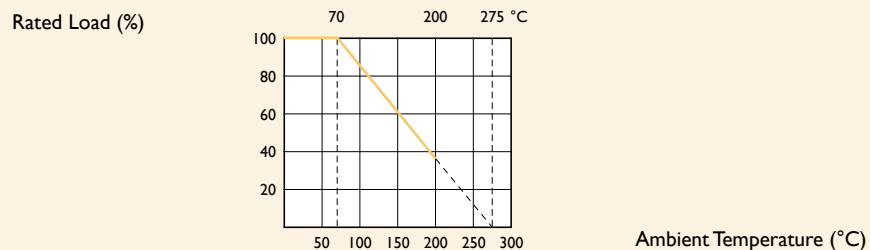
The resistor element is a resistive wire which is wound in a single layer on a ceramic rod, with tinned connecting wires of electrolytic copper welded to the end-caps. The ends of the resistive wire and the leads are connected to the caps by welding. The resistors are coated with layers of green color flame-proof lacquer. High power in small packages.

### FEATURES

|                                        |                |
|----------------------------------------|----------------|
| Power Rating                           | 1W, 2W, 3W, 4W |
| Resistance Tolerance                   | ±1%, ±5%       |
| T.C.R.                                 | ±300ppm/°C     |
| Flameproof Multi-layer Coating Meets   | UL-94V-0       |
| Flameproof Feature Meets Overload Test | UL-1412        |

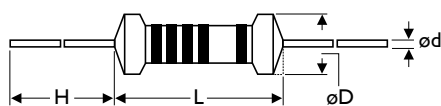
### DERATING CURVE

For resistors operated in ambient temperatures above 70°C, power rating must be derated in accordance with the curve below.



### DIMENSIONS

Unit: mm



5th color code: violet

| STYLE           | DIMENSION |         |        |           |
|-----------------|-----------|---------|--------|-----------|
| Ultra Miniature | L         | øD      | H      | ød        |
| PNP100          | 6.3±0.5   | 2.4±0.2 | 28±2.0 | 0.55±0.05 |
| PNP200          | 9.0±0.5   | 3.3±0.3 | 26±2.0 | 0.55±0.05 |
| PNP300          | 11.5±1.0  | 4.5±0.5 | 35±2.0 | 0.8±0.05  |
| PNP400          | 15.5±1.0  | 5.0±0.5 | 33±2.0 | 0.8±0.05  |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                           | PNP100                             | PNP200                        | PNP300                         | PNP400                        |
|---------------------------------|------------------------------------|-------------------------------|--------------------------------|-------------------------------|
| Power Rating at 70°C            | 1W                                 | 2W                            | 3W                             | 4W                            |
| Dielectric Withstanding Voltage | 300V                               |                               |                                |                               |
| Resistance Range ( $\pm 1\%$ )  | 0.22 $\Omega$ - 130 $\Omega$       | 0.1 $\Omega$ - 820 $\Omega$   | 0.1 $\Omega$ - 2.2K $\Omega$   | 0.1 $\Omega$ - 2.8K $\Omega$  |
| Resistance Range ( $\pm 5\%$ )  | 0.1 $\Omega$ - 130 $\Omega$        | 0.068 $\Omega$ - 820 $\Omega$ | 0.025 $\Omega$ - 2.2K $\Omega$ | 0.03 $\Omega$ - 2.8K $\Omega$ |
| Operating Temp. Range           | -40°C to +200°C                    |                               |                                |                               |
| Temperature Coefficient         | $\pm 300\text{ppm}/^\circ\text{C}$ |                               |                                |                               |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

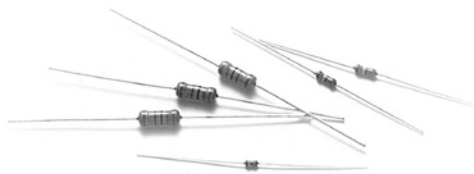
| PERFORMANCE TEST              | TEST METHOD      |                                                                                                       | APPRAISE                                  |
|-------------------------------|------------------|-------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 10 times rated power for 5 Sec.                                                                       | $\pm 2.0\% + 0.05 \Omega$                 |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                                          | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                                       | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                                | >100M $\Omega$                            |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm 5^\circ\text{C}$ for 3 $\pm 0.5$ Sec.                                                        | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm 0.5$ Min. with ultrasonic                                                              | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                                        | $\geq 2.5\text{kg}$ (24.5N)               |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm 2^\circ\text{C}$ , 90-95% RH for 56 days, loaded with 0.1 times RCWV                          | $\pm 5.0\% + 0.05 \Omega$                 |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm 2^\circ\text{C}$ at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                              | $\pm 5.0\% + 0.05 \Omega$                 |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles)               | $\pm 1.0\% + 0.05 \Omega$                 |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm 3^\circ\text{C}$ for 10 $\pm 1$ Sec., immersed to a point 3 $\pm 0.5\text{mm}$ from the body | $\pm 1.0\% + 0.05 \Omega$                 |
| Accidental Overload Test      | IEC 60115-1 4.26 | 4 times RCWV for 1 Min.                                                                               | No evidence of flaming or arcing          |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Wirewound Resistors

# High Power Type

## Normal Style [ PNP V Series ]



### INTRODUCTION

The resistor element is a resistive wire which is wound in a single layer on a ceramic rod, with tinned connecting wires of electrolytic copper welded to the end-caps. The ends of the resistive wire and the leads are connected to the caps by welding. The resistors are coated with layers of green color flame-proof lacquer. High power in small package. The 5th color band is violet to represent PNP V series.

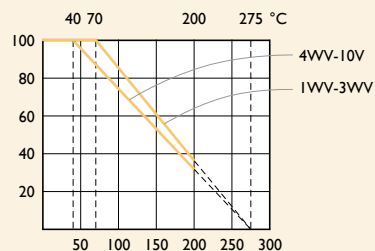
### FEATURES

|                                        |                                                                             |
|----------------------------------------|-----------------------------------------------------------------------------|
| Power Rating                           | 1W, 3W, 4W, 5W, 7W, 10W                                                     |
| Resistance Tolerance                   | $\pm 1\%$ , $\pm 5\%$                                                       |
| T.C.R.                                 | $\pm 100\text{ppm}/^{\circ}\text{C}$ , $\pm 300\text{ppm}/^{\circ}\text{C}$ |
| Flameproof Multi-layer Coating Meets   | UL-94V-0                                                                    |
| Flameproof Feature Meets Overload Test | UL-1412                                                                     |

### DERATING CURVE

For resistors operated in ambient temperatures above 40°C, power rating must be derated in accordance with the curve below.

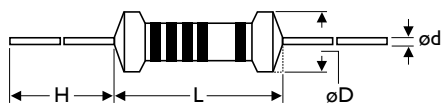
Rated Load (%)



Ambient Temperature ( $^{\circ}\text{C}$ )

### DIMENSIONS

Unit: mm



5th color code: violet

| STYLE  | DIMENSION    |               |              |                |
|--------|--------------|---------------|--------------|----------------|
| Normal | L            | øD            | H            | ød             |
| PNP1WV | 10 $\pm$ 1.0 | 4.3 $\pm$ 0.5 | 26 $\pm$ 2.0 | 0.8 $\pm$ 0.05 |
| PNP3WV | 13 $\pm$ 1.0 | 5.5 $\pm$ 0.5 | 34 $\pm$ 2.0 | 0.8 $\pm$ 0.05 |
| PNP4WV | 17 $\pm$ 1.0 | 5.5 $\pm$ 0.5 | 32 $\pm$ 2.0 | 0.8 $\pm$ 0.05 |
| PNP5WV | 17 $\pm$ 1.0 | 7.5 $\pm$ 0.5 | 32 $\pm$ 2.0 | 0.8 $\pm$ 0.05 |
| PNP7WV | 25 $\pm$ 1.0 | 7.5 $\pm$ 0.5 | 38 $\pm$ 2.0 | 0.8 $\pm$ 0.05 |
| PNP10V | 44 $\pm$ 1.0 | 8.0 $\pm$ 0.5 | 28 $\pm$ 2.0 | 0.8 $\pm$ 0.05 |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                   | PNPIWV          | PNP3WV           | PNP4WV          | PNP5WV           | PNP7WV         | PNP10V        |
|-------------------------|-----------------|------------------|-----------------|------------------|----------------|---------------|
| Power Rating at 40°C    |                 |                  | 4W              | 5W               | 7W             | 10W           |
| Power Rating at 70°C    | 1W              | 3W               |                 |                  |                |               |
| Voltage Proof           | 300V            |                  |                 |                  |                |               |
| Resistance Range (±1%)  | 0.1 Ω - 1K Ω    | 0.1 Ω - 2.8K Ω   | 0.1 Ω - 4.3K Ω  | 0.1 Ω - 8.2K Ω   | 0.1 Ω - 10K Ω  | 0.1 Ω - 17K Ω |
| Resistance Range (±5%)  | 0.03 Ω - 1K Ω   | 0.015 Ω - 2.8K Ω | 0.02 Ω - 4.3K Ω | 0.025 Ω - 8.2K Ω | 0.03 Ω - 10K Ω | 0.1 Ω - 17K Ω |
| Operating Temp. Range   | -40°C to +200°C |                  |                 |                  |                |               |
| Temperature Coefficient | ±300ppm/°C      |                  |                 |                  |                |               |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST              | TEST METHOD      |                                                                  | APPRAISE                                  |
|-------------------------------|------------------|------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 10 times rated power for 5 Sec.                                  | ±2.0%+0.05 Ω                              |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                     | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                  | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                           | >100M Ω                                   |
| Solderability                 | IEC 60115-1 4.17 | 235±5°C for 3±0.5 Sec.                                           | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5±0.5 Min. with ultrasonic                               | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads   | ≥2.5kg (24.5N)                            |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40±2°C, 90-95% RH for 56 days, loaded with 0.1 times RCWV        | ±5.0%+0.05 Ω                              |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70±2°C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)           | ±5.0%+0.05 Ω                              |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C ⇄ Room Temp. ⇄ +155°C ⇄ Room Temp. (5 cycles)              | ±1.0%+0.05 Ω                              |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260±3°C for 10±1 Sec., immersed to a point 3±0.5mm from the body | ±1.0%+0.05 Ω                              |
| Accidental Overload Test      | IEC 60115-1 4.26 | 4 times RCWV for 1 Min.                                          | No evidence of flaming or arcing          |

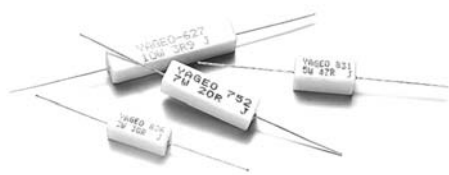
Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Cement Resistors

# Axial Lead Type

Normal Style [ SQP Series ]

Non-Inductive Style [ NSP Series ]



## INTRODUCTION

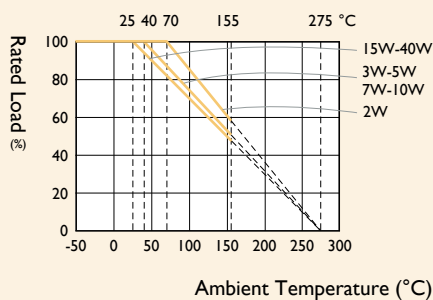
The materials used and the construction techniques ensure excellent flame resistance, arc resistance and moisture resistance as well as self-extinguishing capabilities. They will withstand the most rigorous loading test.

As resistors in radio and television receivers, hazardous conditions such as smoking and redheat can be completely prevented by the proper choice of power resistors.

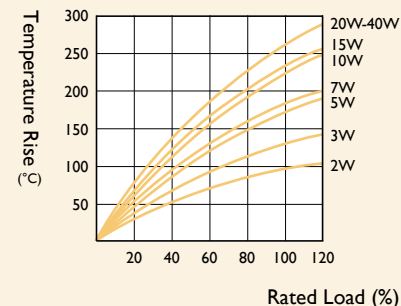
## FEATURES

|                      |                                              |
|----------------------|----------------------------------------------|
| Power Rating         | 2W, 3W, 5W, 7W, 10W, 15W, 20W, 25W, 30W, 40W |
| Resistance Tolerance | ±5%                                          |
| T.C.R.               | ±300ppm/°C                                   |

## DERATING CURVE

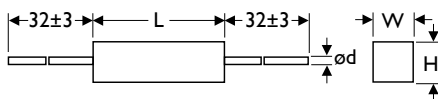


## TEMPERATURE RISE



## DIMENSIONS

Unit: mm



| STYLE  |               | DIMENSION |          |          |           |
|--------|---------------|-----------|----------|----------|-----------|
| Normal | Non-Inductive | L         | W        | H        | ød        |
| SQP200 | NSP200        | 18±1.0    | 7.0±1.0  | 7.0±1.0  | 0.65±0.05 |
| SQP300 | NSP300        | 22±1.5    | 8.0±1.0  | 8.0±1.0  | 0.8±0.05  |
| SQP500 | NSP500        | 22±1.5    | 9.5±1.0  | 9.0±1.0  | 0.8±0.05  |
| SQP700 | NSP700        | 35±1.5    | 9.5±1.0  | 9.0±1.0  | 0.8±0.05  |
| SQP10A | NSP10A        | 48±1.5    | 9.5±1.0  | 9.0±1.0  | 0.8±0.05  |
| SQP15A | NSP15A        | 48±1.5    | 12.5±1.0 | 12.5±1.0 | 0.8±0.05  |
| SQP20A | NSP20A        | 60±5.0    | 12.5±1.0 | 12.5±1.0 | 0.8±0.05  |
| SQP25A | NSP25A        | 60±5.0    | 14.0±1.5 | 13.0±1.5 | 0.8±0.05  |
| SQP30A | NSP30A        | 77±5.0    | 18.0±1.5 | 17.0±1.5 | 0.8±0.05  |
| SQP40A | NSP40A        | 90±5.0    | 19.0±1.5 | 18.0±1.5 | 0.8±0.05  |

## ELECTRICAL CHARACTERISTICS

### NORMAL STYLE

| STYLE                               | SQP200          | SQP300         | SQP500          | SQP700         | SQP10A         | SQP15A        | SQP20A        | SQP25A | SQP30A | SQP40A |
|-------------------------------------|-----------------|----------------|-----------------|----------------|----------------|---------------|---------------|--------|--------|--------|
| Power Rating at 25°C                |                 |                |                 |                |                | 15W           | 20W           | 25W    | 30W    | 40W    |
| Power Rating at 40°C                |                 | 3W             | 5W              | 7W             | 10W            |               |               |        |        |        |
| Power Rating at 70°C                | 2W              |                |                 |                |                |               |               |        |        |        |
| Maximum Working Voltage             | 250V            | 350V           |                 | 500V           |                |               |               | 1,000V |        |        |
| Maximum Overload Voltage            | 500V            | 700V           |                 | 1,000V         |                |               |               | 2,000V |        |        |
| Voltage Proof                       | 500V            | 700V           |                 | 1,000V         |                |               |               | 2,000V |        |        |
| Resistance Range (Wirewound)        | 0.03 Ω - 36 Ω   | 0.015 Ω - 68 Ω | 0.015 Ω - 130 Ω | 0.05 Ω - 330 Ω | 0.08 Ω - 510 Ω | 0.1 Ω - 680 Ω | 0.15 Ω - 1K Ω |        |        |        |
| Resistance Range (Metal Oxide Film) | 39 Ω - 1M Ω     | 75 Ω - 1M Ω    | 150 Ω - 1M Ω    | 360 Ω - 1M Ω   | 560 Ω - 1M Ω   | 750 Ω - 1M Ω  | 1.2K Ω - 1M Ω |        |        |        |
| Operating Temp. Range               | -55°C to +155°C |                |                 |                |                |               |               |        |        |        |
| Temperature Coefficient             | ±300ppm/°C      |                |                 |                |                |               |               |        |        |        |

### NON-INDUCTIVE STYLE

| STYLE                        | NSP200          | NSP300         | NSP500        | NSP700        | NSP10A         | NSP15A         | NSP20A         | NSP25A | NSP30A | NSP40A |
|------------------------------|-----------------|----------------|---------------|---------------|----------------|----------------|----------------|--------|--------|--------|
| Power Rating at 25°C         |                 |                |               |               |                | 15W            | 20W            | 25W    | 30W    | 40W    |
| Power Rating at 40°C         |                 | 3W             | 5W            | 7W            | 10W            |                |                |        |        |        |
| Power Rating at 70°C         | 2W              |                |               |               |                |                |                |        |        |        |
| Maximum Working Voltage      | 250V            | 350V           |               | 500V          |                |                |                | 1,000V |        |        |
| Maximum Overload Voltage     | 500V            | 700V           |               | 1,000V        |                |                |                | 2,000V |        |        |
| Voltage Proof                | 500V            | 700V           |               | 1,000V        |                |                |                | 2,000V |        |        |
| Resistance Range (Wirewound) | 0.08 Ω - 10 Ω   | 0.033 Ω - 30 Ω | 0.03 Ω - 40 Ω | 0.15 Ω - 65 Ω | 0.25 Ω - 100 Ω | 0.25 Ω - 120 Ω | 0.36 Ω - 160 Ω |        |        |        |
| Operating Temp. Range        | -55°C to +155°C |                |               |               |                |                |                |        |        |        |
| Temperature Coefficient      | ±300ppm/°C      |                |               |               |                |                |                |        |        |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST              | TEST METHOD      |                                                                  | APPRAISE                                  |
|-------------------------------|------------------|------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                        | ±2.0%+0.05 Ω                              |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                     | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                  | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                           | >1,000M Ω                                 |
| Solderability                 | IEC 60115-1 4.17 | 235±5°C for 3±0.5 Sec.                                           | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5±0.5 Min. with ultrasonic                               | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads   | ≥2.5kg (24.5N)                            |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)              | ±2.0%+0.05 Ω                              |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40±2°C, 90-95% RH for 56 days, loaded with 0.1 times RCWV        | ±5.0%+0.05 Ω                              |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70±2°C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)           | ±5.0%+0.05 Ω                              |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C ⇒ Room Temp. ⇒ +155°C ⇒ Room Temp. (5 cycles)              | ±2.0%+0.05 Ω                              |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260±3°C for 10±1 Sec., immersed to a point 3±0.5mm from the body | ±1.0%+0.05 Ω                              |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Cement Resistors

# Vertical Lead Type

Normal Style [ SQM Series ]

Non-Inductive Style [ NSM Series ]



### INTRODUCTION

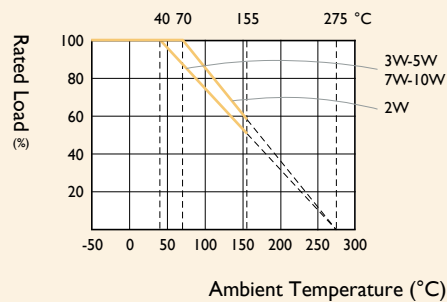
The materials used and the construction techniques ensure excellent flame resistance, arc resistance and moisture resistance as well as self-extinguishing capabilities. They will withstand the most rigorous loading test.

As resistors in radio and television receivers, hazardous conditions such as smoking and redheat can be completely prevented by the proper choice of power resistors.

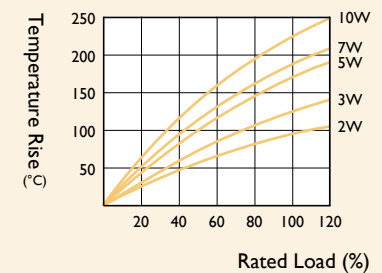
### FEATURES

|                      |                     |
|----------------------|---------------------|
| Power Rating         | 2W, 3W, 5W, 7W, 10W |
| Resistance Tolerance | ±5%                 |
| T.C.R.               | ±300ppm/°C          |

### DERATING CURVE

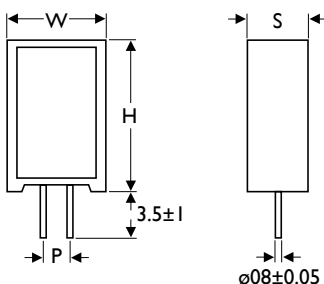


### TEMPERATURE RISE



### DIMENSIONS

Unit: mm



| STYLE  |          | DIMENSION |          |          |                   |
|--------|----------|-----------|----------|----------|-------------------|
| Normal | Non-Ind. | H         | W        | S        | P                 |
| SQM200 | NSM200   | 20±1.5    | 11.0±1.0 | 7.0±1.0  | 5 <sup>+2-1</sup> |
| SQM300 | NSM300   | 25±1.5    | 12.0±1.0 | 8.0±1.0  | 5 <sup>+2-1</sup> |
| SQM500 | NSM500   | 25±1.5    | 13.0±1.0 | 9.0±1.0  | 5 <sup>+2-1</sup> |
| SQM700 | NSM700   | 39±1.5    | 13.0±1.0 | 9.0±1.0  | 5 <sup>+2-1</sup> |
| SQM10A | NSM10A   | 51±1.5    | 13.0±1.0 | 9.0±1.0  | 5 <sup>+2-1</sup> |
| SQM10S | NSM10S   | 35±1.5    | 16.0±1.0 | 12.0±1.0 | 7 <sup>+2-1</sup> |

## ELECTRICAL CHARACTERISTICS

### NORMAL STYLE

| STYLE                               | SQM200          | SQM300         | SQM500          | SQM700         | SQM10A         | SQM10S         |
|-------------------------------------|-----------------|----------------|-----------------|----------------|----------------|----------------|
| Power Rating at 40°C                |                 | 3W             | 5W              | 7W             | 10W            |                |
| Power Rating at 70°C                | 2W              |                |                 |                |                |                |
| Maximum Working Voltage             | 250V            | 350V           |                 | 500V           |                |                |
| Maximum Overload Voltage            | 500V            | 700V           |                 | 1,000V         |                |                |
| Voltage Proof                       | 500V            | 700V           |                 | 1,000V         |                |                |
| Resistance Range (Wirewound)        | 0.03 Ω - 36 Ω   | 0.015 Ω - 68 Ω | 0.015 Ω - 130 Ω | 0.05 Ω - 330 Ω | 0.08 Ω - 510 Ω | 0.03 Ω - 270 Ω |
| Resistance Range (Metal Oxide Film) | 12 Ω - 1M Ω     | 75 Ω - 1M Ω    | 150 Ω - 1M Ω    | 360 Ω - 1M Ω   | 560 Ω - 1M Ω   | 300 Ω - 1M Ω   |
| Operating Temp. Range               | -55°C to +155°C |                |                 |                |                |                |
| Temperature Coefficient             | ±300ppm/°C      |                |                 |                |                |                |

### NON-INDUCTIVE STYLE

| STYLE                        | NSM200          | NSM300         | NSM500        | NSM700         | NSM10A         | NSM10S        |
|------------------------------|-----------------|----------------|---------------|----------------|----------------|---------------|
| Power Rating at 40°C         |                 | 3W             | 5W            | 7W             | 10W            |               |
| Power Rating at 70°C         | 2W              |                |               |                |                |               |
| Maximum Working Voltage      | 250V            | 350V           |               | 500V           |                |               |
| Maximum Overload Voltage     | 500V            | 700V           |               | 1,000V         |                |               |
| Voltage Proof                | 500V            | 700V           |               | 1,000V         |                |               |
| Resistance Range (Wirewound) | 0.08 Ω - 10 Ω   | 0.033 Ω - 30 Ω | 0.15 Ω - 65 Ω | 0.25 Ω - 100 Ω | 0.12 Ω - 100 Ω | 0.12 Ω - 50 Ω |
| Operating Temp. Range        | -55°C to +155°C |                |               |                |                |               |
| Temperature Coefficient      | ±300ppm/°C      |                |               |                |                |               |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST              | TEST METHOD      |                                                                  | APPRAISE                                  |
|-------------------------------|------------------|------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                        | ±2.0%+0.05 Ω                              |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                     | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                  | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                           | >1,000M Ω                                 |
| Solderability                 | IEC 60115-1 4.17 | 235±5°C for 3±0.5 Sec.                                           | 95% Min. coverage                         |
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| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)              | ±2.0%+0.05 Ω                              |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40±2°C, 90-95% RH for 56 days, loaded with 0.1 times RCWV        | ±5.0%+0.05 Ω                              |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70±2°C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)           | ±5.0%+0.05 Ω                              |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C ⇄ Room Temp. ⇄ +155°C ⇄ Room Temp. (5 cycles)              | ±2.0%+0.05 Ω                              |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260±3°C for 10±1 Sec., immersed to a point 3±0.5mm from the body | ±1.0%+0.05 Ω                              |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Cement Resistors

# Radial Terminals Type

Normal Style [ SQZ Series ]

Non-Inductive Style [ NSZ Series ]



## INTRODUCTION

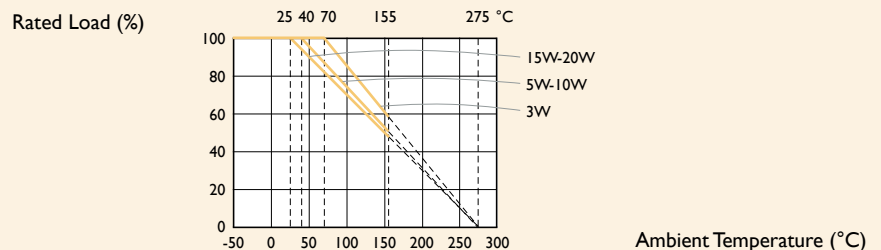
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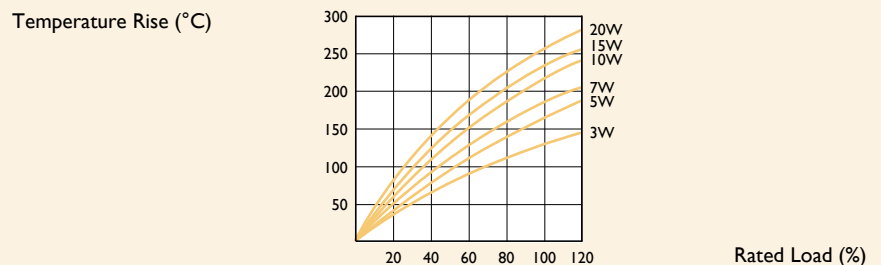
## FEATURES

|                      |                           |
|----------------------|---------------------------|
| Power Rating         | 3W, 5W, 7W, 10W, 15W, 20W |
| Resistance Tolerance | ±5%                       |
| T.C.R.               | ±300ppm/°C                |

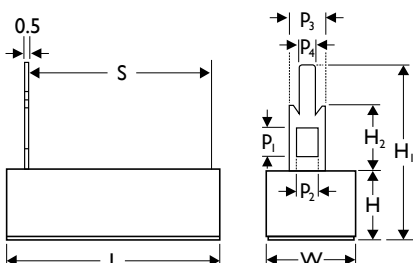
## DERATING CURVE



## TEMPERATURE RISE



## DIMENSIONS



Unit: mm

| STYLE  |          | DIMENSION |        |        |        |                |                |                |                |                |                |
|--------|----------|-----------|--------|--------|--------|----------------|----------------|----------------|----------------|----------------|----------------|
| Normal | Non-Ind. | L         | H      | W      | S      | H <sub>1</sub> | H <sub>2</sub> | P <sub>1</sub> | P <sub>2</sub> | P <sub>3</sub> | P <sub>4</sub> |
| SQZ300 | NSZ300   | 24.0±1.5  | 9.0±1  | 9.0±1  | 10.0±1 | 24.0±1         | 9.5±1.0        | 4.0±0.2        | 2.0±0.2        | 5.0±0.2        | 1.4±0.1        |
| SQZ500 | NSZ500   | 27.0±1.5  | 9.5±1  | 9.5±1  | 15.0±1 | 24.0±1         | 9.5±1.0        | 4.0±0.2        | 2.0±0.2        | 5.0±0.2        | 1.4±0.1        |
| SQZ700 | NSZ700   | 35.0±1.5  | 9.5±1  | 9.5±1  | 22.5±1 | 24.0±1         | 9.5±1.0        | 4.0±0.2        | 2.0±0.2        | 5.0±0.2        | 1.4±0.1        |
| SQZ10A | NSZ10A   | 48.0±1.5  | 9.5±1  | 9.5±1  | 32.5±1 | 24.0±1         | 9.5±1.0        | 4.0±0.2        | 2.0±0.2        | 5.0±0.2        | 1.4±0.1        |
| SQZ15A | NSZ15A   | 48.0±1.5  | 12.5±1 | 12.5±1 | 32.5±1 | 34.5±1         | 15.0±1.5       | 7.0±0.2        | 6.0±0.2        | 10.0±0.2       | 2.7±0.1        |
| SQZ20A | NSZ20A   | 63.5±2.0  | 12.5±1 | 12.5±1 | 42.5±1 | 34.5±1         | 15.0±1.5       | 7.0±0.2        | 6.0±0.2        | 10.0±0.2       | 2.7±0.1        |

## ELECTRICAL CHARACTERISTICS

### NORMAL STYLE

| STYLE                               | SQZ300          | SQZ500         | SQZ700       | SQZI0A         | SQZI5A       | SQZ20A        |
|-------------------------------------|-----------------|----------------|--------------|----------------|--------------|---------------|
| Power Rating at 25°C                |                 |                |              |                | 15W          | 20W           |
| Power Rating at 40°C                |                 | 5W             | 7W           | 10W            |              |               |
| Power Rating at 70°C                | 3W              |                |              |                |              |               |
| Maximum Working Voltage             | 250V            | 350V           | 500V         |                |              |               |
| Maximum Overload Voltage            | 500V            | 700V           | 1,000V       |                |              |               |
| Voltage Proof                       | 500V            | 700V           | 1,000V       |                |              |               |
| Resistance Range (Wirewound)        | 0.3 Ω - 130 Ω   | 0.36 Ω - 200 Ω |              | 0.56 Ω - 430 Ω | 1 Ω - 560 Ω  | 1.5 Ω - 750 Ω |
| Resistance Range (Metal Oxide Film) | 150 Ω - 1M Ω    | 220 Ω - 1M Ω   | 300 Ω - 1M Ω | 470 Ω - 1M Ω   | 750 Ω - 1M Ω | 820 Ω - 1M Ω  |
| Operating Temp. Range               | -55°C to +155°C |                |              |                |              |               |
| Temperature Coefficient             | ±300ppm/°C      |                |              |                |              |               |

### NON-INDUCTIVE STYLE

| STYLE                        | NSZ300          | NSZ500 | NSZ700 | NSZI0A       | NSZI5A | NSZ20A       |
|------------------------------|-----------------|--------|--------|--------------|--------|--------------|
| Power Rating at 25°C         |                 |        |        |              | 15W    | 20W          |
| Power Rating at 40°C         |                 | 5W     | 7W     | 10W          |        |              |
| Power Rating at 70°C         | 3W              |        |        |              |        |              |
| Maximum Working Voltage      | 250V            | 350V   | 500V   |              |        |              |
| Maximum Overload Voltage     | 500V            | 700V   | 1,000V |              |        |              |
| Voltage Proof                | 500V            | 700V   | 1,000V |              |        |              |
| Resistance Range (Wirewound) | 0.1 Ω - 10 Ω    |        |        | 0.1 Ω - 20 Ω |        | 0.1 Ω - 30 Ω |
| Operating Temp. Range        | -55°C to +155°C |        |        |              |        |              |
| Temperature Coefficient      | ±300ppm/°C      |        |        |              |        |              |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

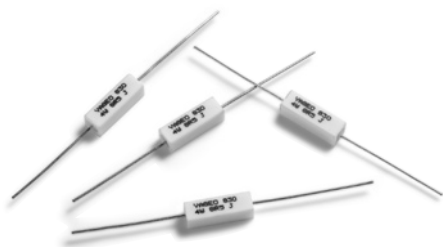
| PERFORMANCE TEST              | TEST METHOD      |                                                                  | APPRAISE                                  |
|-------------------------------|------------------|------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                        | ±2.0%+0.05 Ω                              |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                     | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                  | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                           | >1,000M Ω                                 |
| Solderability                 | IEC 60115-1 4.17 | 235±5°C for 3±0.5 Sec.                                           | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5±0.5 Min. with ultrasonic                               | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads   | ≥2.5kg (24.5N)                            |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)              | ±2.0%+0.05 Ω                              |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40±2°C, 90-95% RH for 56 days, loaded with 0.1 times RCWV        | ±5.0%+0.05 Ω                              |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70±2°C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)           | ±5.0%+0.05 Ω                              |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C ⇒ Room Temp. ⇒ +155°C ⇒ Room Temp. (5 cycles)              | ±2.0%+0.05 Ω                              |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260±3°C for 10±1 Sec., immersed to a point 3±0.5mm from the body | ±1.0%+0.05 Ω                              |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Cement Resistors

# Power Wirewound & Axial Lead Type

## Normal & Miniature Style [ PSP Series ]



### INTRODUCTION

The materials used and the construction techniques ensure excellent flame resistance, arc resistance and moisture resistance as well as self-extinguishing capabilities. They will withstand the most rigorous loading test.

As resistors in radio and television receivers, hazardous conditions such as smoking and redheat can be completely prevented by the proper choice of power resistors.

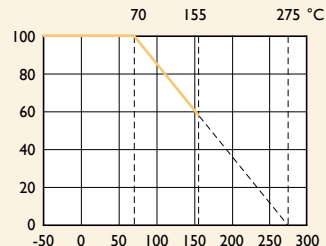
### FEATURES

|                      |                                      |
|----------------------|--------------------------------------|
| Power Rating         | 4W, 5W, 7W, 9W                       |
| Resistance Tolerance | $\pm 5\%$ , $\pm 10\%$               |
| T.C.R                | $\pm 400\text{ppm}/^{\circ}\text{C}$ |

### DERATING CURVE

For resistors operated in ambient temperatures above  $70^{\circ}\text{C}$ , power rating must be derated in accordance with the curve below.

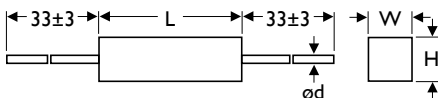
Rated Load (%)



Ambient Temperature ( $^{\circ}\text{C}$ )

### DIMENSIONS

Unit: mm



#### STYLE

#### DIMENSION

| Normal | Miniature | L            | W             | H             | ød             |
|--------|-----------|--------------|---------------|---------------|----------------|
| PSP400 | -         | 20 $\pm$ 1.0 | 6.4 $\pm$ 0.3 | 6.4 $\pm$ 0.3 | 0.8 $\pm$ 0.02 |
| PSP500 | -         | 25 $\pm$ 1.0 | 6.4 $\pm$ 0.3 | 6.4 $\pm$ 0.3 | 0.8 $\pm$ 0.02 |
| -      | PSP7WS    | 25 $\pm$ 1.0 | 9.0 $\pm$ 0.3 | 9.0 $\pm$ 0.3 | 0.8 $\pm$ 0.02 |
| PSP700 | -         | 38 $\pm$ 1.0 | 6.4 $\pm$ 0.3 | 6.4 $\pm$ 0.3 | 0.8 $\pm$ 0.02 |
| PSP900 | -         | 38 $\pm$ 1.0 | 9.0 $\pm$ 0.3 | 9.0 $\pm$ 0.3 | 0.8 $\pm$ 0.02 |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                   | PSP400                       | PSP500 | PSP7WS                       | PSP700                       | PSP900 |
|-------------------------|------------------------------|--------|------------------------------|------------------------------|--------|
| Power Rating at 70°C    | 4W                           | 5W     | 7W                           |                              | 9W     |
| Resistance Range        | 0.1 $\Omega$ - 2.2K $\Omega$ |        | 0.1 $\Omega$ - 2.5K $\Omega$ | 0.5 $\Omega$ - 3.9K $\Omega$ |        |
| Operating Temp. Range   | -55°C to +155°C              |        |                              |                              |        |
| Temperature Coefficient | $\pm 400$ ppm/°C             |        |                              |                              |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

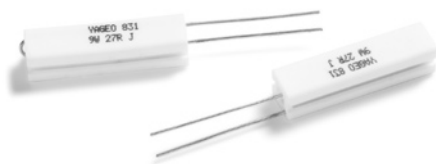
| PERFORMANCE TEST              | TEST METHOD      |                                                                                         | APPRAISE                                  |
|-------------------------------|------------------|-----------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                               | $\pm 2.0\% + 0.05 \Omega$                 |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                            | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                         | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                  | $> 1,000M \Omega$                         |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm 5$ °C for 3 $\pm 0.5$ Sec.                                                     | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm 0.5$ Min. with ultrasonic                                                | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                          | $\geq 2.5$ kg (24.5N)                     |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                     | $\pm 2.0\% + 0.05 \Omega$                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm 2$ °C, 90-95% RH for 56 days, loaded with 0.1 times RCWV                        | $\pm 5.0\% + 0.05 \Omega$                 |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm 2$ °C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                           | $\pm 5.0\% + 0.05 \Omega$                 |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles) | $\pm 2.0\% + 0.05 \Omega$                 |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm 3$ °C for 10 $\pm 1$ Sec., immersed to a point 3 $\pm 0.5$ mm from the body    | $\pm 1.0\% + 0.05 \Omega$                 |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Cement Resistors

# Power Wirewound & Vertical Lead Type

## Normal & Miniature Style [ PSM Series ]



### INTRODUCTION

The materials used and the construction techniques ensure excellent flame resistance, arc resistance and moisture resistance as well as self-extinguishing capabilities. They will withstand the most rigorous loading test.

As resistors in radio and television receivers, hazardous conditions such as smoking and redheat can be completely prevented by the proper choice of power resistors.

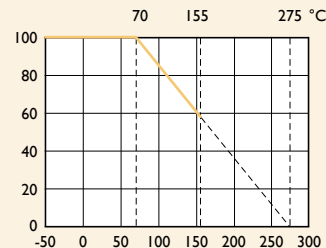
### FEATURES

|                      |                                      |
|----------------------|--------------------------------------|
| Power Rating         | 4W, 5W, 7W, 9W                       |
| Resistance Tolerance | $\pm 5\%$ , $\pm 10\%$               |
| T.C.R                | $\pm 400\text{ppm}/^{\circ}\text{C}$ |

### DERATING CURVE

For resistors operated in ambient temperatures above  $70^{\circ}\text{C}$ , power rating must be derated in accordance with the curve below.

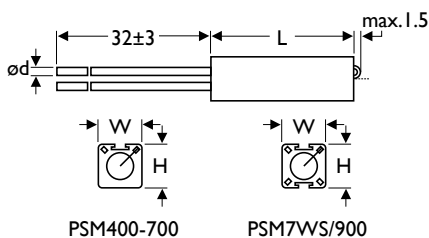
Rated Load (%)



Ambient Temperature ( $^{\circ}\text{C}$ )

### DIMENSIONS

Unit: mm



#### STYLE

#### DIMENSION

| Normal | Miniature | L            | W              | H              | ød             |
|--------|-----------|--------------|----------------|----------------|----------------|
| PSM400 | -         | $20 \pm 1.0$ | $7.0 \pm 0.5$  | $8.0 \pm 0.4$  | $0.8 \pm 0.02$ |
| PSM500 | -         | $25 \pm 1.0$ | $7.0 \pm 0.5$  | $8.0 \pm 0.4$  | $0.8 \pm 0.02$ |
| -      | PSM7WS    | $25 \pm 1.0$ | $9.0 \pm 0.4$  | $10.0 \pm 0.4$ | $0.8 \pm 0.02$ |
| PSM700 | -         | $38 \pm 1.0$ | $7.0 \pm 0.5$  | $8.0 \pm 0.4$  | $0.8 \pm 0.02$ |
| PSM900 | -         | $38 \pm 1.0$ | $10.0 \pm 0.4$ | $10.0 \pm 0.4$ | $0.8 \pm 0.02$ |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                   | PSM400                       | PSM500 | PSM7WS                       | PSM700                       | PSM900 |
|-------------------------|------------------------------|--------|------------------------------|------------------------------|--------|
| Power Rating at 70°C    | 4W                           | 5W     | 7W                           |                              | 9W     |
| Resistance Range        | 0.1 $\Omega$ - 2.2K $\Omega$ |        | 0.1 $\Omega$ - 2.5K $\Omega$ | 0.5 $\Omega$ - 3.9K $\Omega$ |        |
| Operating Temp. Range   | -55°C to +155°C              |        |                              |                              |        |
| Temperature Coefficient | $\pm 400$ ppm/°C             |        |                              |                              |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

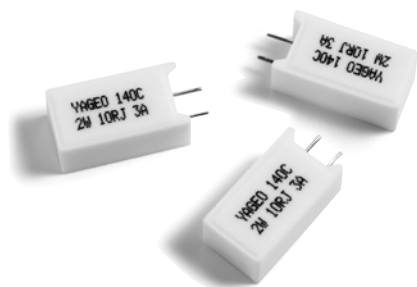
| PERFORMANCE TEST              | TEST METHOD      |                                                                                         | APPRAISE                                  |
|-------------------------------|------------------|-----------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                               | $\pm 2.0\% + 0.05 \Omega$                 |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                            | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                                         | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                  | $> 1,000M \Omega$                         |
| Solderability                 | IEC 60115-1 4.17 | 235 $\pm 5$ °C for 3 $\pm 0.5$ Sec.                                                     | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5 $\pm 0.5$ Min. with ultrasonic                                                | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads                          | $\geq 2.5$ kg (24.5N)                     |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)                                     | $\pm 2.0\% + 0.05 \Omega$                 |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40 $\pm 2$ °C, 90-95% RH for 56 days, loaded with 0.1 times RCWV                        | $\pm 5.0\% + 0.05 \Omega$                 |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70 $\pm 2$ °C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                           | $\pm 5.0\% + 0.05 \Omega$                 |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C $\Rightarrow$ Room Temp. $\Rightarrow$ +155°C $\Rightarrow$ Room Temp. (5 cycles) | $\pm 2.0\% + 0.05 \Omega$                 |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260 $\pm 3$ °C for 10 $\pm 1$ Sec., immersed to a point 3 $\pm 0.5$ mm from the body    | $\pm 1.0\% + 0.05 \Omega$                 |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Cement Resistors

# Fusible Thermal & Vertical Lead Type

## Normal Style [ FTR Series ]



### INTRODUCTION

The material used and the construction techniques ensure excellent flame resistance, arc resistance and moisture resistance as well as self-extinguishing capabilities. They will withstand the most rigorous loading test.

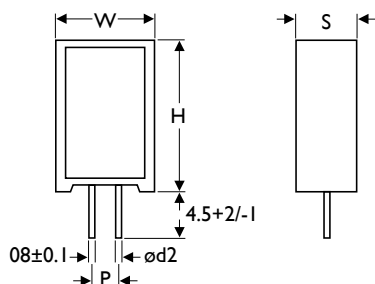
Apply fusible thermal resistors, respond quickly to overloading as external overheating. These resistors also provide outstanding feature against surges, suitable for the prevention of inrush current for switching regulators.

### FEATURES

|                      |                 |
|----------------------|-----------------|
| Rated Current        | 2A, 3A, 5A, 10A |
| Resistance Tolerance | ±5%, ±10%       |
| T.C.R                | ±250ppm/°C      |

### DIMENSIONS

Unit: mm



| STYLE  | DIMENSION |        |         |         |         |
|--------|-----------|--------|---------|---------|---------|
| Normal | H         | W      | S       | P       | ød2     |
| FTR100 | 25±1.5    | 13±1.0 | 9.0±1.0 | 5.0±1.0 | 0.6±0.1 |
| FTR200 | 38±1.5    | 13±1.0 | 9.0±1.0 | 5.0±1.0 |         |
| FTR300 | 35±1.5    | 16±1.0 | 12±1.0  | 7.5±1.0 |         |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE              | STANDARD<br>CURRENT (A) | FUSING<br>TEMPERATURE (°C) | STANDARD<br>VOLTAGE (V) | RESISTANCE<br>RANGE | POWER RATING AT 70°C |        |        |
|--------------------|-------------------------|----------------------------|-------------------------|---------------------|----------------------|--------|--------|
|                    |                         |                            |                         |                     | FTR100               | FTR200 | FTR300 |
| FTR100 / 200 / 300 | 10A                     | 109+1/-3                   | 250                     | 1 Ω - 10K Ω         | 1.2                  | 1.4    | 2.0    |
|                    |                         | 129±4                      |                         |                     | 1.6                  | 2.0    | 2.5    |
|                    |                         | 152±4                      |                         |                     | 1.6                  | 2.0    | 2.5    |
|                    |                         | 188+3/-1                   |                         |                     | 2.0                  | 2.4    | 3.5    |
|                    |                         | 226+1/-3                   |                         |                     | 2.0                  | 2.4    | 3.5    |
|                    | 5A                      | 129±3                      |                         |                     | 1.6                  | 2.2    | -      |
|                    |                         | 187+1/-3                   |                         |                     | 2.1                  | 2.4    | -      |
|                    | 3A                      | 145±4                      |                         |                     | 1.6                  | 2.2    | -      |
|                    | 2A                      | 95+3/0                     |                         |                     | 0.8                  | 1.2    | -      |
|                    |                         | 110±4                      |                         |                     | 1.2                  | 1.4    | -      |
|                    |                         | 126±4                      |                         |                     | 1.4                  | 1.6    | -      |
|                    |                         | 130±4                      |                         |                     | 1.6                  | 2.1    | -      |
|                    |                         | 135±4                      |                         |                     | 1.8                  | 2.2    | -      |
|                    |                         | 145±4                      |                         |                     | 2.1                  | 2.4    | -      |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST           | TEST METHOD      |                                                                | APPRAISE     |
|----------------------------|------------------|----------------------------------------------------------------|--------------|
| Short Time Overload        | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                      | ±2.0%+0.05 Ω |
| Temperature Coefficient    | IEC 60115-1 4.8  | -25°C to +125°C                                                | By type      |
| Robustness of Terminations | IEC 60115-1 4.16 | Direct load for 10 Sec. In the direction of the terminal leads | ≥25N         |
| Damp Heat Steady State     | IEC 60115-1 4.24 | 40±2°C, 90-95% RH for 56 days, loaded with 0.1 times RCWV      | ±5.0%+0.1 Ω  |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Cement Resistors

# Low Ohmic Metal Plate Type

## Normal Style [ SLR Series ]



### INTRODUCTION

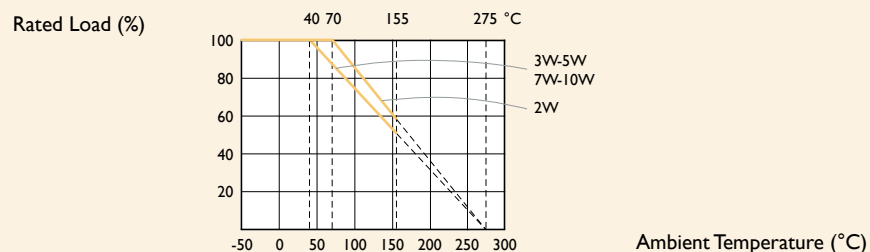
The materials used and the construction techniques ensure excellent flame resistance, arc resistance and moisture resistance as well as self-extinguishing capabilities. They will withstand the most rigorous loading test.

As resistors in radio and television receivers, hazardous conditions such as smoking and redheat can be completely prevented by the proper choice of power resistors.

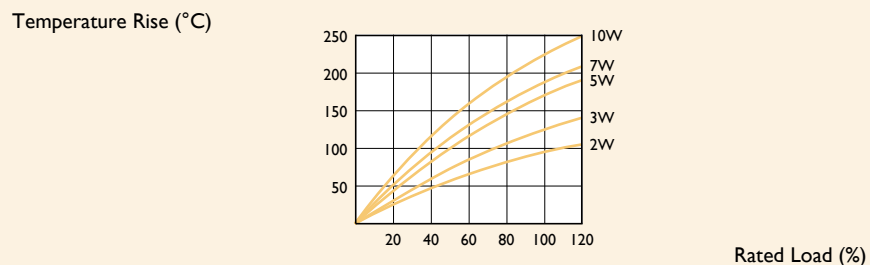
### FEATURES

|                      |                     |
|----------------------|---------------------|
| Power Rating         | 2W, 3W, 5W, 7W, 10W |
| Resistance Tolerance | ±5%, ±10%           |
| T.C.R.               | ±250ppm/°C          |

### DERATING CURVE

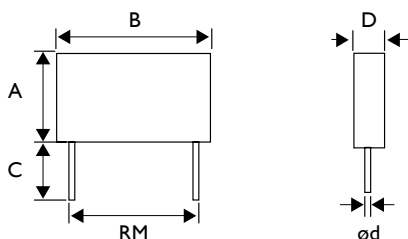


### TEMPERATURE RISE



### DIMENSIONS

Unit: mm



| STYLE  | DIMENSION |      |       |     |          |      |
|--------|-----------|------|-------|-----|----------|------|
| Normal | A         | B    | C     | D   | ød       | RM   |
| SLR200 | 8±1       | 13±1 | 3.5±1 | 5±1 | 0.6±0.05 | 9±1  |
| SLR300 | 13±1      | 13±1 | 3.5±1 | 5±1 | 0.6±0.05 | 8±1  |
| SLR500 | 18±1      | 14±1 | 3.5±1 | 5±1 | 0.6±0.05 | 10±1 |
| SLR700 | 18±1      | 26±1 | 3.5±1 | 5±1 | 0.8±0.05 | 20±1 |
| SLR10A | 20±1      | 26±1 | 3.5±1 | 5±1 | 0.8±0.05 | 20±1 |

Note:

## ELECTRICAL CHARACTERISTICS

| STYLE                           | SLR200                        | SLR300                     | SLR500                       | SLR700 | SLR10A |
|---------------------------------|-------------------------------|----------------------------|------------------------------|--------|--------|
| Power Rating at 40°C            |                               | 3W                         | 5W                           | 7W     | 10W    |
| Power Rating at 70°C            | 2W                            |                            |                              |        |        |
| Maximum Working Voltage         | 250V                          | 350V                       |                              | 500V   |        |
| Maximum Overload Voltage        | 500V                          | 700V                       |                              | 1,000V |        |
| Dielectric Withstanding Voltage | 500V                          | 700V                       |                              | 1,000V |        |
| Resistance range                | 0.10 $\Omega$ - 0.68 $\Omega$ | 0.01 $\Omega$ - 1 $\Omega$ | 0.01 $\Omega$ - 3.3 $\Omega$ |        |        |
| Operating Temp. Range           | -55°C to +155°C               |                            |                              |        |        |
| Temperature Coefficient         | ±250ppm/°C                    |                            |                              |        |        |

Note: Special value is available on request

## ENVIRONMENTAL CHARACTERISTICS

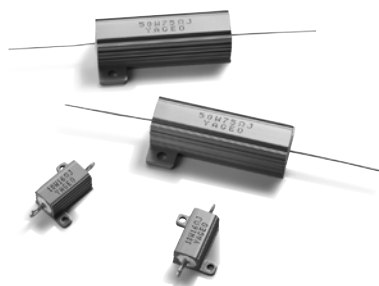
| PERFORMANCE TEST              | TEST METHOD      |                                                                  | APPRAISE                                  |
|-------------------------------|------------------|------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                        | ±2.0%+0.05 $\Omega$                       |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                     | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +155°C                                                  | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                           | >1,000M $\Omega$                          |
| Solderability                 | IEC 60115-1 4.17 | 235±5°C for 3±0.5 Sec.                                           | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5±0.5 Min. with ultrasonic                               | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Direct load for 10 Sec. in the direction of the terminal leads   | ≥2.5kg (24.5N)                            |
| Periodic-pulse Overload       | IEC 60115-1 4.39 | 4 times RCWV 10,000 cycles (1 Sec. on, 25 Sec. off)              | ±2.0%+0.05 $\Omega$                       |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40±2°C, 90-95% RH for 56 days, loaded with 0.1 times RCWV        | ±5.0%+0.1 $\Omega$                        |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70±2°C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)           | ±5.0%+0.1 $\Omega$                        |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C ⇌ Room Temp. ⇌ +155°C ⇌ Room Temp. (5 cycles)              | ±2.0%+0.05 $\Omega$                       |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260±3°C for 10±1 Sec., immersed to a point 3±0.5mm from the body | ±1.0%+0.05 $\Omega$                       |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

## Aluminum Housed Resistors

# Power Wirewound Type

Lug / Threaded Style [ AHA Series ]  
Straight Leadwire Style [ AHP Series ]

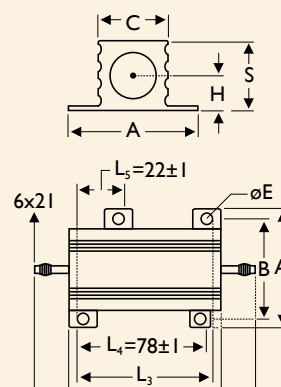
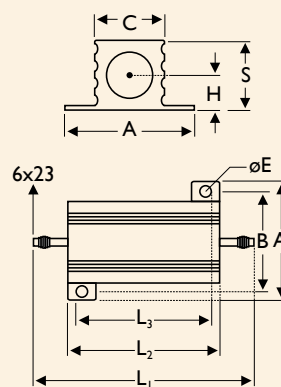
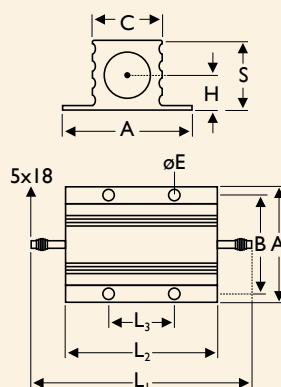
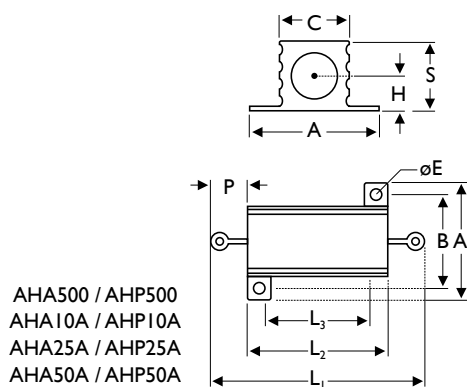


### FEATURES

|                      |                                                                 |
|----------------------|-----------------------------------------------------------------|
| Power Rating         | 5W, 10W, 25W, 50W, 80W, 100W, 250W                              |
| Resistance Tolerance | $\pm 0.25\%$ , $\pm 0.5\%$ , $\pm 1\%$ , $\pm 5\%$ , $\pm 10\%$ |
| T.C.R.               | $\pm 200\text{ppm}/^{\circ}\text{C}$                            |

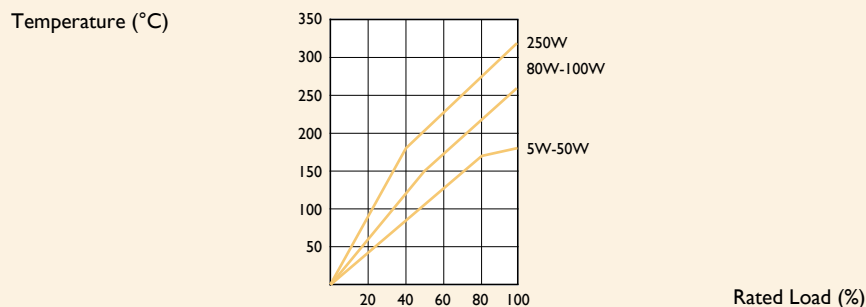
### DIMENSIONS

Unit: mm



| STYLE           | DIMENSION      |                |                |        |        |        |         |        |          |      |  |
|-----------------|----------------|----------------|----------------|--------|--------|--------|---------|--------|----------|------|--|
| Normal          | L <sub>1</sub> | L <sub>2</sub> | L <sub>3</sub> | A      | B      | C      | øE      | S      | H        | P    |  |
| AHA500 / AHP500 | 25±2           | 15±1           | 10±1           | 16.5±1 | 12.5±1 | 8.5±1  | 2±0.3   | 8±1    | 4±0.5    | 5±2  |  |
| AHA10A / AHP10A | 32±2           | 19±1           | 14±1           | 20±1   | 15.5±1 | 10.5±1 | 2±0.3   | 10±1   | 5±0.5    | 6±2  |  |
| AHA25A / AHP25A | 47±2           | 27±1           | 18±1           | 27±1   | 19±1   | 15±1   | 3.2±0.3 | 15.5±1 | 7±0.5    | 10±2 |  |
| AHA50A / AHP50A | 70±2           | 50±1           | 39±1           | 29±1   | 21±1   | 15±1   | 3.2±0.3 | 15.5±1 | 7±0.5    | 10±2 |  |
| AHA80A          | 102±2          | 66±1           | 35±1           | 47±1   | 37±1   | 28±1   | 4.5±0.3 | 25±1   | 12±0.5   | -    |  |
| AHA10B          | 135±2          | 89±1           | 69±1           | 70±1   | 48±1   | 46±1   | 5±0.3   | 44.5±1 | 19.5±0.5 | -    |  |
| AHA25B          | 155±2          | 114±1          | 98±1           | 77±1   | 64±1   | 53±1   | 5±0.3   | 55.5±1 | 25±0.5   | -    |  |

## TEMPERATURE RISE



## ELECTRICAL CHARACTERISTICS

| STYLE                   | AHA500<br>AHP500 | AHA10A<br>AHP10A | AHA25A<br>AHP25A | AHA50A<br>AHP50A | AHA80A       | AHA10B | AHA25B |
|-------------------------|------------------|------------------|------------------|------------------|--------------|--------|--------|
| Power Rating at 70°C    | 5W               | 10W              | 25W              | 50W              | 80W          | 100W   | 250W   |
| Voltage Proof           | 1,000V           |                  |                  | 2,000V           |              | 4,500V |        |
| Resistance Range        | 0.1 Ω - 100 Ω    |                  |                  |                  | 0.1 Ω - 3K Ω |        |        |
| Operating Temp. Range   | -55°C to +250°C  |                  |                  |                  |              |        |        |
| Temperature Coefficient | ±200ppm/°C       |                  |                  |                  |              |        |        |

Note: Special value is available on request.

## ENVIRONMENTAL CHARACTERISTICS

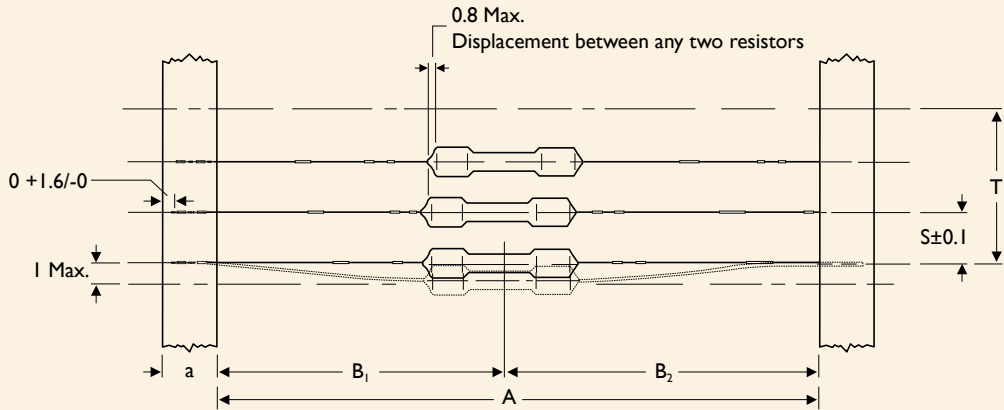
| PERFORMANCE TEST              | TEST METHOD      |                                                                                                                            | APPRAISE                                  |
|-------------------------------|------------------|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload           | IEC 60115-1 4.13 | 2.5 times RCWV for 5 Sec.                                                                                                  | ±0.5%+0.05 Ω                              |
| Voltage Proof                 | IEC 60115-1 4.7  | in V-block for 60 Sec., test voltage by type                                                                               | By type                                   |
| Temperature Coefficient       | IEC 60115-1 4.8  | -55°C to +250°C                                                                                                            | By type                                   |
| Insulation Resistance         | IEC 60115-1 4.6  | in V-block for 60 Sec.                                                                                                     | >100M Ω                                   |
| Solderability                 | IEC 60115-1 4.17 | 235±5°C for 3±0.5 Sec.                                                                                                     | 95% Min. coverage                         |
| Solvent Resistance of Marking | IEC 60115-1 4.30 | IPA for 5±0.5 Min. with ultrasonic                                                                                         | No deterioration of coatings and markings |
| Robustness of Terminations    | IEC 60115-1 4.16 | Pull test (30 Sec. Min): 5W: 1kg, 10W: 2.3kg, 25 - 50W: 4.5kg<br>Torque test (5 - 15 Sec): 80W: 2N, 100W: 2.7N, 250W: 3.7N | ±0.2%+0.05 Ω                              |
| Damp Heat Steady State        | IEC 60115-1 4.24 | 40±2°C, 90-95% RH for 56 days, loaded with 0.1 times RCWV                                                                  | ±0.5%+0.05 Ω                              |
| Endurance at 70°C             | IEC 60115-1 4.25 | 70±2°C at RCWV for 1,000 Hr. (1.5 Hr. on, 0.5 Hr. off)                                                                     | ±1.5%+0.05 Ω                              |
| Temperature Cycling           | IEC 60115-1 4.19 | -55°C ⇄ Room Temp. ⇄ +155°C ⇄ Room Temp. (5 cycles)                                                                        | ±1.0%+0.05 Ω                              |
| Resistance to Soldering Heat  | IEC 60115-1 4.18 | 260±3°C for 10±1 Sec., immersed to a point 3±0.5mm from the body                                                           | ±1.0%+0.05 Ω                              |

Note: Rated Continuous Working Voltage (RCWV) =  $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

GENERAL INFORMATION

PACKING METHODS

The resistors are supplied on bandolier; either 1,000 resistors in ammpack or 5,000 resistors on reel.



Bandolier for Axial Leads

| STYLE           |               | DIMENSIONS |                  |                                 |             |                                           | Unit: mm |
|-----------------|---------------|------------|------------------|---------------------------------|-------------|-------------------------------------------|----------|
| Normal          | Miniature     | a          | A <sup>(1)</sup> | B <sub>1</sub> - B <sub>2</sub> | S (Spacing) | T (Max. Deviation of Spacing)             |          |
| TYPE-12         | TYPE25S / 204 | 6±0.5      | 52.4±1.5         | 1.2                             | 5           | 1mm Per 10 Spacings, 0.5mm Per 5 Spacings |          |
|                 |               |            | 26.0±1.5         | 1                               |             |                                           |          |
| TYPE-25         | TYPE50S / 207 | 6±0.5      | 52.4±1.5         | 1.2                             | 5           |                                           |          |
|                 |               |            | 26.0±1.5         | 1                               |             |                                           |          |
| TYPE-50         | TYPE1WS       | 6±0.5      | 52.4±1.5         | 1.2                             | 5           |                                           |          |
| TYPE100         | TYPE2WS       | 6±0.5      | 73.0±1.5         | 1.5                             | 5           |                                           |          |
|                 |               |            | 52.4±1.5         | 1.2                             |             |                                           |          |
| TYPE200         | TYPE3WS       | 6±0.5      | 73.0±1.5         | 1.5                             | 10          |                                           |          |
| KNP300          | KNP5WS        |            | 52.4±1.5         | 1.2                             |             |                                           |          |
| RSF300          | RSF5WS        | 6±0.5      | 91.0±1.5         | 1.5                             | 10          |                                           |          |
| RSF500 / KNP500 | KNP7WS        |            | 73.0±1.5         | 1.5                             |             |                                           |          |

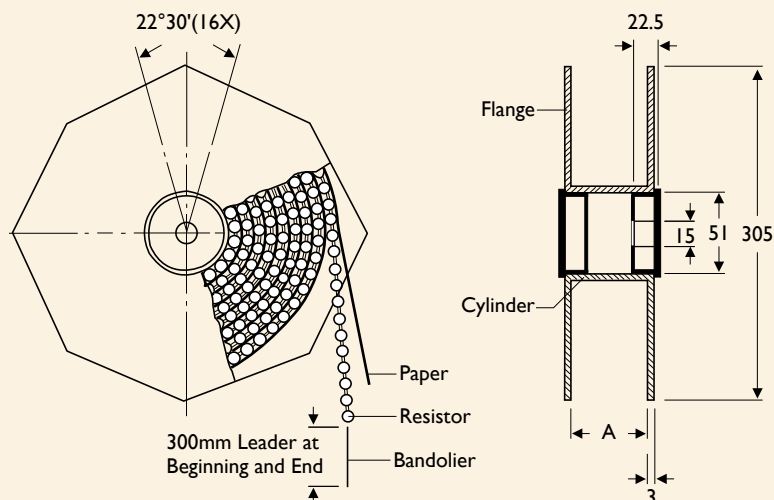
Note: 1. Optional please refer to table "Exception"

EXCEPTION

| SERIES                | POWER RATING  | STANDARD LEAD LENGTH | MINIATURE LEAD LENGTH |
|-----------------------|---------------|----------------------|-----------------------|
| RSF                   | 3WM, 5SS      | 73                   | 52.4                  |
| KNP / NKN / FKN       | 3W, 4W, 5WS   | 73                   | 52.4                  |
| RSF / KNP / NKN / FKN | 5W, 7W on T/R | 73                   |                       |

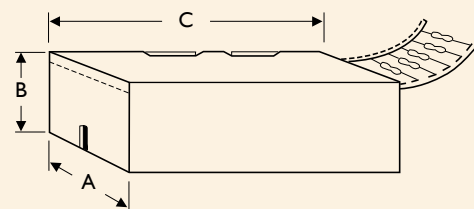
## TAPE ON REEL PACKING

Bandoliers can be reeled; dimension a differ with type.



## TAPE ON BOX PACKING

Bandoliers may also be supplied in a cardboard box ("ammopack").



"Ammopack" is an abbreviation of "ammunition packing"  
The dimensions of A-B-C vary with type and quantity.

| STYLE           |               | TAPE ON REEL      |               | TAPE ON BOX |        |       | Unit: mm/pcs |
|-----------------|---------------|-------------------|---------------|-------------|--------|-------|--------------|
| Normal          | Miniature     | Across Flange (A) | Q'TY Per Reel | W (A)       | H (B)  | L (C) | Q'TY Per Box |
| TYPE-12         | TYPE25S / 204 | 72                | 5,000         | 78/81       | 24/70  | 260   | 2,000/5,000  |
| TYPE-25         | TYPE50S / 207 | 48/72             | 5,000         | 78/81       | 24/104 | 260   | 1,000/5,000  |
| TYPE-50         | TYPE1WS       | 72                | 2,500         | 73          | 45     | 258   | 1,000        |
| TYPE100         | TYPE2WS       | 95                | 2,000         | 103         | 78     | 260   | 1,000        |
| TYPE200         | TYPE3WS       | 95                | 1,000         | 103         | 94     | 260   | 1,000        |
| KNP300          | KNP5WS        | 95                | 1,000         | 103         | 78     | 260   | 500          |
| RSF300          | RSF5WS        | 95                | 250           | 116         | 79     | 255   | 250          |
| RSF500 / KNP500 | KNP7WS        |                   |               |             |        |       |              |

## BULK PACKING

| POWER RATING      | PCS/PER INNER BOX | BAG/PER INNER BOX | PCS/PER BAG |
|-------------------|-------------------|-------------------|-------------|
| 1/6W, 1/4WS, 0.4W | 10,000            | 10                | 1,000       |
| 1/4W, 1/2WS, 0.6W | 10,000            | 10                | 1,000       |
| 1/2W, 1WS         | 5,000             | 5                 | 1,000       |
| 1W, 2WS           | 2,000             | 4                 | 500         |
| 2W, 3WS           | 1,000             | 2                 | 500         |
| 3W                | 1,000             | 2                 | 500         |
| 5W                | 500               | 10                | 50          |
| 7W                | 500               | 10                | 50          |

PACKING QUANTITIES

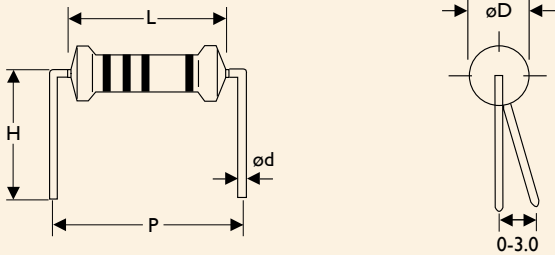
| TYPE            | POWER   | PACKAGE     | Q'TY   | WEIGHT | CARTON Q'TY | NW   | GW   | CARTON SIZE  | CUBIC FIT |
|-----------------|---------|-------------|--------|--------|-------------|------|------|--------------|-----------|
| (Unit)          | (Watt)  |             | (Pcs)  | (Kg)   | (Pcs)       | (Kg) | (Kg) | (cm)         | (Cu.ft.)  |
| Coating<br>Type | 1/6W    | Tape / Reel | 5,000  | 1.1    | 50,000      | 11   | 13   | 60×30.5×43.5 | 3         |
|                 | 1/4WS   | Tape / Box  | 5,000  | 0.74   | 100,000     | 15   | 16   | 42.5×28×35   | 1.5       |
|                 | 0.4W    | Bulk        | 10,000 | 1.18   | 160,000     | 19   | 20   | 42.5×28×35   | 1.5       |
|                 | 1/4W    | Tape / Reel | 5,000  | 1.5    | 50,000      | 16   | 18   | 60×30.5×43.5 | 3         |
|                 | 1/2WS   | Tape / Box  | 5,000  | 1.1    | 75,000      | 18   | 19   | 42.5×28×35   | 1.5       |
|                 | 0.6W    | Bulk        | 10,000 | 1.6    | 80,000      | 12   | 13   | 42.5×28×35   | 1.5       |
|                 | 1/2W    | Tape / Reel | 2,500  | 1.1    | 25,000      | 11   | 13   | 60×30.5×43.5 | 3         |
|                 | 1WS     | Tape / Box  | 1,000  | 0.43   | 30,000      | 13   | 14   | 40.5×28×33   | 1.4       |
|                 | 1SS     | Bulk        | 5,000  | 1.86   | 40,000      | 14   | 15   | 42.5×28×35   | 1.5       |
|                 | 1W      | Tape / Reel | 2,000  | 2.2    | 20,000      | 22   | 24   | 60×30.5×43.5 | 3         |
|                 | 2WS     | Tape / Box  | 1,000  | 0.9    | 20,000      | 17   | 18   | 42.5×28×35   | 1.5       |
|                 | 2SS     | Bulk        | 2,000  | 1.4    | 32,000      | 22   | 23   | 42.5×28×35   | 1.5       |
|                 | 2W      | Tape / Reel | 1,000  | 1.6    | 10,000      | 13   | 14   | 60×30.5×43.5 | 3         |
|                 | 3WS     | Tape / Box  | 1,000  | 1.12   | 12,000      | 14   | 15   | 42.5×28×35   | 1.5       |
|                 | 3WV     | Bulk        | 1,000  | 1.02   | 16,000      | 22   | 24   | 42.5×28×35   | 1.5       |
|                 | 3W      | Tape / Reel | 250    | 1.4    | 2,000       | 11   | 13   | 60×30.5×43.5 | 3         |
|                 | 5WS     | Tape / Box  | 250    | 1.02   | 4,000       | 16   | 17   | 42.5×28×35   | 1.5       |
|                 |         | Bulk        | 500    | 1.85   | 4,000       | 14   | 15   | 42.5×28×35   | 1.5       |
|                 | 5W, 7WS | Tape / Box  | 250    | 1      | 4,000       | 16   | 17   | 42.5×28×35   | 1.5       |
|                 | 5SS     | Tape / Reel | 1,000  | 2.5    | 8,000       | 21   | 23   | 60×30.5×43.5 | 3         |
|                 | 3WM     | Tape / Box  | 500    | 0.93   | 8,000       | 15   | 16   | 42.5×28×35   | 1.5       |
|                 |         | Bulk        | 1,000  | 1.7    | 16,000      | 27   | 28   | 42.5×28×35   | 1.5       |
| Jumper<br>Wire  | JPW-05  | Tape / Reel | 10,000 | 1.4    | 100,000     | 15   | 17   | 60×30.5×43.5 | 3         |
|                 |         | Tape / Box  | 10,000 | 1.06   | 150,000     | 16   | 17   | 42.5×28×35   | 1.5       |
|                 |         | Bulk        | 10,000 | 0.98   | 160,000     | 16   | 17   | 42.5×28×35   | 1.5       |
|                 | JPW-06  | Tape / Reel | 10,000 | 1.9    | 100,000     | 22   | 24   | 60×30.5×43.5 | 3         |
|                 |         | Tape / Box  | 10,000 | 1.5    | 150,000     | 24   | 25   | 42.5×28×35   | 1.5       |
|                 |         | Bulk        | 10,000 | 1.4    | 160,000     | 23   | 24   | 42.5×28×35   | 1.5       |
|                 | JPW-07  | Tape / Reel | 10,000 | 3      | 100,000     | 32   | 34   | 60×30.5×43.5 | 3         |
|                 | JPW-08  | Tape / Box  | 5,000  | 2.7    | 100,000     | 27   | 28   | 42.5×28×35   | 1.5       |
|                 |         | Bulk        | 10,000 | 2.5    | 160,000     | 40   | 41   | 42.5×28×35   | 1.5       |
|                 | JPW-10  | Tape / Reel | 10,000 | 5      | 100,000     | 50   | 52   | 60×30.5×43.5 | 3         |
|                 |         | Tape / Box  | 5,000  | 2.33   | 75,000      | 35   | 36   | 42.5×28×35   | 1.5       |
|                 |         | Bulk        | 10,000 | 4.7    | 160,000     | 75   | 76   | 42.5×28×35   | 1.5       |

## PACKING QUANTITIES

| SERIES    | POWER  | PACKAGE | Q'TY  | WEIGHT | CARTON Q'TY | NW   | GW   | CARTON SIZE | CUBIC FIT |
|-----------|--------|---------|-------|--------|-------------|------|------|-------------|-----------|
| (Unit)    | (Watt) |         | (Pcs) | (Kg)   | (Pcs)       | (Kg) | (Kg) | (cm)        | (Cu.ft.)  |
| SQP / NSP | 2W     | Bulk    | 1,000 | 3.8    | 4,000       | 15   | 16   | 42.5×28×35  | 1.5       |
|           | 3W     | Bulk    | 1,000 | 4.6    | 2,000       | 9    | 10   | 42.5×28×35  | 1.5       |
|           | 5W     | Bulk    | 900   | 4.8    | 1,800       | 10   | 10.5 | 42.5×28×35  | 1.5       |
|           | 7W     | Bulk    | 500   | 4.5    | 2,000       | 18   | 19   | 42.5×28×35  | 1.5       |
|           | 10W    | Bulk    | 500   | 5.8    | 2,000       | 23   | 24   | 42.5×28×35  | 1.5       |
|           | 15W    | Bulk    | 50    | 1.1    | 1,000       | 20   | 21   | 42.5×28×35  | 1.5       |
|           | 20W    | Bulk    | 50    | 1.4    | 1,000       | 27   | 28   | 42.5×28×35  | 1.5       |
|           | 25W    | Bulk    | 50    | 1.5    | 250         | 7    | 8    | 42.5×28×35  | 1.5       |
|           | 30W    | Bulk    | 50    | 3.3    | 250         | 16   | 17   | 42.5×28×35  | 1.5       |
|           | 40W    | Bulk    | 50    | 3.9    | 250         | 19   | 20   | 42.5×28×35  | 1.5       |
| SQM / NSM | 2W     | Bulk    | 1,500 | 8.3    | 3,000       | 16.5 | 18   | 42.5×28×35  | 1.5       |
|           | 3W     | Bulk    | 1,500 | 9.1    | 3,000       | 18   | 19   | 42.5×28×35  | 1.5       |
|           | 5W     | Bulk    | 1,000 | 6.6    | 2,000       | 13   | 14   | 42.5×28×35  | 1.5       |
|           | 7W     | Bulk    | 800   | 8.1    | 3,200       | 32   | 33   | 42.5×28×35  | 1.5       |
|           | 10W    | Bulk    | 500   | 8.6    | 2,000       | 34   | 35   | 42.5×28×35  | 1.5       |
|           | 10WS   | Bulk    | 90    | 1.5    | 2,700       | 42   | 43   | 42.5×28×35  | 1.5       |
| SQZ / NSZ | 3W     | Bulk    | 150   | 0.9    | 2,400       | 14   | 15   | 42.5×28×35  | 1.5       |
|           | 5W     | Bulk    | 150   | 1.0    | 2,400       | 16   | 16.5 | 42.5×28×35  | 1.5       |
|           | 7W     | Bulk    | 150   | 1.6    | 2,400       | 24   | 25   | 42.5×28×35  | 1.5       |
|           | 10W    | Bulk    | 150   | 2.1    | 2,400       | 33   | 34   | 42.5×28×35  | 1.5       |
|           | 15W    | Bulk    | 50    | 1.1    | 800         | 17   | 18   | 42.5×28×35  | 1.5       |
|           | 20W    | Bulk    | 50    | 1.4    | 800         | 21   | 22   | 42.5×28×35  | 1.5       |
| SLR       | 2W     | Bulk    | 1,000 | 1.6    | 8,000       | 12   | 13   | 42.5×28×35  | 1.5       |
|           | 3W     | Bulk    | 1,000 | 2.2    | 8,000       | 17   | 18.3 | 42.5×28×35  | 1.5       |
|           | 5W     | Bulk    | 240   | 0.9    | 4,800       | 17   | 18   | 42.5×28×35  | 1.5       |

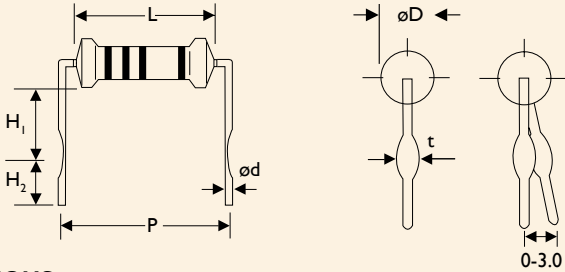
FORMING DIMENSION (SPECIAL TYPE)

M TYPE



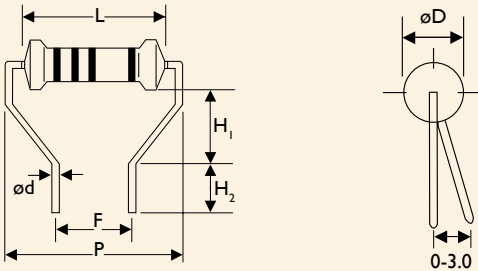
| STYLE   |           | DIMENSIONS |        |         |           |        | Unit: mm |  |
|---------|-----------|------------|--------|---------|-----------|--------|----------|--|
| Normal  | Miniature | L          | P      | øD      | ød        | H      |          |  |
| TYPE-12 | TYPE25S   | 3.4±0.3    | 6.0±1  | 1.9±0.2 | 0.45±0.05 | 10.0±1 |          |  |
| TYPE-25 | TYPE50S   | 6.3±0.5    | 10.0±1 | 2.4±0.2 | 0.55±0.05 | 10.0±1 |          |  |
| TYPE-50 | TYPE1WS   | 9.0±0.5    | 12.5±1 | 3.3±0.3 | 0.55±0.05 | 10.0±1 |          |  |
| TYPE100 | TYPE2WS   | 11.5±1.0   | 15.0±1 | 4.5±0.5 | 0.8±0.05  | 12.5±1 |          |  |
| TYPE200 | TYPE3WS   | 15.5±1.0   | 20.0±1 | 5.0±0.5 | 0.8±0.05  | 15.0±1 |          |  |

MB TYPE



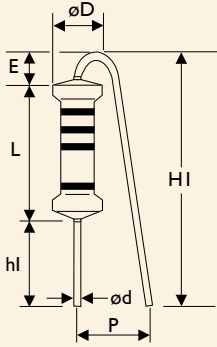
| STYLE   |           | DIMENSIONS |        |         |           |                |                |         | Unit: mm |  |
|---------|-----------|------------|--------|---------|-----------|----------------|----------------|---------|----------|--|
| Normal  | Miniature | L          | P      | øD      | ød        | H <sub>1</sub> | H <sub>2</sub> | t       |          |  |
| TYPE-25 | TYPE50S   | 6.3±0.5    | 10.0±1 | 2.4±0.2 | 0.55±0.05 | 6.0±1          | 5.0±1          | 1.2±0.2 |          |  |
| TYPE-50 | -         | 9.0±0.5    | 12.5±1 | 3.3±0.3 | 0.55±0.05 | 6.0±1          | 5.0±1          | 1.2±0.2 |          |  |
| -       | TYPE1WS   | 9.0±0.5    | 12.5±1 | 3.3±0.3 | 0.8±0.05  | 6.0±1          | 5.0±1          | 1.4±0.2 |          |  |
| TYPE100 | TYPE2WS   | 11.5±1.0   | 15.0±1 | 4.5±0.5 | 0.8±0.05  | 6.0±1          | 5.0±1          | 1.4±0.2 |          |  |
| TYPE200 | TYPE3WS   | 15.5±1.0   | 20.0±1 | 5.0±0.5 | 0.8±0.05  | 10.0±1         | 5.0±1          | 1.4±0.2 |          |  |
| TYPE300 | TYPE5WS   | 24.5±1.0   | 30.0±1 | 8.0±0.5 | 0.8±0.05  | 15.0±1         | 5.0±1          | 1.4±0.2 |          |  |
| TYPE500 | -         | 24.5±1.0   | 30.0±1 | 8.0±0.5 | 0.8±0.05  | 15.0±1         | 5.0±1          | 1.4±0.2 |          |  |

MR TYPE

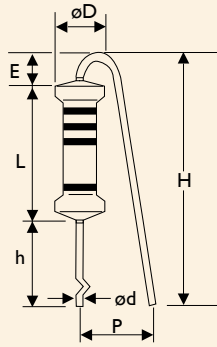


| STYLE   |           | DIMENSIONS |        |         |         |           |                |                | Unit: mm |  |
|---------|-----------|------------|--------|---------|---------|-----------|----------------|----------------|----------|--|
| Normal  | Miniature | L          | P      | F       | øD      | ød        | H <sub>1</sub> | H <sub>2</sub> |          |  |
| TYPE-50 | TYPE1WS   | 9.0±0.5    | 14.5±1 | 7.0±0.5 | 3.3±0.3 | 0.55±0.05 | 7.0±1          | 5.0±1          |          |  |
| TYPE100 | TYPE2WS   | 11.5±1.0   | 17.5±1 | 7.0±0.5 | 4.5±0.5 | 0.8±0.05  | 8.0±1          | 5.0±1          |          |  |
| TYPE200 | TYPE3WS   | 15.5±1.0   | 21.5±1 | 7.0±0.5 | 5.0±0.5 | 0.8±0.05  | 9.0±1          | 5.0±1          |          |  |

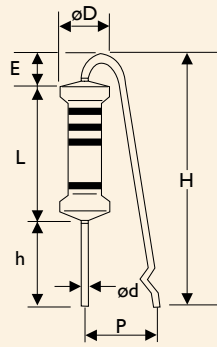
### F TYPE



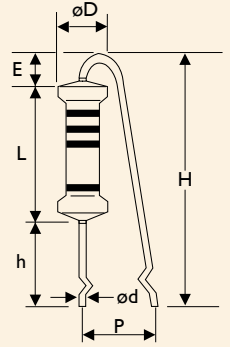
### FK TYPE



### FFK TYPE



### FKK TYPE



### STYLE

### DIMENSIONS

Unit: mm

| Normal  | Miniature | L      | P   | øD      | ød       | h      | H Max. | h1    | H1 Max. | E Max. |
|---------|-----------|--------|-----|---------|----------|--------|--------|-------|---------|--------|
| TYPE100 | TYPE2WS   | 11.5±1 | 6±1 | 4.5±0.5 | 0.8±0.05 | 10.0±1 | 25     | 5.0±1 | 20      | 3.5    |
| TYPE200 | TYPE3WS   | 15.5±1 | 6±1 | 5.0±0.5 | 0.8±0.05 | 10.0±1 | 30     | 5.0±1 | 25      | 3.5    |

Note: TYPE-25/50S is available.

### FT Type Forming for Taping

Rated Watts 1/4W, 1/2WS & 0.6W

Body Dimension : L = 6.3±0.5mm

øD = 2.4±0.2mm

Rated Watts : 1/2W & 1WS

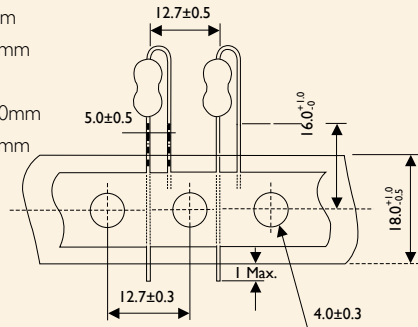
Body Dimension : L = 9±0.5mm

øD = 3.3±0.3mm

Rated Watts : 1W & 2WS

Body Dimension : L = 11.5±1.0mm

øD = 4.5±0.5mm

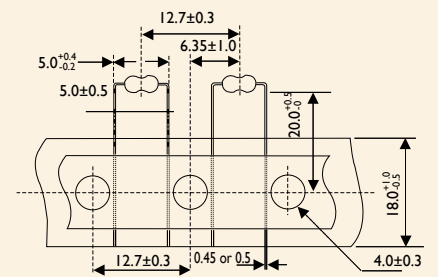


### MT Type Forming for Taping

Rated Watts 1/6W, 1/4WS & 0.4W

Body Dimension : L = 3.4±0.3mm

øD = 1.9±0.2mm



### PN Type Forming for Taping

Rated Watts 1/4W, 1/2WS & 0.6W

Body Dimension : L = 6.3±0.5mm

øD = 2.4±0.2mm

Rated Watts : 1/2W & 1WS

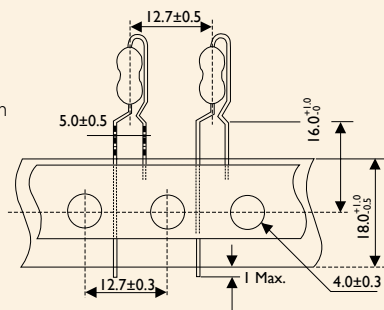
Body Dimension : L = 9±0.5mm

øD = 3.3±0.3mm

Rated Watts : 1W & 2WS

Body Dimension : L = 11.5±1.0mm

øD = 4.5±0.5mm



### AV Type Forming for Taping

Rated Watts 1/4W, 1/2WS & 0.6W

Body Dimension : L = 6.3±0.5mm

øD = 2.4±0.2mm

Rated Watts : 1/2W & 1WS

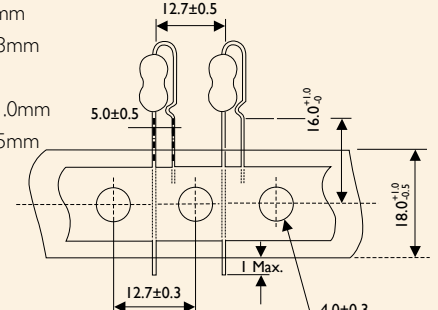
Body Dimension : L = 9±0.5mm

øD = 3.3±0.3mm

Rated Watts : 1W & 2WS

Body Dimension : L = 11.5±1.0mm

øD = 4.5±0.5mm





## EXPLANATIONS OF ORDERING CODE

| MFR                                           | -12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | F                                                                                                                                                                                                                      | T                                                                           | F                                                                                                                                                                                                                                                                                                                                                                                                                                   | 52-                                                                                                                                                                                                                                                                                                   | 100R                                                                                                   |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| Code 1 - 3<br><b>Series Name</b><br>See Index | Code 4 - 6<br><b>Power Rating</b><br>-05 = $\varnothing$ d0.5mm<br>-06 = $\varnothing$ d0.6mm<br>-07 = $\varnothing$ d0.7mm<br>-08 = $\varnothing$ d0.8mm<br>-10 = $\varnothing$ d1.0mm<br>-14 = $\varnothing$ d1.4mm<br>-12 = 1/6W<br>-25 = 1/4W<br>25S = 1/4WS<br>-50 = 1/2W<br>50S = 1/2WS<br>100 = 1W<br>1WS = 1WS<br>200 = 2W<br>2WS = 2WS<br>204 = 0.4W<br>207 = 0.6W<br>300 = 3W<br>3WS = 3WS<br>3WM = 3WM<br>400 = 4W<br>500 = 5W<br>5WS = 5WS<br>5SS = 5WSS<br>700 = 7W<br>7WS = 7WS<br>10A = 10W<br>20A = 20W<br>30A = 30W<br>40A = 40W<br>50A = 50W<br>10S = 10WS<br>15A = 15W<br>25A = 25W<br>10B = 100W<br>25B = 250W | Code 7<br><b>Tolerance</b><br>P = $\pm 0.02$ %<br>A = $\pm 0.05$ %<br>B = $\pm 0.1$ %<br>C = $\pm 0.25$ %<br>D = $\pm 0.5$ %<br>F = $\pm 1$ %<br>G = $\pm 2$ %<br>J = $\pm 5$ %<br>K = $\pm 10$ %<br>- = Base on Spec. | Code 8<br><b>Packing Style</b><br>T = Tape/Box<br>R = Tape/Reel<br>B = Bulk | Code 9<br><b>Temperature Coefficient of Resistance</b><br>- = Base on Spec.<br>A = $\pm 5$ ppm/ $^{\circ}$ C<br>B = $\pm 10$ ppm/ $^{\circ}$ C<br>C = $\pm 15$ ppm/ $^{\circ}$ C<br>D = $\pm 25$ ppm/ $^{\circ}$ C<br>E = $\pm 50$ ppm/ $^{\circ}$ C<br>F = $\pm 100$ ppm/ $^{\circ}$ C<br>G = $\pm 200$ ppm/ $^{\circ}$ C<br>H = $\pm 250$ ppm/ $^{\circ}$ C<br>I = $\pm 300$ ppm/ $^{\circ}$ C<br>J = $\pm 350$ ppm/ $^{\circ}$ C | Code 10 - 12<br><b>Forming Type</b><br>26- = 26mm<br>52- = 52.4mm<br>73- = 73mm<br>81- = 81mm<br>91- = 91mm<br>F = F Type<br>FK = FK Type<br>FKK = FKK Type<br>FFK = F-form Kink<br>M = M-Type Forming<br>MB = M-form W/flat<br>MT = MT Type Forming<br>MR = MR Type<br>AV = AVIsert<br>PN = PANAsert | Code 13 - 17<br><b>Resistance Value</b><br>0R1 = 0.1<br>100R = 100<br>10K = 10,000<br>10M = 10,000,000 |

### EXCEPTION:

#### • Cement series:

<Code 8>: Special packing style code

B: Bulk with wirewound or metal oxide sub-assembly for resistance value

W: Bulk with wirewound sub-assembly for resistance value

M: Bulk with metal oxide sub-assembly for resistance value

<Code 10-12>: Without forming code

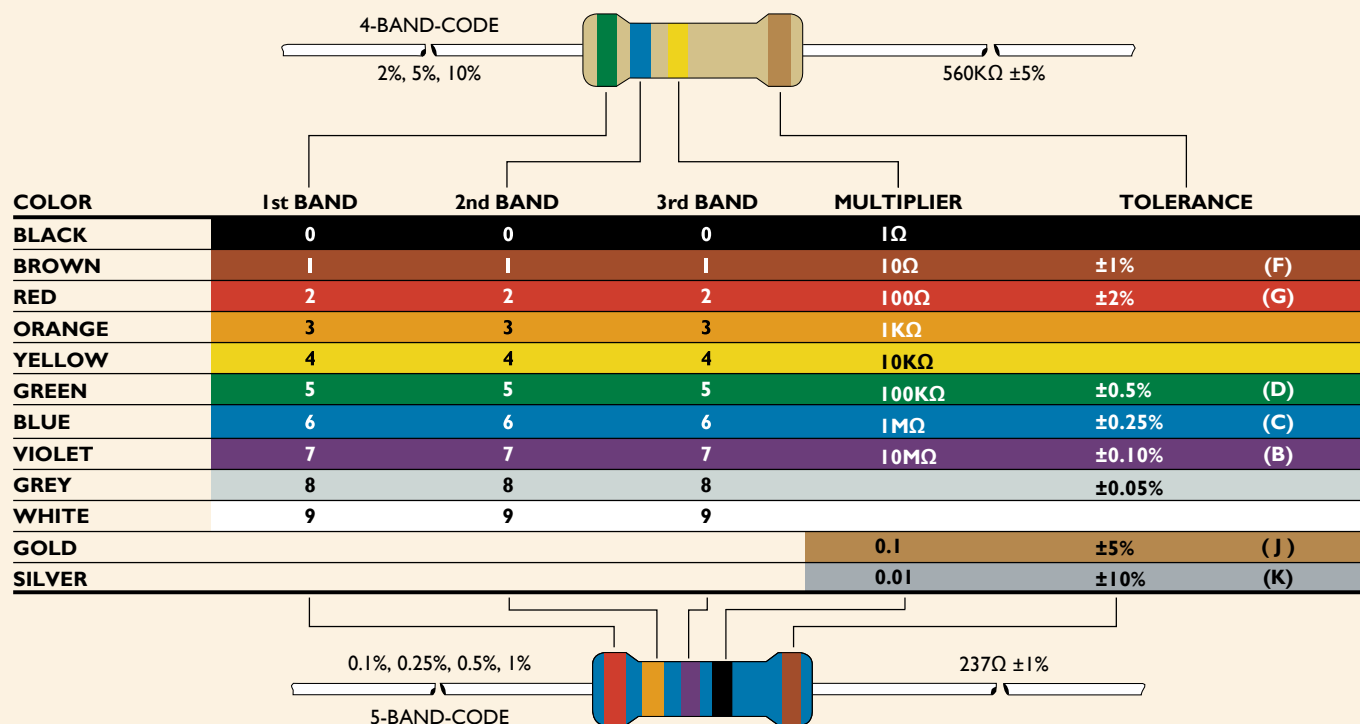
Example: **SQP500JB-10R**

#### • JPW series:

<Code 13-17>: without resistance value code

Example: **JPW-06-T-52-**

## MARKING AND STANDARD RESISTANCE VALUE FOR THE 10-TO-100 DECADE



## STANDARD RESISTANCE VALUES FOR THE 10-TO-100 DECADE

(Also Usable in Decade Multiples or Sub-Multiples)

| RESISTANCE TOLERANCE (±%) |       |       |     |       |       |       |     |       |       |       |     |       |       |       |     |       |       |
|---------------------------|-------|-------|-----|-------|-------|-------|-----|-------|-------|-------|-----|-------|-------|-------|-----|-------|-------|
| 0.10%                     | 0.25% | 1%    | 2%  | 0.10% | 0.25% | 1%    | 2%  | 0.10% | 0.25% | 1%    | 2%  | 0.10% | 0.25% | 1%    | 2%  | 0.10% | 0.25% |
| 0.50%                     | 10%   | 0.50% | 10% | 0.50% | 10%   | 0.50% | 10% | 0.50% | 10%   | 0.50% | 10% | 0.50% | 10%   | 0.50% | 10% | 0.50% | 10%   |
| 10                        | 10    | 10    |     | 14.7  | 14.7  | -     |     | 21.5  | 21.5  | -     |     | 31.6  | 31.6  | -     |     | 46.4  | 46.4  |
| 10.1                      | -     | -     |     | 14.9  | -     | -     |     | 21.8  | -     | -     |     | 32    | -     | -     |     | 47    | -     |
| 10.2                      | 10.2  | -     |     | 15    | 15    | 15    |     | 22.1  | 22.1  | 22    |     | 32.4  | 32.4  | -     |     | 47.5  | 47.5  |
| 10.4                      | -     | -     |     | 15.2  | -     | -     |     | 22.3  | -     | -     |     | 32.8  | -     | -     |     | 48.1  | -     |
| 10.5                      | 10.5  | -     |     | 15.4  | 15.4  | -     |     | 22.6  | 22.6  | -     |     | 33.2  | 33.2  | 33    |     | 48.7  | 48.7  |
| 10.6                      | -     | -     |     | 15.6  | -     | -     |     | 22.9  | -     | -     |     | 33.6  | -     | -     |     | 49.3  | -     |
| 10.7                      | 10.7  | -     |     | 15.8  | 15.8  | -     |     | 23.2  | 23.2  | -     |     | 34    | 34    | -     |     | 49.9  | 49.9  |
| 10.9                      | -     | -     |     | 16    | -     | 16    |     | 23.4  | -     | -     |     | 34.4  | -     | -     |     | 50.5  | -     |
| 11                        | 11    | 11    |     | 16.2  | 16.2  | -     |     | 23.7  | 23.7  | -     |     | 34.8  | 34.8  | -     |     | 51.1  | 51.1  |
| 11.1                      | -     | -     |     | 16.4  | -     | -     |     | 24    | -     | 24    |     | 35.2  | -     | -     |     | 51.7  | -     |
| 11.3                      | 11.3  | -     |     | 16.5  | 16.5  | -     |     | 24.3  | 24.3  | -     |     | 35.7  | 35.7  | -     |     | 52.3  | 52.3  |
| 11.4                      | -     | -     |     | 16.7  | -     | -     |     | 24.6  | -     | -     |     | 36.1  | -     | 36    |     | 53    | -     |
| 11.5                      | 11.5  | -     |     | 16.9  | 16.9  | -     |     | 24.9  | 24.9  | -     |     | 36.5  | 36.5  | -     |     | 53.6  | 53.6  |
| 11.7                      | -     | -     |     | 17.2  | -     | -     |     | 25.2  | -     | -     |     | 37    | -     | -     |     | 54.2  | -     |
| 11.8                      | 11.8  | -     |     | 17.4  | 17.4  | -     |     | 25.5  | 25.5  | -     |     | 37.4  | 37.4  | -     |     | 54.9  | 54.9  |
| 12                        | -     | 12    |     | 17.6  | -     | -     |     | 25.8  | -     | -     |     | 37.9  | -     | -     |     | 55.6  | -     |
| 12.1                      | 12.1  | -     |     | 17.8  | 17.8  | -     |     | 26.1  | 26.1  | -     |     | 38.3  | 38.3  | -     |     | 56.2  | 56.2  |
| 12.3                      | -     | -     |     | 18    | -     | 18    |     | 26.4  | -     | -     |     | 38.8  | -     | -     |     | 56.9  | -     |
| 12.4                      | 12.4  | -     |     | 18.2  | 18.2  | -     |     | 26.7  | 26.7  | -     |     | 39.2  | 39.2  | 39    |     | 57.6  | 57.6  |
| 12.6                      | -     | -     |     | 18.4  | -     | -     |     | 27.1  | -     | 27    |     | 39.7  | -     | -     |     | 58.3  | -     |
| 12.7                      | 12.7  | -     |     | 18.7  | 18.7  | -     |     | 27.4  | 27.4  | -     |     | 40.2  | 40.2  | -     |     | 59    | 59    |
| 12.9                      | -     | -     |     | 18.9  | -     | -     |     | 27.7  | -     | -     |     | 40.7  | -     | -     |     | 59.7  | -     |
| 13                        | 13    | 13    |     | 19.1  | 19.1  | -     |     | 28    | 28    | -     |     | 41.2  | 41.2  | -     |     | 60.4  | 60.4  |
| 13.2                      | -     | -     |     | 19.3  | -     | -     |     | 28.4  | -     | -     |     | 41.7  | -     | -     |     | 61.2  | -     |
| 13.3                      | 13.3  | -     |     | 19.6  | 19.6  | -     |     | 28.7  | 28.7  | -     |     | 42.2  | 42.2  | -     |     | 61.9  | 61.9  |
| 13.5                      | -     | -     |     | 19.8  | -     | -     |     | 29.1  | -     | -     |     | 42.7  | -     | -     |     | 62.6  | -     |
| 13.7                      | 13.7  | -     |     | 20    | 20    | 20    |     | 29.4  | 29.4  | -     |     | 43.2  | 43.2  | 43    |     | 63.4  | 63.4  |
| 13.8                      | -     | -     |     | 20.3  | -     | -     |     | 29.8  | -     | -     |     | 43.7  | -     | -     |     | 64.2  | -     |
| 14                        | 14    | -     |     | 20.5  | 20.5  | -     |     | 30.1  | 30.1  | 30    |     | 44.2  | 44.2  | -     |     | 64.9  | 64.9  |
| 14.2                      | -     | -     |     | 20.8  | -     | -     |     | 30.5  | -     | -     |     | 44.8  | -     | -     |     | 65.7  | -     |
| 14.3                      | 14.3  | -     |     | 21    | 21    | -     |     | 30.9  | 30.9  | -     |     | 45.3  | 45.3  | -     |     | 66.5  | 66.5  |
| 14.5                      | -     | -     |     | 21.3  | -     | -     |     | 31.2  | -     | -     |     | 45.9  | -     | -     |     | 67.3  | -     |
| E-192                     | E-96  | E-24  |     | E-192 | E-96  | E-24  |     | E-192 | E-96  | E-24  |     | E-192 | E-96  | E-24  |     | E-192 | E-96  |

Note:

Note:

Note:



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