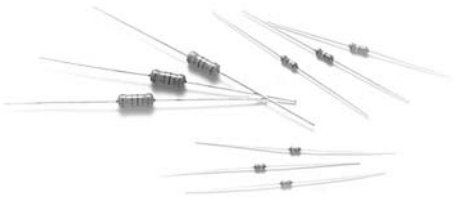
INDEX

Metal Film Resistors

MFR Series

Normal & Miniature Style



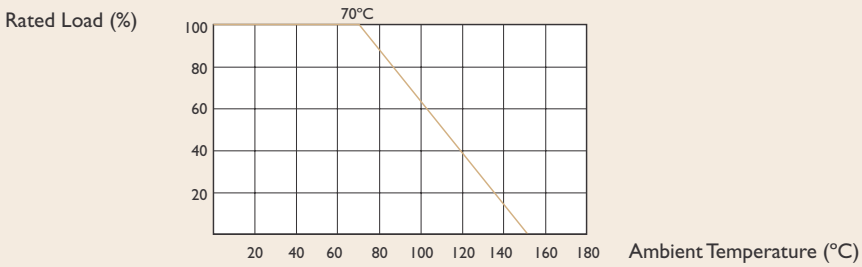
INTRODUCTION

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.

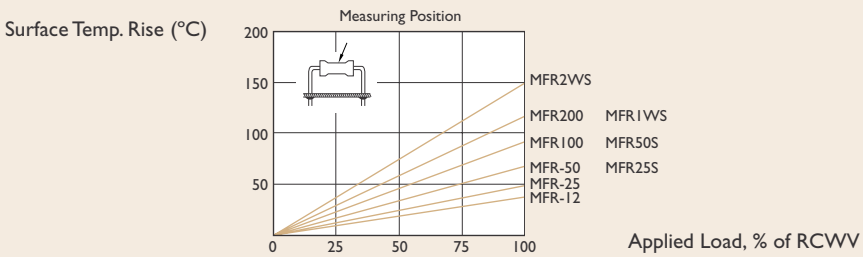
FEATURES

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

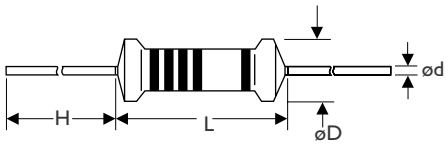
DERATING CURVE



HOT-SPOT TEMPERATURE



DIMENSIONS



Unit : mm

STYLE		DIMENSION			
Normal	**Miniature**	**L**	**øD**	**H**	**ød**
MFR-12	MFR25S	3.4±0.3	1.9±0.2	28±2.0	0.5±0.05
MFR-25	MFR50S	6.3±0.5	2.4±0.2	28±2.0	0.6±0.05
MFR-50	MFR1WS	9.0±0.5	3.3±0.3	26±2.0	0.6±0.05
MFR100	MFR2WS	11.5±1.0	4.5±0.5	35±2.0	0.8±0.05
MFR200	–	15.5±1.0	5.0±0.5	33±2.0	0.8±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 +155°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 ±0.5%, ±1%	10Ω~1MΩ								
Value Rang ±0.1%, ±0.25%	100Ω~100KΩ								
Temperature Coefficient (by Type)	±15ppm/°C, ±25ppm/°C, ±50ppm/°C, ±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°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)= $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

Metal Film Resistors

Precision Type

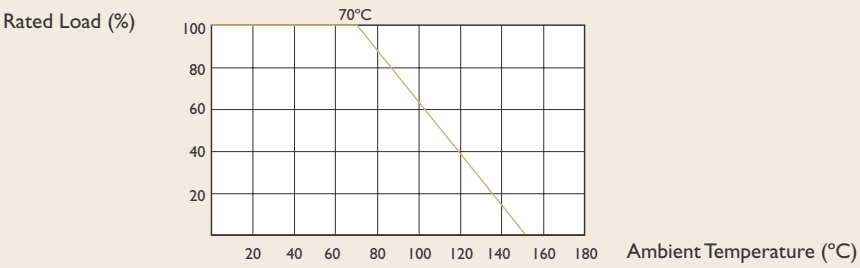
MFP Series

FEATURES

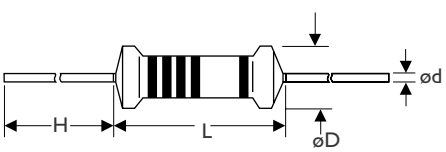
- Power Rating : 1/6W, 1/4W, 0.4W, 1/2W, 0.6W
- Resistance Tolerance : ±0.1%, ±0.25%
- T.C.R. : ±15ppm/°C, ±25ppm/°C
- High thermal conductivity and specific gravity rods
- Epoxy coating
- Blue body color

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		DIMENSION			
Normal	**Miniature**	**L**	**øD**	**H**	**ød**
MFP-12	MFP25S	3.4±0.3	1.9±0.2	28±2.0	0.5±0.05
MFP204	—	3.4±0.3	1.9±0.2	28±2.0	0.5±0.05
MFP-25	MFP50S	6.3±0.5	2.4±0.2	28±2.0	0.6±0.05
MFP207	—	6.3±0.5	2.4±0.2	28±2.0	0.6±0.05

Note :

ELECTRICAL CHARACTERISTICS

PERFORMANCE 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	±15ppm/°C, ±25ppm/°C					
Short Time Overload	JIS-C-5202 5.5 2.5 Times RCWV for 5 Sec.	±0.1%+0.05Ω					
Insulation Resistance	JIS-C-5202 5.6 in V-Block	>10,000MΩ					
Pulse Overload	JIS-C-5202 5.8 4 Times RCWV 10,000 Cycles (1 Sec. on , 25 Sec. off)	±1.0%+0.05Ω					
Operating Temp. Range		-55°C to + 155°C					
Value Rang ±0.1%		100Ω~100K			100Ω~200KΩ		
Value Range ±0.25%		50Ω~200K			50Ω~301KΩ		

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

ENVIRONMENTAL CHARACTERISTICS

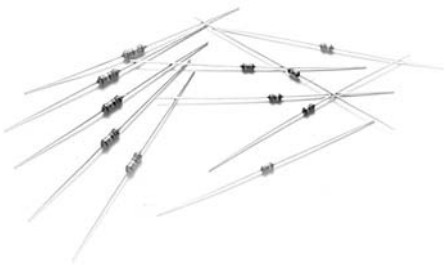
PERFORMANCE TEST	TEST METHOD		APPRAISE
Terminal Strength	JIS-C-5202 6.1	Direct load for 10 Sec. in the Direction of the Terminal Leads	≥2.5kg (24.5N)
Resistance to Soldering Heat	JIS-C-5202 6.4	350°C ± 10°C for 3 ± 0.5 Seconds	±0.20%+0.05Ω
Solderability	JIS-C-5202 6.5	235°C ± 5°C for 5 ± 0.5 Seconds	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	±0.25%+0.05Ω
Humidity	JIS-C-5202 7.5	40±2°C, 90~95% RH for 1,000 Hrs.	±0.50%+0.05Ω
Load Life in Humidity	JIS-C-5202 7.9	40±2°C, 90~95% RH at RCWV for 1,000 Hrs. (1.5 Hrs. on , 0.5 Hrs. off)	±1.0%+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)	±1.0%+0.05Ω

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

Metal Film Resistors

PROFESSIONAL TYPE

Miniature Style [MF0 Series]



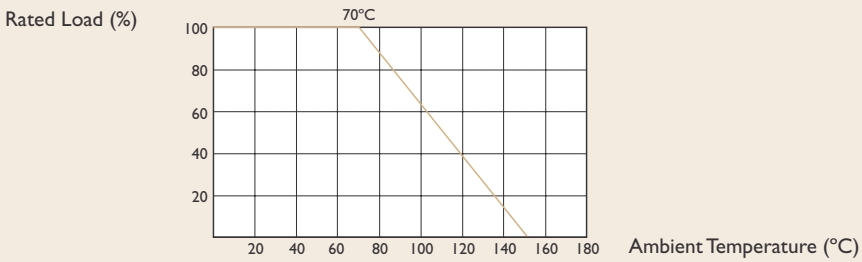
INTRODUCTION

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.

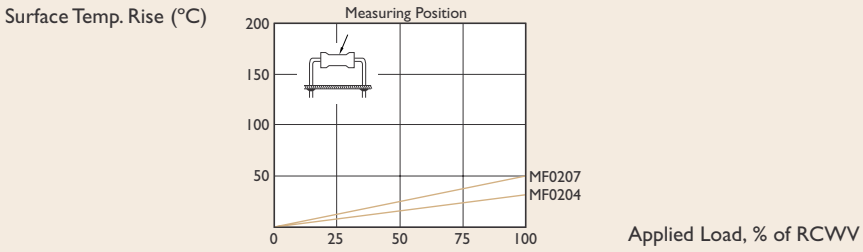
FEATURES

DIN	44061, 45921 part 107
CECC	40101-039, 40101-017
MIL	10509F (Char. D & C)
Resistance Tolerance	±1%
T.C.R.	±50ppm/°C

DERATING CURVE

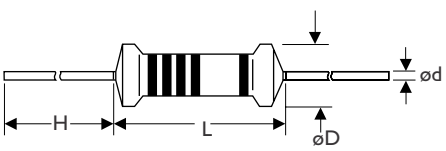


HOT-SPOT TEMPERATURE



DIMENSIONS

Unit : mm



STYLE	L	øD	H	ød
MF0204	3.4±0.3	1.9±0.2	28±2.0	0.5±0.05
MF0207	6.3±0.5	2.4±0.2	28±2.0	0.6±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 ±1%	10Ω~1MΩ	
Temperature Coefficient	±50ppm/°C	

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

ENVIRONMENTAL CHARACTERISTICS

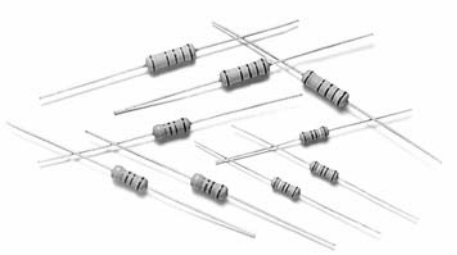
PERFORMANCE TEST	TEST METHOD		APPRAISE
Short Time Overload	JIS-C-5202 5.5	2.5 Times RCWV for 5 Seconds	±(0.25%+0.05Ω)
Dielectric Withstanding Voltage	JIS-C-5202 5.7	in V-Block for 60 Seconds	by Type
Temperature Coefficient of Resistance	JIS-C-5202 5.2	-55°C to +155°C	±50ppm/°C
Insulation Resistance	JIS-C-5202 5.6	in V-Block	>10000MΩ
Solderability	JIS-C-5202 6.5	235°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)= $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

Metal Film Resistors

FLAME-PROOF TYPE

Normal & Miniature Style [FMF Series]



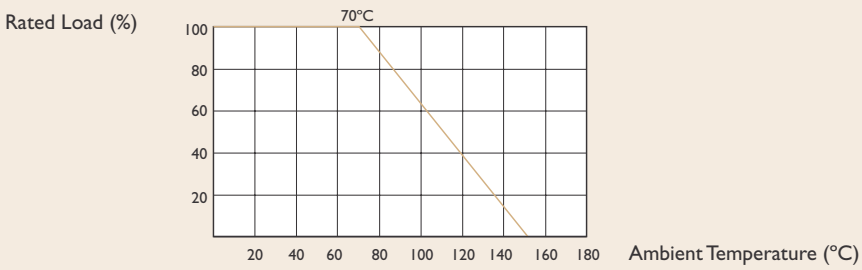
INTRODUCTION

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 resistor is designed to replace the metal oxide resistors and low power wire wound resistors, where when flame-proof and small size is needed.

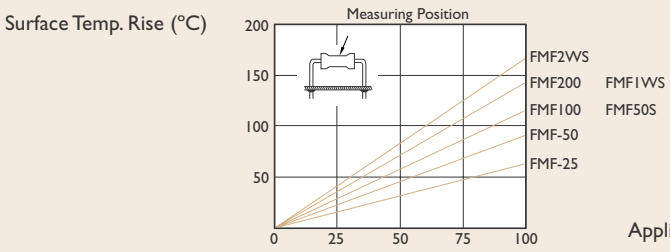
FEATURES

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

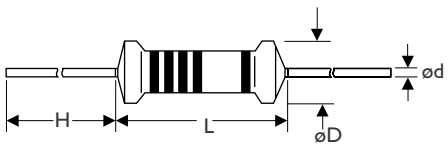
DERATING CURVE



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

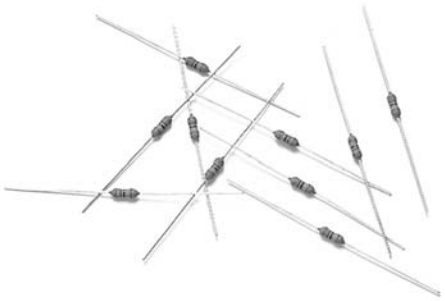
PERFORMANCE TEST	TEST METHOD		APPRAISE
Short Time Overload	JIS-C-5202 5.5	2.5 Times RCWV for 5 Seconds	±(0.25%+0.05Ω)
Dielectric Withstanding Voltage	JIS-C-5202 5.7	in V-Block for 60 Seconds	by Type
Temperature Coefficient of Resistance	JIS-C-5202 5.2	-55°C to +155°C	by Type
Insulation Resistance	JIS-C-5202 5.6	in V-Block	>1000MΩ
Solderability	JIS-C-5202 6.5	235°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)=$\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

Metal Film Resistors

PROFESSIONAL & FLAME-PROOF TYPE

Miniature Style [FM0 Series]



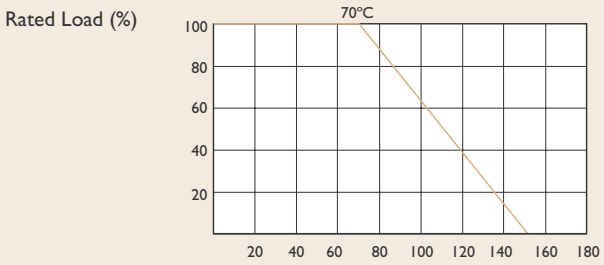
INTRODUCTION

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.

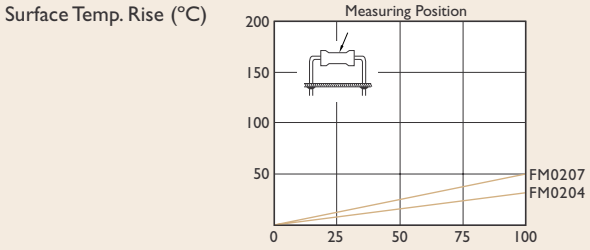
FEATURES

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

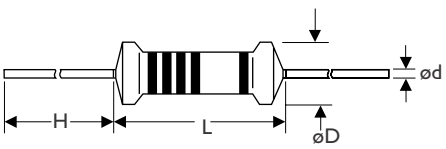


HOT-SPOT TEMPERATURE



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 ±1%	10Ω~1MΩ	
Temperature Coefficient	±50ppm/°C	

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

ENVIRONMENTAL CHARACTERISTICS

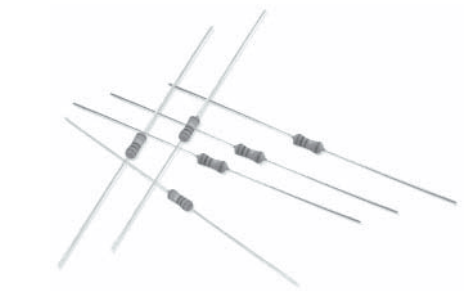
PERFORMANCE TEST	TEST METHOD		APPRAISE
Short Time Overload	JIS-C-5202 5.5	2.5 Times RCWV for 5 Seconds	±(0.25%+0.05Ω)
Dielectric Withstanding Voltage	JIS-C-5202 5.7	in V-Block for 60 Seconds	by Type
Temperature Coefficient of Resistance	JIS-C-5202 5.2	-55°C to +155°C	±50ppm/°C
Insulation Resistance	JIS-C-5202 5.6	in V-Block	>1000MΩ
Solderability	JIS-C-5202 6.5	235°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)=$\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

Metal Film Resistors

Power Flame-proof Type

FMP Series

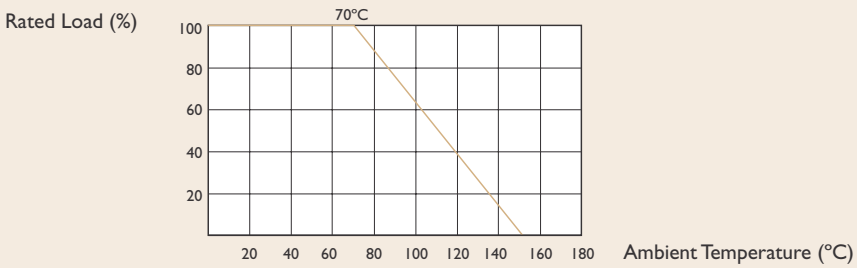


GENERAL PURPOSE

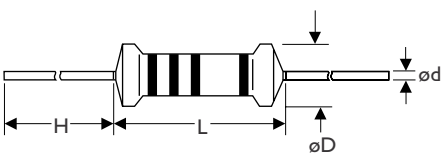
- Power Rating : 1/2W, 1W, 2W, 3W
- Resistance Tolerance : ±1% , ±5%
- High thermal conductivity and specific gravity rods
- FlameProof Silicone Coating : UL94V-0
- Pink body color

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	0.8±0.05
FMP300	15.5±1.0	5.0±0.5	33±2.0	0.8±0.05

Note :

ELECTRICAL CHARACTERISTICS

PERFORMANCE 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 (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

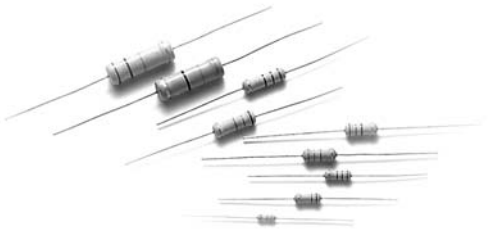
PERFORMANCE TEST	TEST METHOD		APPRAISE
Terminal Strength	JIS-C-5202 6.1	Direct load for 10 Sec. in the Direction of the Terminal Leads	≥2.5kg (24.5N)
Resistance to Soldering Heat	JIS-C-5202 6.4	350°C ± 10°C for 3 ± 0.5 Seconds	±0.25%+0.05Ω
Solderability	JIS-C-5202 6.5	235°C ± 5°C for 5 ± 0.5 Seconds	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. (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)= $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

Metal Oxide Film Resistors

FLAME-PROOF TYPE

Normal & Miniature Style [RSF Series]



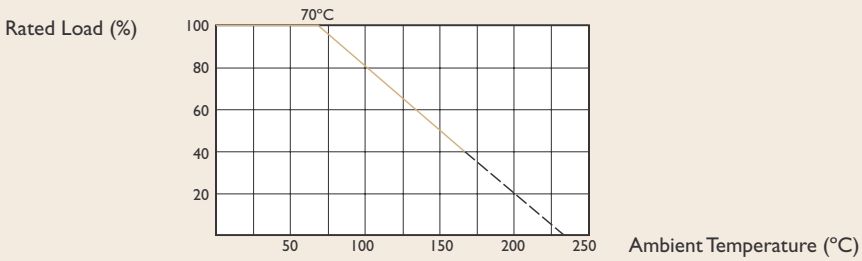
FEATURES

- Low Cost, Prompt Delivery
- High Power-to-Size Ratio for Significant Space Savings
- Flameproof Silicone Coating (UL94V-0)
- High Surge/Overload Capability
- Non-Inductive Design
- Wide Resistance Range: 1Ω~1MΩ
- Resistance ToLerance: ±5%

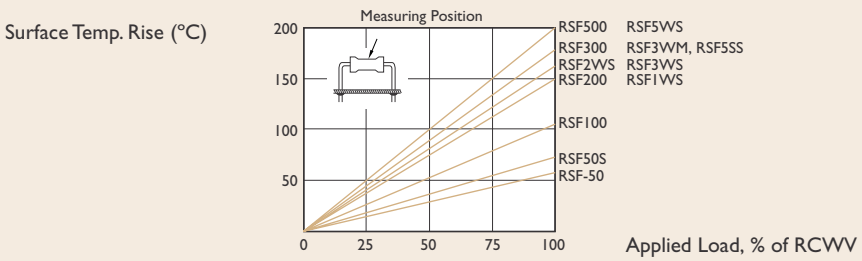
INTRODUCTION

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

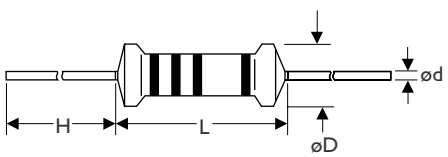
DERATING CURVE



HOT-SPOT TEMPERATURE



DIMENSIONS



Unit : mm

STYLE		DIMENSION			
Normal	**Miniature**	**L**	**øD**	**H**	**ød**
RSF-25	RSF50S	6.3±0.5	2.4±0.2	28±2.0	0.6±0.05
RSF-50	RSF1WS	9.0±0.5	3.3±0.3	26±2.0	0.6±0.05
RSF100	RSF2WS	11.5±1.0	4.5±0.5	35±2.0	0.8±0.05
RSF200	RSF3WS	15.5±1.0	5.0±0.5	33±2.0	0.8±0.05
RSF5SS	RSF3WM	17.5±1.0	6.5±1.0	32±2.0	0.8±0.05
RSF300	RSF5WS	24.5±1.0	8.5±1.0	38±2.0	0.8±0.05
RSF500	–	24.5±1.0	8.5±1.0	38±2.0	0.8±0.05

* RSF1WS (MB Type) ød0.8±0.05

Note :

ELECTRICAL CHARACTERISTICS

STYLE	RSF-25	RSF50S	RSF-50	RSF1WS	RSF100	RSF2WS	RSF200	RSF3WS/ RSF3WM	RSF300	RSF5SS/ 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

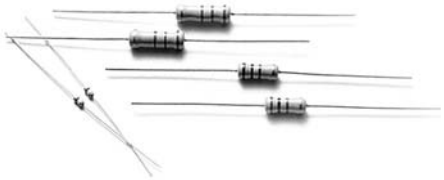
PERFORMANCE TEST	TEST METHOD		APPRAISE
Short Time Overload	JIS-C-5202 5.5	2.5 Times RCWV for 5 Seconds	±(1%+0.05Ω)
Dielectric Withstanding Voltage	JIS-C-5202 5.7	in V-Block for 60 Seconds	by Type
Temperature Coefficient of Resistance	JIS-C-5202 5.2	-55°C to +155°C	±300ppm/°C
Insulation Resistance	JIS-C-5202 5.6	in V-Block	>1000MΩ
Solderability	JIS-C-5202 6.5	235°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)= $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

Carbon Film Resistors

CFR Series

Normal & Miniature Style



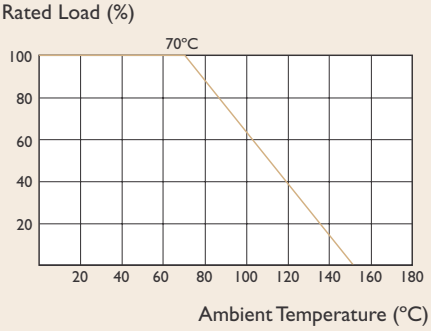
FEATURES

- 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: ±2%, ±5%
- Variety of Packaging–Bulk, Strip Pack, 26mm and 52mm Tape and Reel, Cut and Formed, or Radial Panasert/Avisert

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.

DERATING CURVE



HOT-SPOT TEMPERATURE

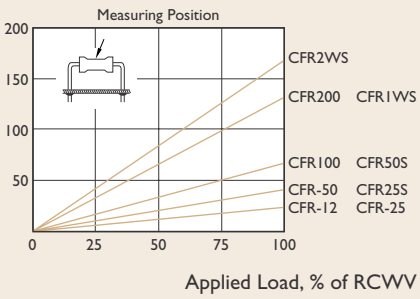
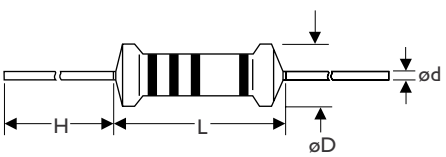


TABLE I TEMPERATURE COEFFICIENT

STYLE	Max. Value of Temp. Coefficient ppm/°C		
	under 100KΩ	100KΩ ~ 1MΩ	1MΩ ~ 10MΩ
CFR100, CFR200, CFR2WS	±350	-500	-1500
CFR-12, CFR-25, CFR-50, CFR25S, CFR50S, CFR1WS	+350 -500	-700	-1500

DIMENSIONS



Unit : mm

STYLE		DIMENSION			
Normal	Miniature	L	øD	H	ød
CFR-12	CFR25S	3.4±0.3	1.9±0.2	28±2.0	0.5±0.05
CFR-25	CFR50S	6.3±0.5	2.4±0.2	28±2.0	0.6±0.05
CFR-50	CFR1WS	9.0±0.5	3.3±0.3	26±2.0	0.6±0.05
CFR100	CFR2WS	11.5±1.0	4.5±0.5	35±2.0	0.8±0.05
CFR200	–	15.5±1.0	5.0±0.5	33±2.0	0.8±0.05

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 1								

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

ENVIRONMENTAL CHARACTERISTICS

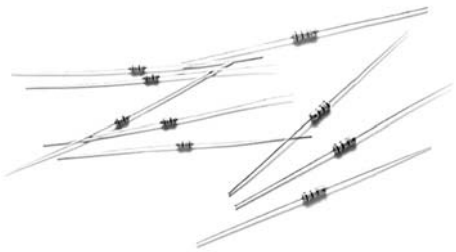
PERFORMANCE TEST	TEST METHOD		APPRAISE
Short Time Overload	JIS-C-5202 5.5	2.5 Times RCWV for 5 Seconds	±(0.75%+0.05Ω)
Dielectric Withstanding Voltage	JIS-C-5202 5.7	in V-Block for 60 Seconds	by Type
Temperature Coefficient of Resistance	JIS-C-5202 5.2	-55°C to +155°C	by Type
Insulation Resistance	JIS-C-5202 5.6	in V-Block	>1000MΩ
Solderability	JIS-C-5202 6.5	235°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]



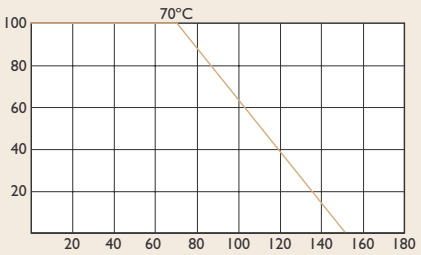
FEATURES

- Excellent Long-Term Stability
- Miniature in Size
- Resistance Tolerance: ±5%
- Resistance Range: 1Ω~10MΩ

INTRODUCTION

The CF0 series are manufactured by Coating a homogeneous film of pure carbon on high grade ceramic rods, resistance less than 10Ω have an electroless-deposited nickel film. The resistors are coated with layers of tan color lacquer.

DERATING CURVE



HOT-SPOT TEMPERATURE

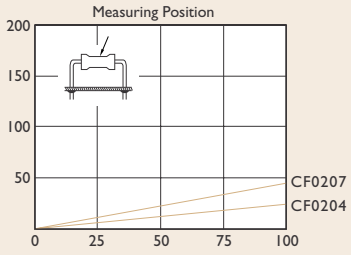
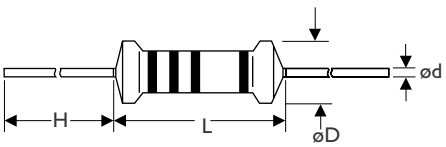


TABLE I TEMPERATURE COEFFICIENT

STYLE	Max. Value of Temp. Coefficient ppm/°C		
	under 100KΩ	100KΩ ~ 1MΩ	1MΩ ~ 10MΩ
CF0204, CF0207	+350 -500	-700	-1500

DIMENSIONS

Unit : mm



STYLE	L	øD	H	ød
CF0204	3.4±0.3	1.9±0.2	28±2.0	0.5±0.05
CF0207	6.3±0.5	2.4±0.2	28±2.0	0.6±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 ±5%	1Ω~10MΩ	
Temp. Coefficient (by Type)	see TABLE 1	

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

ENVIRONMENTAL CHARACTERISTICS

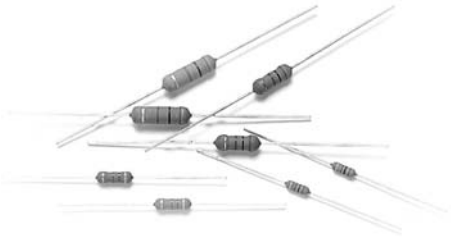
PERFORMANCE TEST	TEST METHOD		APPRAISE
Short Time Overload	JIS-C-5202 5.5	2.5 Times RCWV for 5 Seconds	±(0.75%+0.05Ω)
Dielectric Withstanding Voltage	JIS-C-5202 5.7	in V-Block for 60 Seconds	by Type
Temperature Coefficient of Resistance	JIS-C-5202 5.2	-55°C to +155°C	by Type
Insulation Resistance	JIS-C-5202 5.6	in V-Block	>1000MΩ
Solderability	JIS-C-5202 6.5	235°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

FLAME-PROOF TYPE

Normal & Miniature Style [FCR Series]



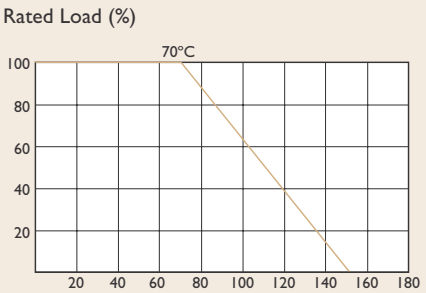
FEATURES

- 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: 1Ω~10MΩ
- Resistance Tolerance: ±5%

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 10Ω 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.

DERATING CURVE



HOT-SPOT TEMPERATURE

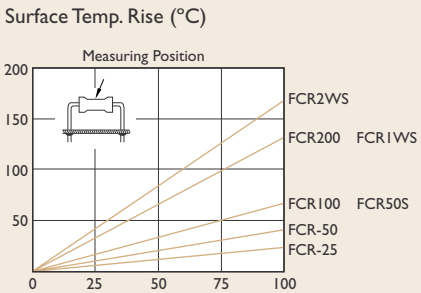
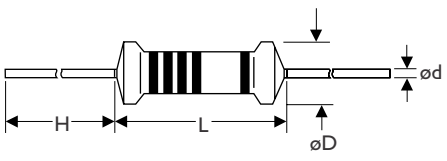


TABLE1 TEMPERATURE COEFFICIENT

STYLE	Max. Value of Temp. Coefficient ppm/°C		
	under 100KΩ	100KΩ ~ 1MΩ	1MΩ ~ 10MΩ
FCR100, FCR200, FCR2WS	±350	-500	-1500
FCR-25, FCR-50, FCR50S, FCR1WS	+350 -500	-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±0.5	2.4±0.2	28±2.0	0.6±0.05
FCR-50	FCR1WS	9.0±0.5	3.3±0.3	26±2.0	0.6±0.05
FCR100	FCR2WS	11.5±1.0	4.5±0.5	35±2.0	0.8±0.05
FCR200	–	15.5±1.0	5.0±0.5	33±2.0	0.8±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 ±2%, ±5%	1Ω~10MΩ						
Temperature Coefficient (by Type)	see TABLE1						

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

ENVIRONMENTAL CHARACTERISTICS

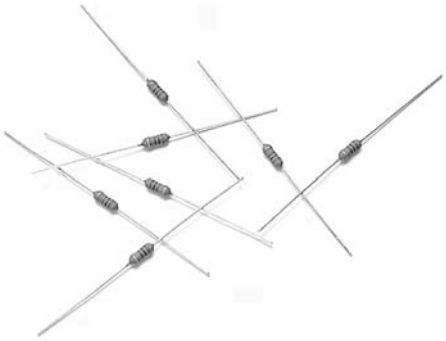
PERFORMANCE TEST	TEST METHOD		APPRAISE
Short Time Overload	JIS-C-5202 5.5	2.5 Times RCWV for 5 Seconds	±(0.75%+0.05Ω)
Dielectric Withstanding Voltage	JIS-C-5202 5.7	in V-Block for 60 Seconds	by Type
Temperature Coefficient of Resistance	JIS-C-5202 5.2	-55°C to +155°C	by Type
Insulation Resistance	JIS-C-5202 5.6	in V-Block	>1000MΩ
Solderability	JIS-C-5202 6.5	235°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 & FLAME-PROOF TYPE

Miniature Style [FC0 Series]



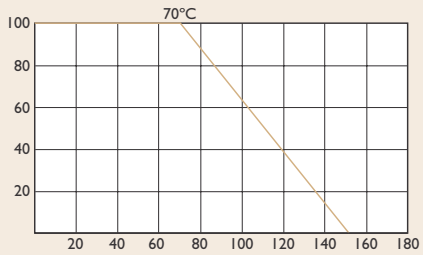
FEATURES

- Excellent Long-Term Stability
- Miniature in Size
- Flameproof Silicone Coating (UL94V-0)
- Resistance Tolerance: ±5%
- Resistance Range: 1Ω~10MΩ

INTRODUCTION

The FC0 series are manufactured by Coating a homogeneous film of pure carbon on high grade ceramic rods, resistance less than 10Ω 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.

DERATING CURVE



HOT-SPOT TEMPERATURE

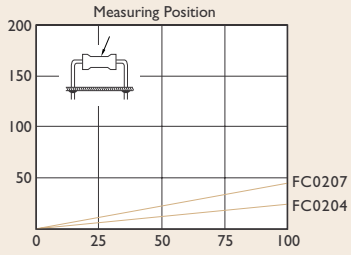
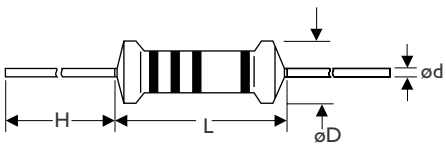


TABLE I TEMPERATURE COEFFICIENT

STYLE	Max. Value of Temp. Coefficient ppm/°C		
	under 100KΩ	100KΩ ~ 1MΩ	1MΩ ~ 10MΩ
FC0204, FC0207	+350 -500	-700	-1500

DIMENSIONS

Unit : mm



STYLE	L	øD	H	ød
FC0204	3.4±0.3	1.9±0.2	28±2.0	0.5±0.05
FC0207	6.3±0.5	2.4±0.2	28±2.0	0.6±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 ±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°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)= $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

Metal Film Resistors

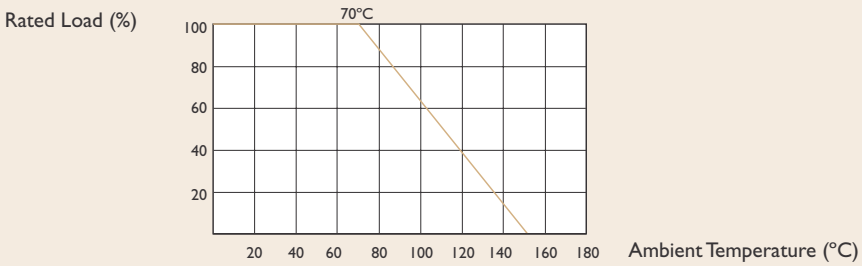
Non Inductive Type
NCR Series
Normal Style

FEATURES

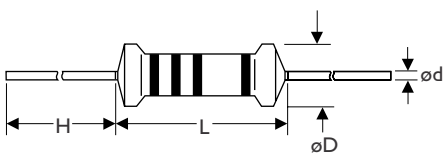
- Power Rating : 1/4W, 1/2W, 1W, 2W
- Resistance Tolerance : ±5% , ±10%
- FlameProof Silicone Coating : UL94V-0
- Gray body color
- The 5th color band is green to represent non-inductive resistors
- Inductance : <1μH

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
NCR-25	6.3±0.5	2.4±0.2	28±2.0	0.6±0.05
NCR-50	9.0±0.5	3.3±0.3	26±2.0	0.7±0.05
NCR100	11.5±1.0	4.5±0.5	35±2.0	0.8±0.05
NCR200	15.5±1.0	5.0±0.5	33±2.0	0.8±0.05

Note :

ELECTRICAL CHARACTERISTICS

PERFORMANCE STYLE	TEST METHOD		NCR-25	NCR-50	NCR100	NCR200
Power Rating at 70°C			1/4W	1/2W	1W	2W
Dielectric Withstanding Voltage	JIS-C-5202 5.7	in V-Block for 60 Seconds	500V	700V	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			
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 (1 Sec. on , 25 Sec. off)	±0.75%+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. (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)= $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

Metal Film Resistors

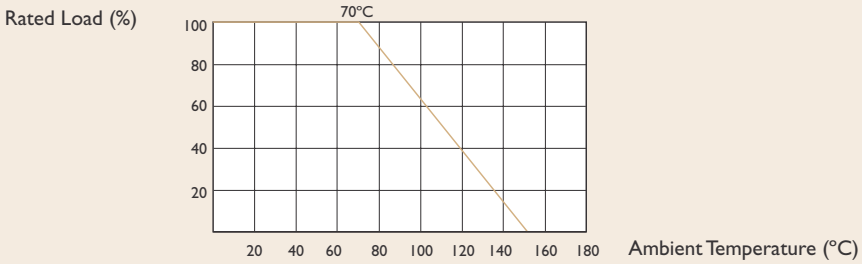
Non Inductive Type
NCR Series
Miniature Style

FEATURES

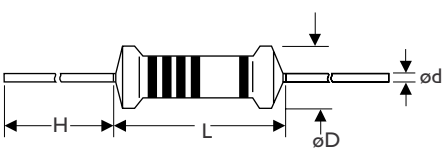
- Power Rating : 1/2WS, 1WS, 2WS, 3WS
- Resistance Tolerance : ±5% , ±10%
- FlameProof Silicone Coating : UL94V-0
- High thermal conductivity and specific gravity rods.
- Pink body color
- The 5th color band is green to represent non-inductive resistors
- Inductance : <1 μ H

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
NCR50S	6.3±0.5	2.4±0.2	28±2.0	0.6±0.05
NCR1WS	9.0±0.5	3.3±0.3	26±2.0	0.7±0.05
NCR2WS	11.5±1.0	4.5±0.5	35±2.0	0.8±0.05
NCR3WS	15.5±1.0	5.0±0.5	33±2.0	0.8±0.05

Note :

ELECTRICAL CHARACTERISTICS

PERFORMANCE STYLE	TEST METHOD		NCR50S	NCR1WS	NCR2WS	NCR3WS
Power Rating at 70°C			1/2W	1W	2W	3W
Dielectric Withstanding Voltage	JIS-C-5202 5.7	in V-Block for 60 Seconds	500V	700V	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	±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 (1 Sec. on , 25 Sec. off)	±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. (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)= $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

Zerohm Resistors

ZOR Series

INTRODUCTION

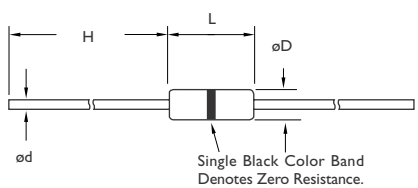
- Similar to a 1/4W resistor (1/6W size also available, typical resistance 0.004Ω)
- Ideal for automatic insertion or Cut and Form
- Available in Tape/Reel, Tape/Box and Bulk
- Film type Zerohm also available in 1/4W (ZOR-25) and 1/6W (ZOR-12) size

SPECIFICATIONS

Maximum Resistance	0.005Ω
Min. Insulation Resistance Dry Wet	 10,000MΩ 100MΩ
Min. Dielectric Withstanding Voltage Atmospheric Reduced	 500V RMS 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 10 AMPS at 70°C for 1/6W

DIMENSIONS

Unit : mm



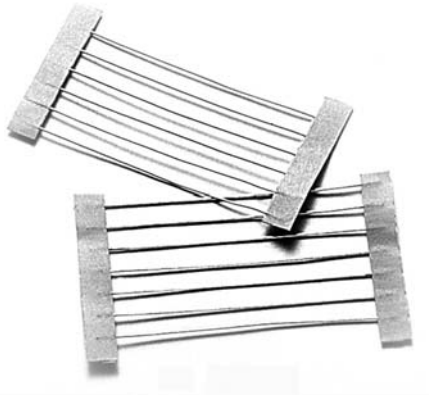
STYLE	L	øD	H	ød
ZOR-12	3.3±0.3	1.8±0.3	28±2.0	0.5±0.05
ZOR-25	6.3±0.5	2.3±0.3	28±2.0	0.6±0.05

JPW Series

Jumper Wires

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^2		
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-H3101 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:

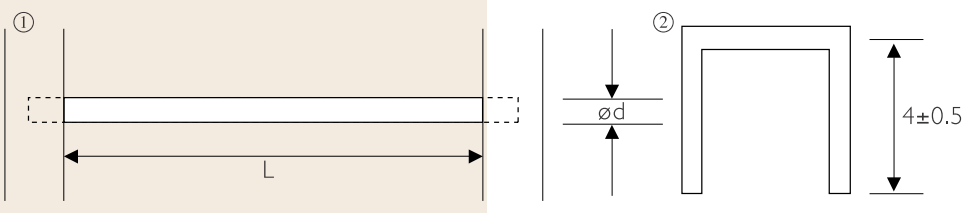
- Inability to connect two points on a P.C. Board due to other circuit paths which must be crossed over.
- An After-the-Fact design change that requires new point connections.
- Circuit tuning by changing point connections.

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

Unit : mm

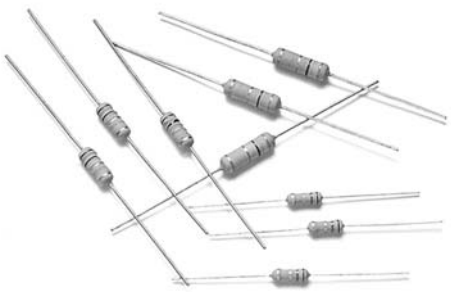
STYLE	ød	L		
JPW-05	0.5±0.05	26±1	52.4±1	–
JPW-06	0.6±0.05	26±1	52.4±1	73±1
JPW-07	0.7±0.05	26±1	52.4±1	73±1
JPW-08	0.8±0.05	26±1	52.4±1	73±1
JPW-10	1.0±0.05	26±1	52.4±1	73±1



Wire Wound Resistors

FLAME-PROOF TYPE

Normal & Miniature Style [KNP Series]



INTRODUCTION

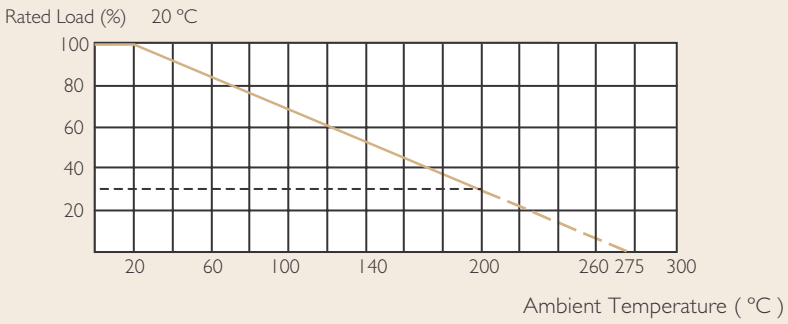
- The resistor is fabricated using a suitable fiberglass or ceramic core with the resistance wire securely crimped to the terminals
- Small in size comparatively than other kind resistor
- Electrical and Mectanical stability and high reliability
- The KNP/NKN series are coated with layers of green color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

GENERAL PURPOSE

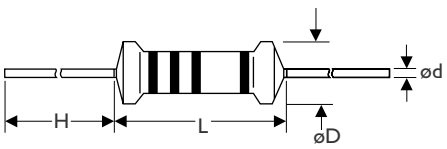
Power Rating : 1/4W, 1/2W, 1W, 2W, 3W, 5W, 7W
Resistance Tolerance : ±5%
FlameProof Silicone Coating : UL94V-0
Green body color
Stable performance in diverse environments
High safety standard

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

PERFORMANCE STYLE	TEST METHOD		APPRAISE
Limiting Voltage		$V=\sqrt{P\times R}$	
Temperature Coefficient	JIS-C-5202 5.2	Room Temp. Add 100°C	±300ppm/°C
Rated Load	JIS-C-5202 5.4	RCWV for 30 minutes	±1.0%+0.05Ω
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 , test voltage 500V	>100MΩ
Dielectric Withstanding Voltage	JIS-C-5202 5.7	in V-Block for 60 Seconds	300V
Operating Temp. Range			-40°C to + 200°C
Standard Value Range			E24 Series
Minimum Value Range			0.05Ω

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

ENVIRONMENTAL CHARACTERISTICS

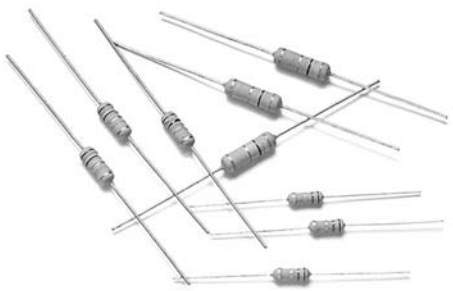
PERFORMANCE TEST	TEST METHOD		APPRAISE
Terminal Strength	JIS-C-5202 6.1	Direct load for 10 Sec. in the Direction of the Terminal Leads	≥2.5kg (24.5N)
Resistance to Soldering Heat	JIS-C-5202 6.4	350°C ± 10°C for 3 ± 0.5 Seconds	±1.0%+0.05Ω
Solderability	JIS-C-5202 6.5	235°C ± 5°C for 5 ± 0.5 Seconds	95% 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. (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)= $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

Wire Wound Resistors

Non Inductive Type

NKN Series

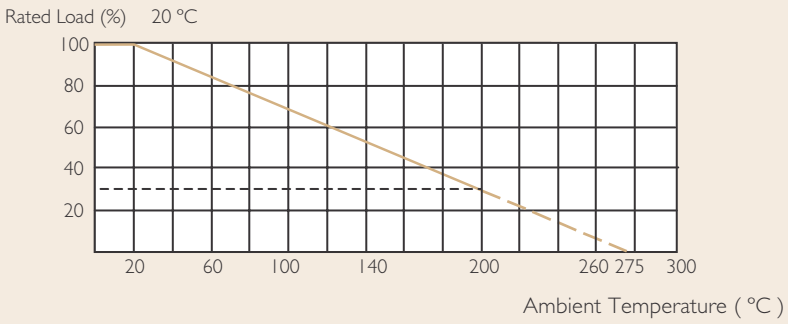


GENERAL PURPOSE

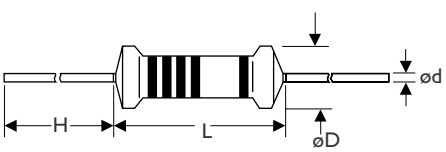
Power Rating : 1/2W, 1W, 2W, 3W, 5W, 7W
Resistance Tolerance : ±5%
FlameProof Silicone Coating : UL94V-0
Green body color
The 5th color band is black to represent non-inductive resistors
High safety standard

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

PERFORMANCE STYLE	TEST METHOD		APPRAISE
Limiting Voltage		$V=\sqrt{P\times R}$	
Temperature Coefficient	JIS-C-5202 5.2	Room Temp. Add 100°C	±300ppm/°C
Rated Load	JIS-C-5202 5.4	RCWV for 30 minutes	±1.0%+0.05Ω
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 , test voltage 500V	>100MΩ
Dielectric Withstanding Voltage	JIS-C-5202 5.7	in V-Block for 60 Seconds	250V
Operating Temp. Range			-40°C to + 200°C
Standard Value Range			E24 Series
Minimum Value Range			0.05Ω

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

ENVIRONMENTAL CHARACTERISTICS

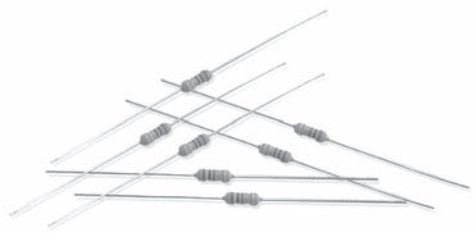
PERFORMANCE TEST	TEST METHOD		APPRAISE
Terminal Strength	JIS-C-5202 6.1	Direct load for 10 Sec. in the Direction of the Terminal Leads	≥2.5kg (24.5N)
Resistance to Soldering Heat	JIS-C-5202 6.4	350°C ± 10°C for 3 ± 0.5 Seconds	±1.0%+0.05Ω
Solderability	JIS-C-5202 6.5	235°C ± 5°C for 5 ± 0.5 Seconds	95% 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. (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

Fusible Type

Normal Style [FRM Series]

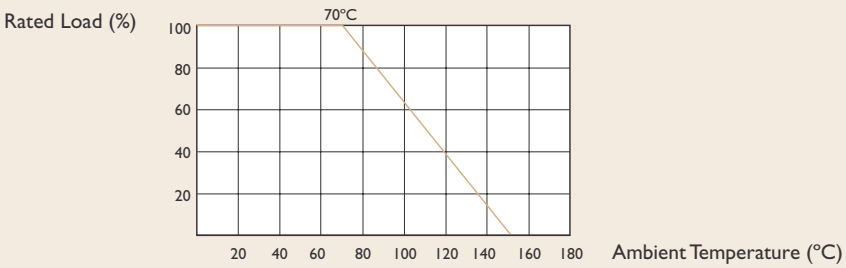


FEATURES

- Power Rating : 1/4W, 1/2W, 1W, 2W
- Resistance tolerance : ±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.

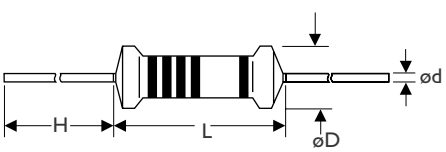


FUSING CHARACTERISTICS

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	L	øD	H	ød
FRM-25	6.3±0.5	2.4±0.2	28±2.0	0.6±0.05
FRM-50	9.0±0.5	3.3±0.3	26±2.0	0.6±0.05
FRM100	11.5±1.0	4.5±0.5	35±2.0	0.8±0.05
FRM200	15.5±1.0	5.0±0.5	33±2.0	0.8±0.05

Note :

ELECTRICAL CHARACTERISTICS

PERFORMANCE STYLE	TEST METHOD		FRM-25	FRM-50	FRM100	FRM200
Power Rating at 70°C			1/4W	1/2W	1W	2W
Dielectric Withstanding Voltage	JIS-C-5202 5.7	in V-Block for 60 Seconds	250V	250V	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 (1 Sec. on , 25 Sec. off)	±1.0%+0.05Ω			
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

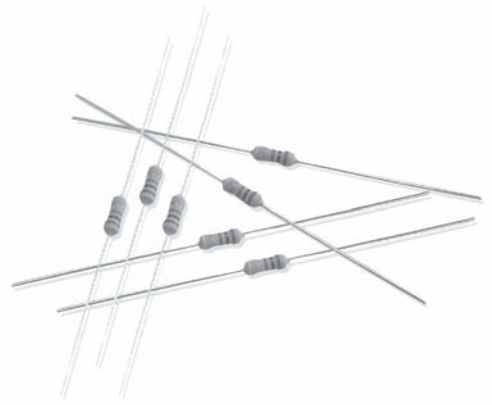
PERFORMANCE TEST	TEST METHOD		APPRAISE
Terminal Strength	JIS-C-5202 6.1	Direct load for 10 Sec. in the Direction of the Terminal Leads	≥2.5kg (24.5N)
Resistance to Soldering Heat	JIS-C-5202 6.4	350°C ± 10°C for 3 ± 0.5 Seconds	±1.0%+0.05Ω
Solderability	JIS-C-5202 6.5	235°C ± 5°C for 5 ± 0.5 Seconds	95% 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. (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

Fusible Type

Miniature Style [FRM Series]

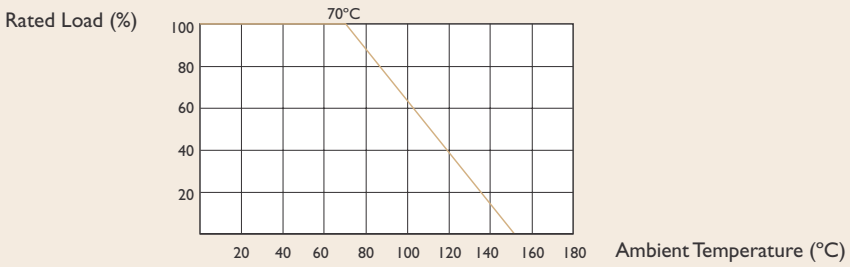


FEATURES

- Power Rating : 1/2W, 1W, 2W, 3W
- Resistance tolerance : ±5%
- FlameProof Silicone Coating : UL94V-0
- Pink 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.

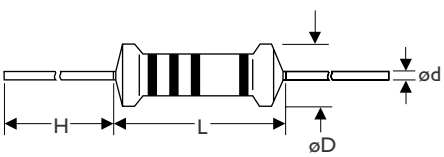


FUSING CHARACTERISTICS

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	L	øD	H	ød
FRM50S	6.3±0.5	2.4±0.2	28±2.0	0.6±0.05
FRM1WS	9.0±0.5	3.3±0.3	26±2.0	0.6±0.05
FRM2WS	11.5±1.0	4.5±0.5	35±2.0	0.8±0.05
FRM3WS	15.5±1.0	5.0±0.5	33±2.0	0.8±0.05

Note :

ELECTRICAL CHARACTERISTICS

PERFORMANCE STYLE	TEST METHOD		FRM50S	FRM1WS	FRM2WS	FRM3WS
Power Rating at 70°C			1/2W	1W	2W	3W
Dielectric Withstanding Voltage	JIS-C-5202 5.7	in V-Block for 60 Seconds	250V	250V	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 (1 Sec. on , 25 Sec. off)	±2.0%+0.05Ω			
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

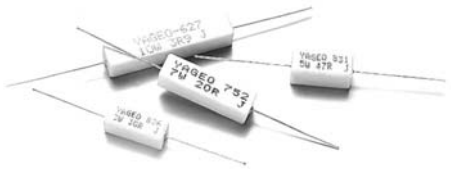
PERFORMANCE TEST	TEST METHOD		APPRAISE
Terminal Strength	JIS-C-5202 6.1	Direct load for 10 Sec. in the Direction of the Terminal Leads	≥2.5kg (24.5N)
Resistance to Soldering Heat	JIS-C-5202 6.4	350°C ± 10°C for 3 ± 0.5 Seconds	±1.0%+0.05Ω
Solderability	JIS-C-5202 6.5	235°C ± 5°C for 5 ± 0.5 Seconds	95% 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. (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 Type[SQP Series], Non-Inductive Type[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

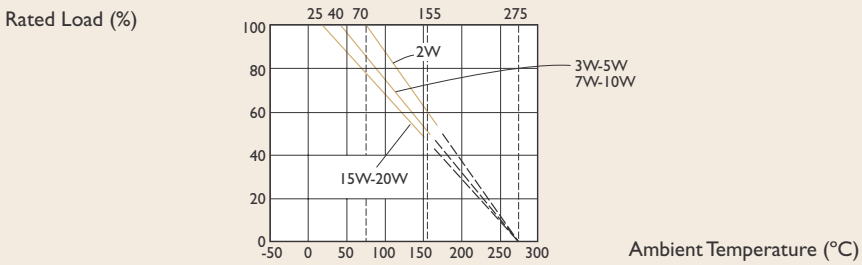
FEATURES

Exceptionally Small and Sturdy; Mechanically Safe. Excellent Electrical Characteristics

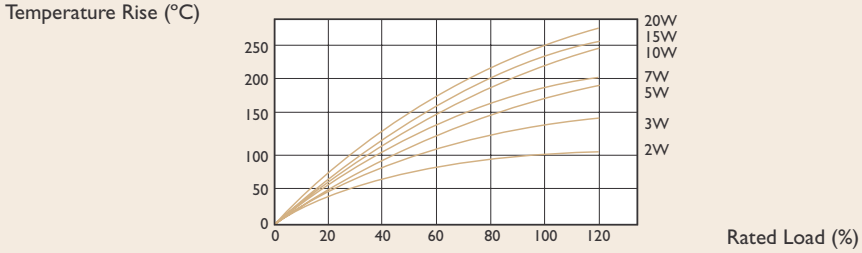
Resistance Tolerance: ±5%

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

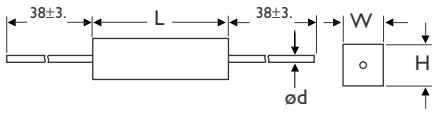
DERATING CURVE



TEMPERATURE RISE



DIMENSIONS



Unit : mm

STYLE	L	W	H	ød
SQP200	18±1.0	6.5±1.0	6.5±1.0	0.8±0.05
SQP300	22±1.5	8.0±1.0	8.0±1.0	0.8±0.05
SQP500	22±1.5	9.5±1.0	9.0±1.0	0.8±0.05
SQP700	35±1.5	9.5±1.0	9.0±1.0	0.8±0.05
SQP10A	48±1.5	9.5±1.0	9.0±1.0	0.8±0.05
SQP15A	48±1.5	12.5±1.5	12.5±1.5	1.0±0.05
SQP20A	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 50Ω only.

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	±300ppm/°C
Insulation Resistance	JIS-C-5202 5.6	in V-Block	>100MΩ
Solderability	JIS-C-5202 6.5	235°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	±(2%+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)= $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

Cement Resistors

VERTICAL LEAD TYPE

Standard Type[SQM Series], Non-Inductive Type[NSM Series]

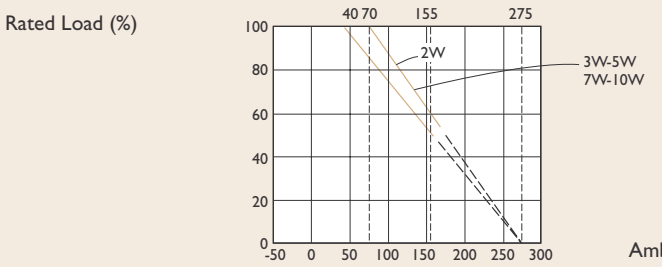
INTRODUCTION

- 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

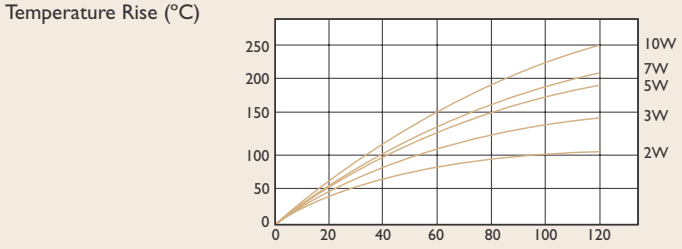
FEATURES

- Space Saving Stand-Off Type
- Small Size, High Power Capacity
- Resistance Tolerance: ±5%
- Completely Unflamable

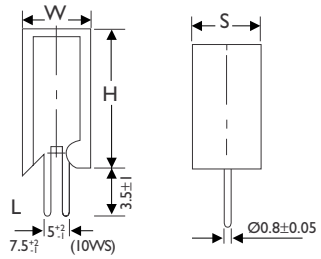
DERATING CURVE



TEMPERATURE RISE



DIMENSIONS



Unit : mm

STYLE	H	W	S
SQM200	20± 1.5	11.0± 1.0	7.0± 1.0
SQM300	25± 1.5	12.0± 1.0	8.0± 1.0
SQM500	25± 1.5	13.0± 1.0	9.0± 1.0
SQM700	39± 1.5	13.0± 1.0	9.0± 1.0
SQM10A	35± 1.5	16.0± 1.0	12.0± 1.0

Note :

ELECTRICAL CHARACTERISTICS

STYLE	SQM200	SQM300	SQM500	SQM700	SQM10A
Power Rating	2W	3W	5W	7W	10W
Operating Temp. Range	-55°C to +155°C				
Maximum Working Voltage	250V	350V	350V	500V	500V
Maximum Overload Voltage	500V	700V	700V	1000V	1000V
Dielectric Withstanding Voltage	500V	700V	700V	1000V	1000V
Value Range ±5% (Ceramic Core)	0.15Ω~100Ω	0.24Ω~120Ω	0.3Ω~180Ω	0.51Ω~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 50Ω only.

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	±300ppm/°C
Insulation Resistance	JIS-C-5202 5.6	in V-Block	>100MΩ
Solderability	JIS-C-5202 6.5	235°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	±(2%+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)= $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

Cement Resistors

RADIAL TERMINALS TYPE

Standard Type[SQZ Series], Non-Inductive Type[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

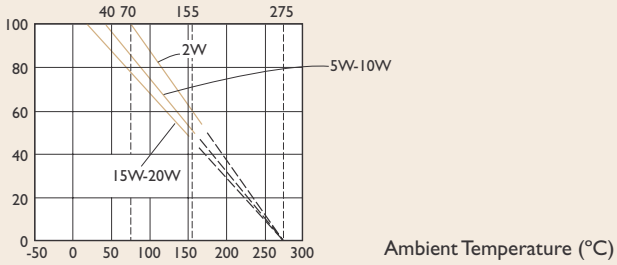
FEATURES

Space Saving Stand-Off Type

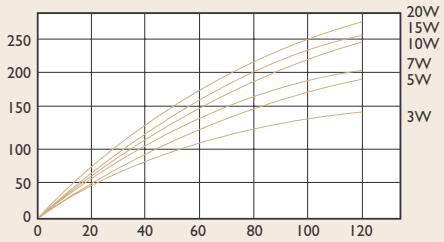
Resistance Tolerance: ±5%

Completely Unflamable

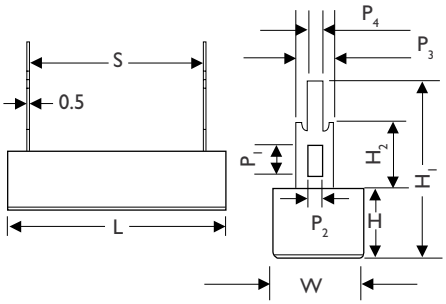
DERATING CURVE



TEMPERATURE RISE



DIMENSIONS



Unit : mm

STYLE	L	H	W	S	H_1	H_2	P_1	P_2	P_3	P_4
SQZ300	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	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	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	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	48.0±1.5	12.5±1	12.5±1	35.0±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	63.5±2.0	12.5±1	12.5±1	50.0±1	34.5±1	15.0±1.5	7.0±0.2	6.0±0.2	10.0±0.2	2.7±0.1

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 ±5% (Ceramic Core)	0.22Ω~120Ω	0.47Ω~180Ω	0.68Ω~220Ω	1Ω~270Ω		
Value Range ±5% (Metal Oxide Film)	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 50Ω only.

ENVIRONMENTAL CHARACTERISTICS

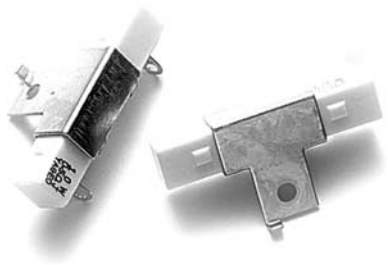
PERFORMANCE TEST	TEST METHOD		APPRAISE
Short Time Overload	JIS-C-5202 5.5	2.5 Times RCWV for 5 Seconds	±(2%+0.05Ω)
Dielectric Withstanding Voltage	JIS-C-5202 5.7	in V-Block for 60 Seconds	by Type
Temperature Coefficient of Resistance	JIS-C-5202 5.2	-55°C to +155°C	±300ppm/°C
Insulation Resistance	JIS-C-5202 5.6	in V-Block	>100MΩ
Solderability	JIS-C-5202 6.5	235°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	±(2%+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)= $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

Cement Resistors

CLAMP MOUNTING TYPE

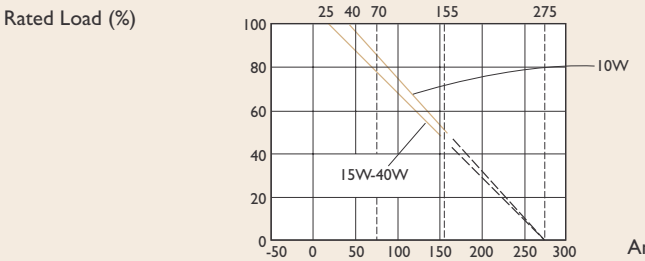
Standard Type[SQH Series], Non-Inductive Type[NSH Series]



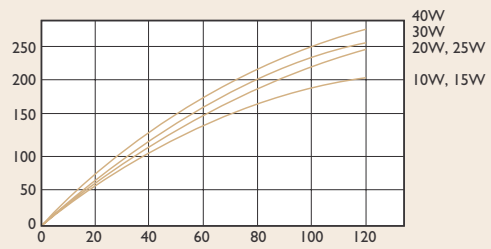
FEATURES

- Low Cost
- Small Size, High Power Capacity
- Resistance Tolerance: ±5%, ±10%
- Completely Unflamable

DERATING CURVE

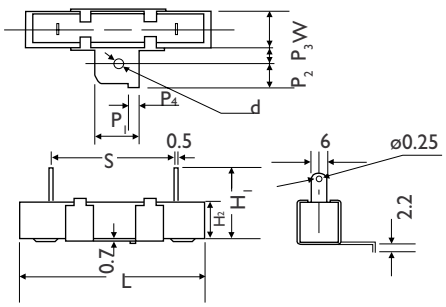


TEMPERATURE RISE

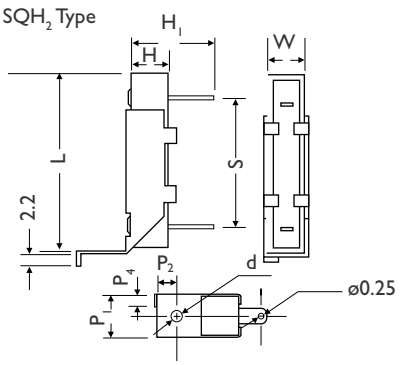


DIMENSIONS

SQH$_1$ Type



SQH$_2$ Type



Unit : mm

STYLE	L	H	W	S	H_1	H_2	P_1	P_2	P_3	P_4
SQH10A	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	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	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	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	70.0±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	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 ±5% (Ceramic Core)	0.39Ω~270Ω	0.39Ω~300Ω	0.51Ω~300Ω	0.51Ω~1KΩ	0.62Ω~1KΩ	0.62Ω~1KΩ
Value Range ±5% (Metal Oxide Film)	300Ω~10KΩ	330Ω~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 50Ω only.

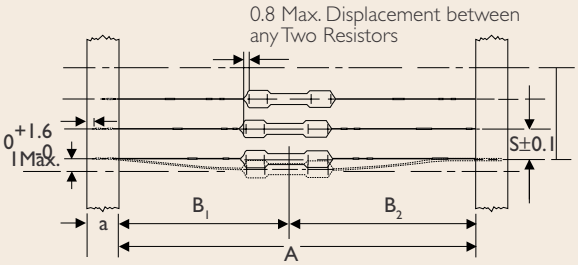
ENVIRONMENTAL CHARACTERISTICS

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	±300ppm/°C
Insulation Resistance	JIS-C-5202 5.6	in V-Block	>100MΩ
Solderability	JIS-C-5202 6.5	235°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	±(2%+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)= $\sqrt{\text{Power Rating} \times \text{Resistance Value}}$

Note :

PACKING METHODS

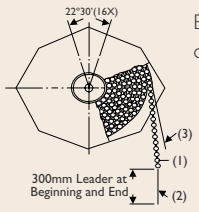


Bandolier for Axial Leads

The resistors are supplied on bandolier; either 1000 resistors in ammopack or 5000 resistors on reel.

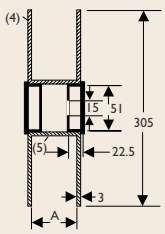
STYLE		DIMENSIONS				Unit : mm
Normal	**Miniature**	**a**	**A**	**B1-B2**	**S (Spacing)**	**T (Max. Deviation of Spacing)**
TYPE-12	TYPE25S	6±0.5	52.4±1.5	1.2	5	
			26.0±1.5			
TYPE-25	TYPE50S	6±0.5	52.4±1.5	1.2	5	
			26.0±1.5	1.0		
TYPE-50	TYPE1WS	6±0.5	52.4±1.5	1.2	5	1mm Per 10 Spacings, 0.5mm Per 5 Spacings
TYPE100	TYPE2WS	6±0.5	73.0±1.5	1.5	5	
			52.4±1.5			
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

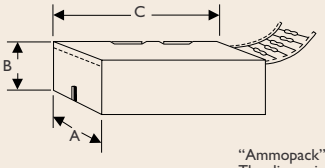


Bandoliers can be reeled; dimension a differ with type.

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



TAPE ON BOX PACKING



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

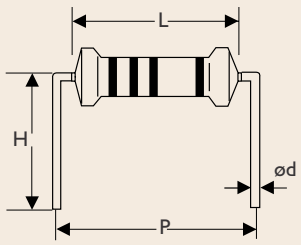
"Ammopack" is an abbreviation of "ammunition packing"
The dimensions of A-B-C vary with type and quantity.

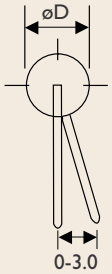
STYLE		TAPE ON REEL		TAPE ON BOX				Unit : mm/pcs
Normal	**Miniature**	**Across Flange (A)**	**QTY Per Reel**	**W(A)**	**H (B)**	**L (C)**	**QTY Per Box**
TYPE-12	TYPE25S	72	5,000	78/81	24/70	260	2,000/5,000
TYPE-25	TYPE50S	48/72	5,000	78/81	24/104	260	1,000/5,000
TYPE-50	TYPE1WS	72	2,500	73	45	258	1,000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

Note :

SPECIAL TYPE (FORMING DIMENSIONS)

M TYPE

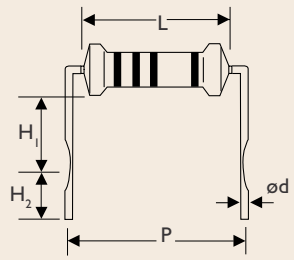


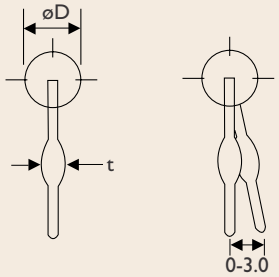


Unit : mm

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

MB TYPE



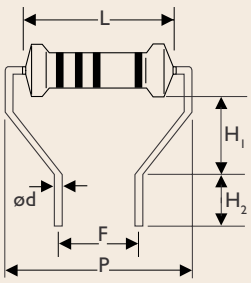


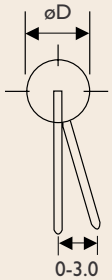
Unit : mm

STYLE		DIMENSIONS						
Normal	**Miniature**	**L**	**P**	**øD**	**ød**	**H_1**	**H_2**	**t**
TYPE-25	TYPE50S	6.3±0.5	10.0±1	2.4±0.2	0.6±0.05	6.0±1	5.0±1	1.2±0.2
TYPE-50	–	9.0±0.5	12.5±1	3.3±0.3	0.6±0.05	6.0±1	5.0±1	1.2±0.2
–	TYPE1WS	9.0±0.5	12.5±1	3.3±0.3	0.8±0.05	6.0±1	5.0±1	1.4±0.2
TYPE100	TYPE2WS	11.5±1.0	15.0±1	4.5±0.5	0.8±0.05	6.0±1	5.0±1	1.4±0.2
TYPE200	TYPE3WS	15.5±1.0	20.0±1	5.0±0.5	0.8±0.05	10.0±1	5.0±1	1.4±0.2
TYPE300	TYPE5WS	24.5±1.0	30.0±1	8.0±0.5	0.8±0.05	15.0±1	5.0±1	1.4±0.2
TYPE500	–	24.5±1.0	30.0±1	8.0±0.5	0.8±0.05	15.0±1	5.0±1	1.4±0.2

Note :

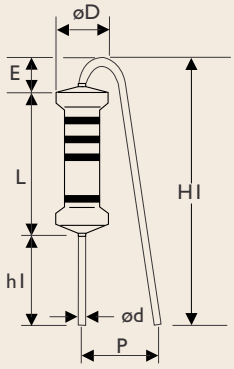
MR TYPE





STYLE	DIMENSIONS							Unit : mm
Normal	**Miniature**	**L**	**P**	**F**	**øD**	**ød**	**H_1**	**H_2**
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



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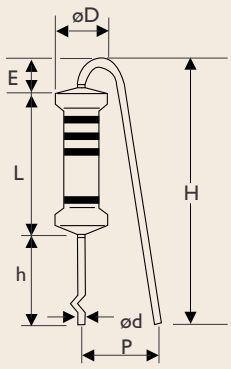
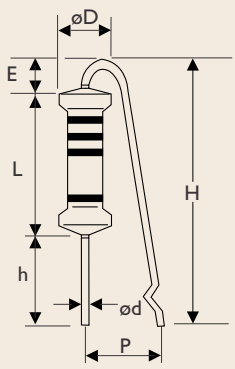


FFK TYPE



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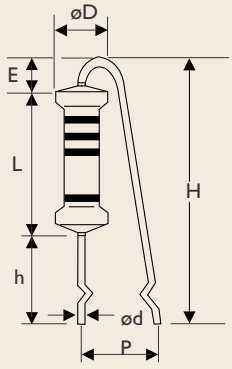


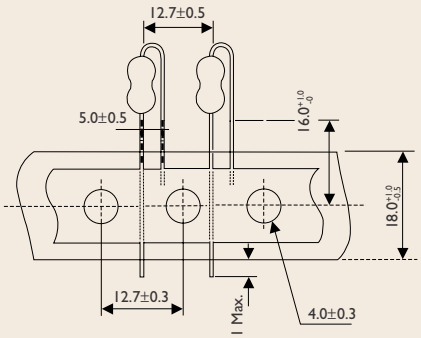
STYLE	DIMENSIONS									Unit : mm
Normal	**Miniature**	**L**	**P**	**øD**	**ød**	**h**	**H Max.**	**h_1**	**H_1 Max.**	**E Max.**
TYPE100	TYPE2WS	11.5±1	6±1	4.5±0.5	0.8±0.05	10.0±1	25	5.0±1	20	3.5
TYPE200	TYPE3WS	15.5±1	6±1	5.0±0.5	0.8±0.05	10.0±1	30	5.0±1	25	3.5

*TYPE-25/50S is available.

Note :

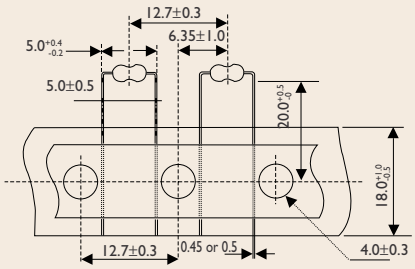
FT Type Forming for Taping

Rated Watts 1/4W & 1/2WS
Body Dimension : L = 6.3±0.5mm
øD = 2.4±0.2mm
Rated Watts : 1/2W & 1WS
Body Dimension : L = 9±0.5mm
øD = 3.3±0.3mm



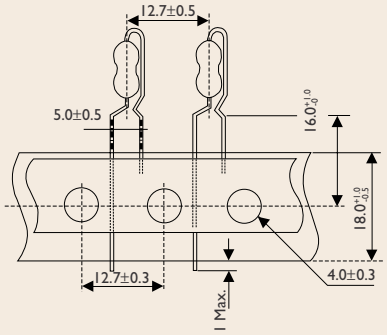
MT Type Forming for Taping

Rated Watts 1/6W & 1/4WS
Body Dimension : L = 3.4±0.3mm
øD = 1.9±0.2mm



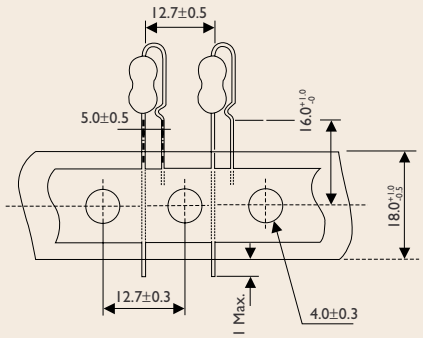
PN Type Forming for Taping

Rated Watts 1/4W & 1/2WS
Body Dimension : L = 6.3±0.5mm
øD = 2.4±0.2mm
Rated Watts : 1/2W & 1WS
Body Dimension : L = 9±0.5mm
øD = 3.3±0.3mm



AV Type Forming for Taping

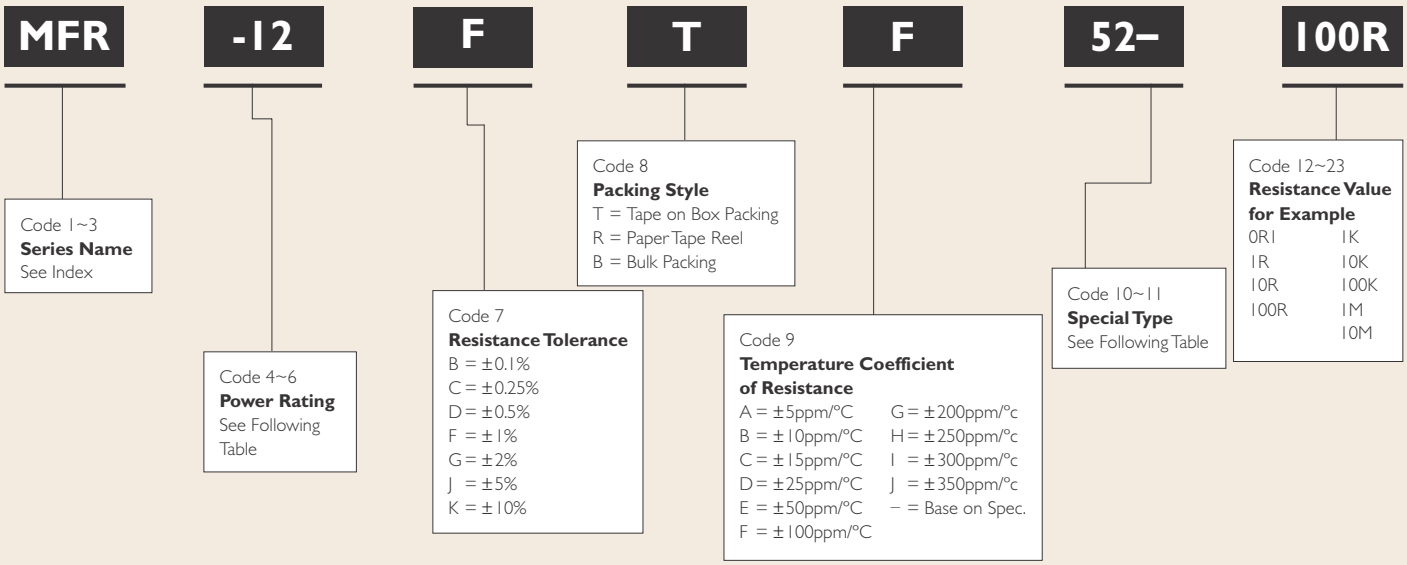
Rated Watts 1/4W & 1/2WS
Body Dimension : L = 6.3±0.5mm
øD = 2.4±0.2mm
Rated Watts : 1/2W & 1WS
Body Dimension : L = 9±0.5mm
øD = 3.3±0.3mm



Note :

EXPLANATIONS OF ORDERING CODE

For Leaded Resistor
Explanations of Ordering Code

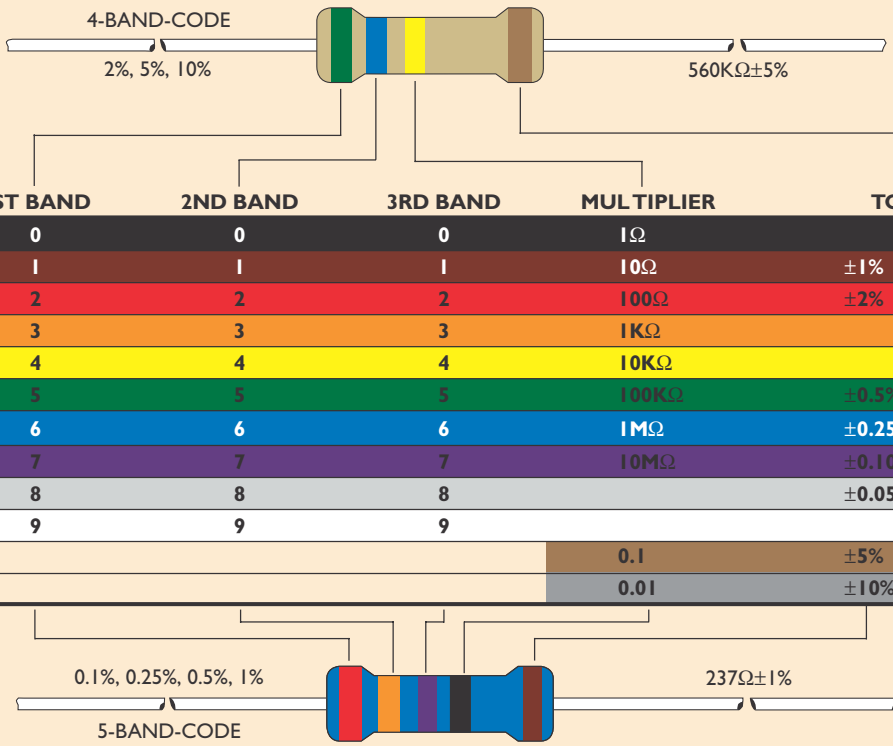


CODE 4~6

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 10~11

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	



COLOR	1ST BAND	2ND BAND	3RD BAND	MULTIPLIER	TOLERANCE	
BLACK	0	0	0	1Ω		
BROWN	1	1	1	10Ω	±1%	(F)
RED	2	2	2	100Ω	±2%	(G)
ORANGE	3	3	3	1KΩ		
YELLOW	4	4	4	10KΩ		
GREEN	5	5	5	100KΩ	±0.5%	(D)
BLUE	6	6	6	1MΩ	±0.25%	(C)
VIOLET	7	7	7	10MΩ	±0.10%	(B)
GREY	8	8	8		±0.05%	
WHITE	9	9	9			
GOLD				0.1	±5%	(J)
SILVER				0.01	±10%	(K)

STANDARD RESISTANCE VALUES FOR THE 10-TO-100 DECADE

(Also Usable in Decade Multiples or Sub-Multiples)

RESISTANCE TOLERANCE (±%)

0.1% 0.25% 0.5%	1%	2% 5% 10%	0.1% 0.25% 0.5%	1%	2% 5% 10%	0.1% 0.25% 0.5%	1%	2% 5% 10%	0.1% 0.25% 0.5%	1%	2% 5% 10%	0.1% 0.25% 0.5%	1%	2% 5% 10%	0.1% 0.25% 0.5%	1%	2% 5% 10%
10.0	10.0	10	14.7	14.7	–	21.5	21.5	–	31.6	31.6	–	46.4	46.4	–	68.1	68.1	68
10.1	–	–	14.9	–	–	21.8	–	–	32.0	–	–	47.0	–	47	69.0	–	–
10.2	10.2	–	15.0	15.0	15	22.1	22.1	22	32.4	32.4	–	47.5	47.5	–	69.8	69.8	–
10.4	–	–	15.2	–	–	22.3	–	–	32.8	–	–	48.1	–	–	70.6	–	–
10.5	10.5	–	15.4	15.4	–	22.6	22.6	–	33.2	33.2	33	48.7	48.7	–	71.5	71.5	–
10.6	–	–	15.6	–	–	22.9	–	–	33.6	–	–	49.3	–	–	72.3	–	–
10.7	10.7	–	15.8	15.8	–	23.2	23.2	–	34.0	34.0	–	49.9	49.9	–	73.2	73.2	–
10.9	–	–	16.0	–	16	23.4	–	–	34.4	–	–	50.5	–	–	74.1	–	–
11.0	11.0	11	16.2	16.2	–	23.7	23.7	–	34.8	34.8	–	51.1	51.1	51	75.0	75.0	75
11.1	–	–	16.4	–	–	24.0	–	24	35.2	–	–	51.7	–	–	75.9	–	–
11.3	11.3	–	16.5	16.5	–	24.3	24.3	–	35.7	35.7	–	52.3	52.3	–	76.8	76.8	–
11.4	–	–	16.7	–	–	24.6	–	–	36.1	–	36	53.0	–	–	77.7	–	–
11.5	11.5	–	16.9	16.9	–	24.9	24.9	–	36.5	36.5	–	53.6	53.6	–	78.7	78.7	–
11.7	–	–	17.2	–	–	25.2	–	–	37.0	–	–	54.2	–	–	79.6	–	–
11.8	11.8	–	17.4	17.4	–	25.5	25.5	–	37.4	37.4	–	54.9	54.9	–	80.6	80.6	–
12.0	–	12	17.6	–	–	25.8	–	–	37.9	–	–	55.6	–	–	81.6	–	–
12.1	12.1	–	17.8	17.8	–	26.1	26.1	–	38.3	38.3	–	56.2	56.2	56	82.5	82.5	82
12.3	–	–	18.0	–	18	26.4	–	–	38.8	–	–	56.9	–	–	83.5	–	–
12.4	12.4	–	18.2	18.2	–	26.7	26.7	–	39.2	39.2	39	57.6	57.6	–	84.5	84.5	–
12.6	–	–	18.4	–	–	27.1	–	27	39.7	–	–	58.3	–	–	85.6	–	–
12.7	12.7	–	18.7	18.7	–	27.4	27.4	–	40.2	40.2	–	59.0	59.0	–	86.6	86.6	–
12.9	–	–	18.9	–	–	27.7	–	–	40.7	–	–	59.7	–	–	87.6	–	–
13.0	13.0	13	19.1	19.1	–	28.0	28.0	–	41.2	41.2	–	60.4	60.4	–	88.7	88.7	–
13.2	–	–	19.3	–	–	28.4	–	–	41.7	–	–	61.2	–	–	89.8	–	–
13.3	13.3	–	19.6	19.6	–	28.7	28.7	–	42.2	42.2	–	61.9	61.9	62	90.9	90.9	91
13.5	–	–	19.8	–	–	29.1	–	–	42.7	–	–	62.6	–	–	92.0	–	–
13.7	13.7	–	20.0	20.0	20	29.4	29.4	–	43.2	43.2	43	63.4	63.4	–	93.1	93.1	–
13.8	–	–	20.3	–	–	29.8	–	–	43.7	–	–	64.2	–	–	94.2	–	–
14.0	14.0	–	20.5	20.5	–	30.1	30.1	30	44.2	44.2	–	64.9	64.9	–	95.3	95.3	–
14.2	–	–	20.8	–	–	30.5	–	–	44.8	–	–	65.7	–	–	96.5	–	–
14.3	14.3	–	21.0	21.0	–	30.9	30.9	–	45.3	45.3	–	66.5	66.5	–	97.6	97.6	–
14.5	–	–	21.3	–	–	31.2	–	–	45.9	–	–	67.3	–	–	98.8	–	–
E-192	E-96	E-24	E-192	E-96	E-24	E-192	E-96	E-24	E-192	E-96	E-24	E-192	E-96	E-24	E-192	E-96	E-24