

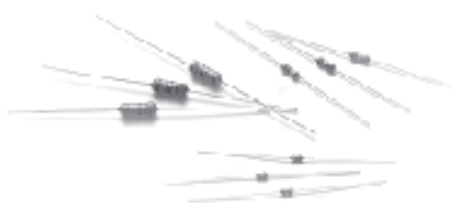


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## Metal Film Resistors

# MFR Type

## Normal & Miniature Style [ MFR Series ]



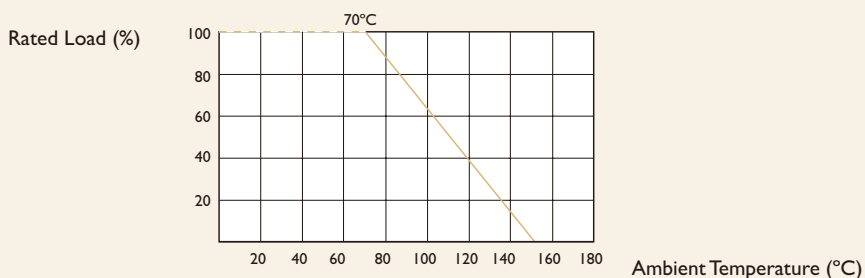
### INTRODUCTION

The MFR Series Metal Film Resistors are manufactured using vacuum sputtering system to deposit multiple layers of mixed metals and passivative materials onto a carefully treated high grade ceramic substrate, the resistors are coated with layers of blue lacquer.

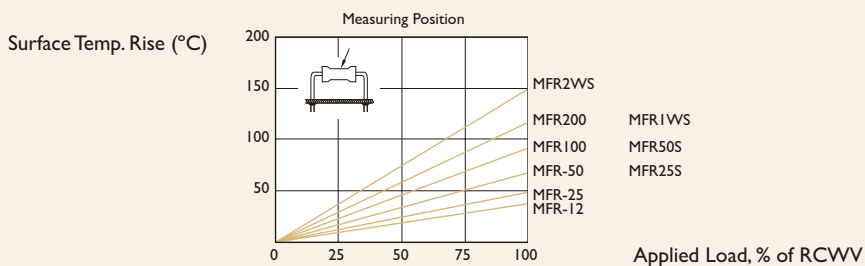
### FEATURES

|                      |                                                                                                                                                        |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| Power Rating         | 1/6W, 1/4W, 1/2W, 1W, 2W                                                                                                                               |
| Resistance Tolerance | $\pm 0.1\%$ , $\pm 0.25\%$ , $\pm 0.5\%$ , $\pm 1\%$                                                                                                   |
| T.C.R.               | $\pm 15\text{ppm}/^{\circ}\text{C}$ , $\pm 25\text{ppm}/^{\circ}\text{C}$ , $\pm 50\text{ppm}/^{\circ}\text{C}$ , $\pm 100\text{ppm}/^{\circ}\text{C}$ |

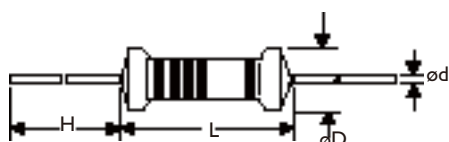
### DERATING CURVE



### HOT-SPOT TEMPERATURE



### DIMENSIONS



| STYLE  |           | DIMENSION      |               |              |                | Unit : mm |
|--------|-----------|----------------|---------------|--------------|----------------|-----------|
| Normal | Miniature | L              | øD            | H            | ød             |           |
| MFR-12 | MFR25S    | 3.4 $\pm$ 0.3  | 1.9 $\pm$ 0.2 | 28 $\pm$ 2.0 | 0.5 $\pm$ 0.05 |           |
| MFR-25 | MFR50S    | 6.3 $\pm$ 0.5  | 2.4 $\pm$ 0.2 | 28 $\pm$ 2.0 | 0.6 $\pm$ 0.05 |           |
| MFR-50 | MFR1WS    | 9.0 $\pm$ 0.5  | 3.3 $\pm$ 0.3 | 26 $\pm$ 2.0 | 0.6 $\pm$ 0.05 |           |
| MFR100 | MFR2WS    | 11.5 $\pm$ 1.0 | 4.5 $\pm$ 0.5 | 35 $\pm$ 2.0 | 0.8 $\pm$ 0.05 |           |
| MFR200 | -         | 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 | MFR1WS | MFR100 | MFR2WS | MFR200 |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Power Rating at 70°C                   | 1/6W                                                                                                                                           | 1/4W   |        | 1/2W   |        | 1W     |        | 2W     |        |
| Operating Temp. Range                  | -55°C to +125°C                                                                                                                                |        |        |        |        |        |        |        |        |
| Maximum Working Voltage                | 200V                                                                                                                                           | 200V   | 250V   | 300V   | 350V   | 400V   | 500V   | 500V   | 500V   |
| Maximum Overload Voltage               | 400V                                                                                                                                           | 400V   | 500V   | 600V   | 700V   | 800V   | 1000V  | 1000V  | 1000V  |
| Dielectric Withstanding Voltage        | 300V                                                                                                                                           | 400V   | 500V   | 500V   | 500V   | 700V   | 1000V  | 1000V  | 1000V  |
| Value Range $\pm 0.5\%$ , $\pm 1\%$    | 10 $\Omega$ ~1M $\Omega$                                                                                                                       |        |        |        |        |        |        |        |        |
| Value Range $\pm 0.1\%$ , $\pm 0.25\%$ | 100 $\Omega$ ~100K $\Omega$                                                                                                                    |        |        |        |        |        |        |        |        |
| Temperature Coefficient (by Type)      | $\pm 15\text{ppm}/^\circ\text{C}$ , $\pm 25\text{ppm}/^\circ\text{C}$ , $\pm 50\text{ppm}/^\circ\text{C}$ , $\pm 100\text{ppm}/^\circ\text{C}$ |        |        |        |        |        |        |        |        |

\* Resistance range for standard resistance, below or over this resistance on request.

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST                      | TEST METHOD                                                    |                                                                                         | APPRAISE                                  |
|---------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload                   | JIS-C-5202 5.5                                                 | 2.5 Times RCWV for 5 Seconds                                                            | $\pm(0.25\%+0.05\Omega)$                  |
| Dielectric Withstanding Voltage       | JIS-C-5202 5.7                                                 | in V-Block for 60 Seconds                                                               | by Type                                   |
| Temperature Coefficient of Resistance | JIS-C-5202 5.2                                                 | -55°C to +155°C                                                                         | by Type                                   |
| Insulation Resistance                 | JIS-C-5202 5.6                                                 | in V-Block                                                                              | >10000M $\Omega$                          |
| Solderability                         | JIS-C-5202 6.5                                                 | 235 $\pm 5^\circ\text{C}$ for 5 $\pm 0.5$ Seconds                                       | 95% Min. Coverage                         |
| Resistance to Solvent                 | JIS-C-5202 6.9                                                 | IPA for 1 Min. with Ultrasonic                                                          | No Deterioration of Coatings and Markings |
| Terminal Strength                     | Direct load for 10 Sec. in The Direction of The Terminal Leads |                                                                                         | $\pm 2.5\text{kg}$ (24.5N)                |
| Pulse Overload                        | JIS-C-5202 5.8                                                 | 4 Times RCWV 10000 Cycles (1 Sec. on , 25 Sec. off)                                     | $\pm(1\%+0.05\Omega)$                     |
| Load Life in Humidity                 | JIS-C-5202 7.9                                                 | 40 $\pm 2^\circ\text{C}$ , 90~95% RH at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off) | $\pm(1.5\%+0.05\Omega)$                   |
| Load Life                             | JIS-C-5202 7.10                                                | 70°C at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off)                                 | $\pm(1.5\%+0.05\Omega)$                   |
| Temperature Cycling                   | JIS-C-5202 7.4                                                 | -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                                         | $\pm(0.75\%+0.05\Omega)$                  |
| Resistance to Soldering Heat          | JIS-C-5202 6.4                                                 | 350°C $\pm 10^\circ\text{C}$ for 3 $\pm 0.5$ Seconds                                    | $\pm(0.25\%+0.05\Omega)$                  |

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

## Metal Film Resistors

# PRECISION Type

## Normal & Miniature Style [ MFP Series ]



## FEATURES

Power Rating : 1/6W, 1/4W, 0.4W, 1/2W, 0.6W

Resistance Tolerance :  $\pm 0.1\%$ ,  $\pm 0.25\%$ T.C.R. :  $\pm 15\text{ppm}/^{\circ}\text{C}$ ,  $\pm 25\text{ppm}/^{\circ}\text{C}$ 

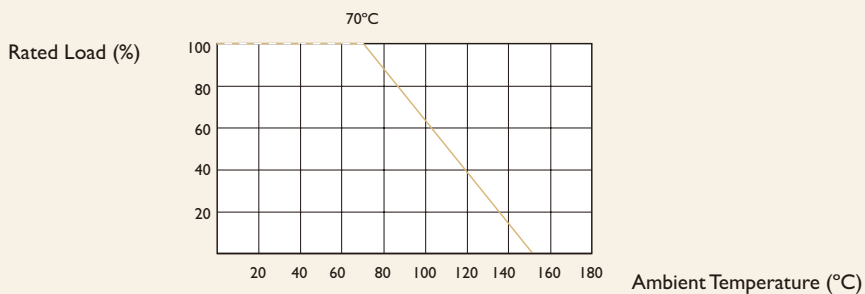
High thermal conductivity and specific gravity rods

Epoxy coating

Blue body color

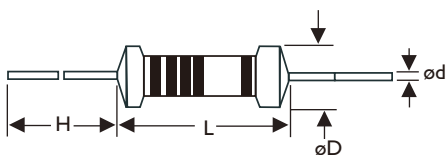
## POWER DERATING CURVE

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             | $\phi D$      | H            | $\phi d$       |
| MFP-12 | MFP25S    | $3.4 \pm 0.3$ | $1.9 \pm 0.2$ | $28 \pm 2.0$ | $0.5 \pm 0.05$ |
| MFP204 | —         | $3.4 \pm 0.3$ | $1.9 \pm 0.2$ | $28 \pm 2.0$ | $0.5 \pm 0.05$ |
| MFP-25 | MFP50S    | $6.3 \pm 0.5$ | $2.4 \pm 0.2$ | $28 \pm 2.0$ | $0.6 \pm 0.05$ |
| MFP207 | —         | $6.3 \pm 0.5$ | $2.4 \pm 0.2$ | $28 \pm 2.0$ | $0.6 \pm 0.05$ |



Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                           | TEST METHOD                                                          | MFP-12                                                                    | MFP25S | MFP204 | MFP-25                      | MFP50S | MFP207 |
|---------------------------------|----------------------------------------------------------------------|---------------------------------------------------------------------------|--------|--------|-----------------------------|--------|--------|
| Power Rating at 70°C            |                                                                      | 1/6W                                                                      | 1/4W   | 0.4W   | 1/4W                        | 1/2W   | 0.6W   |
| Maximum Working Voltage         |                                                                      | 150V                                                                      | 200V   | 200V   | 250V                        | 250V   | 250V   |
| Maximum Overload Voltage        |                                                                      | 300V                                                                      | 400V   | 400V   | 500V                        | 600V   | 600V   |
| Dielectric Withstanding Voltage | JIS-C-5202 5.7 in V-Block for 60 Seconds                             | 300V                                                                      | 300V   | 300V   | 500V                        | 500V   | 500V   |
| Temperature Coefficient         | JIS-C-5202 5.2 Room Temp. Add 100°C                                  | $\pm 15\text{ppm}/^{\circ}\text{C}$ , $\pm 25\text{ppm}/^{\circ}\text{C}$ |        |        |                             |        |        |
| Short Time Overload             | JIS-C-5202 5.5 2.5 Times RCWV for 5 Sec.                             | $\pm 0.1\% + 0.05\Omega$                                                  |        |        |                             |        |        |
| Insulation Resistance           | JIS-C-5202 5.6 in V-Block                                            | $> 10,000\text{M}\Omega$                                                  |        |        |                             |        |        |
| Pulse Overload                  | JIS-C-5202 5.8 4 Times RCWV 10,000 Cycles (1 Sec. on , 25 Sec. off ) | $\pm 1.0\% + 0.05\Omega$                                                  |        |        |                             |        |        |
| Operating Temp. Range           |                                                                      | $-55^{\circ}\text{C}$ to $+155^{\circ}\text{C}$                           |        |        |                             |        |        |
| Value Rang $\pm 0.1\%$          |                                                                      | 100 $\Omega$ ~100K                                                        |        |        | 100 $\Omega$ ~200K $\Omega$ |        |        |
| Value Range $\pm 0.25\%$        |                                                                      | 50 $\Omega$ ~200K                                                         |        |        | 50 $\Omega$ ~301K $\Omega$  |        |        |

\* Resistance range for standard resistance, below or over this resistance on request.

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST             | TEST METHOD                                                                                                                                    | APPRAISE                                  |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Terminal Strength            | JIS-C-5202 6.1 Direct load for 10 Sec. in the Direction of the Terminal Leads                                                                  | $\geq 2.5\text{kg}$ (24.5N)               |
| Resistance to Soldering Heat | JIS-C-5202 6.4 $350^{\circ}\text{C} \pm 10^{\circ}\text{C}$ for $3 \pm 0.5$ Seconds                                                            | $\pm 0.20\% + 0.05\Omega$                 |
| Solderability                | JIS-C-5202 6.5 $235^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for $5 \pm 0.5$ Seconds                                                             | 95% Min. Coverage                         |
| Resistance to Solvent        | JIS-C-5202 6.9 IPA for 1 Min. with Ultrasonic                                                                                                  | No Deterioration of Coatings and Markings |
| Temperature Cycling          | JIS-C-5202 7.4 $-55^{\circ}\text{C} \rightarrow \text{Room Temp.} \rightarrow +155^{\circ}\text{C} \rightarrow \text{Room Temp.}$ for 5 Cycles | $\pm 0.25\% + 0.05\Omega$                 |
| Humidity                     | JIS-C-5202 7.5 $40 \pm 2^{\circ}\text{C}$ , 90~95% RH for 1,000 Hrs.                                                                           | $\pm 0.50\% + 0.05\Omega$                 |
| Load Life in Humidity        | JIS-C-5202 7.9 $40 \pm 2^{\circ}\text{C}$ , 90~95% RH at RCWV for 1,000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off )                                     | $\pm 1.0\% + 0.05\Omega$                  |
| Load Life                    | JIS-C-5202 7.10 $70^{\circ}\text{C}$ at RCWV for 1,000 Hrs. (1.5 Hrs. on, 0.5 Hrs. off )                                                       | $\pm 1.0\% + 0.05\Omega$                  |

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

## Metal Film Resistors

# PROFESSIONAL Type

## Miniature Style [ MF0 Series ]



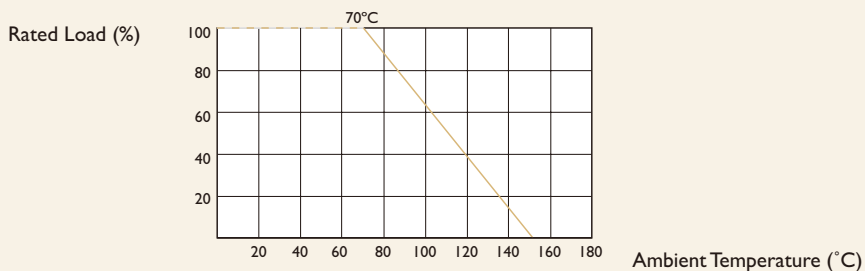
### INTRODUCTION

The MF0 Series are manufactured by high vacuum sputtering deposit Metal Film on high thermal conductivity and specific gravity ROSENTHAL ceramic or same grade rods. The resistors are coated with multilayers of blue color lacquer.

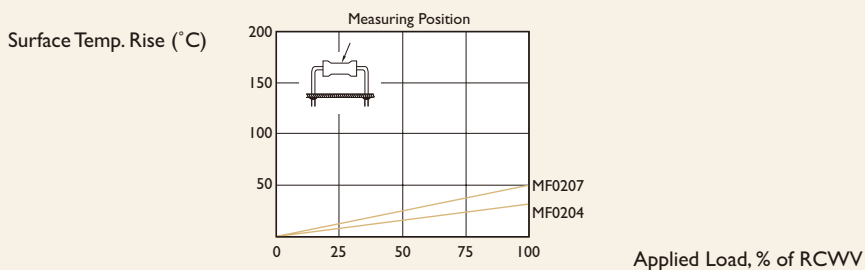
### FEATURES

|                      |                                     |
|----------------------|-------------------------------------|
| DIN                  | 44061, 45921 part 107               |
| CECC                 | 40101-039, 40101-017                |
| MIL                  | 10509F (Char. D & C)                |
| Resistance Tolerance | $\pm 1\%$                           |
| T.C.R.               | $\pm 50\text{ppm}/^{\circ}\text{C}$ |

### DERATING CURVE

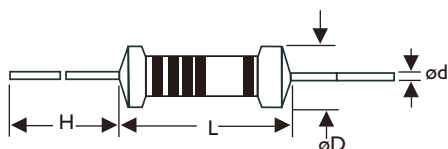


### HOT-SPOT TEMPERATURE



### DIMENSIONS

Unit : mm



| STYLE  | L             | $\phi D$      | H            | $\phi d$       |
|--------|---------------|---------------|--------------|----------------|
| MF0204 | $3.4 \pm 0.3$ | $1.9 \pm 0.2$ | $28 \pm 2.0$ | $0.5 \pm 0.05$ |
| MF0207 | $6.3 \pm 0.5$ | $2.4 \pm 0.2$ | $28 \pm 2.0$ | $0.6 \pm 0.05$ |



Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                           | MF0204                            | MF0207 |
|---------------------------------|-----------------------------------|--------|
| Power Rating at 70°C            | 0.4W                              | 0.6W   |
| Operating Temp. Range           | -55°C to +155°C                   |        |
| Maximum Working Voltage         | 200V                              | 300V   |
| Maximum Overload Voltage        | 400V                              | 600V   |
| Dielectric Withstanding Voltage | 300V                              | 500V   |
| Value Range $\pm 1\%$           | 10 $\Omega$ ~1M $\Omega$          |        |
| Temperature Coefficient         | $\pm 50\text{ppm}/^\circ\text{C}$ |        |

\* Standard resistance is 10 $\Omega$ ~1M $\Omega$ , below or over this resistance on request.

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST                      | TEST METHOD                                                    |                                                                                          | APPRAISE                                  |
|---------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload                   | JIS-C-5202 5.5                                                 | 2.5 Times RCWV for 5 Seconds                                                             | $\pm(0.25\%+0.05\Omega)$                  |
| Dielectric Withstanding Voltage       | JIS-C-5202 5.7                                                 | in V-Block for 60 Seconds                                                                | by Type                                   |
| Temperature Coefficient of Resistance | JIS-C-5202 5.2                                                 | -55°C to +155°C                                                                          | $\pm 50\text{ppm}/^\circ\text{C}$         |
| Insulation Resistance                 | JIS-C-5202 5.6                                                 | in V-Block                                                                               | > 10000M $\Omega$                         |
| Solderability                         | JIS-C-5202 6.5                                                 | 235 $\pm 5^\circ\text{C}$ for 5 $\pm 0.5$ Seconds                                        | 95% Min. Coverage                         |
| Resistance to Solvent                 | JIS-C-5202 6.9                                                 | IPA for 1 Min. with Ultrasonic                                                           | No Deterioration of Coatings and Markings |
| Terminal Strength                     | Direct Load for 10 Sec. in The Direction of The Terminal Leads |                                                                                          | $\geq 2.5\text{kg}$ (24.5N)               |
| Pulse Overload                        | JIS-C-5202 5.8                                                 | 4 Times RCWV 10000 Cycles (1 Sec. on , 25 Sec. off)                                      | $\pm(1\%+0.05\Omega)$                     |
| Load Life in Humidity                 | JIS-C-5202 7.9                                                 | 40 $\pm 2^\circ\text{C}$ , 90~95% RH at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off ) | $\pm(1.5\%+0.05\Omega)$                   |
| Load Life                             | JIS-C-5202 7.10                                                | 70°C at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off)                                  | $\pm(1.5\%+0.05\Omega)$                   |
| Temperature Cycling                   | JIS-C-5202 7.4                                                 | -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                                          | $\pm(0.75\%+0.05\Omega)$                  |
| Resistance to Soldering Heat          | JIS-C-5202 6.4                                                 | 350°C $\pm 10^\circ\text{C}$ for 3 $\pm 0.5$ Seconds                                     | $\pm(0.25\%+0.05\Omega)$                  |

\* 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

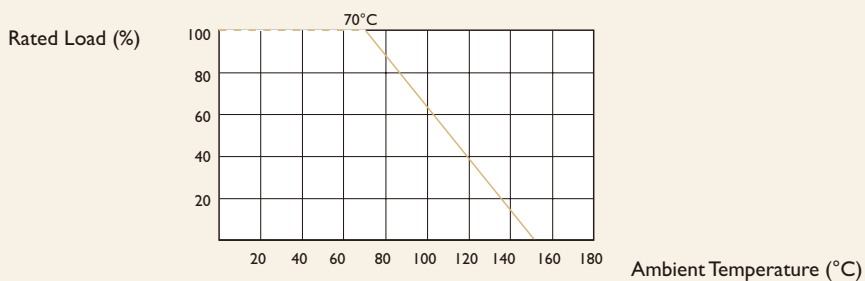
The FMF series flame-proof type Metal Film Resistors are manufactured by vacuum deposit Metal Film on high thermal conductivity ceramic rods, and are coated with layers of gray color flame-proof lacquer.

These FMF flame-proof Metal Film Resistors is designed to replace the Metal Oxide Resistors and low power wire wound resistors, where when flame-proof and small size is needed.

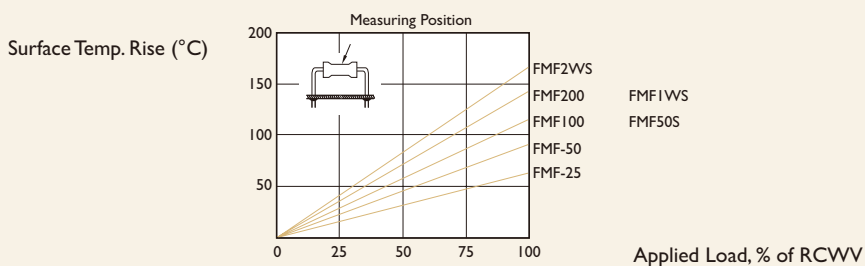
### FEATURES

|                             |                       |
|-----------------------------|-----------------------|
| Power Rating                | 1/4W, 1/2W, 1W, 2W    |
| FlameProof Silicone Coating | UL94V-0               |
| Resistance Tolerance        | ±1%                   |
| T.C.R.                      | ±50ppm/°C, ±100ppm/°C |

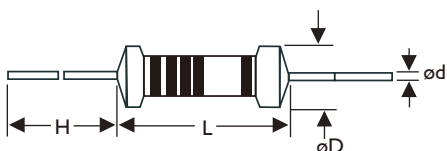
### DERATING CURVE



### HOT-SPOT TEMPERATURE



### 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 | 0.6±0.05 |
| FMF-50 | FMF1WS    | 9.0±0.5   | 3.3±0.3 | 26±2.0 | 0.6±0.05 |
| FMF100 | FMF2WS    | 11.5±1.0  | 4.5±0.5 | 35±2.0 | 0.8±0.05 |
| FMF200 | -         | 15.5±1.0  | 5.0±0.5 | 33±2.0 | 0.8±0.05 |





Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                             | FMF-25                | FMF50S | FMF-50 | FMF1WS | FMF100 | FMF2WS | FMF200 |
|-----------------------------------|-----------------------|--------|--------|--------|--------|--------|--------|
| Power Rating at 70°C              | 1/4W                  | 1/2W   |        | 1W     |        | 2W     |        |
| Operating Temp. Range             | -55°C to +155°C       |        |        |        |        |        |        |
| Maximum Working Voltage           | 250V                  | 300V   | 350V   | 400V   | 500V   | 500V   | 500V   |
| Maximum Overload Voltage          | 500V                  | 600V   | 700V   | 800V   | 1000V  | 1000V  | 1000V  |
| Dielectric Withstanding Voltage   | 400V                  | 400V   | 500V   | 600V   | 750V   | 750V   | 750V   |
| Value Range ±1%                   | 10Ω~1MΩ               |        |        |        |        |        |        |
| Temperature Coefficient (by Type) | ±50ppm/°C, ±100ppm/°C |        |        |        |        |        |        |

\* Standard resistance is 10Ω~1MΩ, below or over this resistance on request.

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST                      | TEST METHOD                                                    |                                                                          | APPRAISE                                  |
|---------------------------------------|----------------------------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload                   | JIS-C-5202 5.5                                                 | 2.5 Times RCWV for 5 Seconds                                             | ±(0.25%+0.05Ω)                            |
| Dielectric Withstanding Voltage       | JIS-C-5202 5.7                                                 | in V-Block for 60 Seconds                                                | by Type                                   |
| Temperature Coefficient of Resistance | JIS-C-5202 5.2                                                 | -55°C to +155°C                                                          | by Type                                   |
| Insulation Resistance                 | JIS-C-5202 5.6                                                 | in V-Block                                                               | >1000MΩ                                   |
| Solderability                         | JIS-C-5202 6.5                                                 | 235±5°C for 5±0.5 Seconds                                                | 95% Min. Coverage                         |
| Resistance to Solvent                 | JIS-C-5202 6.9                                                 | IPA for 1 Min. with Ultrasonic                                           | No Deterioration of Coatings and Markings |
| Terminal Strength                     | Direct Load for 10 Sec. in The Direction of The Terminal Leads |                                                                          | ≥2.5kg (24.5N)                            |
| Pulse Overload                        | JIS-C-5202 5.8                                                 | 4 Times RCWV 10000 Cycles (1 Sec. on , 25 Sec. off)                      | ±(1%+0.05Ω)                               |
| Load Life in Humidity                 | JIS-C-5202 7.9                                                 | 40±2°C, 90~95% RH at RCWV for 1000 Hrs.<br>(1.5 Hrs. on , 0.5 Hrs. off ) | ±(1.5%+0.05Ω)                             |
| Load Life                             | JIS-C-5202 7.10                                                | 70°C at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off)                  | ±(1.5%+0.05Ω)                             |
| Temperature Cycling                   | JIS-C-5202 7.4                                                 | -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                          | ±(0.75%+0.05Ω)                            |
| Resistance to Soldering Heat          | JIS-C-5202 6.4                                                 | 350°C±10°C for 3±0.5 Seconds                                             | ±(0.25%+0.05Ω)                            |

\* 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

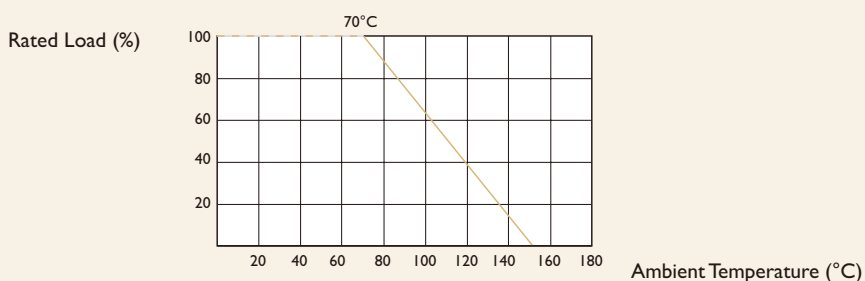
The FM0 Series are manufactured by high vacuum sputtering deposit Metal Film on high thermal conductivity and specific gravity ROSENTHAL ceramic or same grade rods. The FM0207 are coated with multilayers of light-green color flame-proof lacquer.

The FM0207 meets severe overload test in accordance with UL specification # 1412 without fire hazard.

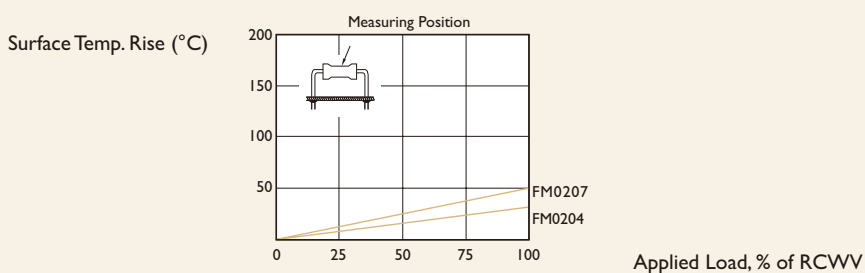
### FEATURES

|                             |                       |
|-----------------------------|-----------------------|
| DIN                         | 44061, 45921 part 107 |
| CECC                        | 40101-039, 40101-017  |
| Flameproof Silicone Coating | UL94V-0               |
| Resistance Tolerance        | ±1%                   |
| T.C.R.                      | ±50ppm/°C             |

### DERATING CURVE

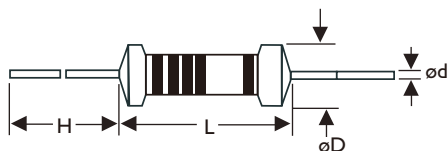


### HOT-SPOT TEMPERATURE



### DIMENSIONS

Unit : mm



| STYLE  | L       | øD      | H      | ød       |
|--------|---------|---------|--------|----------|
| FM0204 | 3.4±0.3 | 1.9±0.2 | 28±2.0 | 0.5±0.05 |
| FM0207 | 6.3±0.5 | 2.4±0.2 | 28±2.0 | 0.6±0.05 |



Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                           | FM0204                            | FM0207 |
|---------------------------------|-----------------------------------|--------|
| Power Rating at 70°C            | 0.4W                              | 0.6W   |
| Operating Temp. Range           | -55°C to +155°C                   |        |
| Maximum Working Voltage         | 200V                              | 300V   |
| Maximum Overload Voltage        | 400V                              | 600V   |
| Dielectric Withstanding Voltage | 300V                              | 500V   |
| Value Range $\pm 1\%$           | 10 $\Omega$ ~1M $\Omega$          |        |
| Temperature Coefficient         | $\pm 50\text{ppm}/^\circ\text{C}$ |        |

\* Standard resistance is 10 $\Omega$ ~1M $\Omega$ , below or over this resistance on request.

## ENVIRONMENTAL CHARACTERISTICS

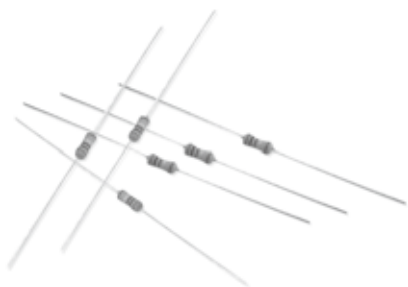
| PERFORMANCE TEST                      | TEST METHOD                                                    |                                                                                          | APPRAISE                                  |
|---------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload                   | JIS-C-5202 5.5                                                 | 2.5 Times RCWV for 5 Seconds                                                             | $\pm(0.25\%+0.05\Omega)$                  |
| Dielectric Withstanding Voltage       | JIS-C-5202 5.7                                                 | in V-Block for 60 Seconds                                                                | by Type                                   |
| Temperature Coefficient of Resistance | JIS-C-5202 5.2                                                 | -55°C to +155°C                                                                          | $\pm 50\text{ppm}/^\circ\text{C}$         |
| Insulation Resistance                 | JIS-C-5202 5.6                                                 | in V-Block                                                                               | >1000M $\Omega$                           |
| Solderability                         | JIS-C-5202 6.5                                                 | 235 $\pm 5^\circ\text{C}$ for 5 $\pm 0.5$ Seconds                                        | 95% Min. Coverage                         |
| Resistance to Solvent                 | JIS-C-5202 6.9                                                 | IPA for 1 Min. with Ultrasonic                                                           | No Deterioration of Coatings and Markings |
| Terminal Strength                     | Direct Load for 10 sec. in The Direction of The Terminal Leads |                                                                                          | $\geq 2.5\text{kg}$ (24.5N)               |
| Pulse Overload                        | JIS-C-5202 5.8                                                 | 4 Times RCWV 10000 Cycles (1 Sec. on , 25 Sec. off)                                      | $\pm(1\%+0.05\Omega)$                     |
| Load Life in Humidity                 | JIS-C-5202 7.9                                                 | 40 $\pm 2^\circ\text{C}$ , 90~95% RH at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off ) | $\pm(1.5\%+0.05\Omega)$                   |
| Load Life                             | JIS-C-5202 7.10                                                | 70°C at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off)                                  | $\pm(1.5\%+0.05\Omega)$                   |
| Temperature Cycling                   | JIS-C-5202 7.4                                                 | -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                                          | $\pm(0.75\%+0.05\Omega)$                  |
| Resistance to Soldering Heat          | JIS-C-5202 6.4                                                 | 350°C $\pm 10^\circ\text{C}$ for 3 $\pm 0.5$ Seconds                                     | $\pm(0.25\%+0.05\Omega)$                  |

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

## Metal Film Resistors

# POWER FLAME-PROOF Type

## Normal Style [ FMP Series ]



### GENERAL PURPOSE

Power Rating : 1/2W, 1W, 2W, 3W

Resistance Tolerance :  $\pm 1\%$  ,  $\pm 5\%$

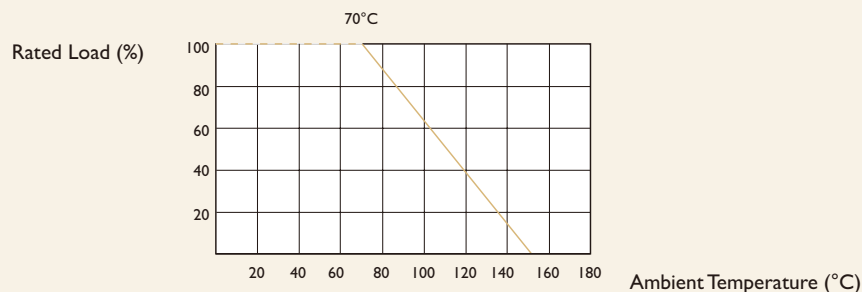
High thermal conductivity and specific gravity rods

FlameProof Silicone Coating : UL94V-0

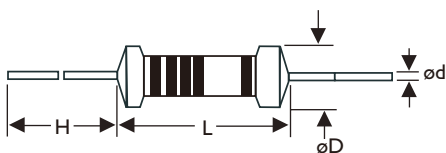
Pink body color

### POWER 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  | L        | øD      | H      | ød       |
|--------|----------|---------|--------|----------|
| FMP-50 | 3.4±0.3  | 1.9±0.2 | 28±2.0 | 0.5±0.05 |
| FMP100 | 6.3±0.5  | 2.4±0.2 | 28±2.0 | 0.6±0.05 |
| FMP200 | 9.0±0.5  | 3.9±0.3 | 26±2.0 | 0.6±0.05 |
| FMP300 | 15.5±1.0 | 5.0±0.5 | 33±2.0 | 0.8±0.05 |



Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                           | TEST METHOD                                                             | FMP-50                           | FMP100 | FMP200 | FMP300 |
|---------------------------------|-------------------------------------------------------------------------|----------------------------------|--------|--------|--------|
| Power Rating at 70°C            |                                                                         | 1/2W                             | 1W     | 2W     | 3W     |
| Maximum Working Voltage         |                                                                         | 200V                             | 350V   | 500V   | 750V   |
| Maximum Overload Voltage        |                                                                         | 400V                             | 600V   | 700V   | 1000V  |
| Dielectric Withstanding Voltage | JIS-C-5202 5.7 in V-Block for 60 Seconds                                | 300V                             | 500V   | 500V   | 750V   |
| Temperature Coefficient         | JIS-C-5202 5.2 Room Temp. Add 100°C                                     | ±100ppm/°C                       |        |        |        |
| Short Time Overload             | JIS-C-5202 5.5 2.5 Times RCWV for 5 Sec.                                | ±2.0%+0.05Ω                      |        |        |        |
| Insulation Resistance           | JIS-C-5202 5.6 in V-Block                                               | >1,000MΩ                         |        |        |        |
| Pulse Overload                  | JIS-C-5202 5.8 4 Times RCWV 10,000 Cycles<br>(1 Sec. on , 25 Sec. off ) | ±1.0%+0.05Ω                      |        |        |        |
| Operating Temp. Range           |                                                                         | -55°C to + 155°C                 |        |        |        |
| Value Rang ±1%                  |                                                                         | 10Ω To 1MΩ for E24 or E96 Series |        |        |        |
| Value Range ±5%                 |                                                                         | 1Ω To 1MΩ for E24 Series         |        |        |        |

\* Resistance range for standard resistance, below or over this resistance on request.

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST             | TEST METHOD                                                                              | APPRAISE                                  |
|------------------------------|------------------------------------------------------------------------------------------|-------------------------------------------|
| Terminal Strength            | JIS-C-5202 6.1 Direct load for 10 Sec. in the Direction of the Terminal Leads            | ≥2.5kg (24.5N)                            |
| Resistance to Soldering Heat | JIS-C-5202 6.4 350°C ± 10°C for 3 ± 0.5 Seconds                                          | ±0.25%+0.05Ω                              |
| Solderability                | JIS-C-5202 6.5 235°C ± 5°C for 5 ± 0.5 Seconds                                           | 95% Min. Coverage                         |
| Resistance to Solvent        | JIS-C-5202 6.9 IPA for 1 Min. with Ultrasonic                                            | No Deterioration of Coatings and Markings |
| Temperature Cycling          | JIS-C-5202 7.4 -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                           | ±1.0%+0.05Ω                               |
| Humidity                     | JIS-C-5202 7.5 40±2°C, 90~95% RH for 1,000 Hrs.                                          | ±1.0%+0.05Ω                               |
| Load Life in Humidity        | JIS-C-5202 7.9 40±2°C, 90~95% RH at RCWV for 1,000 Hrs.<br>(1.5 Hrs. on , 0.5 Hrs. off ) | ±2.0%+0.05Ω                               |
| Load Life                    | JIS-C-5202 7.10 70°C at RCWV for 1,000 Hrs. (1.5 Hrs. on, 0.5 Hrs. off )                 | ±2.0%+0.05Ω                               |
| Overload Flame Retardant     | JIS-C-5202 7.12 4 Times RCWV for 1 minute                                                | No evidence of flaming or arcing          |

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

## A collection of various electronic components, including resistors and capacitors, arranged on a white background. The components are of different sizes and shapes, some with color bands and others with numerical markings. They are connected by thin wires, suggesting they are part of a circuit or a test setup.

The normal style & the miniature style of RSF series are coated with layers of gray and pink colors flame-proof lacquer respectively.

## Downloaded from Arrow.com.



Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                           | RSF-25          | RSF50S | RSF-50 | RSF1WS | RSF100 | RSF2WS | RSF200 | RSF3WS/<br>RSF3WM | RSF300 | RSF5SS/<br>RSF5WS | RSF500 |
|---------------------------------|-----------------|--------|--------|--------|--------|--------|--------|-------------------|--------|-------------------|--------|
| Power Rating at 70°C            | 1/4W            | 1/2W   |        | 1W     |        | 2W     |        | 3W                |        | 5W                |        |
| Operating Temp. Range           | -55°C to +155°C |        |        |        |        |        |        |                   |        |                   |        |
| Maximum Working Voltage         | 200V            | 250V   | 250V   | 300V   | 350V   | 350V   | 350V   | 350V/450V         | 500V   | 500V/500V         | 750V   |
| Maximum Overload Voltage        | 300V            | 400V   | 400V   | 500V   | 600V   | 600V   | 600V   | 600V/700V         | 800V   | 800V/800V         | 1000V  |
| Dielectric Withstanding Voltage | 250V            | 350V   | 350V   | 400V   | 500V   | 500V   | 500V   | 500V/600V         | 700V   | 700V/750V         | 750V   |
| Value Range ±5%                 | 1Ω~1MΩ          |        |        |        |        |        |        |                   |        |                   |        |
| Temperature Coefficient         | ±300ppm/°C      |        |        |        |        |        |        |                   |        |                   |        |

\* Standard resistance is 1Ω~1MΩ, below or over this resistance on request.

## ENVIRONMENTAL CHARACTERISTICS

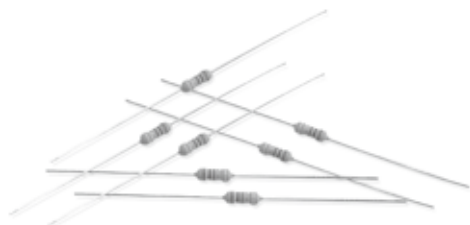
| PERFORMANCE TEST                      | TEST METHOD                                                    |                                                                       | APPRAISE                                  |
|---------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload                   | JIS-C-5202 5.5                                                 | 2.5 Times RCWV for 5 Seconds                                          | ±(1%+0.05Ω)                               |
| Dielectric Withstanding Voltage       | JIS-C-5202 5.7                                                 | in V-Block for 60 Seconds                                             | by Type                                   |
| Temperature Coefficient of Resistance | JIS-C-5202 5.2                                                 | -55°C to +155°C                                                       | ±300ppm/°C                                |
| Insulation Resistance                 | JIS-C-5202 5.6                                                 | in V-Block                                                            | >1000MΩ                                   |
| Solderability                         | JIS-C-5202 6.5                                                 | 235±5°C for 5±0.5 Seconds                                             | 95% Min. Coverage                         |
| Resistance to Solvent                 | JIS-C-5202 6.9                                                 | IPA for 1 Min. with Ultrasonic                                        | No Deterioration of Coatings and Markings |
| Terminal Strength                     | Direct Load for 10 Sec. in The Direction of The Terminal Leads |                                                                       | ≥2.5kg (24.5N)                            |
| Pulse Overload                        | JIS-C-5202 5.8                                                 | 4 Times RCWV 10000 Cycles (1 Sec. on , 25 Sec. off)                   | ±(2%+0.05Ω)                               |
| Load Life in Humidity                 | JIS-C-5202 7.9                                                 | 40±2°C, 90~95% RH at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off ) | ±(5%+0.05Ω)                               |
| Load Life                             | JIS-C-5202 7.10                                                | 70°C at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off)               | ±(5%+0.05Ω)                               |
| Temperature Cycling                   | JIS-C-5202 7.4                                                 | -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                       | ±(1%+0.05Ω)                               |
| Resistance to Soldering Heat          | JIS-C-5202 6.4                                                 | 350°C±10°C for 3±0.5 Seconds                                          | ±(1%+0.05Ω)                               |

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

## Metal Film Resistors

## FUSIBLE Type

Normal &amp; Miniature Style [ FRM Series ]



## FEATURES

Power Rating : 1/4W, 1/2W, 1W, 2W

Resistance tolerance :  $\pm 5\%$ 

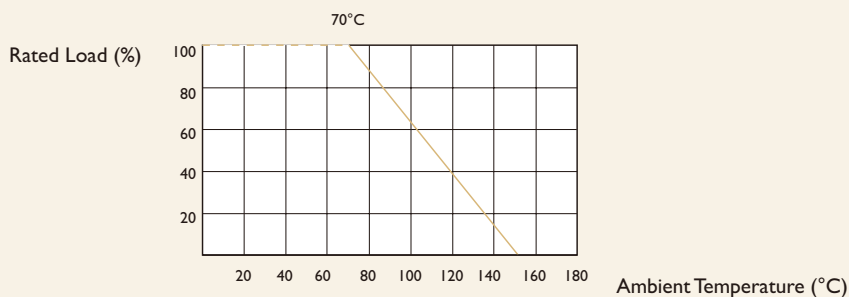
FlameProof Silicone Coating : UL94V-0

Gray body color

The 5th color band is white to represent fusible resistors

## POWER DERATING CURVE

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



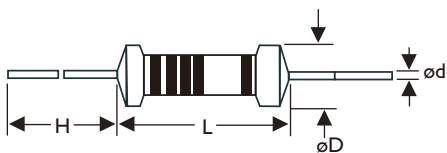
## FUSING CHARACTERISTICS

Fusing time within 30 seconds at 16 times of rated power

Fusing residual resistive value at least 100 times rated resistance

## DIMENSIONS

Unit : mm



| STYLE  |           | DIMENSION |         |        |          |
|--------|-----------|-----------|---------|--------|----------|
| Normal | Miniature | L         | øD      | H      | ød       |
| FRM-25 | FRM50S    | 6.3±0.5   | 2.4±0.2 | 28±2.0 | 0.6±0.05 |
| FRM-50 | FRM1WS    | 9.0±0.5   | 3.3±0.3 | 26±2.0 | 0.6±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                           | TEST METHOD                                                             | FRM-25                                                            | FRM50S | FRM-50 | FRM1WS | FRM100 | FRM2WS | FRM200 | FRM3WS |
|---------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|
| Power Rating at 70°C            |                                                                         | 1/4W                                                              | 1/2W   |        | 1W     |        | 2W     |        | 3W     |
| Dielectric Withstanding Voltage | JIS-C-5202 5.7 in V-Block for 60 Seconds                                | 250V                                                              | 250V   | 250V   | 250V   | 350V   | 350V   | 350V   | 350V   |
| Temperature Coefficient         | JIS-C-5202 5.2 Room Temp.Add 100°C                                      | ±200ppm/°C                                                        |        |        |        |        |        |        |        |
| Short Time Overload             | JIS-C-5202 5.5 2.5 Times RCWV for 5 Seconds                             | ±2.0%+0.05Ω                                                       |        |        |        |        |        |        |        |
| Insulation Resistance           | JIS-C-5202 5.6 in V-Block                                               | >100MΩ                                                            |        |        |        |        |        |        |        |
| Pulse Overload                  | JIS-C-5202 5.8 4 Times RCWV 10,000 Cycles<br>(1 Sec. on , 25 Sec. off ) | ±1.0%+0.05Ω(for Normal Style)<br>±2.0%+0.05Ω(for Miniature Style) |        |        |        |        |        |        |        |
| Operating Temp. Range           |                                                                         | -55°C to + 155°C                                                  |        |        |        |        |        |        |        |
| Value Range                     |                                                                         | 2.2Ω To 1KΩ for E24 Series                                        |        |        |        |        |        |        |        |

\* Resistance range for standard resistance, below or over this resistance on request.

## ENVIRONMENTAL CHARACTERISTICS

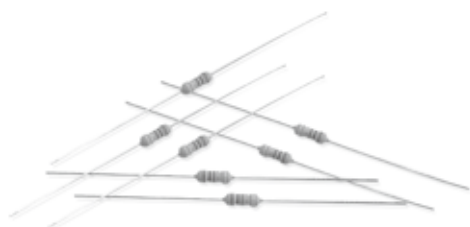
| PERFORMANCE TEST             | TEST METHOD                                                                              | APPRAISE                                  |
|------------------------------|------------------------------------------------------------------------------------------|-------------------------------------------|
| Terminal Strength            | JIS-C-5202 6.1 Direct load for 10 Sec. in the Direction of the Terminal Leads            | ≥2.5kg (24.5N)                            |
| Resistance to Soldering Heat | JIS-C-5202 6.4 350°C ± 10°C for 3 ± 0.5 Seconds                                          | ±1.0%+0.05Ω                               |
| Solderability                | JIS-C-5202 6.5 235±5°C ± 5°C for 5 ± 0.5 Seconds                                         | 95% Min. Coverage                         |
| Resistance to Solvent        | JIS-C-5202 6.9 IPA for 1 Min. with Ultrasonic                                            | No Deterioration of Coatings and Markings |
| Temperature Cycling          | JIS-C-5202 7.4 -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                           | ±2.0%+0.05Ω                               |
| Humidity                     | JIS-C-5202 7.5 40±2°C, 90~95% RH for 1,000 Hrs.                                          | ±5.0%+0.05Ω                               |
| Load Life in Humidity        | JIS-C-5202 7.9 40±2°C, 90~95% RH at RCWV for 1,000 Hrs.<br>(1.5 Hrs. on , 0.5 Hrs. off ) | ±5.0%+0.05Ω                               |
| Load Life                    | JIS-C-5202 7.10 70°C at RCWV for 1,000 Hrs. (1.5 Hrs. on, 0.5 Hrs. off )                 | ±5.0%+0.05Ω                               |
| Overload Flame Retardant     | JIS-C-5202 7.12 4 Times RCWV for 1 minute                                                | No evidence of flaming or arcing          |

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

## Metal Film Resistors

# MFL Type

## Low Values Style [ MFL Series ]



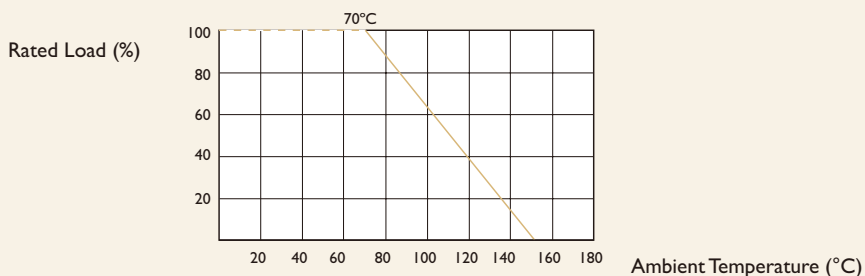
### INTRODUCTION

The MFL Series Metal Film Low Values Resistors are manufactured using vacuum sputtering system to deposit multiple layers of mixed metals and passivative materials onto a carefully treated high grade ceramic substrate, the resistors are coated with layers of blue lacquer.

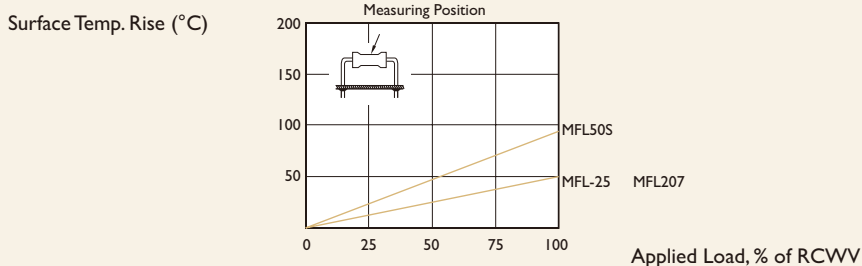
### FEATURES

|                      |                    |
|----------------------|--------------------|
| Power Rating         | 1/4W , 1/2W , 0.6W |
| Resistance Tolerance | ±1%                |
| T.C.R                | 100ppm/°C          |

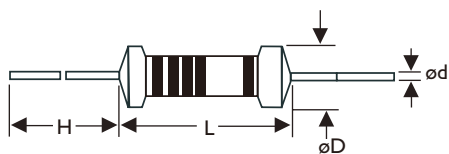
### DERATING CURVE



### HOT-SPOT TEMPERATURE



### DIMENSIONS



| STYLE  |           | DIMENSION |         |        |          | Unit : mm |
|--------|-----------|-----------|---------|--------|----------|-----------|
| Normal | Miniature | L         | øD      | H      | ød       |           |
| MFL-25 | MFL50S    | 6.3±0.5   | 2.4±0.2 | 28±2.0 | 0.6±0.05 |           |
|        | MFL207    | 6.3±0.5   | 2.4±0.2 | 28±2.0 | 0.6±0.05 |           |



Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                            | MFL-25                           | MFL50S | MFL207 |
|----------------------------------|----------------------------------|--------|--------|
| Power Rating at 70°C             | 1/4W                             | 1/2W   | 0.6W   |
| Operating Temp. Range            | - 55°C to +155°C                 |        |        |
| Maximum Working Voltage          | 250V                             | 300V   | 300V   |
| Maximum Overload Voltage         | 500V                             | 600V   | 600V   |
| Dielectric Withstanding Voltage  | 500V                             | 500V   | 500V   |
| Value Range , ±1%                | OR1Ω~OR91Ω for E24 Series values |        |        |
| Temperature Coefficient(by Type) | ±100ppm/°C                       |        |        |

\* Resistance range for standard resistance , below or over this resistance on request.

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST                      | TEST METHOD                                                    |                                                                       | APPRAISE                                  |
|---------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload                   | JIS-C-5202 5.5                                                 | 2.5 Times RCWV for 5 Seconds                                          | ±(0.25%+0.05Ω)                            |
| Dielectric Withstanding Voltage       | JIS-C-5202 5.7                                                 | in V-Block for 60 Seconds                                             | by Type                                   |
| Temperature Coefficient of Resistance | JIS-C-5202 5.2                                                 | -55°C to +155°C                                                       | by Type                                   |
| Insulation Resistance                 | JIS-C-5202 5.6                                                 | in V-Block                                                            | >10000MΩ                                  |
| Solderability                         | JIS-C-5202 6.5                                                 | 235±5°C for 5±0.5 Seconds                                             | 95% Min. Coverage                         |
| Resistance to Solvent                 | JIS-C-5202 6.9                                                 | IPA for 1 Min. with Ultrasonic                                        | No Deterioration of Coatings and Markings |
| Terminal Strength                     | Direct Load for 10 Sec. in The Direction of The Terminal Leads |                                                                       | ≥2.5kg (24.5N)                            |
| Pulse Overload                        | JIS-C-5202 5.8                                                 | 4 Times RCWV 10000 Cycles (1 Sec. on , 25 Sec. off)                   | ±(1%+0.05Ω)                               |
| Load Life in Humidity                 | JIS-C-5202 7.9                                                 | 40±2°C, 90~95% RH at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off ) | ±(1.5%+0.05Ω)                             |
| Load Life                             | JIS-C-5202 7.10                                                | 70°C at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off)               | ±(1.5%+0.05Ω)                             |
| Temperature Cycling                   | JIS-C-5202 7.4                                                 | -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                       | ±(0.75%+0.05Ω)                            |
| Resistance to Soldering Heat          | JIS-C-5202 6.4                                                 | 350°C±10°C for 3±0.5 Seconds                                          | ±(0.25%+0.05Ω)                            |

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

## Melf Metal Film Resistors

## MMF Type

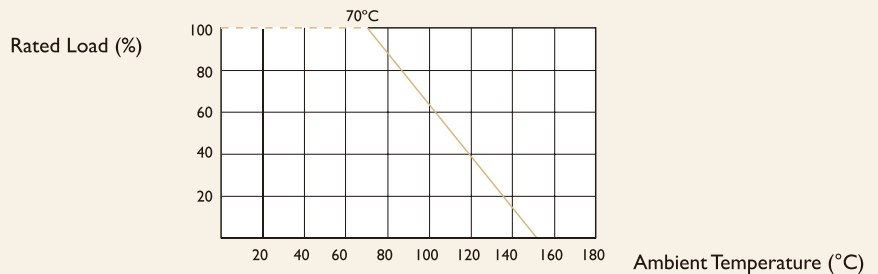
## Normal &amp; Miniature Style [ MMF Series ]



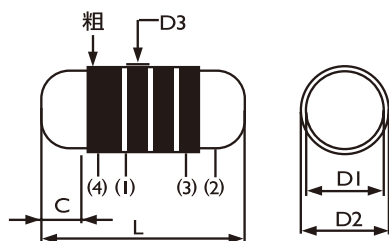
## FEATURES

|                      |                                                                                                                                                |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Power Rating         | 1/6W, 1/4W, 1/2W, 1W, 2W                                                                                                                       |
| Resistance Tolerance | $\pm 0.1\%$ , $\pm 0.25\%$ , $\pm 0.5\%$ , $\pm 1\%$                                                                                           |
| 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



## DIMENSIONS



| STYLE  |               | DIMENSION     |                |       |      | Unit : mm |
|--------|---------------|---------------|----------------|-------|------|-----------|
| Normal | Miniature     | L             | D1             | D2max | Cmin |           |
| MMF-12 | MMF25S/MMF204 | 3.5 $\pm$ 0.2 | 1.4 $\pm$ 0.15 | 1.55  | 0.5  |           |
| MMF-25 | MMF50S/MMF207 | 5.9 $\pm$ 0.2 | 2.2 $\pm$ 0.15 | 2.4   | 0.5  |           |
| MMF-50 | MMF1WS        | 8.5 $\pm$ 0.2 | 3.2 $\pm$ 0.20 | 3.4   | 0.5  |           |



Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                    | MMF-12                           | MMF25S | MMF204 | MMF-25 | MMF50S | MMF207 | MMF-50 | MMF1WS |
|--------------------------|----------------------------------|--------|--------|--------|--------|--------|--------|--------|
| 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   | 200V   | 250V   | 300V   | 300V   | 350V   | 350V   |
| Maximum Overload Voltage | 300V                             | 400V   | 400V   | 500V   | 600V   | 600V   | 700V   | 700V   |
| Operating Temp. Range    | - 55°C to +155°C                 |        |        |        |        |        |        |        |
| Standard Value Range     | 1Ω~10MΩ                          |        |        |        |        |        |        |        |
| Temperature Coefficient  | ±25ppm/°C, ±50ppm/°C, ±100ppm/°C |        |        |        |        |        |        |        |

\* Standard resistance is 1Ω~10MΩ, below or over this resistance on request.

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST                      | TEST METHOD                                                    |                                                                       | APPRAISE                                  |
|---------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload                   | JIS-C-5202 5.5                                                 | 2.5 Times RCWV for 5 Seconds                                          | ±(0.25%+0.05Ω)                            |
| Dielectric Withstanding Voltage       | JIS-C-5202 5.7                                                 | in V-Block for 60 Seconds                                             | by Type                                   |
| Temperature Coefficient of Resistance | JIS-C-5202 5.2                                                 | -55°C to +155°C                                                       | by Type                                   |
| Insulation Resistance                 | JIS-C-5202 5.6                                                 | in V-Block                                                            | >10000MΩ                                  |
| Solderability                         | JIS-C-5202 6.5                                                 | 235±5°C for 5±0.5 Seconds                                             | 95% Min. Coverage                         |
| Resistance to Solvent                 | JIS-C-5202 6.9                                                 | IPA for 1 Min. with Ultrasonic                                        | No Deterioration of Coatings and Markings |
| Terminal Strength                     | Direct Load for 10 Sec. in The Direction of The Terminal Leads |                                                                       | ≥2.5kg (24.5N)                            |
| Pulse Overload                        | JIS-C-5202 5.8                                                 | 4 Times RCWV 10000 Cycles (1 Sec. on , 25 Sec. off)                   | ±(1%+0.05Ω)                               |
| Load Life in Humidity                 | JIS-C-5202 7.9                                                 | 40±2°C, 90~95% RH at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off ) | ±(1.5%+0.05Ω)                             |
| Load Life                             | JIS-C-5202 7.10                                                | 70°C at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off)               | ±(1.5%+0.05Ω)                             |
| Temperature Cycling                   | JIS-C-5202 7.4                                                 | -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                       | ±(0.75%+0.05Ω)                            |
| Resistance to Soldering Heat          | JIS-C-5202 6.4                                                 | 350°C±10°C for 3±0.5 Seconds                                          | ±(0.25%+0.05Ω)                            |

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

## Melf Metal Film Resistors

# MMP Type

## Power Type Normal Style [ MMP Series ]

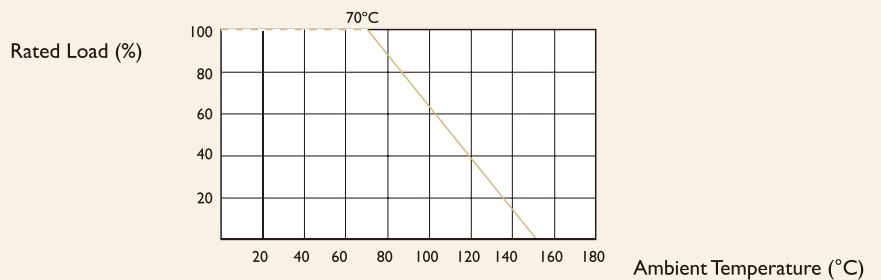


### FEATURES

|                                                     |                                   |
|-----------------------------------------------------|-----------------------------------|
| Power Rating                                        | 1W, 2W                            |
| Resistance Tolerance                                | $\pm 1\%$ , $\pm 2\%$ , $\pm 5\%$ |
| High thermal conductivity and specific gravity rods |                                   |
| Flame Proof Silicone Coating: UL94V-0               |                                   |
| Pink body color                                     |                                   |

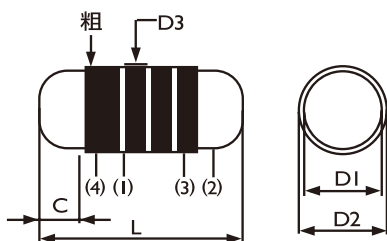
### POWER DERATING CURVE

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



### DIMENSIONS

Unit : mm



| STYLE  | L             | D1             | D2max | Cmin |
|--------|---------------|----------------|-------|------|
| MMP100 | 5.9 $\pm$ 0.2 | 2.2 $\pm$ 0.15 | 2.4   | 0.5  |
| MMP200 | 8.5 $\pm$ 1.0 | 3.2 $\pm$ 0.20 | 3.4   | 0.5  |



Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                          | TEST METHOD                                                       | MMP100                            | MMP200 |
|--------------------------------|-------------------------------------------------------------------|-----------------------------------|--------|
| Power Rating at 70°C           |                                                                   | 1W                                | 2W     |
| Maximum Overload Voltage       |                                                                   | 700V                              | 700V   |
| Maximum Working Voltage        |                                                                   | 350V                              | 350V   |
| Dielectric Withstanding Voltag | JIS-C-5202 5.7 in V-Block for 60 Seconds                          | 500V                              | 500V   |
| Temperature Coefficient        | JIS-C-5202 5.2 Room Temp.Add 100°C                                | ±50, ±100 ,±200ppm/°C             |        |
| Short Time Overload            | JIS-C-5202 5.5 2.5 Times RCWV for 5Seconds                        | ±2.0% +0.05Ω                      |        |
| Insulation Resistance          | JIS-C-5202 5.6 in V-Block                                         | >1000MΩ                           |        |
| Pulse Overload                 | JIS-C-5202 5.8 4Times RCWV 1000Hrs Cycles<br>(1sec.on,25sec.off ) | ±1.0 % +0.05Ω                     |        |
| Operating Temp. Range          |                                                                   | - 55°C to +155°C                  |        |
| Value Range , ±0.5 % ±1%       |                                                                   | 10Ω To 1MΩ for E240 or E90 Series |        |
| Value Range ±5 %               |                                                                   | 1Ω To 1MΩ for E24 Series          |        |

\* Standard resistance is 1Ω~1MΩ, below or over this resistance on request.

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST             | TEST METHOD                                                                          | APPRAISE                                  |
|------------------------------|--------------------------------------------------------------------------------------|-------------------------------------------|
| Terminal Strength            | JIS-C-5202 6.1 Direct load for 10 sec.in the direction of the terminal leads         | ≥2.5kg(24.5N)                             |
| Resistance to Soldering Heat | JIS-C-5202 6.4 350°C±10°Cfor 3±0.5 Seconds                                           | ±0.25% ±0.05Ω                             |
| Solderability                | JIS-C-5202 6.5 235±5°Cfor 5±0.5 Seconds                                              | 95% Min. Coverage                         |
| Resistance to Solvent        | JIS-C-5202 6.9 IPA for1 Min..with Ultrasonic                                         | No Deterioration of Coatings and Markings |
| Temperature Cycling          | JIS-C-5202 7.4 -55→Room Temp.→+155°C→Room Temp. for5Cycles                           | ±1.0 % +0.05Ω                             |
| Humidity                     | JIS-C-5202 7.5 40±2°C, 90~95% RH for 1,000Hrs                                        | ±1.0 % +0.05Ω                             |
| Load Life in Humidity        | JIS-C-5202 7.9 40±2°C,90~95% RH at RCWV for 1000Hrs<br>(1.5 Hrs. on , 0.5 Hrs. off ) | ±2.0%+0.05Ω                               |
| Load Life                    | JIS-C-5202 7.10 70°Cat RCWV for 1000Hrs. (1.5Hrs.on,0.5Hrs.off)                      | ±2.0%+0.05Ω                               |
| Overload Flame Retardant     | JIS-C-5202 7.12 4Times RCWV for 1 minute.                                            | No evidence of Flaming or arcing          |

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

## Carbon Film Resistors

## CFR Type

## Normal &amp; Miniature Style [ CFR Series ]



## INTRODUCTION

Billions of products are already in use worldwide in all types of applications—from process control instrumentation to telephone receivers and FM radio to color television.

The secret is in a proprietary production system and baking by a uniquely designed and automated production technique. Years of experience in making raw materials and production machinery prove the unique quality and high reliability of these products.

The meet-or far exceed such specifications as EIA RS196A, JIS-C-6402 and IEC-115.

The resistors are coated with layers of tan color lacquer.

## FEATURES

Industry's Lowest Cost

Delivery From Stock in Bulk, Taped and Strip Pack

Exceptional Long-Term Stability

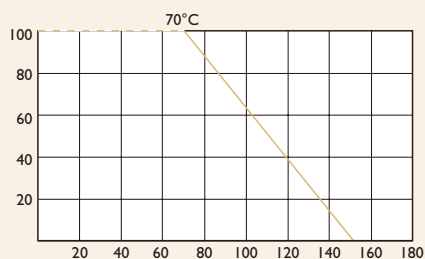
Exceeds Carbon Comp MIL-R-11 Performance

Resistance Tolerance:  $\pm 2\%$ ,  $\pm 5\%$

Variety of Packaging—Bulk, Strip Pack, 26mm and 52mm Tape and Reel, Cut and Formed, or Radial Panaset/Avisert

## DERATING CURVE

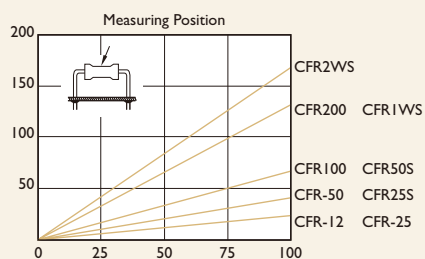
Rated Load (%)



Ambient Temperature (°C)

## HOT-SPOT TEMPERATURE

Surface Temp. Rise (°C)

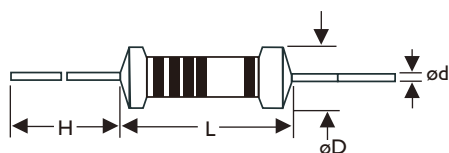


Applied Load, % of RCWV

## TABLE I TEMPERATURE COEFFICIENT

| STYLE                   | Max. Value of Temp. Coefficient ppm/°C |                             |                            |
|-------------------------|----------------------------------------|-----------------------------|----------------------------|
|                         | under 100K $\Omega$                    | 100K $\Omega$ ~ 1M $\Omega$ | 1M $\Omega$ ~ 10M $\Omega$ |
| CFR100, CFR200, CFR2WS  | $\pm 350$                              | -500                        | -1500                      |
| CFR-12, CFR-25, CFR-50, | +350                                   | -700                        | -1500                      |
| CFR25S, CFR50S, CFR1WS  | -500                                   |                             |                            |

## DIMENSIONS



| STYLE  |           | DIMENSION      |               |              |                |
|--------|-----------|----------------|---------------|--------------|----------------|
| Normal | Miniature | L              | $\phi D$      | H            | $\phi d$       |
| CFR-12 | CFR25S    | 3.4 $\pm$ 0.3  | 1.9 $\pm$ 0.2 | 28 $\pm$ 2.0 | 0.5 $\pm$ 0.05 |
| CFR-25 | CFR50S    | 6.3 $\pm$ 0.5  | 2.4 $\pm$ 0.2 | 28 $\pm$ 2.0 | 0.6 $\pm$ 0.05 |
| CFR-50 | CFR1WS    | 9.0 $\pm$ 0.5  | 3.3 $\pm$ 0.3 | 26 $\pm$ 2.0 | 0.6 $\pm$ 0.05 |
| CFR100 | CFR2WS    | 11.5 $\pm$ 1.0 | 4.5 $\pm$ 0.5 | 35 $\pm$ 2.0 | 0.8 $\pm$ 0.05 |
| CFR200 | -         | 15.5 $\pm$ 1.0 | 5.0 $\pm$ 0.5 | 33 $\pm$ 2.0 | 0.8 $\pm$ 0.05 |

Unit : mm





Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                             | CFR-12          | CFR25S | CFR-25 | CFR50S | CFR-50 | CFR1WS | CFR100 | CFR2WS | CFR200 |
|-----------------------------------|-----------------|--------|--------|--------|--------|--------|--------|--------|--------|
| Power Rating at 70°C              | 1/6W            | 1/4W   |        | 1/2W   |        | 1W     |        | 2W     |        |
| Operating Temp. Range             | -55°C to +155°C |        |        |        |        |        |        |        |        |
| Maximum Working Voltage           | 150V            | 200V   | 250V   | 300V   | 350V   | 400V   | 500V   | 500V   | 500V   |
| Maximum Overload Voltage          | 300V            | 400V   | 500V   | 600V   | 700V   | 800V   | 1000V  | 1000V  | 1000V  |
| Dielectric Withstanding Voltage   | 300V            | 400V   | 500V   | 500V   | 500V   | 700V   | 1000V  | 1000V  | 1000V  |
| Value Range ±2%, ±5%              | 1Ω~10MΩ         |        |        |        |        |        |        |        |        |
| Temperature Coefficient (by Type) | see TABLE I     |        |        |        |        |        |        |        |        |

\* Standard resistance is 1Ω~10MΩ, below or over this resistance on request.

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST                      | TEST METHOD                                                    |                                                                       | APPRAISE                                  |
|---------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload                   | JIS-C-5202 5.5                                                 | 2.5 Times RCWV for 5 Seconds                                          | ±(0.75%+0.05Ω)                            |
| Dielectric Withstanding Voltage       | JIS-C-5202 5.7                                                 | in V-Block for 60 Seconds                                             | by Type                                   |
| Temperature Coefficient of Resistance | JIS-C-5202 5.2                                                 | -55°C to +155°C                                                       | by Type                                   |
| Insulation Resistance                 | JIS-C-5202 5.6                                                 | in V-Block                                                            | >1000MΩ                                   |
| Solderability                         | JIS-C-5202 6.5                                                 | 235±5°C for 5±0.5 Seconds                                             | 95% Min. Coverage                         |
| Resistance to Solvent                 | JIS-C-5202 6.9                                                 | IPA for 1 Min. with Ultrasonic                                        | No Deterioration of Coatings and Markings |
| Terminal Strength                     | Direct Load for 10 Sec. in The Direction of The Terminal Leads |                                                                       | ≥2.5kg (24.5N)                            |
| Pulse Overload                        | JIS-C-5202 5.8                                                 | 4 Times RCWV 10000 Cycles (1 Sec. on , 25 Sec. off)                   | ±(1%+0.05Ω)                               |
| Load Life in Humidity                 | JIS-C-5202 7.9                                                 | 40±2°C, 90~95% RH at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off ) | ±(3%+0.05Ω)                               |
| Load Life                             | JIS-C-5202 7.10                                                | 70°C at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off)               | ±(3%+0.05Ω)                               |
| Temperature Cycling                   | JIS-C-5202 7.4                                                 | -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                       | ±(1%+0.05Ω)                               |
| Resistance to Soldering Heat          | JIS-C-5202 6.4                                                 | 350°C±10°C for 3±0.5 Seconds                                          | ±(1%+0.05Ω)                               |

\* 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 are manufactured by Coating a homogeneous film of pure carbon on high grade ceramic rods, resistance less than 10 $\Omega$  have an electroless-deposited nickel film.

The resistors are coated with layers of tan color lacquer.

### FEATURES

Excellent Long-Term Stability

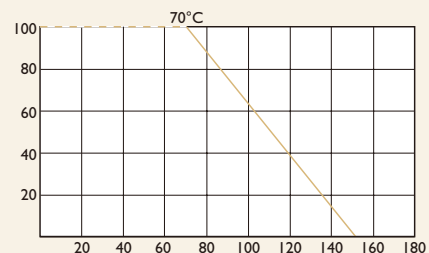
Miniature in Size

Resistance Tolerance:  $\pm 5\%$

Resistance Range: 1 $\Omega$ ~10M $\Omega$

### DERATING CURVE

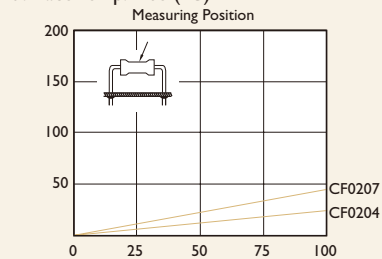
Rated Load (%)



Ambient Temperature (°C)

### HOT-SPOT TEMPERATURE

Surface Temp. Rise (°C)



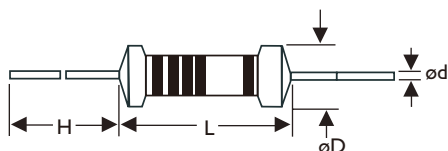
Applied Load, % of RCWV

### 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<br>-500                           | -700                        | -1500                      |

### DIMENSIONS

Unit : mm



| STYLE  | L             | øD            | H            | ød             |
|--------|---------------|---------------|--------------|----------------|
| CF0204 | 3.4 $\pm$ 0.3 | 1.9 $\pm$ 0.2 | 28 $\pm$ 2.0 | 0.5 $\pm$ 0.05 |
| CF0207 | 6.3 $\pm$ 0.5 | 2.4 $\pm$ 0.2 | 28 $\pm$ 2.0 | 0.6 $\pm$ 0.05 |



Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                           | CF0204                   | CF0207 |
|---------------------------------|--------------------------|--------|
| Power Rating at 70°C            | 0.4W                     | 0.6W   |
| Operating Temp. Range           | -55°C to +155°C          |        |
| Maximum Working Voltage         | 200V                     | 300V   |
| Maximum Overload Voltage        | 400V                     | 600V   |
| Dielectric Withstanding Voltage | 300V                     | 500V   |
| Value Range $\pm 5\%$           | 1 $\Omega$ ~10M $\Omega$ |        |
| Temp. Coefficient (by Type)     | see TABLE I              |        |

\* Standard resistance is 1 $\Omega$ ~10M $\Omega$ , below or over this resistance on request.

## ENVIRONMENTAL CHARACTERISTICS

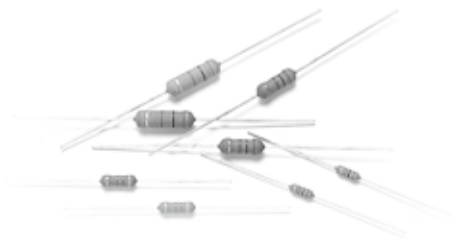
| PERFORMANCE TEST                      | TEST METHOD                                                    |                                                                                          | APPRAISE                                  |
|---------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload                   | JIS-C-5202 5.5                                                 | 2.5 Times RCWV for 5 Seconds                                                             | $\pm(0.75\%+0.05\Omega)$                  |
| Dielectric Withstanding Voltage       | JIS-C-5202 5.7                                                 | in V-Block for 60 Seconds                                                                | by Type                                   |
| Temperature Coefficient of Resistance | JIS-C-5202 5.2                                                 | -55°C to +155°C                                                                          | by Type                                   |
| Insulation Resistance                 | JIS-C-5202 5.6                                                 | in V-Block                                                                               | >1000M $\Omega$                           |
| Solderability                         | JIS-C-5202 6.5                                                 | 235 $\pm 5^\circ\text{C}$ for 5 $\pm 0.5$ Seconds                                        | 95% Min. Coverage                         |
| Resistance to Solvent                 | JIS-C-5202 6.9                                                 | IPA for 1 Min. with Ultrasonic                                                           | No Deterioration of Coatings and Markings |
| Terminal Strength                     | Direct Load for 10 Sec. in The Direction of The Terminal Leads |                                                                                          | $\geq 2.5\text{kg}$ (24.5N)               |
| Pulse Overload                        | JIS-C-5202 5.8                                                 | 4 Times RCWV 10000 Cycles (1 Sec. on , 25 Sec. off)                                      | $\pm(1\%+0.05\Omega)$                     |
| Load Life in Humidity                 | JIS-C-5202 7.9                                                 | 40 $\pm 2^\circ\text{C}$ , 90~95% RH at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off ) | $\pm(3\%+0.05\Omega)$                     |
| Load Life                             | JIS-C-5202 7.10                                                | 70°C at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off)                                  | $\pm(3\%+0.05\Omega)$                     |
| Temperature Cycling                   | JIS-C-5202 7.4                                                 | -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                                          | $\pm(1\%+0.05\Omega)$                     |
| Resistance to Soldering Heat          | JIS-C-5202 6.4                                                 | 350°C $\pm 10^\circ\text{C}$ for 3 $\pm 0.5$ Seconds                                     | $\pm(1\%+0.05\Omega)$                     |

\* 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 flame-proof Carbon Film Resistors are manufactured by Coating a homogeneous film of pure carbon on high grade ceramic rods, resistance less than  $10\Omega$  have an electroless deposited nickel film, and are coated with layers of gray color flame-proof lacquer. These resistors meet overload tests in accordance with UL specification #1412 without producing a fire hazard.

### FEATURES

Low Cost. Prompt Delivery

High Power-to-Size Ratio for Significant Space Savings

Flameproof Silicone Coating (UL94V-0)

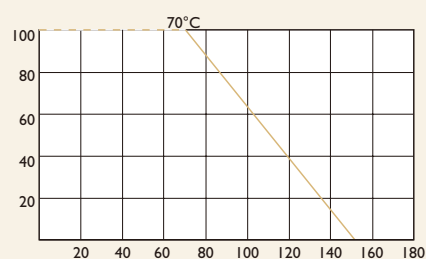
Excellent Long-Term Stability

Wide Resistance Range:  $1\Omega \sim 10M\Omega$

Resistance Tolerance:  $\pm 5\%$

### DERATING CURVE

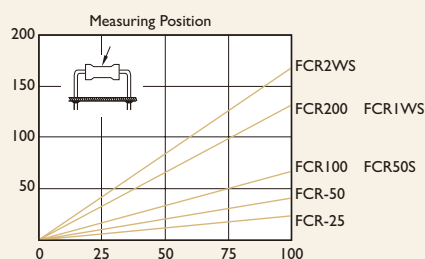
Rated Load (%)



Ambient Temperature (°C)

### HOT-SPOT TEMPERATURE

Surface Temp. Rise (°C)

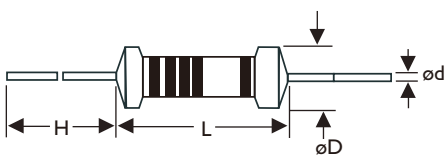


Applied Load, % of RCWW

### TABLE I TEMPERATURE COEFFICIENT

| STYLE                          | Max. Value of Temp. Coefficient ppm/°C |                             |                            |
|--------------------------------|----------------------------------------|-----------------------------|----------------------------|
|                                | under 100K $\Omega$                    | 100K $\Omega$ ~ 1M $\Omega$ | 1M $\Omega$ ~ 10M $\Omega$ |
| FCR100, FCR200, FCR2WS         | $\pm 350$                              | -500                        | -1500                      |
| FCR-25, FCR-50, FCR50S, FCR1WS | +350                                   | -700                        | -1500                      |

### DIMENSIONS



\*The 5th is black color band for FCR series

Unit : mm

| STYLE  |           | DIMENSION      |               |              |                |
|--------|-----------|----------------|---------------|--------------|----------------|
| Normal | Miniature | L              | øD            | H            | ød             |
| FCR-25 | FCR50S    | 6.3 $\pm$ 0.5  | 2.4 $\pm$ 0.2 | 28 $\pm$ 2.0 | 0.6 $\pm$ 0.05 |
| FCR-50 | FCR1WS    | 9.0 $\pm$ 0.5  | 3.3 $\pm$ 0.3 | 26 $\pm$ 2.0 | 0.6 $\pm$ 0.05 |
| FCR100 | FCR2WS    | 11.5 $\pm$ 1.0 | 4.5 $\pm$ 0.5 | 35 $\pm$ 2.0 | 0.8 $\pm$ 0.05 |
| FCR200 | -         | 15.5 $\pm$ 1.0 | 5.0 $\pm$ 0.5 | 33 $\pm$ 2.0 | 0.8 $\pm$ 0.05 |



Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                             | FCR-25          | FCR50S | FCR-50 | FCR1WS | FCR100 | FCR2WS | FCR200 |
|-----------------------------------|-----------------|--------|--------|--------|--------|--------|--------|
| Power Rating at 70°C              | 1/4W            | 1/2W   |        | 1W     |        | 2W     |        |
| Operating Temp. Range             | -55°C to +155°C |        |        |        |        |        |        |
| Maximum Working Voltage           | 250V            | 300V   | 350V   | 400V   | 500V   | 500V   | 500V   |
| Maximum Overload Voltage          | 500V            | 600V   | 700V   | 800V   | 1000V  | 1000V  | 1000V  |
| Dielectric Withstanding Voltage   | 400V            | 400V   | 500V   | 600V   | 750V   | 750V   | 750V   |
| Value Range $\pm 2\%$ , $\pm 5\%$ | 1Ω~10MΩ         |        |        |        |        |        |        |
| Temperature Coefficient (by Type) | see TABLE I     |        |        |        |        |        |        |

\* Standard resistance is 1Ω~10MΩ, below or over this resistance on request.

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST                      | TEST METHOD                                                    |                                                                              | APPRAISE                                  |
|---------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload                   | JIS-C-5202 5.5                                                 | 2.5 Times RCWV for 5 Seconds                                                 | $\pm(0.75\%+0.05\Omega)$                  |
| Dielectric Withstanding Voltage       | JIS-C-5202 5.7                                                 | in V-Block for 60 Seconds                                                    | by Type                                   |
| Temperature Coefficient of Resistance | JIS-C-5202 5.2                                                 | -55°C to +155°C                                                              | by Type                                   |
| Insulation Resistance                 | JIS-C-5202 5.6                                                 | in V-Block                                                                   | >1000MΩ                                   |
| Solderability                         | JIS-C-5202 6.5                                                 | 235 $\pm 5$ °C for 5 $\pm 0.5$ Seconds                                       | 95% Min. Coverage                         |
| Resistance to Solvent                 | JIS-C-5202 6.9                                                 | IPA for 1 Min. with Ultrasonic                                               | No Deterioration of Coatings and Markings |
| Terminal Strength                     | Direct load for 10 Sec. in The Direction of The Terminal Leads |                                                                              | $\geq 2.5\text{kg}$ (24.5N)               |
| Pulse Overload                        | JIS-C-5202 5.8                                                 | 4 Times RCWV 10000 Cycles (1 Sec. on , 25 Sec. off)                          | $\pm(1\%+0.05\Omega)$                     |
| Load Life in Humidity                 | JIS-C-5202 7.9                                                 | 40 $\pm 2$ °C, 90~95% RH at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off ) | $\pm(3\%+0.05\Omega)$                     |
| Load Life                             | JIS-C-5202 7.10                                                | 70°C at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off)                      | $\pm(3\%+0.05\Omega)$                     |
| Temperature Cycling                   | JIS-C-5202 7.4                                                 | -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                              | $\pm(1\%+0.05\Omega)$                     |
| Resistance to Soldering Heat          | JIS-C-5202 6.4                                                 | 350°C $\pm 10$ °C for 3 $\pm 0.5$ Seconds                                    | $\pm(1\%+0.05\Omega)$                     |

\* 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 are manufactured by Coating a homogeneous film of pure carbon on high grade ceramic rods, resistance less than  $10\Omega$  have an electroless-deposited nickel film.

The FC0207 are coated with layers of green color flame-proof lacquer.

The FC0207 resistors meet overload test in accordance with UL specification #1412 without producing a fire hazard.

### FEATURES

Excellent Long-Term Stability

Miniature in Size

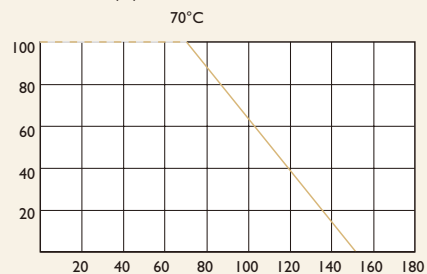
Flameproof Silicone Coating (UL94V-0)

Resistance Tolerance:  $\pm 5\%$

Resistance Range:  $1\Omega \sim 10M\Omega$

### DERATING CURVE

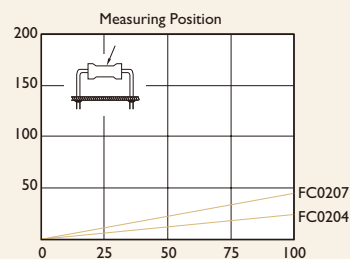
Rated Load (%)



Ambient Temperature (°C)

### HOT-SPOT TEMPERATURE

Surface Temp. Rise (°C)



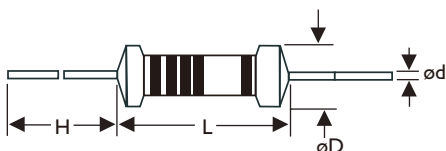
Applied Load, % of RCWV

### TABLE I TEMPERATURE COEFFICIENT

| STYLE          | Max. Value of Temp. Coefficient ppm/°C |                            |                           |
|----------------|----------------------------------------|----------------------------|---------------------------|
|                | under $100K\Omega$                     | $100K\Omega \sim 1M\Omega$ | $1M\Omega \sim 10M\Omega$ |
| FC0204, FC0207 | +350<br>-500                           | -700                       | -1500                     |

### DIMENSIONS

Unit : mm



| STYLE  | L             | øD            | H            | ød             |
|--------|---------------|---------------|--------------|----------------|
| FC0204 | $3.4 \pm 0.3$ | $1.9 \pm 0.2$ | $28 \pm 2.0$ | $0.5 \pm 0.05$ |
| FC0207 | $6.3 \pm 0.5$ | $2.4 \pm 0.2$ | $28 \pm 2.0$ | $0.6 \pm 0.05$ |



Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                             | FC0204                   | FC0207 |
|-----------------------------------|--------------------------|--------|
| Power Rating at 70°C              | 0.4W                     | 0.6W   |
| Operating Temp. Range             | -55°C to +155°C          |        |
| Maximum Working Voltage           | 200V                     | 300V   |
| Maximum Overload Voltage          | 400V                     | 600V   |
| Dielectric Withstanding Voltage   | 300V                     | 500V   |
| Value Range $\pm 5\%$             | 1 $\Omega$ ~10M $\Omega$ |        |
| Temperature Coefficient (by Type) | see TABLE I              |        |

\* Standard resistance is 1 $\Omega$ ~10M $\Omega$ , below or over this resistance on request.

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST                      | TEST METHOD                                                    |                                                                                          | APPRAISE                                  |
|---------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload                   | JIS-C-5202 5.5                                                 | 2.5 Times RCWV for 5 Seconds                                                             | $\pm(0.75\%+0.05\Omega)$                  |
| Dielectric Withstanding Voltage       | JIS-C-5202 5.7                                                 | in V-Block for 60 Seconds                                                                | by Type                                   |
| Temperature Coefficient of Resistance | JIS-C-5202 5.2                                                 | -55°C to +155°C                                                                          | by Type                                   |
| Insulation Resistance                 | JIS-C-5202 5.6                                                 | in V-Block                                                                               | >1000M $\Omega$                           |
| Solderability                         | JIS-C-5202 6.5                                                 | 235 $\pm 5^\circ\text{C}$ for 5 $\pm 0.5$ Seconds                                        | 95% Min. Coverage                         |
| Resistance to Solvent                 | JIS-C-5202 6.9                                                 | IPA for 1 Min. with Ultrasonic                                                           | No Deterioration of Coatings and Markings |
| Terminal Strength                     | Direct Load for 10 Sec. in The Direction of The Terminal Leads |                                                                                          | $\geq 2.5\text{kg}$ (24.5N)               |
| Pulse Overload                        | JIS-C-5202 5.8                                                 | 4 Times RCWV 10000 Cycles (1 Sec. on , 25 Sec. off)                                      | $\pm(1\%+0.05\Omega)$                     |
| Load Life in Humidity                 | JIS-C-5202 7.9                                                 | 40 $\pm 2^\circ\text{C}$ , 90~95% RH at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off ) | $\pm(3\%+0.05\Omega)$                     |
| Load Life                             | JIS-C-5202 7.10                                                | 70°C at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off)                                  | $\pm(3\%+0.05\Omega)$                     |
| Temperature Cycling                   | JIS-C-5202 7.4                                                 | -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                                          | $\pm(1\%+0.05\Omega)$                     |
| Resistance to Soldering Heat          | JIS-C-5202 6.4                                                 | 350°C $\pm 10^\circ\text{C}$ for 3 $\pm 0.5$ Seconds                                     | $\pm(1\%+0.05\Omega)$                     |

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

## Carbon Film Resistors

# NON INDUCTIVE Type

## Normal & Miniature Style [ NCR Series ]



### FEATURES

Power Rating : 1/4W, 1/2WS, 1/2W, 1WS, 1W, 2WS, 2W, 3WS

Resistance Tolerance :  $\pm 5\%$  ,  $\pm 10\%$

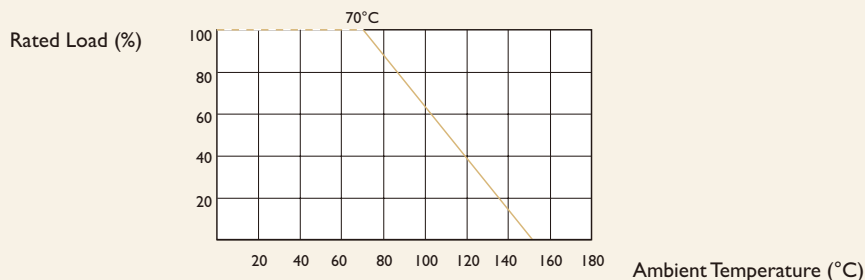
FlameProof Silicone Coating : UL94V-0

Gray body color

The 5th color band is green to represent non-inductive resistors

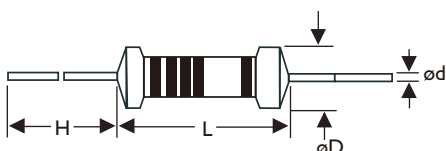
Inductance :  $< 1 \mu\text{H}$

### POWER DERATING CURVE



### DIMENSIONS

Unit : mm



| 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 | 0.6 $\pm$ 0.05 |
| NCR-50 | NCR1WS    | 9.0 $\pm$ 0.5  | 3.3 $\pm$ 0.3 | 26 $\pm$ 2.0 | 0.7 $\pm$ 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                           | TEST METHOD                                                             | NCR-25                     | NCR50S      | NCR-50 | NCR1WS | NCR100 | NCR2WS | NCR200 | NCR3WS |
|---------------------------------|-------------------------------------------------------------------------|----------------------------|-------------|--------|--------|--------|--------|--------|--------|
| Power Rating at 70°C            |                                                                         | 1/4W                       | 1/2W        |        | 1W     |        | 2W     |        | 3W     |
| Dielectric Withstanding Voltage | JIS-C-5202 5.7 in V-Block for 60 Seconds                                | 500V                       | 500V        | 700V   | 700V   | 1000V  | 1000V  | 1000V  | 1000V  |
| Temperature Coefficient         | JIS-C-5202 5.2 Room Temp.Add 100°C                                      | ±500ppm/°C                 |             |        |        |        |        |        |        |
| Short Time Overload             | JIS-C-5202 5.5 2.5 Times RCWV for 5 Seconds                             | ±0.75%+0.05Ω               | ±2.0%+0.05Ω |        |        |        |        |        |        |
| Insulation Resistance           | JIS-C-5202 5.6 in V-Block                                               | >1,000MΩ                   |             |        |        |        |        |        |        |
| Pulse Overload                  | JIS-C-5202 5.8 4 Times RCWV 10,000 Cycles<br>(1 Sec. on , 25 Sec. off ) | ±0.75%+0.05Ω               | ±1.0%+0.05Ω |        |        |        |        |        |        |
| Operating Temp. Range           |                                                                         | -55°C to + 155°C           |             |        |        |        |        |        |        |
| Value Range                     |                                                                         | 2.2Ω To 6KΩ for E24 Series |             |        |        |        |        |        |        |

\* Resistance range for standard resistance, below or over this resistance on request.

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST             | TEST METHOD                                                                              | APPRAISE                                  |
|------------------------------|------------------------------------------------------------------------------------------|-------------------------------------------|
| Terminal Strength            | JIS-C-5202 6.1 Direct load for 10 Sec. in the Direction of the Terminal Leads            | ≥2.5kg (24.5N)                            |
| Resistance to Soldering Heat | JIS-C-5202 6.4 350°C ± 10°C for 3 ± 0.5 Seconds                                          | ±1.0%+0.05Ω                               |
| Solderability                | JIS-C-5202 6.5 235°C ± 5°C for 5 ± 0.5 Seconds                                           | 95% Min. Coverage                         |
| Resistance to Solvent        | JIS-C-5202 6.9 IPA for 1 Min. with Ultrasonic                                            | No Deterioration of Coatings and Markings |
| Temperature Cycling          | JIS-C-5202 7.4 -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                           | ±1.0%+0.05Ω                               |
| Humidity                     | JIS-C-5202 7.5 40±2°C, 90~95% RH for 1,000 Hrs.                                          | ±1.0%+0.05Ω                               |
| Load Life in Humidity        | JIS-C-5202 7.9 40±2°C, 90~95% RH at RCWV for 1,000 Hrs.<br>(1.5 Hrs. on , 0.5 Hrs. off ) | ±3.0%+0.05Ω                               |
| Load Life                    | JIS-C-5202 7.10 70°C at RCWV for 1,000 Hrs. (1.5 Hrs. on, 0.5 Hrs. off )                 | ±3.0%+0.05Ω                               |
| Overload Flame Retardant     | JIS-C-5202 7.12 4 Times RCWV for 1 minute                                                | No evidence of flaming or arcing          |

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

## Melf Carbon Film Resistors

## MCF Type

Normal &amp; Miniature Style [ MCF Series ]



## FEATURES

Industry's Lowest Cost

Delivery From Stock in Taped and Reel, Bulk

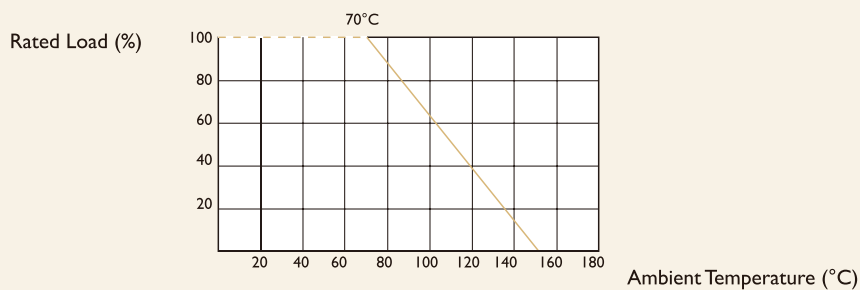
Exceptional Long-Term Stability

Exceeds Carbon Comp MIL-R-11 Performance

Power Rating: 1/8W, 1/4W, 1/2W, 1W

Resistance Tolerance:  $\pm 2\%$ ,  $\pm 5\%$ 

## DERATING CURVE

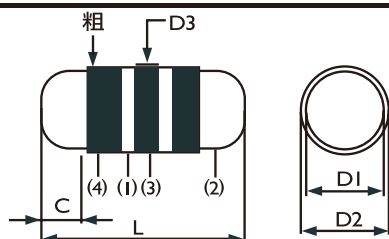


## TABLE I TEMPERATURE COEFFICIENT

| STYLE                  | Max. Value of Temp. Coefficient ppm/°C |                            |                           |
|------------------------|----------------------------------------|----------------------------|---------------------------|
|                        | under 100K $\Omega$                    | 100K $\Omega$ ~1M $\Omega$ | 1M $\Omega$ ~10M $\Omega$ |
| MCF100, MCF200, MCF2WS | $\pm 350$                              | -500                       | -1500                     |
| MCF-12, MCF-25, MCF-50 | +350                                   | -700                       | -1500                     |
| MCF25S, MCF50S, MCF1WS | -500                                   |                            |                           |

## DIMENSIONS

Unit : mm



| STYLE  | DIMENSION     |               |                |        |       |
|--------|---------------|---------------|----------------|--------|-------|
| Normal | Miniature     | L             | D1             | D2 max | C min |
| MCF-12 | MCF25S/MCF204 | 3.5 $\pm$ 0.2 | 1.4 $\pm$ 0.15 | 1.55   | 0.5   |
| MCF-25 | MCF50S/MCF207 | 5.9 $\pm$ 0.2 | 2.2 $\pm$ 0.15 | 2.4    | 0.5   |
| MCF-50 | MCF1WS        | 8.5 $\pm$ 0.2 | 3.2 $\pm$ 0.20 | 3.4    | 0.5   |



Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                    | MCF-12          | MCF25S | MCF204 | MCF-25 | MCF50S | MCF207 | MCF-50 | MCF1WS |
|--------------------------|-----------------|--------|--------|--------|--------|--------|--------|--------|
| 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   | 200V   | 250V   | 300V   | 300V   | 350V   | 350V   |
| Maximum Overload Voltage | 300V            | 400V   | 400V   | 500V   | 600V   | 600V   | 700V   | 700V   |
| Open Temp. Range         | -55°C to +155°C |        |        |        |        |        |        |        |
| Standard Value Range     | 1Ω~10MΩ         |        |        |        |        |        |        |        |
| Temperature Coefficient  | See table I     |        |        |        |        |        |        |        |

\* Standard resistance is 1Ω~10MΩ, below or over this resistance on request

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST                      | TEST METHOD                                                    |                                                                     | APPRAISE                                 |
|---------------------------------------|----------------------------------------------------------------|---------------------------------------------------------------------|------------------------------------------|
| Short Time Overload                   | JIS-C-5202 5.5                                                 | 2.5Times RCWV for 5 Seconds                                         | ±(0.75%+0.05Ω)                           |
| Dielectric Withstanding Voltage       | JIS-C-5202 5.7                                                 | in V-Block for 60 Seconds                                           | by Type                                  |
| Temperature Coefficient of Resistance | JIS-C-5202 5.2                                                 | -55°C to +155°C                                                     | by Type                                  |
| Insulation Resistance                 | JIS-C-5202 5.6                                                 | in V-Block                                                          | >1000MΩ                                  |
| Solderability                         | JIS-C-5202 6.5                                                 | 235±5°C for 5±0.5 Seconds                                           | 95% Min.Coverage                         |
| Resistance to Solvent                 | JIS-C-5202 6.9                                                 | IPA for 1 Min. with Ultrasonic                                      | No Deterioration of Coatings and Markigs |
| Terminal Strength                     | Direct Load for 10 Sec. in the Direction of The Terminal Leads |                                                                     | ≥2.5kg(24.5N)                            |
| Pulse Overload                        | JIS-C-5202 5.8                                                 | 4 Times RCWV 10000 Cycles(1 Sec. on, 25 Sec. of)                    | ±(1%+0.05Ω)                              |
| Load Life in Humidity                 | JIS-C-5202 7.9                                                 | 40±2°C, 90~95% RH at RcWV for 1000 Hrs. (1.5 Hrs. on, 0.5 Hrs. off) | ±(3%+0.05Ω)                              |
| Load Life                             | JIS-C-5202 7.10                                                | 70°C at RCWV for 1000 Hrs.(1.5 Hrs. on, 0.5 Hrs. off)               | ±(3%+0.05Ω)                              |
| Temperature Cycling                   | JIS-C-5202 7.4                                                 | -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                     | ±(1%+0.05Ω)                              |
| Resistance to Soldering Heat          | JIS-C-5202 6.4                                                 | 350°C±10°C for 3±0.5 Seconds                                        | ±(1%+0.05Ω)                              |

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

## Melf Carbon Film Resistors

## MCP Type

## Power Type Miniature [ MCP Series ]



## FEATURES

Industry's Lowest Cost

Delivery From Stock in Taped and Reel, Bulk

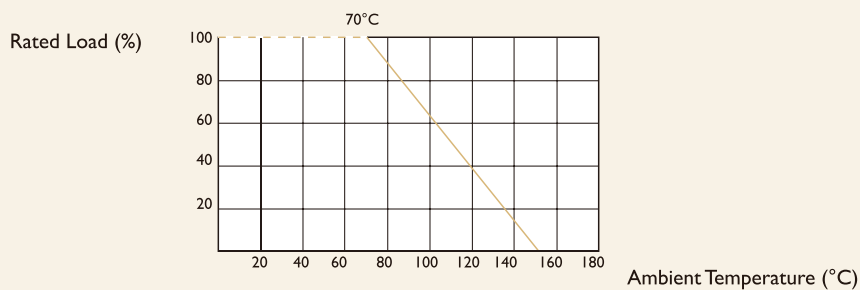
Exceptional Long-Term Stability

Exceeds Carbon Comp MIL-R-111 Performance

Power Rating: 1/8W, 1/4W, 1/2W, 1W

Resistance Tolerance:  $\pm 2\%$ ,  $\pm 5\%$ 

## DERATING CURVE

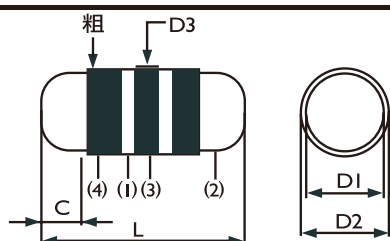


## TABLE I TEMPERATURE COEFFICIENT

| STYLE          | Max. Value of Temp. Coefficient ppm/°C |                            |                           |
|----------------|----------------------------------------|----------------------------|---------------------------|
|                | under 100K $\Omega$                    | 100K $\Omega$ ~1M $\Omega$ | 1M $\Omega$ ~10M $\Omega$ |
| MCP1SS, MCP2SS | +350                                   | -700                       | -1500                     |

## DIMENSIONS

Unit : mm



| STYLE     | DIMENSION     |                |        |     |
|-----------|---------------|----------------|--------|-----|
| Miniature | L             | D1             | D2 max | C   |
| MCP1SS    | 5.9 $\pm$ 0.2 | 2.2 $\pm$ 0.15 | 2.4    | 0.5 |
| MCP2SS    | 8.5 $\pm$ 0.2 | 3.2 $\pm$ 0.20 | 3.4    | 0.5 |



Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                    | MCP1SS          | MCP2SS |
|--------------------------|-----------------|--------|
| Power Rating at 70°C     | 1W              | 2W     |
| Maximum Working Voltage  | 350V            | 350V   |
| Maximum Overload Voltage | 700V            | 700V   |
| Open Temp. Range         | -55°C to +155°C |        |
| Standard Value Range     | 1Ω~10MΩ         |        |
| Temperature Coefficient  | See table I     |        |

\* Standard resistance is 1Ω~10MΩ, below or over this resistance on request

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST                      | TEST METHOD                                                    |                                                                     | APPRAISE                                 |
|---------------------------------------|----------------------------------------------------------------|---------------------------------------------------------------------|------------------------------------------|
| Short Time Overload                   | JIS-C-5202 5.5                                                 | 2.5Times RCWV for 5 Seconds                                         | ±(0.75%+0.05Ω)                           |
| Dielectric Withstanding Voltage       | JIS-C-5202 5.7                                                 | in V-Block for 60 Seconds                                           | by Type                                  |
| Temperature Coefficient of Resistance | JIS-C-5202 5.2                                                 | -55°C to +155°C                                                     | by Type                                  |
| Insulation Resistance                 | JIS-C-5202 5.6                                                 | in V-Block                                                          | >1000MΩ                                  |
| Solderability                         | JIS-C-5202 6.5                                                 | 235±5°C for 5±0.5 Seconds                                           | 95% Min.Coverage                         |
| Resistance to Solvent                 | JIS-C-5202 6.9                                                 | IPA for 1 Min. with Ultrasonic                                      | No Deterioration of Coatings and Markigs |
| Terminal Strength                     | Direct Load for 10 Sec. in the Direction of The Terminal Leads |                                                                     | ≥2.5kg(24.5N)                            |
| Pulse Overload                        | JIS-C-5202 5.8                                                 | 4 Times RCWV 10000 Cycles(1 Sec. on, 25 Sec. of)                    | ±(1%+0.05Ω)                              |
| Load Life in Humidity                 | JIS-C-5202 7.9                                                 | 40±2°C, 90~95% RH at RcWV for 1000 Hrs. (1.5 Hrs. on, 0.5 Hrs. off) | ±(3%+0.05Ω)                              |
| Load Life                             | JIS-C-5202 7.10                                                | 70°C at RCWV for 1000 Hrs.(1.5 Hrs. on, 0.5 Hrs. off)               | ±(3%+0.05Ω)                              |
| Temperature Cycling                   | JIS-C-5202 7.4                                                 | -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                     | ±(1%+0.05Ω)                              |
| Resistance to Soldering Heat          | JIS-C-5202 6.4                                                 | 350°C±10°C for 3±0.5 Seconds                                        | ±(1%+0.05Ω)                              |

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

## Zerohm Resistors

# ZOR Type

## Normal Style [ ZOR Series ]



### INTRODUCTION

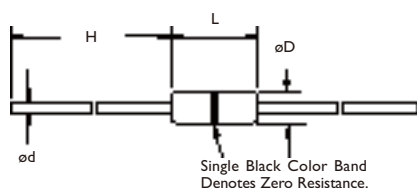
- Similar to a 1/4W resistor (1/6W size also available, typical resistance 0.004Ω)
- Ideal for automatic insertion or Cut and Form
- Available in Tape/Reel, Tape/Box and Bulk
- Film type Zerohm also available in 1/4W (ZOR-25) and 1/6W (ZOR-12) size

### SPECIFICATIONS

|                                      |                                                                                                       |
|--------------------------------------|-------------------------------------------------------------------------------------------------------|
| Maximum Resistance                   | 0.005Ω                                                                                                |
| Min. Insulation Resistance           |                                                                                                       |
| Dry                                  | 10,000MΩ                                                                                              |
| Wet                                  | 100MΩ                                                                                                 |
| Min. Dielectric Withstanding Voltage |                                                                                                       |
| Atmospheric                          | 500V RMS                                                                                              |
| Reduced                              | 325V RMS                                                                                              |
| Insulation Flammability              | Resistor Insulation is Self Extinguishing within 10 Seconds After Externally Applied Flame is Removed |
| Current Rating                       | 15 AMPS at 70°C for 1/4W<br>10 AMPS at 70°C for 1/6W                                                  |

### DIMENSIONS

Unit : mm



| STYLE  | L       | øD      | H      | ød       |
|--------|---------|---------|--------|----------|
| ZOR-12 | 3.3±0.3 | 1.8±0.3 | 28±2.0 | 0.5±0.05 |
| ZOR-25 | 6.3±0.5 | 2.3±0.3 | 28±2.0 | 0.6±0.05 |

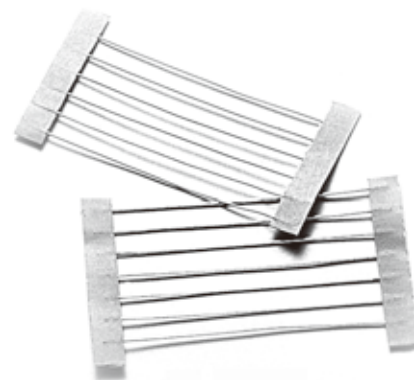
# JPW Type

## Normal Style [ JPW Series ]

## Jumper Wires Resistors

### SPECIFICATIONS

|                         |                                                |                  |          |
|-------------------------|------------------------------------------------|------------------|----------|
| Material of Jumper Wire | Soft Copper Wire with Tin Plating              |                  |          |
| Conductor Resistance    | 0.005Ω/cm                                      |                  |          |
| Wire Diameter           | ø0.5・ø0.6・ø0.7・ø0.8・ø1.0(±0.05mm)              |                  |          |
| Tension Strength        | CNS 8938 within 28kg/mm <sup>2</sup>           |                  |          |
| Extension Rate          | CNS 8938 ø0.5~ø0.6mm                           | over 24%         |          |
|                         | CNS 8938 ø0.7~ø1.0mm                           | over 26%         |          |
| Conductivity            | ø0.5mm                                         | Minmum 94%       |          |
|                         | ø0.6~ø1.0mm                                    | Minmum 96%       |          |
| Twisting Strength       | CNS 8938 ø0.5mm                                | Load 250 g       | 3 cycles |
|                         | CNS 8938 ø0.6~ø0.8mm                           | Load 500 g       | 3 cycles |
|                         | CNS 8938 ø1.0mm                                | Load 1.0 kg      | 3 cycles |
| Solderability           | JIS520 6-5 235°C±5°C , 5±0.5 sec. Coverage 95% |                  |          |
| Element of Plating      | JIS-H310I Tin Minimum 99%                      |                  |          |
| Thickness of Plating    | 3~5μ                                           |                  |          |
| 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                             |                  |          |



### INTRODUCTION

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

- Inability to connect two points on a P.C. 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 or available in all packaging styles including pre-cut and formed leads for manual insertion.

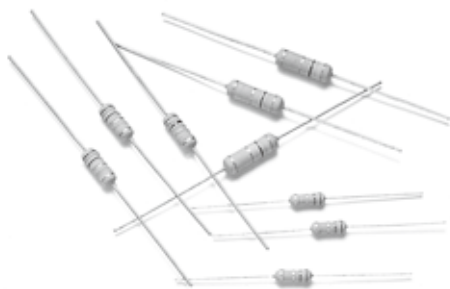
### DIMENSIONS

| STYLE  | ød       | L    |        |      | Unit : mm |  |
|--------|----------|------|--------|------|-----------|--|
| JPW-05 | 0.5±0.05 | 26±1 | 52.4±1 | —    |           |  |
| JPW-06 | 0.6±0.05 | 26±1 | 52.4±1 | 73±1 |           |  |
| JPW-07 | 0.7±0.05 | 26±1 | 52.4±1 | 73±1 |           |  |
| JPW-08 | 0.8±0.05 | 26±1 | 52.4±1 | 73±1 |           |  |
| JPW-10 | 1.0±0.05 | 26±1 | 52.4±1 | 73±1 |           |  |

## Wire Wound Resistors

# FLAME-PROOF Type

## Normal & Miniature Style [ KNP Series ]



### INTRODUCTION

- The resistor is fabricated using a suitable fiberglass or ceramic core with the resistance wire securely crimped to the terminals
- Small in size comparatively than other kind resistor
- Electrical and Mechanical stability and high reliability
- The KNP/NKN series are coated with layers of green color flame-proof lacquer. The resistors meet overload tests in accordance with UL specification #1412 without producing a fire hazard

### GENERAL PURPOSE

Power Rating : 1/4W, 1/2W, 1W, 2W, 3W, 5W, 7W

Resistance Tolerance :  $\pm 1\%$ ,  $\pm 5\%$

FlameProof Silicone Coating : UL94V-0

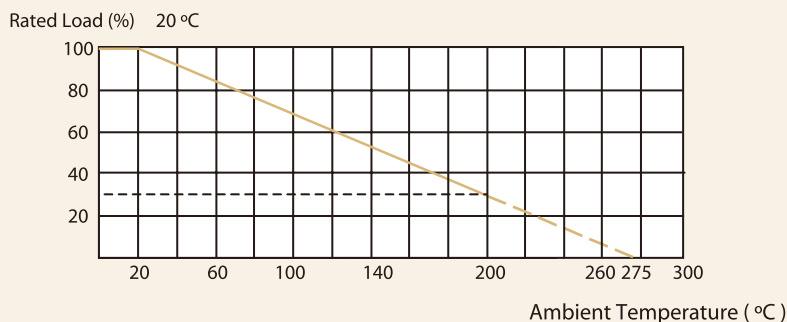
Green body color

Stable performance in diverse environments

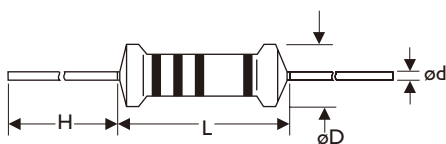
High safety standard

### POWER DERATING CURVE

For resistors operated in ambient temperatures above 20°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 | KNP50S    | 6.3±0.5   | 2.5±0.3 | 28±2.0 | 0.6±0.05 |
| KNP-50 | KNP1WS    | 9.0±0.5   | 3.3±0.3 | 26±2.0 | 0.6±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±1.0 | 32±2.0 | 0.8±0.05 |
| KNP500 | KNP7WS    | 24.5±1.0  | 8.5±1.0 | 39±2.0 | 0.8±0.05 |





Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                           | KNP-25          | KNP50S | KNP-50 | KNP1WS | KNP100 | KNP2WS    | KNP200 | KNP3WS    | KNP300 | KNP5WS    | KNP500 | KNP7WS   |
|---------------------------------|-----------------|--------|--------|--------|--------|-----------|--------|-----------|--------|-----------|--------|----------|
| Power Rating                    | 1/4W            | 1/2W   |        | 1W     |        | 2W        |        | 3W        |        | 5W        |        | 7W       |
| Operating Temp. Range           | -55°C TO +155°C |        |        |        |        |           |        |           |        |           |        |          |
| Dielectric Withstanding Voltage | 300V            | 300V   | 300V   | 300V   | 400V   | 400V      | 400V   | 400V      | 400V   | 400V      | 400V   | 400V     |
| Value Range ±5%                 | 0.1Ω-47Ω        |        |        |        |        | 0.1Ω-100Ω |        | 0.1Ω-300Ω |        | 0.1Ω-560Ω |        | 0.1Ω-1KΩ |
| Temperature Coefficient         | ±400ppm/°C      |        |        |        |        |           |        |           |        |           |        |          |

\* Resistance range for standard resistance, below or over this resistance on request.

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST             | TEST METHOD     |                                                                                           | APPRAISE                                  |
|------------------------------|-----------------|-------------------------------------------------------------------------------------------|-------------------------------------------|
| Terminal Strength            | JIS-C-5202 6.1  | Direct load for 10 Sec. in the Direction of the Terminal Leads                            | $\geq 2.5$ kg (24.5N)                     |
| Resistance to Soldering Heat | JIS-C-5202 6.4  | 350°C $\pm$ 10°C for 3 $\pm$ 0.5 Seconds                                                  | $\pm 1.0\% + 0.05\Omega$                  |
| Solderability                | JIS-C-5202 6.5  | 235°C $\pm$ 5°C for 5 $\pm$ 0.5 Seconds                                                   | 95% Min. Coverage                         |
| Resistance to Solvent        | JIS-C-5202 6.9  | IPA for 1 Min. with Ultrasonic                                                            | No Deterioration of Coatings and Markings |
| Temperature Cycling          | JIS-C-5202 7.4  | -55°C $\rightarrow$ Room Temp. $\rightarrow$ +155°C $\rightarrow$ Room Temp. for 5 Cycles | $\pm 1.0\% + 0.05\Omega$                  |
| Humidity                     | JIS-C-5202 7.5  | 40 $\pm$ 2°C, 90~95% RH for 1,000 Hrs.                                                    | $\pm 3.0\% + 0.05\Omega$                  |
| Load Life in Humidity        | JIS-C-5202 7.9  | 40 $\pm$ 2°C, 90~95% RH at RCWV for 1,000 Hrs. (1.5 Hrs. on, 0.5 Hrs. off)                | $\pm 5.0\% + 0.05\Omega$                  |
| Load Life                    | JIS-C-5202 7.10 | 70°C at RCWV for 1,000 Hrs. (1.5 Hrs. on, 0.5 Hrs. off)                                   | $\pm 5.0\% + 0.05\Omega$                  |
| Overload Flame Retardant     | JIS-C-5202 7.12 | 4 Times RCWV for 1 minute                                                                 | No evidence of flaming or arcing          |

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

## Wire Wound Resistors

# NON INDUCTIVE Type

## Normal & Miniature Style [NKN Series]



### GENERAL PURPOSE

Power Rating : 1/2W, 1WS, 1W, 2WS, 2W, 3WS, 3W, 5WS, 5W, 7WS

Resistance Tolerance :  $\pm 5\%$

FlameProof Silicone Coating : UL94V-0

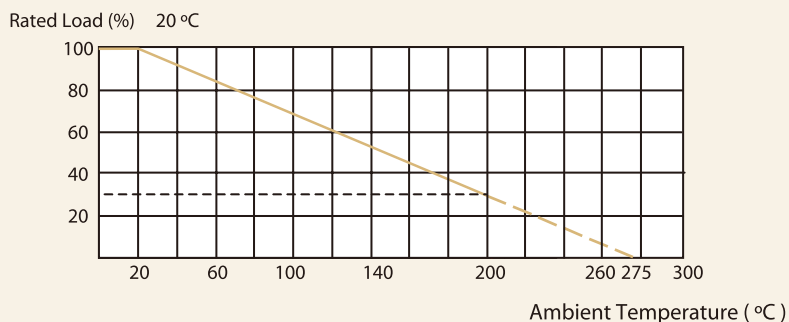
Green body color

The 5th color band is black to represent non-inductive resistors

High safety standard

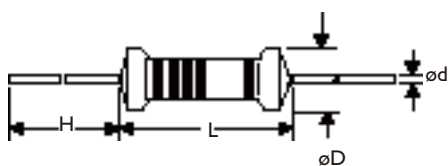
### POWER DERATING CURVE

For resistors operated in ambient temperatures above 20°C, power rating must be derated in accordance with the curve below.



### DIMENSIONS

Unit : mm



| STYLE  |           | DIMENSION |         |        |          |
|--------|-----------|-----------|---------|--------|----------|
| Normal | Miniature | L         | øD      | H      | ød       |
| NKN-50 | NKN1WS    | 9.0±0.5   | 3.3±0.3 | 26±2.0 | 0.6±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 | NKN5WS    | 17.5±1.0  | 6.5±1.0 | 32±2.0 | 0.8±0.05 |
| NKN500 | NKN7WS    | 24.5±1.0  | 8.5±1.0 | 39±2.0 | 0.8±0.05 |



Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                           | NKN-50          | NKN1WS | NKN100   | NKN2WS | NKN200   | NKN3WS | NKN300   | NKN5WS | NKN500   | NKN7WS   |
|---------------------------------|-----------------|--------|----------|--------|----------|--------|----------|--------|----------|----------|
| Power Rating AT 70°C            | 1/2W            | 1W     |          | 2W     |          | 3W     |          | 5W     |          | 7W       |
| Standard Value Range ±5%        | 0.1Ω-5Ω         |        | 0.1Ω-10Ω |        | 0.1Ω-22Ω |        | 0.1Ω-27Ω |        | 0.1Ω-33Ω | 0.1Ω-27Ω |
| Dielectric Withstanding Voltage | 250V            |        |          |        |          |        |          |        |          |          |
| Minimum Value Range ±5%         | 0.05Ω           |        |          |        |          |        |          |        |          |          |
| Operating Temp. Range           | -40°C to +200°C |        |          |        |          |        |          |        |          |          |
| Temperature Coefficient         | ±300ppm/°C      |        |          |        |          |        |          |        |          |          |

\* Resistance range for standard resistance, below or over this resistance on request.

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST             | TEST METHOD     |                                                                           | APPRAISE                                  |
|------------------------------|-----------------|---------------------------------------------------------------------------|-------------------------------------------|
| Terminal Strength            | JIS-C-5202 6.1  | Direct load for 10 Sec. in the Direction of the Terminal Leads            | ≥2.5kg (24.5N)                            |
| Resistance to Soldering Heat | JIS-C-5202 6.4  | 350°C ± 10°C for 3 ± 0.5 Seconds                                          | ±1.0%+0.05Ω                               |
| Solderability                | JIS-C-5202 6.5  | 235°C ± 5°C for 5 ± 0.5 Seconds                                           | 95% Min. Coverage                         |
| Resistance to Solvent        | JIS-C-5202 6.9  | IPA for 1 Min. with Ultrasonic                                            | No Deterioration of Coatings and Markings |
| Temperature Cycling          | JIS-C-5202 7.4  | -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                           | ±1.0%+0.05Ω                               |
| Humidity                     | JIS-C-5202 7.5  | 40±2°C, 90~95% RH for 1,000 Hrs.                                          | ±3.0%+0.05Ω                               |
| Load Life in Humidity        | JIS-C-5202 7.9  | 40±2°C, 90~95% RH at RCWV for 1,000 Hrs.<br>(1.5 Hrs. on , 0.5 Hrs. off ) | ±5.0%+0.05Ω                               |
| Load Life                    | JIS-C-5202 7.10 | 70°C at RCWV for 1,000 Hrs. (1.5 Hrs. on, 0.5 Hrs. off )                  | ±5.0%+0.05Ω                               |
| Overload Flame Retardant     | JIS-C-5202 7.12 | 4 Times RCWV for 1 minute                                                 | No evidence of flaming or arcing          |

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

## Cement Resistors

# AXIAL LEAD Type

Standard Style [ SQP Series ]

Non-Inductive Style [ NSP Series ]



## INTRODUCTION

- The materials used and the construction techniques ensure excellent flame resistance, arc resistance and moisture resistances as well as self-extinguishing capabilities. They will withstand the most rigorous loading test
- As resistors in radio and television receivers, the hazardous conditions of smoking and redheat can be completely prevented by the proper choice of power resistors

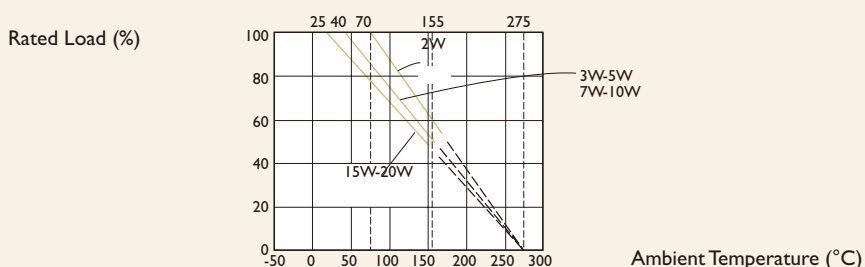
## FEATURES

Exceptionally Small and Sturdy; Mechanically Safe. Excellent Electrical Characteristics

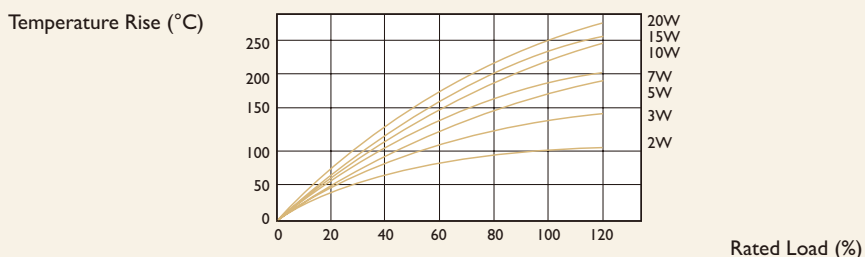
Resistance Tolerance:  $\pm 5\%$

Applicable Specifications: EIA RS-344 and EIA RC-649

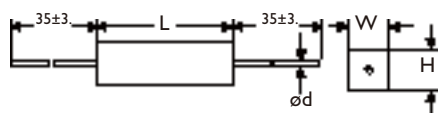
## DERATING CURVE



## TEMPERATURE RISE



## DIMENSIONS



Unit : mm

| STYLE  |          | DIMENSION |          |          |          |
|--------|----------|-----------|----------|----------|----------|
| STD    | Non-Ind. | L         | W        | H        | ød       |
| SQP200 | NSP200   | 18±1.0    | 6.5±1.0  | 6.5±1.0  | 0.8±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±1.5 | 12.5±1.5 | 1.0±0.05 |
| SQP20A | NSP20A   | 60±2.0    | 12.5±1.5 | 12.5±1.5 | 1.0±0.05 |



Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                              | SQP200          | SQP300    | SQP500    | SQP700    | SQP10A    | SQP15A | SQP20A |
|------------------------------------|-----------------|-----------|-----------|-----------|-----------|--------|--------|
| Power Rating                       | 2W              | 3W        | 5W        | 7W        | 10W       | 15W    | 20W    |
| Operating Temp. Range              | -55°C to +155°C |           |           |           |           |        |        |
| Maximum Working Voltage            | 250V            | 350V      | 350V      | 500V      | 500V      | 500V   | 500V   |
| Maximum Overload Voltage           | 500V            | 700V      | 700V      | 1000V     | 1000V     | 1000V  | 1000V  |
| Dielectric Withstanding Voltage    | 500V            | 700V      | 700V      | 1000V     | 1000V     | 1000V  | 1000V  |
| Value Range ±5% (Wirewound)        | 0.15Ω~100Ω      | 0.3Ω~120Ω | 0.3Ω~180Ω | 0.5Ω~220Ω | 1Ω~270Ω   |        |        |
| Value Range ±5% (Metal Oxide Film) | 110Ω~10KΩ       | 130Ω~22KΩ | 200Ω~33KΩ | 240Ω~10KΩ | 300Ω~10KΩ |        |        |
| Temperature Coefficient            | ±300ppm/°C      |           |           |           |           |        |        |

\* 1. Standard resistance is as the above list, below or over this resistance on request.

\* 2. Non-Inductive type up to 50 $\Omega$  only.

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST                      | TEST METHOD                                                    |                                                                              | APPRAISE                                  |
|---------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload                   | JIS-C-5202 5.5                                                 | 2.5 Times RCWV for 5 Seconds                                                 | $\pm (2\%+0.05\Omega)$                    |
| Dielectric Withstanding Voltage       | JIS-C-5202 5.7                                                 | in V-Block for 60 Seconds                                                    | by Type                                   |
| Temperature Coefficient of Resistance | JIS-C-5202 5.2                                                 | -55°C to +155°C                                                              | $\pm 300$ ppm/°C                          |
| Insulation Resistance                 | JIS-C-5202 5.6                                                 | in V-Block                                                                   | >100M $\Omega$                            |
| Solderability                         | JIS-C-5202 6.5                                                 | 235 $\pm 5$ °C for 5 $\pm 0.5$ Seconds                                       | 95% Min. Coverage                         |
| Resistance to Solvent                 | JIS-C-5202 6.9                                                 | IPA for 1 Min. with Ultrasonic                                               | No Deterioration of Coatings and Markings |
| Terminal Strength                     | Direct Load for 10 Sec. in The Direction of The Terminal Leads |                                                                              | $\geq 2.5$ kg (24.5N)                     |
| Pulse Overload                        | JIS-C-5202 5.8                                                 | 4 Times RCWV 10000 Cycles (1 Sec. on , 25 Sec. off)                          | $\pm (2\%+0.05\Omega)$                    |
| Load Life in Humidity                 | JIS-C-5202 7.9                                                 | 40 $\pm 2$ °C, 90~95% RH at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off ) | $\pm (5\%+0.05\Omega)$                    |
| Load Life                             | JIS-C-5202 7.10                                                | 70°C at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off)                      | $\pm (5\%+0.05\Omega)$                    |
| Temperature Cycling                   | JIS-C-5202 7.4                                                 | -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                              | $\pm (2\%+0.05\Omega)$                    |
| Resistance to Soldering Heat          | JIS-C-5202 6.4                                                 | 350°C $\pm 10$ °C for 3 $\pm 0.5$ Seconds                                    | $\pm (1\%+0.05\Omega)$                    |

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

## Cement Resistors

## VERTICAL LEAD Type

Standard Style [SQM Series]

Non-Inductive Style [NSM Series]



## INTRODUCTION

- The materials used and the construction techniques ensure excellent flame resistance, arc resistance and moisture resistances as well as self-extinguishing capabilities. They will withstand the most rigorous loading test
- As resistors in radio and television receivers, the hazardous conditions of smoking and redheat can be completely prevented by the proper choice of power resistors

## FEATURES

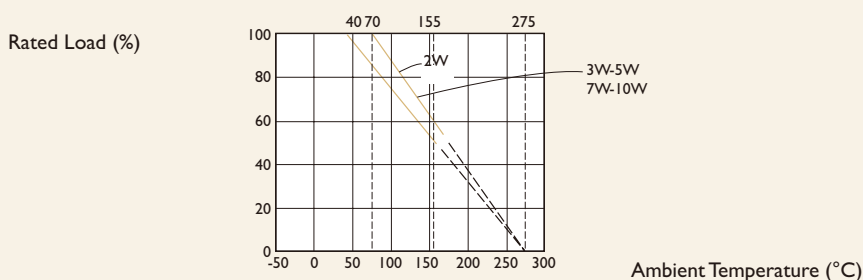
Space Saving Stand-Off Type

Small Size, High Power Capacity

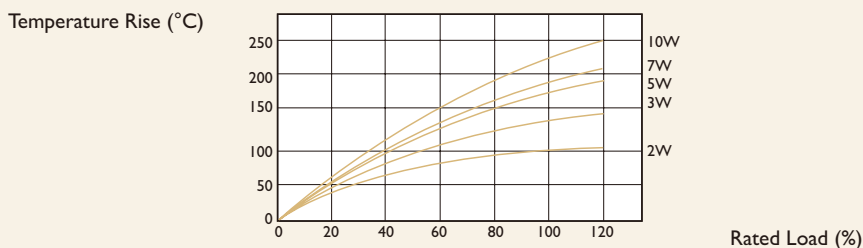
Resistance Tolerance:  $\pm 5\%$ 

Completely Unflamable

## DERATING CURVE

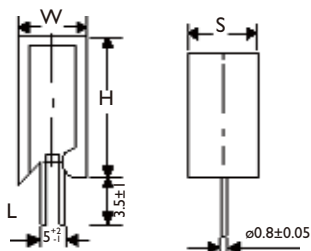


## TEMPERATURE RISE



Unit : mm

## DIMENSIONS



| STYLE  |          | DIMENSION    |                |                |
|--------|----------|--------------|----------------|----------------|
| STD    | Non-Ind. | H            | W              | S              |
| SQM200 | NSM200   | 20 $\pm$ 1.5 | 11.0 $\pm$ 1.0 | 7.0 $\pm$ 1.0  |
| SQM300 | NSM300   | 25 $\pm$ 1.5 | 12.0 $\pm$ 1.0 | 8.0 $\pm$ 1.0  |
| SQM500 | NSM500   | 25 $\pm$ 1.5 | 13.0 $\pm$ 1.0 | 9.0 $\pm$ 1.0  |
| SQM700 | NSM700   | 39 $\pm$ 1.5 | 13.0 $\pm$ 1.0 | 9.0 $\pm$ 1.0  |
| SQM10A | NSM10A   | 51 $\pm$ 1.5 | 13.0 $\pm$ 1.0 | 9.0 $\pm$ 1.0  |
| SQM10S | NSM10S   | 35 $\pm$ 1.5 | 16.0 $\pm$ 1.0 | 12.0 $\pm$ 1.0 |



Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                                    | SQM200                      | SQM300                      | SQM500                     | SQM700                      | SQM10A                     | SQM10S |
|------------------------------------------|-----------------------------|-----------------------------|----------------------------|-----------------------------|----------------------------|--------|
| Power Rating                             | 2W                          | 3W                          | 5W                         | 7W                          | 10W                        |        |
| Operating Temp. Range                    | -55°C to +155°C             |                             |                            |                             |                            |        |
| Maximum Working Voltage                  | 250V                        | 350V                        | 350V                       | 500V                        | 500V                       | 500V   |
| Maximum Overload Voltage                 | 500V                        | 700V                        | 700V                       | 1000V                       | 1000V                      | 1000V  |
| Dielectric Withstanding Voltage          | 500V                        | 700V                        | 700V                       | 1000V                       | 1000V                      | 1000V  |
| Value Range $\pm 5\%$ (Ceramic Core)     | 0.15 $\Omega$ ~100 $\Omega$ | 0.24 $\Omega$ ~120 $\Omega$ | 0.3 $\Omega$ ~180 $\Omega$ | 0.51 $\Omega$ ~220 $\Omega$ | 1 $\Omega$ ~270 $\Omega$   |        |
| Value Range $\pm 5\%$ (Metal Oxide Film) | 110 $\Omega$ ~10K $\Omega$  | 130 $\Omega$ ~22K $\Omega$  | 200 $\Omega$ ~33K $\Omega$ | 240 $\Omega$ ~10K $\Omega$  | 300 $\Omega$ ~10K $\Omega$ |        |
| Temperature Coefficient                  | $\pm 300$ ppm/°C            |                             |                            |                             |                            |        |

\* 1. Standard resistance is as the above list, below or over this resistance on request.

\* 2. Non-Inductive type up to 50 $\Omega$  only.

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST                      | TEST METHOD                                                    |                                                                              | APPRAISE                                  |
|---------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload                   | JIS-C-5202 5.5                                                 | 2.5 Times RCWV for 5 Seconds                                                 | $\pm (2\% + 0.05\Omega)$                  |
| Dielectric Withstanding Voltage       | JIS-C-5202 5.7                                                 | in V-Block for 60 Seconds                                                    | by Type                                   |
| Temperature Coefficient of Resistance | JIS-C-5202 5.2                                                 | -55°C to +155°C                                                              | $\pm 300$ ppm/°C                          |
| Insulation Resistance                 | JIS-C-5202 5.6                                                 | in V-Block                                                                   | >100M $\Omega$                            |
| Solderability                         | JIS-C-5202 6.5                                                 | 235 $\pm 5$ °C for 5 $\pm 0.5$ Seconds                                       | 95% Min. Coverage                         |
| Resistance to Solvent                 | JIS-C-5202 6.9                                                 | IPA for 1 Min. with Ultrasonic                                               | No Deterioration of Coatings and Markings |
| Terminal Strength                     | Direct Load for 10 Sec. in The Direction of The Terminal Leads |                                                                              | $\geq 2.5$ kg (24.5N)                     |
| Pulse Overload                        | JIS-C-5202 5.8                                                 | 4 Times RCWV 10000 Cycles (1 Sec. on , 25 Sec. off)                          | $\pm (2\% + 0.05\Omega)$                  |
| Load Life in Humidity                 | JIS-C-5202 7.9                                                 | 40 $\pm 2$ °C, 90~95% RH at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off ) | $\pm (5\% + 0.05\Omega)$                  |
| Load Life                             | JIS-C-5202 7.10                                                | 70°C at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off)                      | $\pm (5\% + 0.05\Omega)$                  |
| Temperature Cycling                   | JIS-C-5202 7.4                                                 | -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                              | $\pm (2\% + 0.05\Omega)$                  |
| Resistance to Soldering Heat          | JIS-C-5202 6.4                                                 | 350°C $\pm 10$ °C for 3 $\pm 0.5$ Seconds                                    | $\pm (1\% + 0.05\Omega)$                  |

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

## Cement Resistors

RADIAL TERMINALS  
Type

Standard Style[ SQZ Series ]

Non-Inductive Style[ NSZ Series ]



## INTRODUCTION

- The materials used and the construction techniques ensure excellent flame resistance arc resistance and moisture resistances as well as self-extinguishing capabilities. They will withstand the most rigorous loading test
- As resistors in radio and television receivers, the hazardous conditions of smoking and redheat can be completely prevented by the proper choice of power resistors

## FEATURES

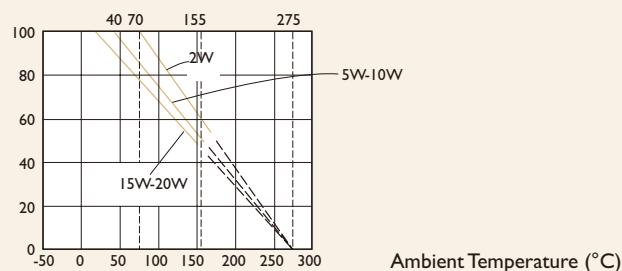
Space Saving Stand-Off Type

Resistance Tolerance:  $\pm 5\%$ 

Completely Unflamable

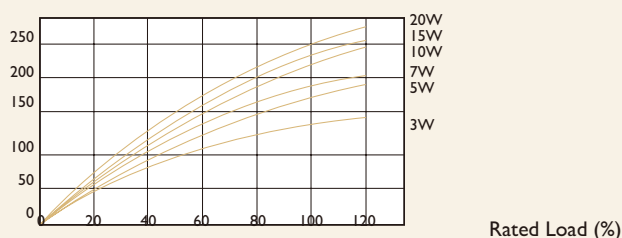
## DERATING CURVE

Rated Load (%)

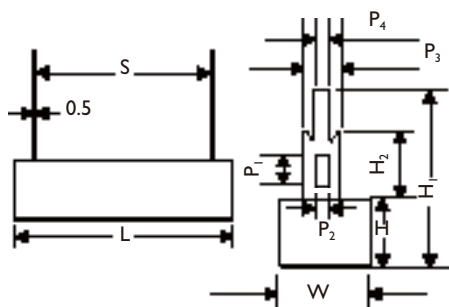


## TEMPERATURE RISE

Temperature Rise (°C)



## DIMENSIONS



| STYLE  |          | DIMENSION |        |        |        |                |                |                |                |                |                |
|--------|----------|-----------|--------|--------|--------|----------------|----------------|----------------|----------------|----------------|----------------|
| STD    | 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  | 12.5±1 | 24.0±1         | 9.5±1.0        | 4.0±0.2        | 2.0±0.2        | 5.0±0.2        | 1.4±0.1        |
| 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        |

Unit : mm





Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                                    | SQZ300                      | SQZ500                      | SQZ700                      | SQZ10A                     | SQZ15A | SQZ20A |
|------------------------------------------|-----------------------------|-----------------------------|-----------------------------|----------------------------|--------|--------|
| Power Rating                             | 3W                          | 5W                          | 7W                          | 10W                        | 15W    | 20W    |
| Operating Temp. Range                    | -55°C to +155°C             |                             |                             |                            |        |        |
| Maximum Working Voltage                  | 250V                        | 350V                        | 500V                        | 500V                       | 500V   | 500V   |
| Maximum Overload Voltage                 | 500V                        | 700V                        | 1000V                       | 1000V                      | 1000V  | 1000V  |
| Dielectric Withstanding Voltage          | 500V                        | 700V                        | 1000V                       | 1000V                      | 1000V  | 1000V  |
| Value Range $\pm 5\%$ (Ceramic Core)     | 0.22 $\Omega$ ~120 $\Omega$ | 0.47 $\Omega$ ~180 $\Omega$ | 0.68 $\Omega$ ~220 $\Omega$ | 1 $\Omega$ ~270 $\Omega$   |        |        |
| Value Range $\pm 5\%$ (Metal Oxide Film) | 130 $\Omega$ ~22K $\Omega$  | 200 $\Omega$ ~33K $\Omega$  | 240 $\Omega$ ~10K $\Omega$  | 300 $\Omega$ ~10K $\Omega$ |        |        |
| Temperature Coefficient                  | $\pm 300$ ppm/°C            |                             |                             |                            |        |        |

\* 1. Standard resistance is as the above list, below or over this resistance on request.

\* 2. Non-Inductive type up to 50 $\Omega$  only.

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST                      | TEST METHOD                                                    |                                                                              | APPRAISE                                  |
|---------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload                   | JIS-C-5202 5.5                                                 | 2.5 Times RCWV for 5 Seconds                                                 | $\pm (2\%+0.05\Omega)$                    |
| Dielectric Withstanding Voltage       | JIS-C-5202 5.7                                                 | in V-Block for 60 Seconds                                                    | by Type                                   |
| Temperature Coefficient of Resistance | JIS-C-5202 5.2                                                 | -55°C to +155°C                                                              | $\pm 300$ ppm/°C                          |
| Insulation Resistance                 | JIS-C-5202 5.6                                                 | in V-Block                                                                   | >100M $\Omega$                            |
| Solderability                         | JIS-C-5202 6.5                                                 | 235 $\pm 5$ °C for 5 $\pm 0.5$ Seconds                                       | 95% Min. Coverage                         |
| Resistance to Solvent                 | JIS-C-5202 6.9                                                 | IPA for 1 Min. with Ultrasonic                                               | No Deterioration of Coatings and Markings |
| Terminal Strength                     | Direct Load for 10 Sec. in The Direction of The Terminal Leads |                                                                              | $\geq 2.5$ kg (24.5N)                     |
| Pulse Overload                        | JIS-C-5202 5.8                                                 | 4 Times RCWV 10000 Cycles (1 Sec. on , 25 Sec. off)                          | $\pm (2\%+0.05\Omega)$                    |
| Load Life in Humidity                 | JIS-C-5202 7.9                                                 | 40 $\pm 2$ °C, 90~95% RH at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off ) | $\pm (5\%+0.05\Omega)$                    |
| Load Life                             | JIS-C-5202 7.10                                                | 70°C at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off)                      | $\pm (5\%+0.05\Omega)$                    |
| Temperature Cycling                   | JIS-C-5202 7.4                                                 | -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                              | $\pm (2\%+0.05\Omega)$                    |
| Resistance to Soldering Heat          | JIS-C-5202 6.4                                                 | 350°C $\pm 10$ °C for 3 $\pm 0.5$ Seconds                                    | $\pm (1\%+0.05\Omega)$                    |

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

## Cement Resistors

CLAMP MOUNTING  
Type

Standard Style [ SQH Series ]

Non-Inductive Style [ NSH Series ]



## FEATURES

Low Cost

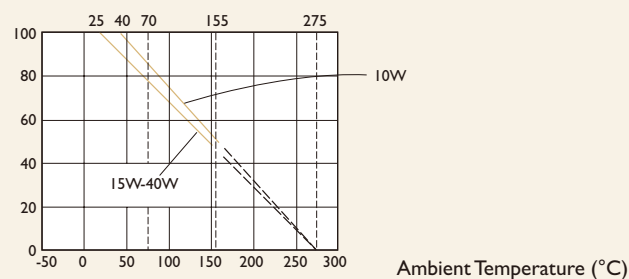
Small Size, High Power Capacity

Resistance Tolerance:  $\pm 5\%$ ,  $\pm 10\%$ 

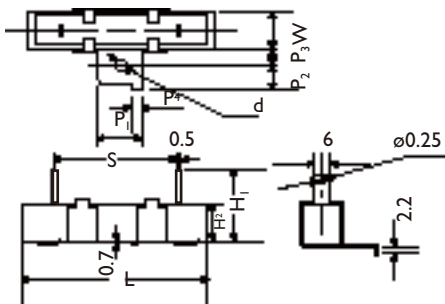
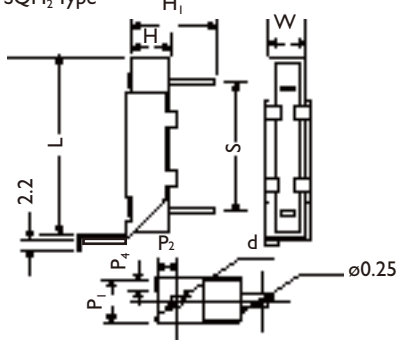
Completely Unflamable

## DERATING CURVE

Rated Load (%)

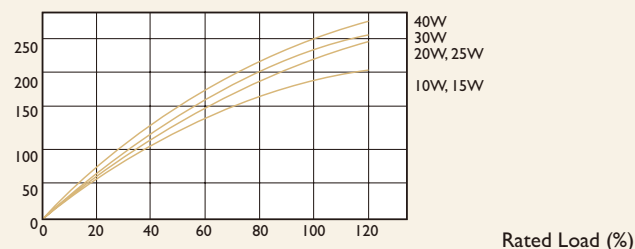


## DIMENSIONS

SQH<sub>1</sub> TypeSQH<sub>2</sub> Type

## TEMPERATURE RISE

Temperature Rise (°C)



| Unit : mm |          |           |          |        |        |                |                |                |                |                |                |
|-----------|----------|-----------|----------|--------|--------|----------------|----------------|----------------|----------------|----------------|----------------|
| STYLE     |          | DIMENSION |          |        |        |                |                |                |                |                |                |
| STD       | 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> |
| SQH10A    | NSH10A   | 48.0±1.5  | 10.5±1.0 | 10.5±1 | 33.0±2 | 19.5±1.0       | 4.0            | 11.0±0.2       | 6.0            | 8.0            | 3.0            |
| SQH15A    | NSH15A   | 48.0±1.5  | 12.5±1.0 | 12.0±1 | 33.0±2 | 20.5±1.0       | 4.0            | 11.0±0.2       | 6.0            | 8.0            | 3.0            |
| SQH20A    | NSH20A   | 63.5±2.0  | 12.5±1.0 | 12.5±1 | 48.0±2 | 20.5±1.0       | 4.0            | 11.0±0.2       | 6.0            | 8.0            | 3.0            |
| SQH25A    | NSH25A   | 63.5±2.0  | 16.0±1.0 | 16.0±1 | 46.0±2 | 28.0±1.5       | 4.2            | 11.0±0.2       | 6.0            | 10.0           | 3.0            |
| SQH30A    | NSH30A   | 75.0±2.0  | 19.0±1.5 | 18.0±1 | 56.0±2 | 28.0±1.5       | 4.2            | 18.0±0.2       | 8.0            | 10.0           | 3.0            |
| SQH40A    | NSH40A   | 90.0±2.5  | 19.0±1.5 | 18.0±1 | 71.0±2 | 28.0±1.5       | 4.2            | 18.0±0.2       | 8.0            | 10.0           | 3.0            |



Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                                    | SQH10A                      | SQH15A                      | SQH20A                      | SQH25A                     | SQH30A                     | SQH40A                     |
|------------------------------------------|-----------------------------|-----------------------------|-----------------------------|----------------------------|----------------------------|----------------------------|
| Power Rating                             | 10W                         | 15W                         | 20W                         | 25W                        | 30W                        | 40W                        |
| Operating Temp. Range                    | -55°C to +155°C             |                             |                             |                            |                            |                            |
| Maximum Working Voltage                  | 250V                        | 350V                        | 500V                        | 500V                       | 500V                       | 500V                       |
| Maximum Overload Voltage                 | 500V                        | 700V                        | 1000V                       | 1000V                      | 1000V                      | 1000V                      |
| Dielectric Withstanding Voltage          | 1000V                       | 1000V                       | 1000V                       | 1000V                      | 1000V                      | 1000V                      |
| Value Range $\pm 5\%$ (Ceramic Core)     | 0.39 $\Omega$ ~270 $\Omega$ | 0.39 $\Omega$ ~300 $\Omega$ | 0.51 $\Omega$ ~300 $\Omega$ | 0.51 $\Omega$ ~1K $\Omega$ | 0.62 $\Omega$ ~1K $\Omega$ | 0.62 $\Omega$ ~1K $\Omega$ |
| Value Range $\pm 5\%$ (Metal Oxide Film) | 300 $\Omega$ ~10K $\Omega$  | 330 $\Omega$ ~10K $\Omega$  |                             |                            |                            |                            |
| Temperature Coefficient                  | $\pm 300$ ppm/°C            |                             |                             |                            |                            |                            |

\* 1. Standard resistance is as the above list, below or over this resistance on request.

\* 2. Non-Inductive type up to 50 $\Omega$  only.

## ENVIRONMENTAL CHARACTERISTICS

| PERFORMANCE TEST                      | TEST METHOD                                                    |                                                                              | APPRAISE                                  |
|---------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload                   | JIS-C-5202 5.5                                                 | 2.5 Times RCWV for 5 Seconds                                                 | $\pm (2\%+0.05\Omega)$                    |
| Dielectric Withstanding Voltage       | JIS-C-5202 5.7                                                 | in V-Block for 60 Seconds                                                    | by Type                                   |
| Temperature Coefficient of Resistance | JIS-C-5202 5.2                                                 | -55°C to +155°C                                                              | $\pm 300$ ppm/°C                          |
| Insulation Resistance                 | JIS-C-5202 5.6                                                 | in V-Block                                                                   | >100M $\Omega$                            |
| Solderability                         | JIS-C-5202 6.5                                                 | 235 $\pm 5$ °C for 5 $\pm 0.5$ Seconds                                       | 95% Min. Coverage                         |
| Resistance to Solvent                 | JIS-C-5202 6.9                                                 | IPA for 1 Min. with Ultrasonic                                               | No Deterioration of Coatings and Markings |
| Terminal Strength                     | Direct Load for 10 Sec. in The Direction of The Terminal Leads |                                                                              | $\geq 2.5$ kg (24.5N)                     |
| Pulse Overload                        | JIS-C-5202 5.8                                                 | 4 Times RCWV 10000 Cycles (1 Sec. on , 25 Sec. off)                          | $\pm (2\%+0.05\Omega)$                    |
| Load Life in Humidity                 | JIS-C-5202 7.9                                                 | 40 $\pm 2$ °C, 90~95% RH at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off ) | $\pm (5\%+0.05\Omega)$                    |
| Load Life                             | JIS-C-5202 7.10                                                | 70°C at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off)                      | $\pm (5\%+0.05\Omega)$                    |
| Temperature Cycling                   | JIS-C-5202 7.4                                                 | -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                              | $\pm (2\%+0.05\Omega)$                    |
| Resistance to Soldering Heat          | JIS-C-5202 6.4                                                 | 350°C $\pm 10$ °C for 3 $\pm 0.5$ Seconds                                    | $\pm (1\%+0.05\Omega)$                    |

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

## High Voltage Resistors

# HVR Type

## High Voltage Style [ HVR Series ]



### INTRODUCTION

The HVR Series High Voltage Resistors are manufactured using vacuum sputtering system to deposit multiple layers of Metal Glaze and passivative materials onto a carefully treated high grade ceramic substrate, the resistors are coated with layers of grey lacquer.

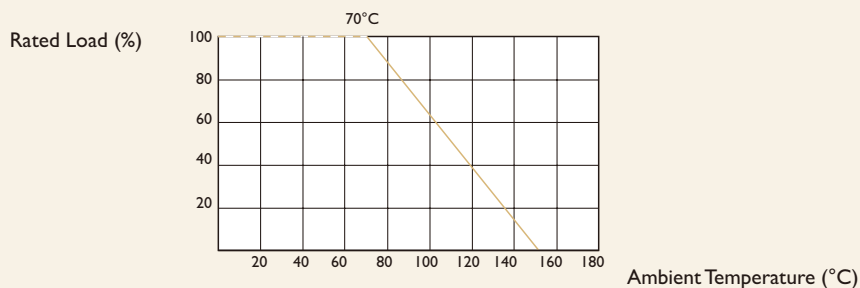
### FEATURES

Power Rating : 1/6W, 1/4W, 1/2W, 1W, 2W

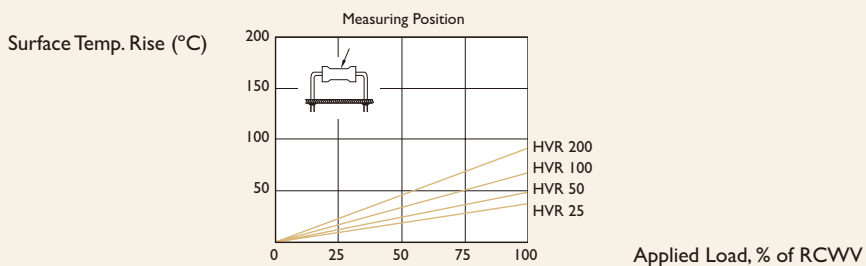
Resistance Tolerance :  $\pm 5\%$

T.C.R:  $\pm 200\text{ppm}/^{\circ}\text{C}$

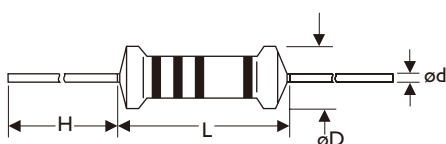
### DERATING CURVE



### HOT-SPOT TEMPERATURE



### DIMENSIONS



Unit : mm

| STYLE  | DIMENSION      |               |              |                |
|--------|----------------|---------------|--------------|----------------|
|        | L              | $\phi D$      | H            | $\phi d$       |
| HVR-25 | $6.3 \pm 0.5$  | $2.4 \pm 0.3$ | $28 \pm 2.0$ | $0.6 \pm 0.05$ |
| HVR-50 | $9.0 \pm 0.5$  | $3.3 \pm 0.3$ | $26 \pm 2.0$ | $0.6 \pm 0.05$ |
| HVR100 | $11.5 \pm 1.0$ | $4.5 \pm 0.5$ | $35 \pm 2.0$ | $0.8 \pm 0.05$ |
| HVR200 | $15.5 \pm 1.0$ | $5.0 \pm 0.5$ | $33 \pm 2.0$ | $0.8 \pm 0.05$ |



Note :

## ELECTRICAL CHARACTERISTICS

| STYLE                           | HVR-25                         | HVR-50 | HVR100 | HVR200 |
|---------------------------------|--------------------------------|--------|--------|--------|
| Power Rating at 70°C            | 1/4W                           | 1/2W   | 1W     | 2W     |
| Maximum Working Voltage         | 1600V                          | 2000V  | 2500V  | 2500V  |
| Maximum Overload Voltage        | 2000V                          | 2500V  | 3000V  | 3000V  |
| Dielectric Withstanding Voltage | 700V                           | 700V   | 700V   | 700V   |
| Open Temp. Range                | -55°C to +155°C                |        |        |        |
| Tolerance Range                 | ±1%, ±5%                       |        |        |        |
| Standard Value Range            | 100K~10MΩ for E24 series value |        |        |        |
| Temperature Coefficient         | ±200 pmm /°C                   |        |        |        |

Resistance range for standard resistance, below or over this resistance on request

## ENVIRONMENTAL CHARACTERISTICS

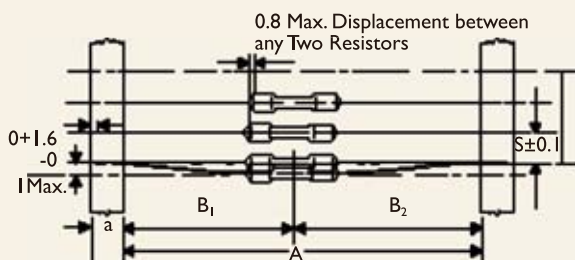
| PERFORMANCE TEST                      | TEST METHOD                                                    |                                                                       | APPRAISE                                  |
|---------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------|-------------------------------------------|
| Short Time Overload                   | JIS-C-5202 5.5                                                 | 2.5 Times RCWV for 5 Seconds                                          | ±(2%+0.05Ω)                               |
| Dielectric Withstanding Voltage       | JIS-C-5202 5.7                                                 | in V-Block for 60 Seconds                                             | by Type                                   |
| Temperature Coefficient of Resistance | JIS-C-5202 5.2                                                 | -55°C to +155°C                                                       | by Type                                   |
| Insulation Resistance                 | JIS-C-5202 5.6                                                 | in V-Block                                                            | >10000MΩ                                  |
| Solderability                         | JIS-C-5202 6.5                                                 | 235±5°C for 5±0.5 Seconds                                             | 95% Min. Coverage                         |
| Resistance to Solvent                 | JIS-C-5202 6.9                                                 | IPA for 1 Min. with Ultrasonic                                        | No Deterioration of Coatings and Markings |
| Terminal Strength                     | Direct Load for 10 Sec. in The Direction of The Terminal Leads |                                                                       | ≥2.5kg (24.5N)                            |
| Pulse Overload                        | JIS-C-5202 5.8                                                 | 4 Times RCWV 10000 Cycles (1 Sec. on , 25 Sec. off)                   | ±(1%+0.05Ω)                               |
| Load Life in Humidity                 | JIS-C-5202 7.9                                                 | 40±2°C, 90~95% RH at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off ) | ±(5.0%+0.05Ω)                             |
| Load Life                             | JIS-C-5202 7.10                                                | 70°C at RCWV for 1000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off)               | ±(5.0%+0.05Ω)                             |
| Temperature Cycling                   | JIS-C-5202 7.4                                                 | -55°C→Room Temp.→+155°C→Room Temp. for 5 Cycles                       | ±(1.0%+0.05Ω)                             |
| Resistance to Soldering Heat          | JIS-C-5202 6.4                                                 | 350°C±10°C for 3±0.5 Seconds                                          | ±(1.0%+0.05Ω)                             |

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



Note :

## PACKING METHODS



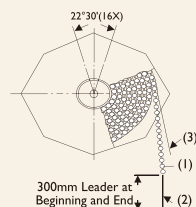
### Bandolier for Axial Leads

The resistors are supplied on bandolier; either 1000 resistors in am-mopack or 5000 resistors on reel.

Unit : mm

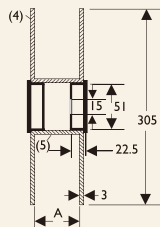
| STYLE         |             | DIMENSIONS |                      |            |             |                                            |
|---------------|-------------|------------|----------------------|------------|-------------|--------------------------------------------|
| Normal        | Miniature   | a          | A                    | B1-B2      | S (Spacing) | T (Max. Deviation of Spacing)              |
| TYPE-12       | TYPE25S/204 | 6±0.5      | 52.4±1.5<br>26.0±1.5 | 1.2        | 5           | 1 mm Per 10 Spacings, 0.5mm Per 5 Spacings |
| TYPE-25       | TYPE50S/207 | 6±0.5      | 52.4±1.5<br>26.0±1.5 | 1.2<br>1.0 | 5           |                                            |
| TYPE-50       | TYPE1WS     | 6±0.5      | 52.4±1.5             | 1.2        | 5           |                                            |
| TYPE100       | TYPE2WS     | 6±0.5      | 73.0±1.5<br>52.4±1.5 | 1.5        | 5           |                                            |
| TYPE200       | TYPE3WS     | 6±0.5      | 73.0±1.5             | 1.5        | 10          |                                            |
| KNP300        | KNP5WS      |            | 52.4±1.5             |            |             |                                            |
| RSF300        | RSF5WS      | 6±0.5      | 91.0±1.5             | 1.5        | 10          |                                            |
| RSF500/KNP500 | KNP7WS      |            | 73.0±1.5             |            |             |                                            |

## TAPE ON REEL PACKING

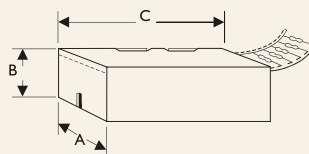


Bandoliers can be reeled;  
dimension **a** differ with type.

- (1) Resistor
- (2) Bandolier
- (3) Paper
- (4) Flange
- (5) Cylinder



## TAPE ON BOX PACKING



Bandoliers may also be supplied  
in a cardboard box ("ammo-  
pack").

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

Unit : mm/pcs

| STYLE             |               | TAPE ON REEL      |              |
|-------------------|---------------|-------------------|--------------|
| Normal            | Miniature     | Across Flange (A) | QTY Per Reel |
| TYPE-12           | TYPE25S/204   | 72                | 5,000        |
| TYPE-25           | TYPE50S/207   | 48/72             | 5,000        |
| TYPE-50           | TYPE1WS       | 72                | 2,500        |
| TYPE100           | TYPE2WS       | 95                | 2,000        |
| TYPE200           | TYPE3WS       | 95                | 1,000        |
| KNP300            | KNP5WS        | 95                | 1,000        |
| RSF300/500 KNP500 | RSF5WS/KNP7WS | 95                | 250          |

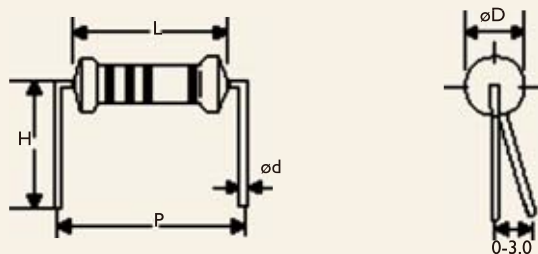
| TAPE ON BOX |        |       |             |
|-------------|--------|-------|-------------|
| W (A)       | H (B)  | L (C) | QTY Per Box |
| 78/81       | 24/70  | 260   | 2,000/5,000 |
| 78/81       | 24/104 | 260   | 1,000/5,000 |
| 73          | 45     | 258   | 1,000       |
| 103         | 78     | 260   | 1,000       |
| 103         | 94     | 260   | 1,000       |
| 103         | 78     | 260   | 500         |
| 116         | 79     | 255   | 250         |



Note :

## SPECIAL TYPE (FORMING DIMENSIONS)

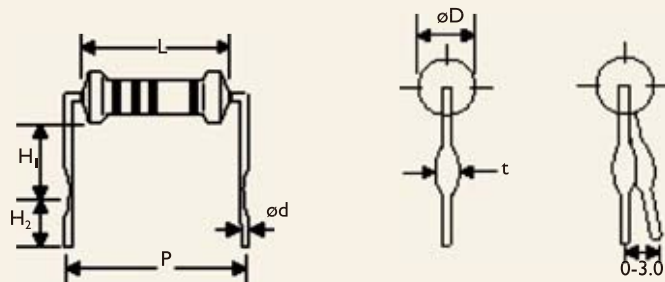
### M TYPE



Unit : mm

| STYLE   | DIMENSIONS |                |              |               |                |              |
|---------|------------|----------------|--------------|---------------|----------------|--------------|
| Normal  | Miniature  | L              | P            | øD            | ød             | H            |
| TYPE-12 | TYPE25S    | $3.4 \pm 0.3$  | $6.0 \pm 1$  | $1.9 \pm 0.2$ | $0.5 \pm 0.05$ | $10.0 \pm 1$ |
| TYPE-25 | TYPE50S    | $6.3 \pm 0.5$  | $10.0 \pm 1$ | $2.4 \pm 0.2$ | $0.6 \pm 0.05$ | $10.0 \pm 1$ |
| TYPE-50 | TYPE1WS    | $9.0 \pm 0.5$  | $12.5 \pm 1$ | $3.3 \pm 0.3$ | $0.6 \pm 0.05$ | $10.0 \pm 1$ |
| TYPE100 | TYPE2WS    | $11.5 \pm 1.0$ | $15.0 \pm 1$ | $4.5 \pm 0.5$ | $0.8 \pm 0.05$ | $12.5 \pm 1$ |
| TYPE200 | TYPE3WS    | $15.5 \pm 1.0$ | $20.0 \pm 1$ | $5.0 \pm 0.5$ | $0.8 \pm 0.05$ | $15.0 \pm 1$ |

### MB TYPE



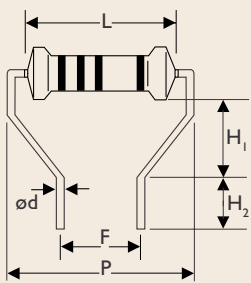
Unit : mm

| STYLE   | DIMENSIONS |                |              |               |                |              |             |               |
|---------|------------|----------------|--------------|---------------|----------------|--------------|-------------|---------------|
| Normal  | Miniature  | L              | P            | øD            | ød             | H1           | H2          | t             |
| TYPE-25 | TYPE50S    | $6.3 \pm 0.5$  | $10.0 \pm 1$ | $2.4 \pm 0.2$ | $0.6 \pm 0.05$ | $6.0 \pm 1$  | $5.0 \pm 1$ | $1.2 \pm 0.2$ |
| TYPE-50 | -          | $9.0 \pm 0.5$  | $12.5 \pm 1$ | $3.3 \pm 0.3$ | $0.6 \pm 0.05$ | $6.0 \pm 1$  | $5.0 \pm 1$ | $1.2 \pm 0.2$ |
| -       | TYPE1WS    | $9.0 \pm 0.5$  | $12.5 \pm 1$ | $3.3 \pm 0.3$ | $0.8 \pm 0.05$ | $6.0 \pm 1$  | $5.0 \pm 1$ | $1.4 \pm 0.2$ |
| TYPE100 | TYPE2WS    | $11.5 \pm 1.0$ | $15.0 \pm 1$ | $4.5 \pm 0.5$ | $0.8 \pm 0.05$ | $6.0 \pm 1$  | $5.0 \pm 1$ | $1.4 \pm 0.2$ |
| TYPE200 | TYPE3WS    | $15.5 \pm 1.0$ | $20.0 \pm 1$ | $5.0 \pm 0.5$ | $0.8 \pm 0.05$ | $10.0 \pm 1$ | $5.0 \pm 1$ | $1.4 \pm 0.2$ |
| TYPE300 | TYPE5WS    | $24.5 \pm 1.0$ | $30.0 \pm 1$ | $8.0 \pm 0.5$ | $0.8 \pm 0.05$ | $15.0 \pm 1$ | $5.0 \pm 1$ | $1.4 \pm 0.2$ |
| TYPE500 | -          | $24.5 \pm 1.0$ | $30.0 \pm 1$ | $8.0 \pm 0.5$ | $0.8 \pm 0.05$ | $15.0 \pm 1$ | $5.0 \pm 1$ | $1.4 \pm 0.2$ |



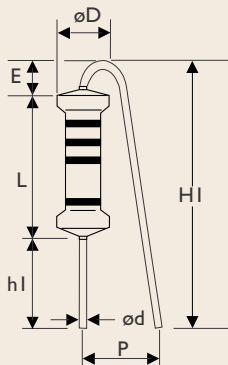
Note :

### MR TYPE

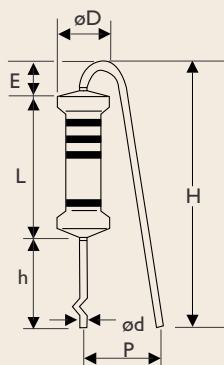


| STYLE   |           | DIMENSIONS |        |         |         |          |                |                | Unit : mm |  |
|---------|-----------|------------|--------|---------|---------|----------|----------------|----------------|-----------|--|
| Normal  | Miniature | L          | P      | F       | 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 | 0.6±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          |           |  |

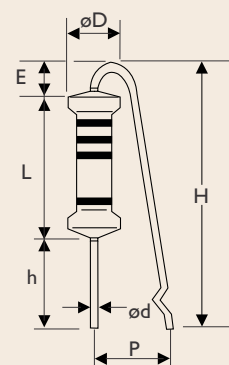
### F TYPE



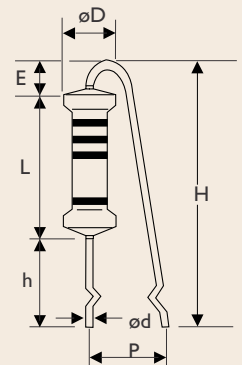
### FK TYPE



### FFK TYPE



### FKK TYPE



| STYLE   |           | DIMENSIONS |     |         |          |        |        |                |                     |        | Unit : mm |  |
|---------|-----------|------------|-----|---------|----------|--------|--------|----------------|---------------------|--------|-----------|--|
| Normal  | Miniature | L          | P   | øD      | ød       | h      | H Max. | h <sub>1</sub> | H <sub>1</sub> 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    |           |  |

\*TYPE-25/50S is available.





Note :

#### FT TYPE FORMING FOR TAPING

Rated Watts 1/4W & 1/2WS

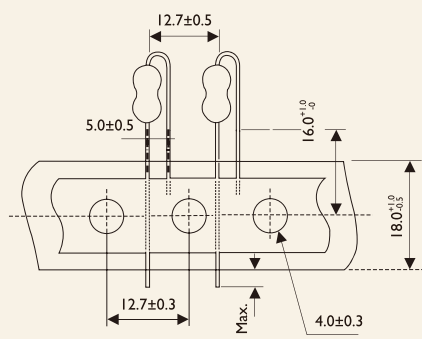
Body Dimension : L =  $6.3 \pm 0.5$ mm

$\phi D = 2.4 \pm 0.2$ mm

Rated Watts : 1/2W & 1WS

Body Dimension : L =  $9 \pm 0.5$ mm

$\phi D = 3.3 \pm 0.3$ mm

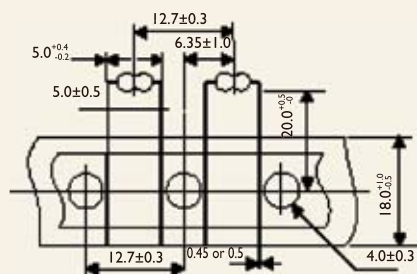


#### MT TYPE FORMING FOR TAPING

Rated Watts 1/6W & 1/4WS

Body Dimension : L =  $3.4 \pm 0.3$ mm

$\phi D = 1.9 \pm 0.2$ mm



#### PN TYPE FORMING FOR TAPING

Rated Watts 1/4W & 1/2WS

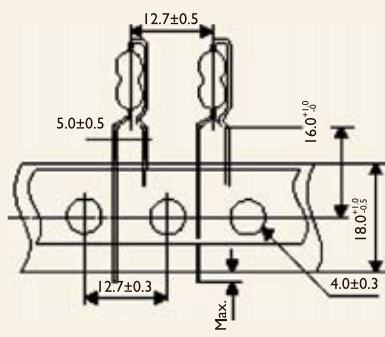
Body Dimension : L =  $6.3 \pm 0.5$ mm

$\phi D = 2.4 \pm 0.2$ mm

Rated Watts : 1/2W & 1WS

Body Dimension : L =  $9 \pm 0.5$ mm

$\phi D = 3.3 \pm 0.3$ mm



#### AV TYPE FORMING FOR TAPING

Rated Watts 1/4W & 1/2WS

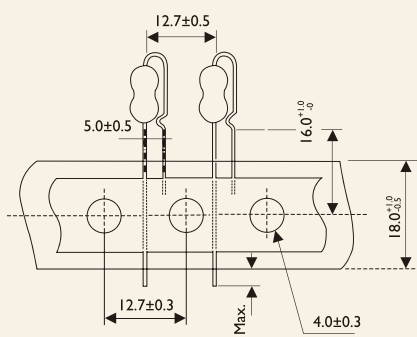
Body Dimension : L =  $6.3 \pm 0.5$ mm

$\phi D = 2.4 \pm 0.2$ mm

Rated Watts : 1/2W & 1WS

Body Dimension : L =  $9 \pm 0.5$ mm

$\phi D = 3.3 \pm 0.3$ mm



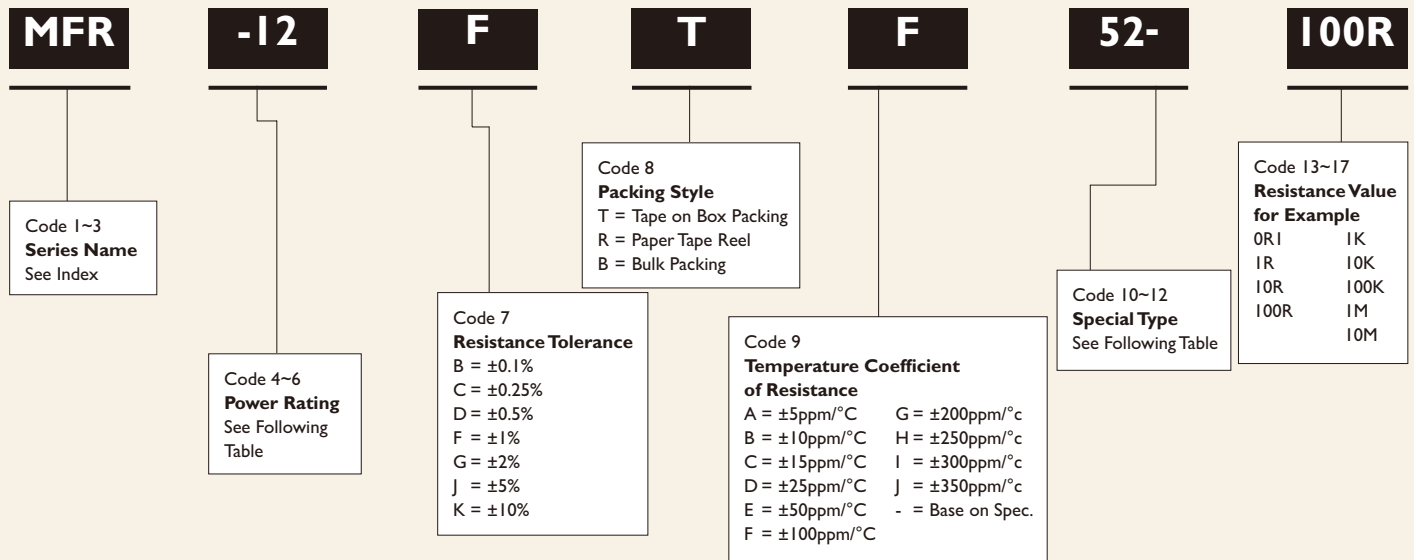


Note :

## EXPLANATIONS OF ORDERING CODE

For Leaded Resistor

Explanations of Ordering Code



## CODE 4~6

## Power Rating

|           |         |          |           |
|-----------|---------|----------|-----------|
| -12=1/6W  | 3WM=3WM | 900=9W   | 90A=90W   |
| -25=1/4W  | 400=4W  | 10A=10W  | 10B=100W  |
| 25S=1/4WS | 4WS=4WS | 10S=10WS | 15B=150W  |
| -50=1/2W  | 500=5W  | 15A=15W  | 20B=200W  |
| 50S=1/2WS | 5WS=5WS | 20A=20W  | 10C=1000W |
| 100=1W    | 5SS=5SS | 30A=30W  | 204=0.4W  |
| 1WS=1WS   | 600=6W  | 40A=40W  | 207=0.6W  |
| 200=2W    | 6WS=6WS | 50A=50W  |           |
| 2WS=2WS   | 700=7W  | 60A=60W  |           |
| 300=3W    | 7WS=7WS | 70A=70W  |           |
| 3WS=3WS   | 800=8W  | 80A=80W  |           |

## CODE 10~12

## Special Type

|                               |                               |
|-------------------------------|-------------------------------|
| 26=26mm                       | FKK=FKK-Type Forming for Bulk |
| 52=52.4mm                     | PN=PANAsert for Taping        |
| 73=73mm                       | AV=AVIsert for Taping         |
| 81=81mm                       | MT=M-Type Forming for Taping  |
| 91=91mm                       | FT=F-Type Forming for Taping  |
| M=M-Type Forming for Bulk     |                               |
| MB=MB-Type Forming for Bulk   |                               |
| MR=MR-Type Forming for Bulk   |                               |
| F=F-Type Forming for Bulk     |                               |
| FK=FK-Type Forming for Bulk   |                               |
| FFK=FFK-Type Forming for Bulk |                               |



Note :

## YAGEO LEADED RESISTOR P/N FOR SYSTEM INPUT

| Series |                                     | Watt |          | Tolerance |              | Packing |            | Forming |                              | T.C.R |                |
|--------|-------------------------------------|------|----------|-----------|--------------|---------|------------|---------|------------------------------|-------|----------------|
| CFR    | Carbon Film                         | -05  | ød=0.5mm | A         | =±0.05%      | T       | =TAPE/BOX  | 05-     | = 0.5MM                      | -     | = BASE ON SPEC |
| CF0    | Carbon 0204 , 0207                  | -06  | ød=0.6mm | B         | =±0.1%       | R       | =TAPE/REEL | 26-     | = 26MM                       | A     | = ±5 PPM/°C    |
| FCR    | Carbon Film Flame-proof             | -07  | ød=0.7mm | C         | =±0.25%      | B       | =BULK      | 52-     | = 52.4MM                     | B     | = 10PPM        |
| FC0    | Carbon Film Flame-proof 0204 , 0207 | -08  | ød=0.8mm | D         | =±0.5%       |         |            | 73-     | = 73MM                       | C     | = 15PPM        |
| FMP    | Metal Film Power Flame-proof        | -10  | ød=1.0mm | F         | =±1%         |         |            | 81-     | = 81MM                       | D     | = 25PPM        |
| FMF    | Metal Film Flame-proof              | -14  | ød=1.4mm | G         | =±2%         |         |            | 91-     | = 91MM                       | E     | = 50PPM        |
| FM0    | Metal Film Flame-proof 0204 , 0207  | -12  | = 1/6W   | J         | =±5%         |         |            | F       | = F Type                     | F     | = 100PPM       |
| FRM    | Metal Film Fusible Flame-proof      | -25  | = 1/4W   | K         | =±10%        |         |            | FT      | = FT Type Forming for Taping | G     | = 200PPM       |
| HMG    | High-Meg Ohm                        | 25S  | = 1/4WS  | -         | Base on Spec |         |            | FK      | = FK Type                    | H     | = ±250 PPM/°C  |
| JPW    | Jumper Wires                        | -33  | = 1/3W   |           |              |         |            | FKK     | = FKK Type                   | I     | = ±300 PPM/°C  |
| KNP    | Wirewound                           | -50  | = 1/2W   |           |              |         |            | FFK     | = F-form Kink                | J     | = ±350 PPM/°C  |
| MFR    | Metal Film                          | 50S  | = 1/2WS  |           |              |         |            | M       | = M-Type Forming             |       |                |
| HVR    | High Voltage                        | 100  | = 1W     |           |              |         |            | MB      | = M-form W/Flat              |       |                |
| MF0    | Metal Film 0204 , 0207              | 1WS  | = 1WS    |           |              |         |            | MK      | = M-form KINK                |       |                |
| MFP    | Metal Film Precision Type           | 200  | = 2W     |           |              |         |            | MT      | = MT Type Forming            |       |                |
| MFL    | Metal Low Values Style              | 2WS  | = 2WS    |           |              |         |            | MR      | = MR Type                    |       |                |
| MMF    | Melf Metal Film                     | 204  | = 0.4W   |           |              |         |            | AV      | = AVIsert                    |       |                |
| MCF    | Melf Carbon Film                    | 207  | = 0.6W   |           |              |         |            | PN      | = PANAsert                   |       |                |
| MCP    | Melf Carbon Film Power Type         | 300  | = 3W     |           |              |         |            |         |                              |       |                |
| MMP    | Melf Metal Film Power Type          | 3WS  | = 3WS    |           |              |         |            |         |                              |       |                |
| RSF    | Metal Oxide Film                    | 400  | = 4W     |           |              |         |            |         |                              |       |                |
| NKN    | Wirewound Non-Inductive             | 500  | = 5W     |           |              |         |            |         |                              |       |                |
| NSM    | Cement- Vertical Lead               | 5WS  | = 5WS    |           |              |         |            |         |                              |       |                |
| NSP    | Cement- Axial Lead                  | 5SS  | = 5WSS   |           |              |         |            |         |                              |       |                |
| NCR    | Non Inductive Cabon Film            | 700  | = 7W     |           |              |         |            |         |                              |       |                |
| NSH    | Non-Inductive Cement-Clamp Mounting | 7WS  | = 7WS    |           |              |         |            |         |                              |       |                |
| NSZ    | Cement- Radial Terminals            | 10A  | = 10W    |           |              |         |            |         |                              |       |                |
| SQH    | Cement- Clamp Mounting              | 20A  | = 20W    |           |              |         |            |         |                              |       |                |
| SQM    | Cement- Vertical Lead               | 30A  | = 30W    |           |              |         |            |         |                              |       |                |
| SQP    | Cement- Axial Lead                  | 40A  | = 40W    |           |              |         |            |         |                              |       |                |
| SQT    | Cement                              | 50A  | = 50W    |           |              |         |            |         |                              |       |                |
| SQZ    | Cement- Radial Terminals            | 10S  | = 10WS   |           |              |         |            |         |                              |       |                |
| ZOR    | Zerohm                              | 15A  | = 15W    |           |              |         |            |         |                              |       |                |
|        |                                     | 25A  | = 25W    |           |              |         |            |         |                              |       |                |



Note :

### LEADED RESISTORS/KGS

| POWER RATING      | PCS/PER INNER BOX | BAG/PER INNER BOX | PCS/PER BAG |
|-------------------|-------------------|-------------------|-------------|
| 1/6W, 1/4WS, 0.4W | 2,000             | 10                | 200         |
| 1/4W, 1/2WS, 0.6W | 1,000             | 5                 | 200         |
| 1/2W, 1WS         | 1,000             | 5                 | 200         |
| 1W, 2WS           | 1,000             | 10                | 100         |
| 2W, 3WS           | 1,000             | 10                | 100         |
| 3W                | 500               | 10                | 50          |
| 5W                | 500               | 10                | 50          |
| 7W                | 500               | 10                | 50          |

### LEAD TO LEAD TAPING

| SIZE/POWER | RATING CODE | STANDARD LEAD LENGTH | MINIATURE LEAD LENGTH |
|------------|-------------|----------------------|-----------------------|
| -12        | 25S         | 52-                  | 26-                   |
| -25        | 50S         | 52-                  | 26-                   |
| 204        |             | 52-                  | 26-                   |
| 207        |             | 52-                  | 26-                   |
| -50        | 1WS         | 52-                  | N/A                   |
| 100        | 2WS         | 73-                  | 52-                   |
| 200        | 3WS         | 73-                  | 52-                   |
|            | 3WM         | 73-                  | 52-                   |
|            | 5SS         | 73-                  | 52-                   |
| 300        | 5WS         | 91-                  | 73-                   |
| 500        |             | 91-                  | 73-                   |
| 700        |             | 91-                  | -                     |

### EXCEPTION

|             |               |     |     |
|-------------|---------------|-----|-----|
| KNP/NKN     | 3W, 4W, 5WS   | 73- | 52- |
| KNP/NKN/RSF | 5W, 7W on T/R | 73- | 52- |



Note :

## LEADED RESISTORS/KGS

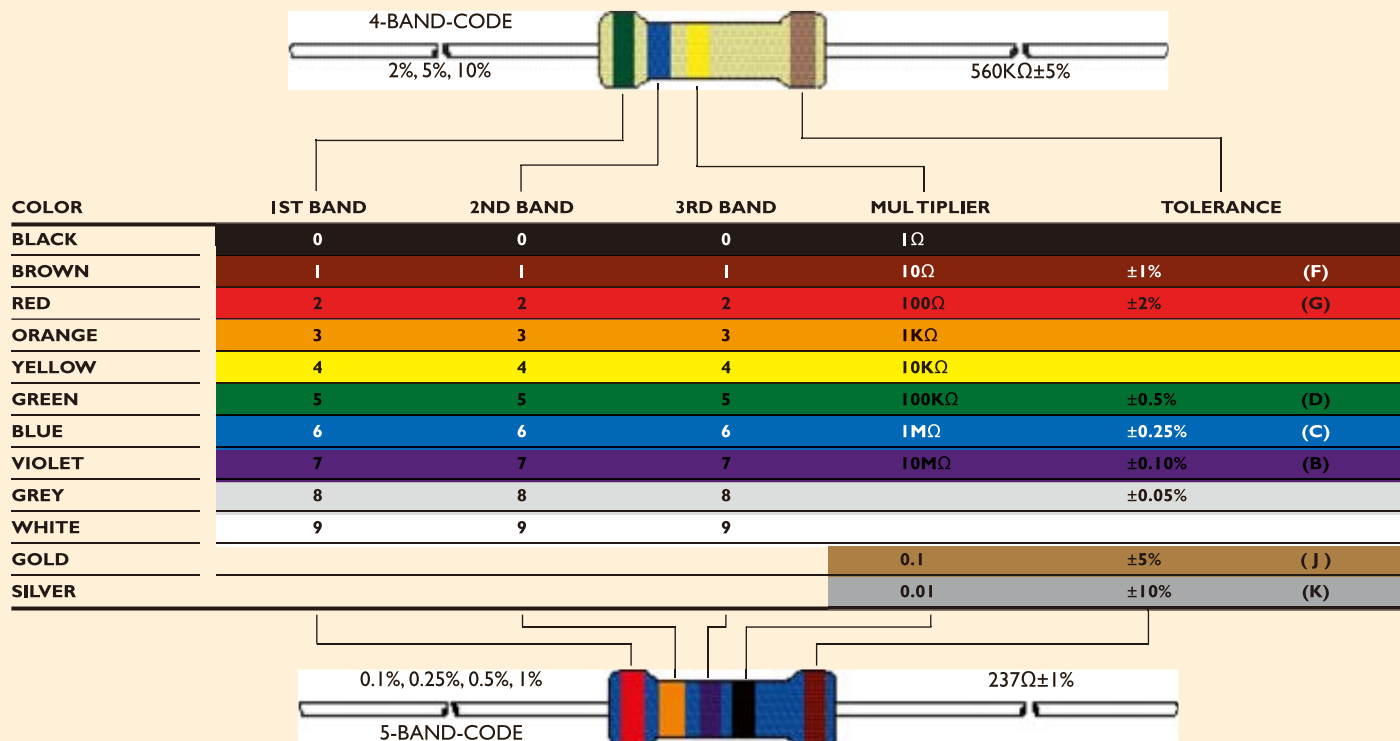
| WATT   | PACKAGE   | Q'TY/PCS | WEIGHT | CTN Q'TY | NW / GW | CTN NO. | CTN SIZE / cm    | CUBIC FIT |
|--------|-----------|----------|--------|----------|---------|---------|------------------|-----------|
| 1/6W   | tape/reel | 5,000    | 1.1    | 50,000   | 11/13   | E1      | 60 x 32 x 43     | 3         |
| 1/4WS  | tape/box  | 2,000    | 0.3    | 120,000  | 18/20   | E3      | 44 x 28 x 36     | 1.6       |
| 0.4W   | tape/box  | 5,000    | 0.74   | 100,000  | 15/17   | E3      | 44 x 28 x 36     | 1.6       |
|        | bulk      | 2,000    | 0.25   | 140,000  | 18/20   | E3      | 44 x 28 x 36     | 1.6       |
| 1/4W   | tape/reel | 5,000    | 1.6    | 50,000   | 16/18   | E1      | 60 x 32 x 43     | 3         |
| 1/2WS  | tape/box  | 1,000    | 0.25   | 60000    | 15/17   | E3      | 44 x 28 x 36     | 1.6       |
| 0.6W   | tape/box  | 5,000    | 1.25   | 75,000   | 19/21   | E3      | 44 x 28 x 36     | 1.6       |
|        | bulk      | 1,000    | 0.23   | 70000    | 16/18   | E3      | 44 x 28 x 36     | 1.6       |
|        | tape/reel | 2,500    | 1.3    | 25,000   | 13/15   | E1      | 60 x 32 x 43     | 3         |
| 1/2W   | tape/reel | 3,000    | 1.6    | 30,000   | 16/18   | E1      | 60 x 32 x 43     | 3         |
| 1WS    | tape/box  | 1,000    | 0.43   | 30,000   | 13/15   | E3      | 44 x 28 x 36     | 1.6       |
|        | bulk      | 1,000    | 0.4    | 40,000   | 16/18   | E3      | 44 x 28 x 36     | 1.6       |
|        | tape/reel | 2,000    | 2.2    | 20,000   | 22/24   | E2      | 60 x 32 x 54.5   | 3.8       |
| 1W     | tape/box  | 1,000    | 0.9    | 16,000   | 14/16   | E3      | 44 x 28 x 36     | 1.6       |
| 2WS    | bulk      | 1,000    | 0.9    | 16,000   | 14/16   | E3      | 44 x 28 x 36     | 1.6       |
|        | forming   | 2,000    | 1.5    | 32,000   | 24/26   | E3      | 44 x 28 x 36     | 1.6       |
|        | tape/reel | 1,000    | 1.6    | 10,000   | 16/18   | E2      | 60 x 32 x 54.5   | 3.8       |
| 2W     | tape/box  | 1,000    | 1.18   | 12,000   | 14/16   | E5      | 28 x 46 x 30     | 1.4       |
| 3WS    | bulk      | 1,000    | 1.12   | 16,000   | 18/20   | E3      | 44 x 28 x 36     | 1.6       |
|        | forming   | 1,000    | 1.02   | 16,000   | 16/18   | E3      | 44 x 28 x 36     | 1.6       |
| 3W     | tape/reel | 500      | 2.2    | 5,000    | 22/24   | E2      | 60 x 32 x 54.5   | 3.8       |
| 5W     | tape/box  | 250      | 1.15   | 3,500    | 16/18   | E3      | 44 x 28 x 36     | 1.6       |
| 5WS    | bulk      | 500      | 2      | 4,000    | 16/18   | E6      | 42.5 x 42.5 x 19 | 1.2       |
| 5SS    | tape/box  | 500      |        | 10,000   | 18/20   |         |                  | 1.7       |
| JPW-05 | tape/reel | 10,000   | 1.4    | 50,000   | 7/8     | J2      |                  |           |
|        | tape/Box  | 10,000   | 1.1    | 100,000  | 11/12   | J1      |                  |           |
| JPW-06 | tape/reel | 10,000   | 2      | 50,000   | 10/11   | J2      |                  |           |
|        | tape/Box  | 10,000   | 1.5    | 100,000  | 15/16   | J1      |                  |           |
| JPW-08 | tape/reel | 10,000   | 2.9    | 50,000   | 14/15   | J2      |                  |           |



Note :

cement resISTORS

| TYPE | WATT | BOX   | CTN  | NW | GW |
|------|------|-------|------|----|----|
| SQP  | 2W   | 1     | 6    | 20 | 21 |
|      | 3W   | 0.6   | 4.8  | 20 | 21 |
|      |      | 0.5   | 4    | 18 | 19 |
|      | 5W   | 0.5   | 4    | 20 | 21 |
|      | 7W   | 0.25  | 2    | 18 | 19 |
|      | 10W  | 0.25  | 2    | 20 | 21 |
|      | 15W  | 0.15  | 0.9  | 18 | 19 |
|      | 20W  | 0.1   | 0.6  | 16 | 17 |
| SQM  | 2W   | 1     | 6    | 20 | 21 |
|      | 3W   | 1.2   | 2.4  | 13 | 14 |
|      | 5W   | 1     | 2    | 13 | 14 |
|      | 7W   | 0.8   | 1.6  | 16 | 17 |
|      | 10W  | 0.5   | 1    | 17 | 18 |
| SQZ  | 5W   | 0.1   | 2    | 16 | 17 |
|      | 7W   | 0.1   | 2    | 20 | 21 |
|      | 10W  | 0.06  | 1.2  | 19 | 20 |
|      | 15W  | 0.03  | 0.6  | 13 | 14 |
|      | 20W  | 0.03  | 0.6  | 16 | 17 |
|      | 40W  |       |      |    |    |
| SQH  | 10W  | 0.04  | 0.8  | 13 | 14 |
|      | 15W  | 0.03  | 0.6  | 13 | 14 |
|      | 20W  | 0.025 | 0.5  | 15 | 16 |
|      | 40W  | 0.018 | 0.25 | 20 | 21 |
| SQHG | 20W  | 0.02  | 0.4  | 16 | 17 |
|      | 30W  | 0.02  | 0.25 |    |    |



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

(Also Usable in Decade Multiples or Sub-Multiples)

| RESISTANCE TOLERANCE (±%) |       |      |     |       |       |      |     |       |       |      |     |       |       |      |     |
|---------------------------|-------|------|-----|-------|-------|------|-----|-------|-------|------|-----|-------|-------|------|-----|
| 0.1%                      | 0.25% | 1%   | 2%  | 0.1%  | 0.25% | 1%   | 2%  | 0.1%  | 0.25% | 1%   | 2%  | 0.1%  | 0.25% | 1%   | 2%  |
| 0.5%                      | 10%   | 5%   | 10% | 0.5%  | 10%   | 5%   | 10% | 0.5%  | 10%   | 5%   | 10% | 0.5%  | 10%   | 5%   | 10% |
| 10.0                      | 10.0  | 10   |     | 14.7  | 14.7  | -    |     | 21.5  | 21.5  | -    |     | 31.6  | 31.6  | -    |     |
| 10.1                      | -     | -    |     | 14.9  | -     | -    |     | 21.8  | -     | -    |     | 32.0  | -     | -    |     |
| 10.2                      | 10.2  | -    |     | 15.0  | 15.0  | 15   |     | 22.1  | 22.1  | 22   |     | 32.4  | 32.4  | -    |     |
| 10.4                      | -     | -    |     | 15.2  | -     | -    |     | 22.3  | -     | -    |     | 32.8  | -     | -    |     |
| 10.5                      | 10.5  | -    |     | 15.4  | 15.4  | -    |     | 22.6  | 22.6  | -    |     | 33.2  | 33.2  | 33   |     |
| 10.6                      | -     | -    |     | 15.6  | -     | -    |     | 22.9  | -     | -    |     | 33.6  | -     | -    |     |
| 10.7                      | 10.7  | -    |     | 15.8  | 15.8  | -    |     | 23.2  | 23.2  | -    |     | 34.0  | 34.0  | -    |     |
| 10.9                      | -     | -    |     | 16.0  | -     | 16   |     | 23.4  | -     | -    |     | 34.4  | -     | -    |     |
| 11.0                      | 11.0  | 11   |     | 16.2  | 16.2  | -    |     | 23.7  | 23.7  | -    |     | 34.8  | 34.8  | -    |     |
| 11.1                      | -     | -    |     | 16.4  | -     | -    |     | 24.0  | -     | 24   |     | 35.2  | -     | -    |     |
| 11.3                      | 11.3  | -    |     | 16.5  | 16.5  | -    |     | 24.3  | 24.3  | -    |     | 35.7  | 35.7  | -    |     |
| 11.4                      | -     | -    |     | 16.7  | -     | -    |     | 24.6  | -     | -    |     | 36.1  | -     | 36   |     |
| 11.5                      | 11.5  | -    |     | 16.9  | 16.9  | -    |     | 24.9  | 24.9  | -    |     | 36.5  | 36.5  | -    |     |
| 11.7                      | -     | -    |     | 17.2  | -     | -    |     | 25.2  | -     | -    |     | 37.0  | -     | -    |     |
| 11.8                      | 11.8  | -    |     | 17.4  | 17.4  | -    |     | 25.5  | 25.5  | -    |     | 37.4  | 37.4  | -    |     |
| 12.0                      | -     | 12   |     | 17.6  | -     | -    |     | 25.8  | -     | -    |     | 37.9  | -     | -    |     |
| 12.1                      | 12.1  | -    |     | 17.8  | 17.8  | -    |     | 26.1  | 26.1  | -    |     | 38.3  | 38.3  | -    |     |
| 12.3                      | -     | -    |     | 18.0  | -     | 18   |     | 26.4  | -     | -    |     | 38.8  | -     | -    |     |
| 12.4                      | 12.4  | -    |     | 18.2  | 18.2  | -    |     | 26.7  | 26.7  | -    |     | 39.2  | 39.2  | 39   |     |
| 12.6                      | -     | -    |     | 18.4  | -     | -    |     | 27.1  | -     | 27   |     | 39.7  | -     | -    |     |
| 12.7                      | 12.7  | -    |     | 18.7  | 18.7  | -    |     | 27.4  | 27.4  | -    |     | 40.2  | 40.2  | -    |     |
| 12.9                      | -     | -    |     | 18.9  | -     | -    |     | 27.7  | -     | -    |     | 40.7  | -     | -    |     |
| 13.0                      | 13.0  | 13   |     | 19.1  | 19.1  | -    |     | 28.0  | 28.0  | -    |     | 41.2  | 41.2  | -    |     |
| 13.2                      | -     | -    |     | 19.3  | -     | -    |     | 28.4  | -     | -    |     | 41.7  | -     | -    |     |
| 13.3                      | 13.3  | -    |     | 19.6  | 19.6  | -    |     | 28.7  | 28.7  | -    |     | 42.2  | 42.2  | -    |     |
| 13.5                      | -     | -    |     | 19.8  | -     | -    |     | 29.1  | -     | -    |     | 42.7  | -     | -    |     |
| 13.7                      | 13.7  | -    |     | 20.0  | 20.0  | 20   |     | 29.4  | 29.4  | -    |     | 43.2  | 43.2  | 43   |     |
| 13.8                      | -     | -    |     | 20.3  | -     | -    |     | 29.8  | -     | -    |     | 43.7  | -     | -    |     |
| 14.0                      | 14.0  | -    |     | 20.5  | 20.5  | -    |     | 30.1  | 30.1  | 30   |     | 44.2  | 44.2  | -    |     |
| 14.2                      | -     | -    |     | 20.8  | -     | -    |     | 30.5  | -     | -    |     | 44.8  | -     | -    |     |
| 14.3                      | 14.3  | -    |     | 21.0  | 21.0  | -    |     | 30.9  | 30.9  | -    |     | 45.3  | 45.3  | -    |     |
| 14.5                      | -     | -    |     | 21.3  | -     | -    |     | 31.2  | -     | -    |     | 45.9  | -     | -    |     |
| E-192                     | E-96  | E-24 |     | E-192 | E-96  | E-24 |     | E-192 | E-96  | E-24 |     | E-192 | E-96  | E-24 |     |