

Firstohm[®] Since 1969

We commit to a better life and a better world

FIRSTOHM GROUP CAN HELP



**SAFETY
QUALITY
RELIABILITY**



第一電阻電容器股份有限公司
FIRST RESISTOR & CONDENSER CO., LTD.

Company Profile

Established in 1969, First Resistor & Condenser Co., Ltd. (Firstohm) is specialized in thin film resistors. Backed by strong in-house research and development capability and manufacturing technology acquired from major partners in Japan and the US, Firstohm has pioneered the development in various types of resistors in response to the changing environment of global industries.



Philosophy and Mission

Given the fast developing technology landscape, the ability of component manufacturers to evolve and provide quality parts in time has become increasingly crucial to introduction of new electronic products. Our goal at Firstohm is to constantly pursue innovation and to provide customers with quality products and reliable services in a cost efficient and timely manner.

Why to stay with us

- **Extensive range of specialty resistors** – These products include MELF resistors, surge resistors, high voltage resistors, precision resistors, and current sense resistors.
- **Customer oriented** – Firstohm is able to customize products and services according to customer's special requirement.
- **In-house research and development capability** – This enables Firstohm's swift responses to the market trend. (Safe, Quality, Reliability, Cost-Down via Innovation).
- **Solution provider** – To ensure optimal outcome, Firstohm closely collaborates with the customers from the initial technical consulting to the final resistor product selection.

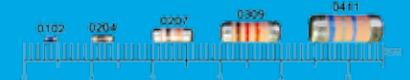
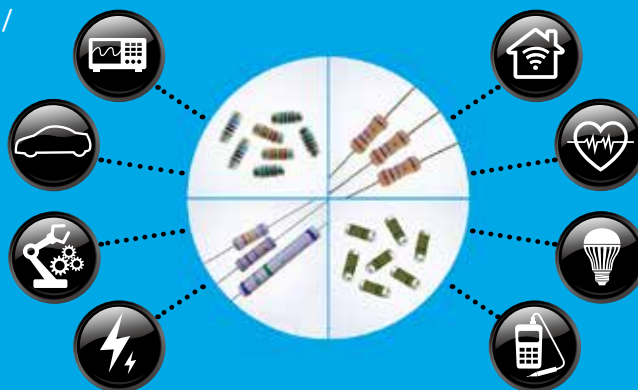
medical / lighting / test & measurement /
industrial automation / power supply /
telecommunication / Automotive /
smart home /

where OHM comes FIRST.

MELF 0102 / 0204 / 0207 /
0309 / 0411 / 0515 /



Made In Taiwan



current sensing / high frequency /
high voltage / ignition / lighting /
precision / surge protection / power /



YOUR HEALTH, WE CARE!



It is not far-fetched to say that the COVID-19 outbreak has been a global health crisis and the biggest challenge we had to face in 2020.

During this pandemic, the demand for stocks of dried foods has soared.

Being easy to store during a potential lockdown, dried fruits and vegetables are becoming a priority on people's shopping lists, with most families preferring the healthiest and most nutritious dried foods that have a natural flavor and a good texture, as close to fresh as possible.

Now, one of FIRSTOHM's group affiliates has done it, making quality dried fruits and vegetables available on the market. CoNutri stands by families all over the world and promises that the dried fruits and vegetables of the future will taste delicious thanks to the special patented RTD, Room Temperature Drying Technology.

This technology conserves and condenses the most nutritional values of the fresh produce while consuming the least amount of energy. RTD converts the values into a product that is both enjoyable and healing. The company is open to extend their help to global manufacturers by drying their agricultural products.

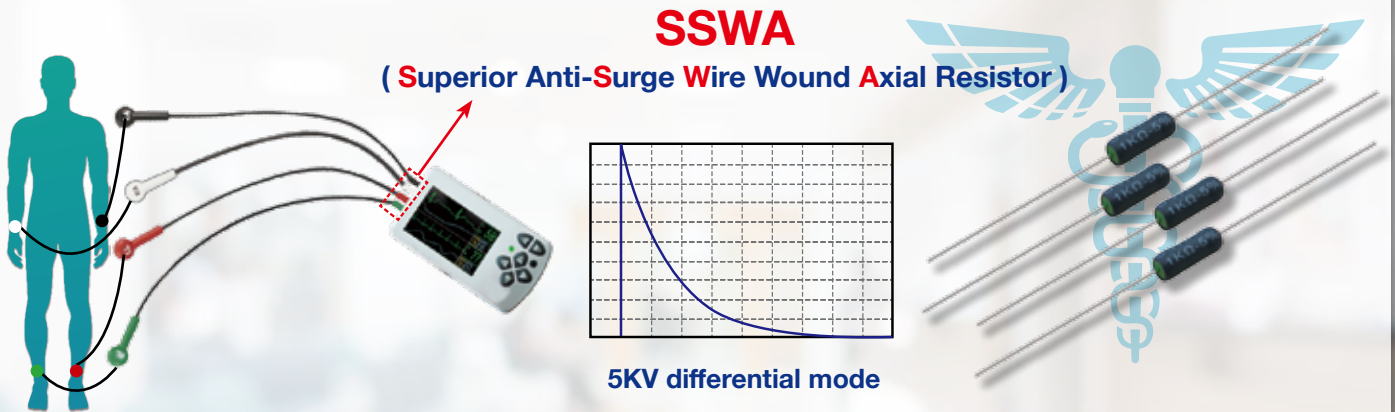
Whether you choose what to eat based on health considerations, on visual temptation or simply to satisfy your taste buds, CoNutri is your choice.

CoNutri, the dried foods of the future.



ECG cable Best Solution

RESPONSE TO COVID-19



We commit to a better life and a better world

ECG cable acts as a necessary route between human body and ECG machine, there are two reasons to add a resistor inside the wire of ECG cable :

1. To avoid EMI/RFI between each party.
2. For safety to limit any current to the patient in case of some sort of equipment failure.

The protective component (SSWA) must have sufficient capability to stand energy of defibrillator pulses but also to stand possible ESD pulses without specification degradation while maintaining high reliability during the lifetime of the components.

★ Advantages of SSWA (Superior Anti-Surge Wire Wound Axial Resistor)

- Special composite wire wound structure enhances anti-surge capability. “Patent pending”
- Rated to withstand the defibrillation pulse tests described in AAMI EC53/IEC 60601-2-27
- Rated to withstand the ESD pulse tests described in IEC 61000-4-2 (including both the 8kV contact discharge and the 15kV air discharge)
- Best quality and reliability for electrocardiogram(ECG) monitor (3/5/10 leads) applications.
- Reduced total BOM cost with stable production lead time.

★ Resistors ; comparison table

Brand	FIRSTOHM	KXX
Construction	Composite wire wound	ceramic resistors
P/N	SSWA03T	HXX1 / PXX1
Power Rating	3W	1W
Resistance Value	1K	1K
Body Length	15.5±1.0(mm)	16.0±2.0(mm)
Body Diameter	5.5±0.5(mm)	4.50±1.0(mm)
Tolerance	±5%	±10%
T.C.R (PPM/°C)	±200	-900 ~ -1900
Operating TEMP.	-55°C ~ +200°C	-40°C ~ +200°C
Derating Curve	+70°C	+40°C
Cost	Low	High

Preface

Since the company's establishment in 1969, we at Firstohm have been constantly pursuing innovation and providing customers with quality products and reliable services in a cost-efficient and timely manner. Building operating culture on the belief in sustaining growth, pursuit of excellence, and most importantly, customer satisfaction, Firstohm will continue to be your valuable partner in the electronic component industry.

第一電阻電容器股份有限公司
FIRST RESISTOR & CONDENSER CO., LTD.



Certificate No. FM 577844



Certificate No. EMS 594693

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Product(s), photos, specifications or data provided herein may be changed at any time without prior notice. Statements by Firstohm of product feasibility in certain application(s) are based on Firstohm's knowledge of performance characteristics that are typically required in particular applications. Please confirm technical specifications before placing orders.

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Safety • Quality • Reliability
Cost-Down via Innovation

Resistor	Key Features	Power Rating	Ohm Range	Tolerance	Page
	<p>C3 Composite Film-Type Ceramic Composition Resistor</p> <ul style="list-style-type: none"> Innovative and cost-effective C3 technology (NOTE 1) Conforms to ANSI/AAMI norm EC53:1995/(R)2008 5.5.3 Suitable replacement for ceramic composition resistors, which are required in most applications. Maximum permissible surge voltage: 15KV Typical 1.2/50us pulse load: 90000W 	1W	33R ~ 22K	±5% ±10% ±20%	P1-P2
	<p>C3M100 Composite Film - Type Ceramic Composition MELF Resistor</p> <ul style="list-style-type: none"> SMD-enabled structure Suitable replacement for ceramic composition resistors, which are requirements in most applications. Maximum permissible surge voltage: 15KV Typical 1.2/50µs pulse load: 20000W Excellent in heat dissipation than chip resistor Stronger mechanical structure to seismic vibration and thermal shock 	1W	33R ~ 22K	±5% ~ 20%	P3-P6
	<p>CM Carbon Film MELF Resistor</p> <ul style="list-style-type: none"> SMD enabled structure Excellent solderability termination Excellent in heat dissipation than chip resistor Stronger mechanical structure to seismic vibration and thermal shock 	1/4W ~ 1/2W	0R, 0.51R ~ 10M	± 5%	P7-P10
	<p>CSM Current Sense MELF Resistor</p> <ul style="list-style-type: none"> High power handling with superior reliability and stability Conformal multi-layer coating against humidity SMD enabled structure with excellent solderability HeatSink™ technology for better heat dissipation Typical temperature coefficient: 50ppm ~ 600ppm Excellent in heat dissipation than chip resistor Stronger mechanical structure to seismic vibration and thermal shock 	1/4W ~ 3W	10mR ~ 510mR	± 1% ~ 5%	P11-P14
	<p>CSR Current Sense Resistor</p> <ul style="list-style-type: none"> Offers better reliability than regular low-ohm resistors using our proprietary HeatSink™ technology Lead-free tin plated deoxygenized copper wire provides stable value of resistor during operation. Flame-proof coating available Typical temperature coefficient: 100ppm ~ 300ppm 	1/4W ~ 5W	68mR ~ 510mR	± 1% ~ 5%	P15-P18
	<p>EFP Enhanced Film Power MELF Resistor</p> <ul style="list-style-type: none"> High power handling Superior reliability and stability SMD enabled structure with excellent solderability Typical temperature coefficient: 200ppm ~ 800ppm Excellent in heat dissipation than chip resistor Stronger mechanical structure to seismic vibration and thermal shock 	1/2W ~ 5W	0R, 0.51R ~ 10M	± 0.5% ~ 5%	P19-P22

* All products are RoHS/REACH compliant unless otherwise specified.

* NOTE 1: patent pending

Resistor	Key Features	Power Rating	Ohm Range	Tolerance	Page
	EFR Enhanced Film Fixed Resistor <ul style="list-style-type: none"> Flameproof multi-layer coating equivalent to UL 94 V-0 Flameproof feature equivalent to overload test UL 1412 High power handling in small size Typical temperature coefficient: 50ppm ~ 500ppm 	1/2W ~ 5W	1R ~ 1M	± 1% ± 2% ± 5%	P23-P26
	ESM ESD Surge Absorber MELF <ul style="list-style-type: none"> Protects the circuit by sparking over the porous layer when surge exceeds the spark-over voltage Patented construction with reduced costs High insulation resistance, low capacitance, and fast response time Excellent in heat dissipation than chip resistor Stronger mechanical structure to seismic vibration and thermal shock 	$\left\{ \begin{array}{l} 80A @2/10\mu s \\ 60A @8/20\mu s \end{array} \right\}$ Surge Current Capacity	$\left\{ \begin{array}{l} 1300V \\ DC \\ Spark-Over \\ Voltage \end{array} \right\}$	± 30%	P27-P30
	FGE Fusible Resistor <ul style="list-style-type: none"> Flameproof multi-layer coating equivalent to UL 94 V-0 Flameproof feature equivalent to overload test UL 1412 Color code per MIL & EIA standards Special tin-plated electrolytic copper lead wire Typical fusing condition - (a) Standard Type: Fuses within 10 sec. at 5W ~ 6.25W (b) Power Types: Fuses within 60 sec. at 8W ~ 24W 	1/4W ~ 3W	2R2 ~ 15K	± 5%	P31-P37
	FM Fusible MELF Resistor <ul style="list-style-type: none"> SMD enabled structure Excellent solderability termination Fuses within 10 sec. at 9.8W ~ 10.5W Excellent in heat dissipation than chip resistor Stronger mechanical structure to seismic vibration and thermal shock 	1/3W ~ 1/2W	2R2 ~ 10K	± 5%	P39-P42
	HFT High Frequency Terminator Resistor <ul style="list-style-type: none"> SMD enabled structure Superior frequency response Excellent solderability termination Excellent in heat dissipation than chip resistor Stronger mechanical structure to seismic vibration and thermal shock 	0.2W ~ 2W	25R ~ 75R	± 0.1% ~ 5%	P43-P48
	HVM High Voltage MELF Resistor <ul style="list-style-type: none"> Handles much higher working voltage than general purpose resistors Pure tin-plated termination for excellent solderability SMD enabled structure Anti-surge feature available Maximum working voltage: 600V DC ~ 8400V DC Excellent in heat dissipation than chip resistor Stronger mechanical structure to seismic vibration and thermal shock 	1/6W ~ 3W	56K ~ 68M	± 1% ~ 5%	P49-P52


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Resistor	Key Features	Power Rating	Ohm Range	Tolerance	Page
	HVR High Voltage Resistor <ul style="list-style-type: none"> Special conductive film withstands high voltage Maximum working voltage far over that of general-purpose resistors Suitable for applications such as TV's, high voltage power supply, and high voltage detection. Maximum working voltage: 1.6KV DC ~ 12KV DC Typical temperature coefficient: 200ppm ~ 800ppm 	1/4W ~ 3W	91K ~ 100M	± 1% ± 5%	P53-P55
	HVR High Voltage Resistor (High Power) <ul style="list-style-type: none"> Special conductive film withstands high voltage Maximum working voltage far over that of general-purpose resistors Suitable for applications such as TV's, high voltage power supply, and high voltage detection. Maximum working voltage: 35KV DC Typical temperature coefficient: 800ppm 	10W ~ 15W	100K ~ 100M	± 1% ± 5%	P57-P58
	IG Ignition Fixed Resistor <ul style="list-style-type: none"> Special coating technique to ensure fast ignition Color code per MIL & EIA standards Special conductive film to fuse at high temperature Auto cut-off after fusing/no sustaining fire hazard Special tin-plated electrolytic copper lead wire for optimal ease of soldering and mounting 	1/6W	1R ~ 150R	± 5%	P59-P61
	ISC Ignition Noise Suppression Resistor (Ceramic Film Composite Type) <ul style="list-style-type: none"> Dedicatedly designed for high-voltage spark ignition systems Proprietary ceramic composite withstands high-voltage surge impacts with long-term stability. One of few sources in the world capable of manufacturing such type of resistor Excellent in heat dissipation than chip resistor Stronger mechanical structure to seismic vibration and thermal shock 	1/2W ~ 3W	1K ~ 10K	±5% ~ 20%	P63-P65
	ISW Ignition Noise Suppression Resistor (Wirewound Type) <ul style="list-style-type: none"> Dedicatedly designed for high-voltage spark ignition systems Enhanced weld spot is reliable against surge with long-term stability Excellent in heat dissipation than chip resistor Stronger mechanical structure to seismic vibration and thermal shock 	2W ~ 3W	1K ~ 5K	±5% ~ 20%	P67-P70
	M-Series Metal Film Fixed Resistor <ul style="list-style-type: none"> Conformal multi-layer coating Color code per MIL & EIA standards Special tin-plated electrolytic copper lead wire 	1/6W ~ 3W	0R1 ~ 10M	± 0.1% ~ 5%	P71-P80

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Resistor	Key Features	Power Rating	Ohm Range	Tolerance	Page
	MM Metal Film MELF Resistor <ul style="list-style-type: none"> SMD enabled structure Excellent solderability termination Typical 1.2/50us pulse load: 32W ~ 70W Typical temperature coefficient: 25ppm ~ 100ppm Excellent in heat dissipation than chip resistor Stronger mechanical structure to seismic vibration and thermal shock 	1/6W ~ 1/2W	0R, 0R51 ~ 10M	± 1% ± 2% ± 5%	P81-P84
	MM(V) Metal Film MELF Resistor, Vehicle Grade <ul style="list-style-type: none"> AEC-Q200 compliant Excellent solderability termination Typical 10us maximum pulse load: 35W ~ 80W Typical temperature coef cient: 25ppm ~ 100ppm Excellent in heat dissipation than chip resistor Stronger mechanical structure to seismic vibration and thermal shock 	1/4W ~ 1/2W	0R47 ~ 10M	± 1% ± 2% ± 5%	P85-P88
	MM102 Metal Film MELF Resistor <ul style="list-style-type: none"> AEC-Q200 compliant SMD-enabled structure Excellent solderability termination Typical temperature coefficient: 25ppm - 100ppm Excellent in heat dissipation than chip resistor Stronger mechanical structure to seismic vibration and thermal shock 	0.2W	0.22R ~ 2.2M	±0.5% ~ 5%	P89-P92
	MM(P) Metal Film MELF Resistor (Pulse Withstanding) <ul style="list-style-type: none"> SMD enabled structure Excellent solderability termination Enhanced pulse withstanding capability Typical temperature coefficient: 50ppm, 100ppm Excellent in heat dissipation than chip resistor Stronger mechanical structure to seismic vibration and thermal shock 	1/6W ~ 1/2W	0R1 ~ 330K	± 1% ± 2% ± 5%	P93-P96
	MMP Metal Film MELF Precision Resistor <ul style="list-style-type: none"> SMD enabled structure Excellent solderability termination Typical 1.2/50us pulse load: 32W ~ 70W Typical temperature coefficient: 5ppm ~ 50ppm Excellent in heat dissipation than chip resistor Stronger mechanical structure to seismic vibration and thermal shock 	1/6W ~ 1W	10R ~ 1M	± 0.1% ± 0.25% ± 0.5%	P97-P101
	MMP(V) Metal Film MELF Precision Resistor, Vehicle Grade <ul style="list-style-type: none"> AEC-Q200 Compliant Excellent solderability termination Typical 1.2/50us pulse load: 35W - 80W Typical temperature coefficient: 25ppm - 100ppm Excellent in heat dissipation than chip resistor Stronger mechanical structure to seismic vibration and thermal shock 	0.25W ~ 0.5W	10R ~ 1M	± 0.1% ± 0.25% ± 0.5%	P103-107

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Resistor	Key Features	Power Rating	Ohm Range	Tolerance	Page
	<p>MO Metal Oxide Film Fixed Resistor</p> <ul style="list-style-type: none"> • Flameproof multi-layer coating equivalent to UL 94 V-0 • Flameproof feature equivalent to overload test UL 1412 • Solvent resistant • Special tin-plated electrolytic copper lead wire 	1/2W ~ 6W	0R1 ~ 330K	± 5%	P109-P116
	<p>MP Metal Film Precision Resistor</p> <ul style="list-style-type: none"> • Conformal multi-layer coating • Color code per MIL & EIA standards • Special tin-plated electrolytic copper lead wire • Typical temperature coefficient: 10ppm ~ 50ppm 	1/6W ~ 1/2W	10R ~ 1M	± 0.05% ~ 0.5%	P117-P120
	<p>MSD Pulse Safety Resistor</p> <ul style="list-style-type: none"> • Low-cost alternative to wire-wound resistors • Special composite film on high grade ceramic substrate • Flameproof multi-layer coating equivalent to UL 94 V-0 • Flameproof feature equivalent to overload test UL 1412 • Excellent anti-surge capability. • Typical 1.2/50us pulse load: 140W ~ 4500W • Absorbs pulse from city power line, direct crossing or inductive coupling and protects electric equipment or parts from accidental shock 	1/4W ~ 6W	0R1 ~ 1M	± 0.1% ~ 5%	P121-P128
	<p>MVM Medium Voltage MELF Resistor</p> <ul style="list-style-type: none"> • SMD enabled structure • Anti-surge feature available • Pure tin-plated termination for excellent solderability • Handles much higher working voltage than general purpose resistors • Maximum working voltage: 750V DC - 1,000V DC • Excellent in heat dissipation than chip resistor • Stronger mechanical structure to seismic vibration and thermal shock 	0.4W ~ 1W	332K ~ 40M	±5%	P129-P132
	<p>MVR Medium Voltage Resistor</p> <ul style="list-style-type: none"> • Higher working voltage with improved reliability • Proprietary conductive film • Especially suitable for SMPS & lighting devices • Low-cost alternative to metal-glazed resistors • Maximum working voltage: 550V DC ~ 7KV DC • Typical temperature coefficient: 100ppm ~ 800ppm 	1/4W ~ 2W	47K ~ 100M	± 0.1% ~ ± 5%	P133-P135
	<p>PMA Professional Metal Film Axial Resistor</p> <ul style="list-style-type: none"> • Conformal multi-layer coating • Excellent stability and better power handling • Typical temperature coefficient: 5ppm ~ 100ppm 	2/5W ~ 1.2W	1R ~ 4M7	± 0.1% ~ 5%	P137-P140

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Resistor	Key Features	Power Rating	Ohm Range	Tolerance	Page
	PPR Pulse Protective Resistor <ul style="list-style-type: none"> • Application: high-frequency, sharp-impulse circuits. • Protects active components in missile detonators, triac switching circuits, etc. • Offers better performance than carbon composition resistor. • No "sintering effect" caused by high surge that greatly decreases resistance value. • Conformal multi-layer non-flammable coating • Maximum permissible surge voltage: 5KV ~ 20KV • Typical 1.2/50us pulse load: 75W ~ 1300W 	1/4W ~ 2W	2R2 ~ 4M7	± 5%	P141-P144
	PSR Power Sink Resistor <ul style="list-style-type: none"> • Designed to replace cement resistors • Auto insertion feasible • Enhanced conductive film absorbs pulse noise • Superior-grade ceramic core dissipates heat efficiently • Flameproof multi-layer coating equivalent to UL 94 V-0 • Flameproof feature equivalent to overload test UL 1412 • Maximum permissible surge voltage: 20KV • Typical 1.2/50us pulse load: 1700W 	6W	1R ~ 4M7	± 5%	P145-P147
	PVM Pulse Load High Voltage MELF Resistor <ul style="list-style-type: none"> • IEC60065 & UL1676 Compliant • SMD enabled structure • Anti-surge feature available • Pure tin-plated termination for excellent solderability • Proprietary thin film handles much higher working voltage than general purpose resistors • Excellent in heat dissipation than chip resistor • Stronger mechanical structure to seismic vibration and thermal shock 	1/4W ~ 1/2W	300K ~ 10M	±1% ± 5%	P149-P152
	PWR Power Metal Film Resistor <ul style="list-style-type: none"> • Conformal multi-layer coating • Color code per MIL & EIA standards • Special tin-plated electrolytic copper lead wire • Typical temperature coefficient: 250ppm 	0.6W ~ 2W	0R22 ~ 1M	± 5%	P153-P156
	SCP Short Circuit Protection Resistor <ul style="list-style-type: none"> • Advanced multi-functional design • Cut-off on overload or accidental short circuit • Excellent withstanding for power-line coupling • Flameproof multi-layer coating equivalent to UL 94 V-0 • Flameproof feature equivalent to overload test UL 1412 • Possible alternative to wire-wound resistors • Maximum overload voltage: 600V ~ 700V • Fuses within 60 sec. at 12W ~ 30W 	1/2W ~ 3W	2R2 ~ 10K	± 5%	P157-P159
	SFP Stabilized Film Power MELF Resistor <ul style="list-style-type: none"> • Low temperature coefficient and tolerances • Excellent stability • Superior power handling • Typical temperature coefficient: 50ppm ~ 200ppm • Excellent in heat dissipation than chip resistor • Stronger mechanical structure to seismic vibration and thermal shock 	0.4W ~ 3W	0R, 0R5 ~ 10M	± 0.5% ~ 5%	P161-P165

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Resistor	Key Features	Power Rating	Ohm Range	Tolerance	Page
	SFP(V) Stabilized Film Power MELF Resistor, Vehicle Grade <ul style="list-style-type: none"> • AEC-Q200 Complicant • Low temperature coefficient and tolerance • Superior power handling • Typical temperature coefficient: 25ppm - 50ppm • Excellent in heat dissipation than chip resistor • Stronger mechanical structure to seismic vibration and thermal shock 	0.4W ~ 3W	0R22 ~ 1M	±1% ~ 5%	P167-P172
	SL Slug Resistor <ul style="list-style-type: none"> • Specially treated metal caps withstand abrasions, impacts, and corrosions, so as to reduce contact resistance during operation. • Conductive film is enhanced to withstand abrasions, impacts, and corrosions as well. • Suitable for clip-in (embedded) application like switches with neon indicators, neon/LED modules, LED display array, etc. • Protective coating is optional • Excellent in heat dissipation than chip resistor • Stronger mechanical structure to seismic vibration and thermal shock 	1/6W ~ 1/2W	1R ~ 9M1	±5% ~ 10%	P173-P174
	SLC Slug Resistor Center Coated <ul style="list-style-type: none"> • Specially treated metal caps withstand abrasions, impacts, and corrosions, so as to reduce contact resistance during operation. • conductive film is enhanced to withstand abrasions, impacts, and corrosions as well. • Suitable for clip-in (embedded) application like switches with neon indicators, neon/LED modules, LED display array, etc. • Excellent in heat dissipation than chip resistor • Stronger mechanical structure to seismic vibration and thermal shock 	1/6W ~ 1/2W	1R ~ 9M1	±5% ~ 10%	P175-P176
	SM Stabilized Metal Film MELF Resistor <ul style="list-style-type: none"> • Conformal coating against humidity • Excellent solderability termination • Typical 1.2/50us pulse load: 32W ~ 70W • Typical temperature coefficient: 25ppm ~ 100ppm • Excellent in heat dissipation than chip resistor • Stronger mechanical structure to seismic vibration and thermal shock 	1/6W ~ 1/2W	0R51 ~ 10M	±1% ~ 5%	P177-P180
 	SRM Surge Resistant MELF Resistor <ul style="list-style-type: none"> • AEC-Q200 compliant • Miniaturized MELF design handles high power • Special conductive film enhances anti-surge capability • Absorbs harmful surge which damages precious devices or components • SMD-enabled alternative to carbon composition resistors • Maximum permissible surge voltage: 2KV ~ 10KV • Typical 1.2/50us pulse load: 60W ~ 6000W 	1/4W ~ 3W	0R1 ~ 1M	±1% ~ 5%	P181-P186
	SSR Surge Safety Resistor <ul style="list-style-type: none"> • Designed to replace carbon or ceramic composition resistor • Absorbs harmful surge energy, so to prevent hazard of fire and circuit damage caused by surge energy with a flame proof coating • High-surge applications: fuel ignition systems, power charging/ discharging circuits, TV sets, etc. • Maximum permissible surge voltage: 7.5KV ~ 35KV • Typical 1.2/50us pulse load: 450W ~ 17000W 	1/4W ~ 5W	10R ~ 330K	±5%	P187-P193

* All products are RoHS/REACH compliant unless otherwise specified.

Resistor	Key Features	Power Rating	Ohm Range	Tolerance	Page
	SSWA Superior Anti-Surge Wire Wound Axial Resistors <ul style="list-style-type: none"> Worldwide patent pending Special composite wire-wound structure enhances anti-surge capability Conforms to ANSI/AAMI EC53/ IEC 60601-2-27:2011(R)2016 Best quality and reliability for electrocardiogram (ECG) monitor (3/5/10 leads) applications Flameproof multi-layer coating equivalent to UL 94 V-0 RoHS/ REACH compliant 	3W	1K	± 5% ±10%	P195-P197
	SWA Anti-Surge Wirewound Resistor <ul style="list-style-type: none"> Flameproof multi-layer coating equivalent to UL 94 V-0 Flameproof feature equivalent to overload test UL 1412 SWA series can be adopted for high surge applications such as high rush current protection for power capacitor, motor start-up protection, car & motorcycle engine ignition, etc. to absorb harmful surge energy and prevent hazard of circuit damage caused by surge impact. Enhanced weld spot is reliable against surge impact Special tin-plated electrolytic copper lead wire Typical 1.2/50us pulse load: 12000W ~ 36000W** 	1W ~3W	0R1 ~ 1K2	± 5%	P199-P202
	SWAT Anti-Surge Wire Wound Fast-Fuse Resistors <ul style="list-style-type: none"> Worldwide patent pending Enhanced welded spot is reliable against surge Fast-acting fuse device for high-power applications Advanced combined anti- surge & fast-fuse structure Flameproof multi-layer coating equivalent to UL 94 V-0 Flameproof feature equivalent to overload test UL 1412 	1W ~ 3W	1R ~470R	± 5%	P203-P206
	SWM Anti-Surge Wirewound MELF Resistor <ul style="list-style-type: none"> AEC-Q200 compliant SMD enabled structure Flameproof multi-layer coating equivalent to UL 94 V-0 Flameproof feature equivalent to overload test UL 1412 SWM series can be adopted for high surge applications such as high rush current protection for power capacitor, motor start-up protection, car & motorcycle engine ignition, etc. Enhanced weld spot is reliable against surge impact Typical 1.2/50us pulse load: 8000W ~ 32000W** 	1W ~4W	0R1 ~ 1K2	± 5%	P207-P211
	SWMT Anti-Surge Wire Wound Fast-Fuse MELF Resistors <ul style="list-style-type: none"> Worldwide patent pending Enhanced welded spot is reliable against surge Fast-acting fuse device for high-power applications Advanced combined anti- surge & fast-fuse structure Flameproof multi-layer coating equivalent to UL 94 V-0 Flameproof feature equivalent to overload test UL 1412 SMD enabled structure Excellent in heat dissipation than chip resistor Stronger mechanical structure to seismic vibration and thermal shock 	1W ~ 4W	1R ~470R	± 5%	P213-P217
	WA Wirewound Resistors <ul style="list-style-type: none"> Flameproof multi-layer coating mequivalent to UL 94 V-0 Flameproof feature equivalent to overload test UL 1412 Color code per MIL & EIA standards Special tin-plated electrolytic copper lead wire 	1/2W ~ 8W	0R1 ~ 3K3	± 2% ± 5%	P219-P224

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Resistor	Key Features	Power Rating	Ohm Range	Tolerance	Page
	ZMM Zero Ohm Metal Film MELF Resistor <ul style="list-style-type: none"> • SMD enable structure • Excellent solderability termination • Stable metal film construction • Excellent in heat dissipation than chip resistor • Stronger mechanical structure to seismic vibration and thermal shock 	2A ~ 4A { Maximum Current }	< 20mR	N/A	P225-P226
	ZOM Zero Ohm Metal Film Resistor <ul style="list-style-type: none"> • Conformal multi-layer coating against humidity • Very low resistance • Stable metal film construction • Special tin-plated deoxygenized copper wire for resistance stabilization during operation 	3A ~ 5A { Maximum Current }	< 10mR	N/A	P227-P228

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~ To be your valuable partner in the
component industry through constant product
innovation and customer satisfaction~

~ Firstohm, where OHM comes FIRST ~

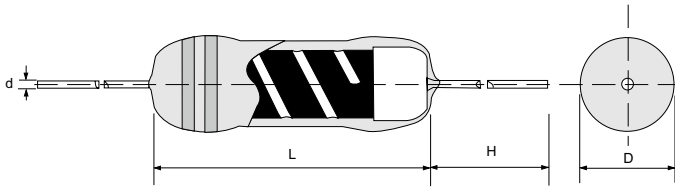
Application Reference Table

Product Datasheets

C3 - Composite Film-Type Ceramic Composition Resistor

Safety • Quality • Reliability
Cost-Down via Innovation

C3



Features

- Innovative and cost-effective C3 technology
- Conforms to ANSI/AAMI EC53:2013/ IEC 60601-2-27:2011
- Suitable replacement for ceramic composition resistors, which are required in most applications.
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

Type	Body Length (L , mm)	Body Diameter (D , mm)	Lead Wire Length (H , mm)	Lead Wire Diameter (d , mm)	Net Weight Per 1000 Pcs
C3100	15.5 ± 1.0	5.0 ± 0.5	30 ± 3.0	0.80 ± 0.03	1150 Grams

GENERAL SPECIFICATIONS

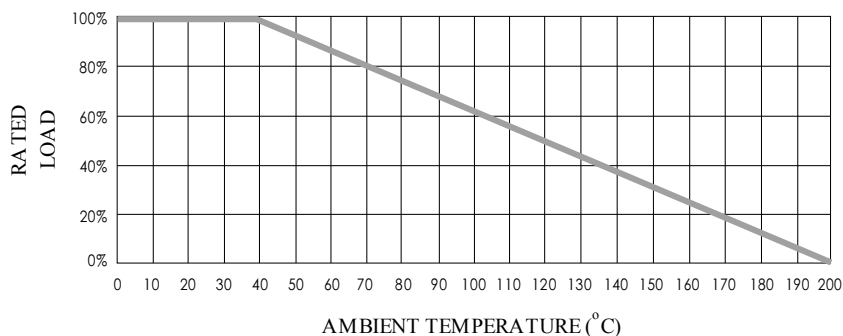
Type	Power Rating (at 40°C)	Maximum Working Voltage	Maximum Permissible Surge Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
C3100	1W	300V	15KV	33Ω	22KΩ	± 5%, ± 10%, ± 20%	E-6 / E-12 / E-24

PART NUMBER

Example: C3100K1K00TKZTB500

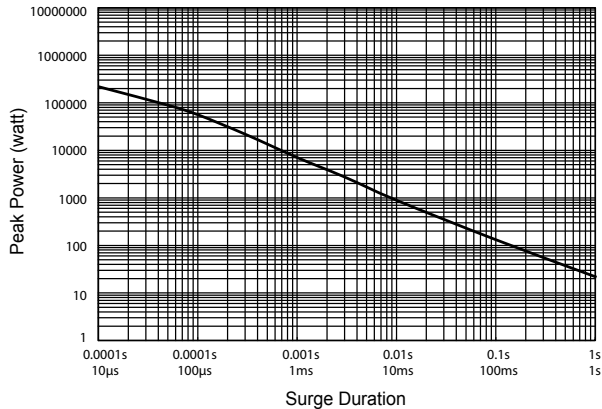
C3100	K	1K00	TKZ	TB500
Type	Tolerance	Resistance	TCR	Packaging
	J (5%) K (10%) M (20%)	1KΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.	5-character code TB = Tape Box 500 pieces per box

POWER DERATING CURVE

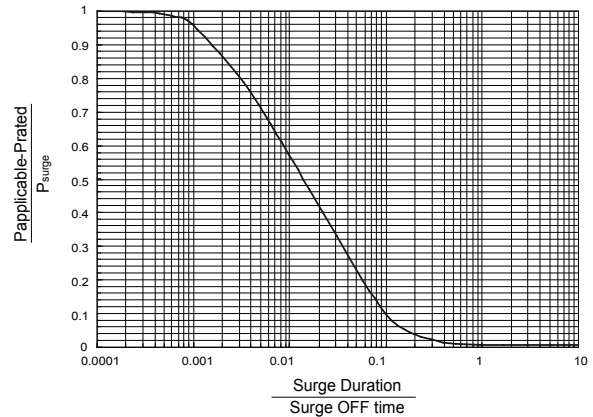


Safety • Quality • Reliability
Cost-Down via Innovation

■ SINGLE SURGE PERFORMANCE



■ SURGE POWER DERATING CURVE



Notes:

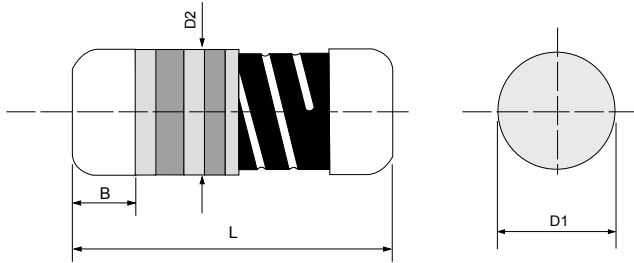
- SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 40°C or less. For temperatures above 40°C, the graph power must be derated further linearly down to zero at 200°C.
- To determine applicable surge power in continuous-surge applications:
 1. Identify allowable duration and peak power P_{surge} of single surge;
 2. Determine ratio of surge duration/surge OFF time in application;
 3. Calculate $P_{applicable}$ backwardly according to Y-axis of SURGE POWER DERATING CURVE.

■ TECHNICAL SUMMARY

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or DC	800
Temperature Coefficient, PPM / °C	-3000 (Typical)
Operating Temperature Range, °C	-55 ~ +200
Insulation Resistance, MΩ	>10 ⁴

■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over 2x max working voltage)	±2%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load at (40±2)°C and (93±3)% relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (40±2)°C	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±2%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C / (2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±2%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 200°C without load	±5%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±3%
Surge Test	Surge voltage = $\sqrt{40,000 \times P \times R}$ DC P is power rating, R is resistance value, surge voltage is not more than listed at right. Surge duration = 1.2/50µs Period = 60 sec Number of surges = 100	15KV ±5%



Specifications Per

- IEC 600115-1

Features

- SMD-enabled structure
- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- Suitable replacement for ceramic composition resistors, which are requirement in most applications.
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

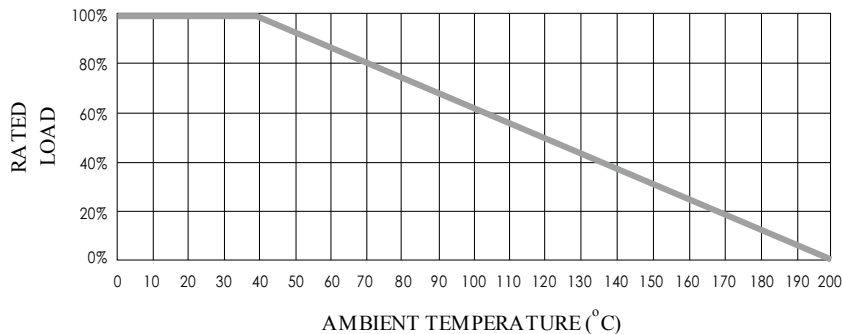
DIMENSIONS

Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
C3M100	14.6 ± 0.6	4.6 ± 0.5	D1+0.05/ -0.5	2.0 Min.	1000 grams

GENERAL SPECIFICATIONS

Type	Power Rating (at 40°C)	Maximum Working Voltage	Maximum Permissible Surge Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
C3M100	1W	400V	15kV	33Ω	22KΩ	±5%, ±10%, ±20%	E-6 / E-12 / E-24

POWER DERATING CURVE



TECHNICAL SUMMARY

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or DC	800
Temperature Coefficient, PPM / °C*	-3000 (Typical)
Operating Temperature Range, °C	-55 ~ +200
Insulation Resistance, MΩ	>10 ⁴
Failure Rate in Time, pcs / 10 ⁹ device hours	<1

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

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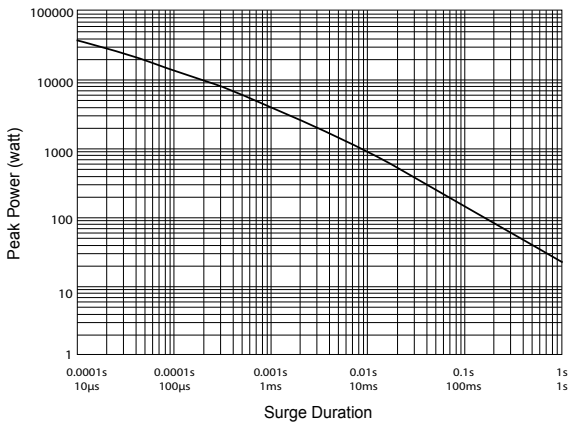
■ PART NUMBER

Example: C3M100K1K00TKZBK500

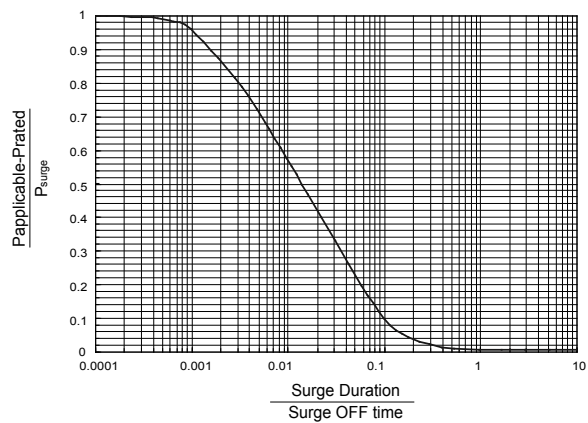
C3M100	K	1K00	TKZ	BK500
Type	Tolerance J (5%) K (10%) M (20%)	Resistance 1K Ω 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	TCR 3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary Section of the datasheet.	Packaging 5-character code BK = Bulk BK + Quantity

C3M100

■ SINGLE SURGE PERFORMANCE



■ SURGE POWER DERATING CURVE



Notes:

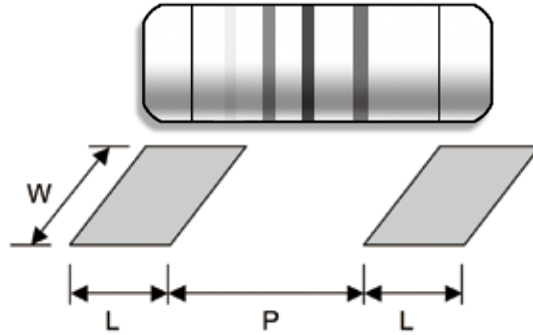
- SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 40°C or less. For temperatures above 40°C, the graph power must be derated further linearly down to zero at 200°C.
- To determine applicable surge power in continuous-surge applications:
 1. Identify allowable duration and peak power P_{surge} of single surge;
 2. Determine ratio of surge duration/surge OFF time in application;
 3. Calculate $P_{applicable}$ backwardly according to Y-axis of SURGE POWER DERATING CURVE.

■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits	
Short Time Overload	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over 2x max. working voltage)	±2%	
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%	
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (40±2)°C	±5%	
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds	±2.5%	
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C / (2±0.2) seconds with flux applied	95% min.coverage	
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±2%	
Thermal Endurance	IEC 60115-1 4.25.3 1,000 hours at 200°C without load	±5%	
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±3%	
Surge Test	Surge voltage = $\sqrt{(40,000 \times P \times R)}$ DC P is power rating, R is resistance value, surge voltage is not more than listed at right. Surge duration = 1.2/50µs Period = 60 sec Number of surge = 100	15KV	±5%

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■ SUGGESTED PAD LAYOUT



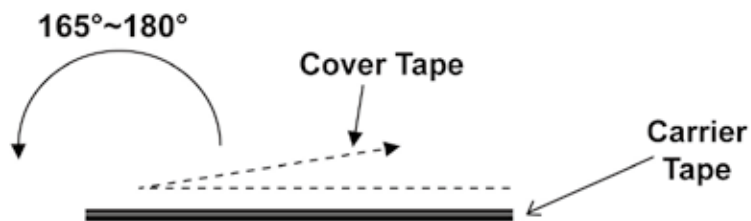
Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
C3M100	Reflow	5.0	9.3 ± 0.4	6.5
	Wave	5.0	9.0 ± 0.4	6.0

For better heat dissipation / lower heat resistance, increase W & L.

■ COVER TAPE PEELING SPECIFICATION

Recommended peeling force:

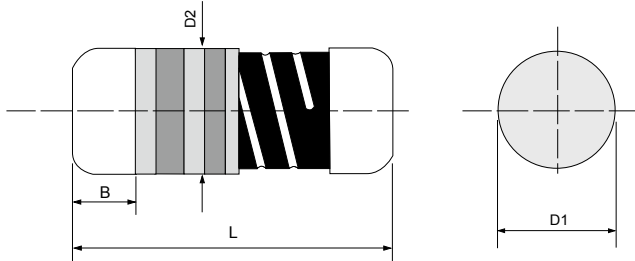
C3M100: 80±10gf



CM Carbon Film MELF Resistor

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CM



Specifications Per

- IEC 60115-1
- MIL-PRF-22684F

Features

- SMD enabled structure
- Excellent solderability termination
- Excellent in heat dissipation than chip resistor.
- Stronger mechanical structure to seismic vibration and thermal shock
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

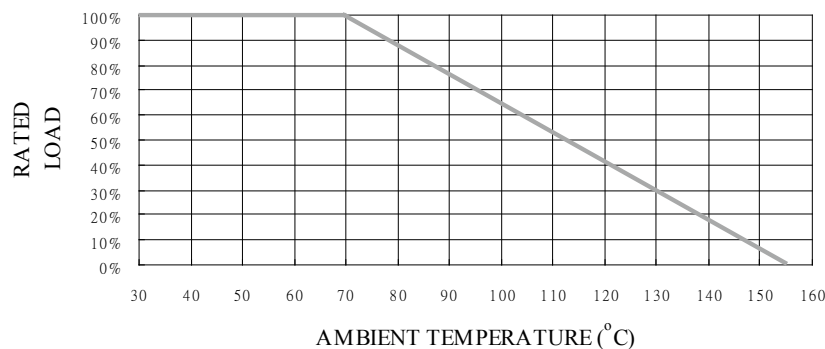
Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
CM204	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/ -0.15	0.6 Min.	17 grams
CM207	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams
CM52	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams

GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
CM204	1/4W	200V	300V	0, 0.51Ω	1MΩ	±5%	E-24
CM207	1/3W	300V	600V	0, 0.51Ω	10MΩ	±5%	E-24
CM52	1/2W	350V	600V	0, 0.51Ω	10MΩ	±5%	E-24

For 10m~510mΩ please see CSM series.
Special sizes, values, and specifications not listed available on special order.

POWER DERATING CURVE



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■ TECHNICAL SUMMARY

Characteristics	Limits			
Dielectric Withstanding Voltage, VAC or DC	CM204: 200, CM207, CM52: 500			
Temperature Coefficient, PPM / °C	CM204		CM207 & CM52	
	1Ω~33K	±300	1Ω~33K	±300
	33K~330K	- 500	33K~330K	- 500
	330K~470K	- 700	330K~470K	- 700
	470K~910K	-1000	470K-1M	-1000
Over 910K	-1500	Over 1M	-1500	
Operating Temperature Range, °C	-55 ~ +155			
Insulation Resistance, MΩ	>10 ⁴			
Tin Whisker (JESD201 Temperature Cycling & High Temp. /Humidity Storage), μm	<5			
Failure Rate in Time, pcs / 10 ⁹ device hours	<1			

■ PART NUMBER

Example: CM204J10K0TKZTR3K0

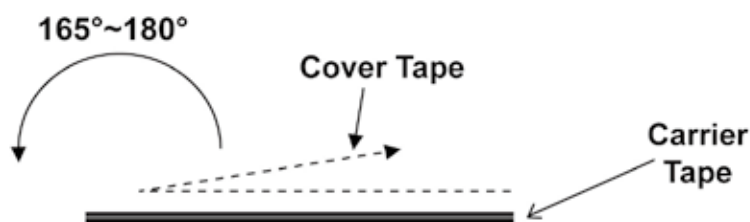
CM204	J	10K0	TKZ	TR3K0
Type	Tolerance	Resistance	TCR	Packaging
	J (5%)	10KΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.	5-character code TR = Tape Reel (pieces per reel) <u>CM204</u> 3K0 = 3,000 6K0 = 6,000* 10K = 10,000* <u>CM207/CM52</u> 2K0 = 2,000 6K0 = 6,000* 10K = 10,000*

*upon request

■ COVER TAPE PEELING SPECIFICATION

Recommended peeling force:

CM204, CM207, CM52: 50±5gf



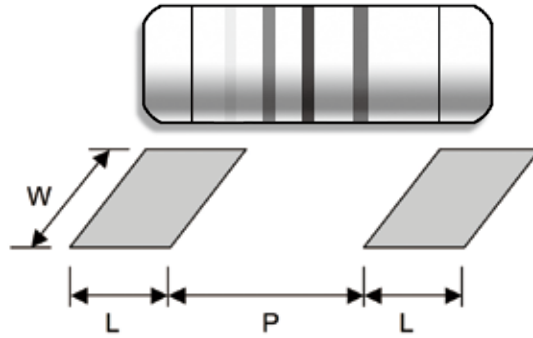
■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Overload	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	± 1%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	± 5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	± 3%
Periodic Electric Overload	IEC 60115-1 4.39 3.9x rated voltage (not over max. overload voltage) with 0.1s ON, 2.5s OFF for 1,000 cycles	± 2%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Dip the resistor into a solder bath measured (260±5)°C and hold it for 10±1 seconds	± 1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (230±3)°C/(2±0.2) seconds with flux applied	95% min. coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 1.52mm and 10 to 2,000 Hz.	± 1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 155°C without load	± 1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	± 1%
Single pulse high voltage overload	IEC 60115-1 4.27 10 pulses of 10/700µs at 10x rated voltage (not over max. overload voltage) with interval of 60 sec.	± 2%
Electrostatic discharge (Human body model)	IEC 60115-1 4.38 3 positive & 3 negative discharges with 2KV for CM16, CM204 or 4KV for CM207, CM52 (For continuous surge application please see Surge Performance paragraph)	± 5%
Climatic test	IEC 60115-1 4.23 4.23.2 - dry heat: 16 hours 155°C 4.23.3 - damp heat: 24 hours 55°C with 95% relative humidity 4.23.4 - cold: 2 hours -55°C 4.23.5 - negative air pressure: 2 hour 8.5KPa at (25±10)°C 4.23.6 - damp heat cyclic: 5 days 55°C with 95% relative humidity 4.23.7 - DC load: rated voltage at -55°C and 155°C each 1 Min.	± 2%
Bending test	IEC 60115-1 4.33 Pressing depth 2mm, 3 times	± 0.25%
Flammability	IEC 60115-1 4.35 Needle flame test 10s	No burning after 30s

CM Carbon Film MELF Resistor

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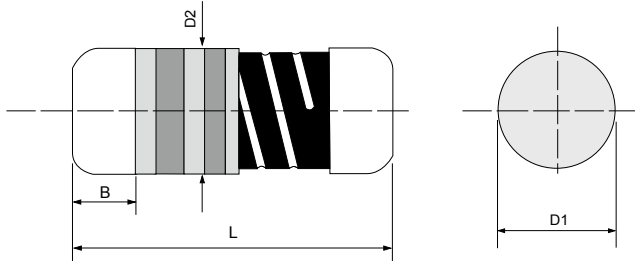
■ SUGGESTED PAD LAYOUT



CM

Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
CM204	Reflow	1.3	1.6 ± 0.1	1.6
	Wave	1.5	1.5 ± 0.1	1.8
CM207	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0
CM52	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0

For better heat dissipation / lower heat resistance, increase W & L.



Specifications Per

• IEC 60115-1

Features

- Low ohmic value
- High power handling with superior reliability and stability
- Conformal multi-layer coating against humidity
- SMD enabled structure with excellent solderability
- Excellent in heat dissipation than chip resistor (Especially suitable for air cooling)
- Stronger mechanical structure to seismic vibration and thermal shock
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
CSM204	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/ -0.15	0.6 Min.	17 grams
CSM101	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams
CSM201	8.50 ± 0.50	3.00 ± 0.2	D1+0.05/ -0.35	1.3 Min.	186 grams
CSM301	10.5 ± 0.50	4.00 ± 0.5	D1+0.05/ -0.45	1.6 Min.	446 grams

GENERAL SPECIFICATIONS

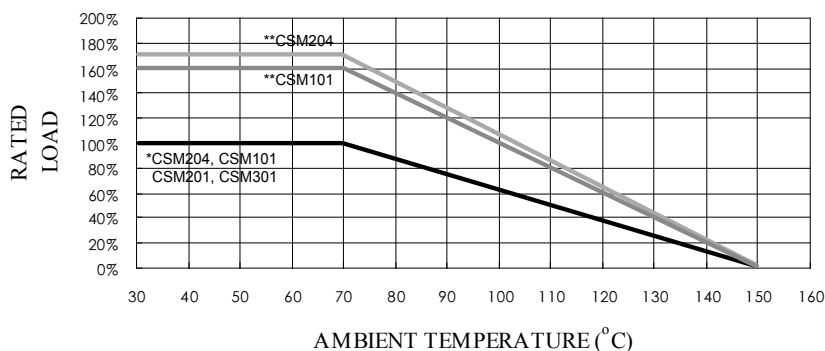
Type	Power Rating (at 70°C)	Up Grade Power Rating*	Maximum Working Voltage**	Maximum Overload Voltage***	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
CSM204	1/2W	0.8W	$\sqrt{P \times R}$	$2.5 \times \sqrt{P \times R}$	10mΩ	510mΩ	±1%~5%	E-24 / E-96
CSM101	1W	1.6W	$\sqrt{P \times R}$	$2.5 \times \sqrt{P \times R}$	10mΩ	510mΩ	±1%~5%	E-24 / E-96
CSM201	2W	-	$\sqrt{P \times R}$	$2.5 \times \sqrt{P \times R}$	10mΩ	510mΩ	±1%~5%	E-24 / E-96
CSM301	3W	-	$\sqrt{P \times R}$	$2.5 \times \sqrt{P \times R}$	10mΩ	510mΩ	±1%~5%	E-24 / E-96

*Wind Speed : 1m/s Please refer to the Power Derating Curve.

** Rated Continuous Maximum Working Voltage (RCWV) should be determined from $RCWV = \sqrt{\text{Power Rating} \times \text{Resistance Values}}$

*** Short-time Overload (STOL) test should be determined from $STOL = 2.5 \times RCWV$

POWER DERATING CURVE



*At 70°C

** Upgrade Power Rating (Wind Speed : 1m/s)

■ TECHNICAL SUMMARY

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or VDC	CSM204: 200 CSM101: 500 CSM201, CSM301: 700
Temperature Coefficient, PPM / °C	±50, ±100, ±200, ±300, ±600
Operating Temperature Range, °C	-55 ~ +150
Insulation Resistance, MΩ	>10 ⁴
Tin Whisker (JESD201 Temperature Cycling & High Temp. /Humidity Storage), μm	<5
Failure Rate in Time, pcs / 10 ⁹ device hours	<1.5

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ PART NUMBER

Example: CSM201JR510TKZTR2K5

CSM201	J	R510	TKZ	TR2K5
Type	Tolerance*	Resistance	TCR	Packaging
	F (1%) G (2%) J (5%)	0.51Ω 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.**	5-character code TR = Tape Reel (pieces per reel) <u>CSM204</u> 3K0 = 3,000 6K0 = 6,000*** 10K = 10,000*** <u>CSM101</u> 2K0 = 2,000 6K0 = 6,000*** 10K = 10,000*** <u>CSM201</u> 2K5 = 2,500 <u>CSM301</u> 2K0 = 2,000

* Listed values may not be applicable to all resistance values. Please check with us before placing order.

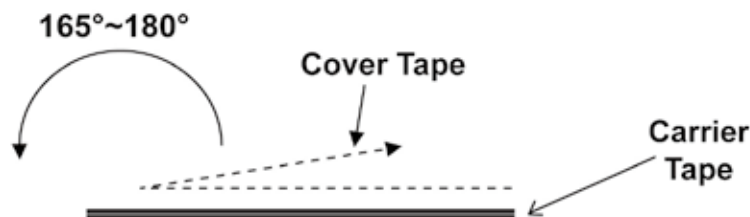
** For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

*** upon request

■ COVER TAPE PEELING SPECIFICATION

Recommended peeling force:

CSM204, CSM101: 50±5gf CSM201, CSM301: 70±10gf

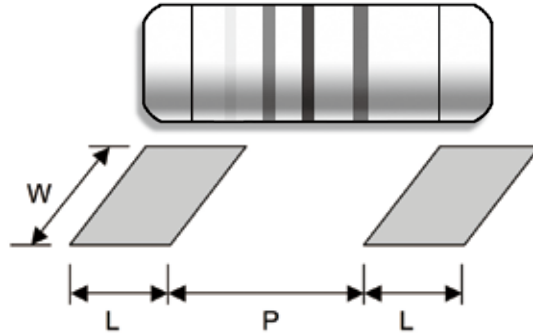


■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Overload	IEC 60115-1 4.13 2 seconds 2.5x rated voltage (not over max. overload voltage)	±1%, 2%: ±0.75% ±5%: ±2%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±3%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at 40°C and (93±3)% relative humidity	±3%
Periodic Electric Overload	IEC 60115-1 4.39 3.9x rated voltage (not over max. overload voltage) with 0.1s ON, 2.5s OFF for 1,000 cycles	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Dip the resistor into a solder bath measured (260±5)°C and hold it for 10±1 seconds	±1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 150°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +150°C 30minutes, 5 cycles	±2%
Single pulse high voltage overload	IEC 60115-1 4.27 10 pulses of 10/700µs at 10x rated voltage (not over max. overload voltage) with interval of 60 sec.	± 2%
Electrostatic discharge (Human body model)	IEC 60115-1 4.38 3 positive & 3 negative discharges with 2KV for CSM204 or 4KV for CSM52, CSM101, CSM201, CSM301 (For continuous surge application please see Surge Performance paragraph)	± 5%
Climatic test	IEC 60115-1 4.23 4.23.2 - dry heat: 16 hours 150°C 4.23.3 - damp heat: 24 hours 55°C with 95% relative humidity 4.23.4 - cold: 2 hours -55°C 4.23.5 - negative air pressure: 2 hour 8.5KPa at (25±10)°C 4.23.6 - damp heat cyclic: 5 days 55°C with 95% relative humidity 4.23.7 - DC load: rated voltage at -55°C and 150°C each 1 Min.	± 2%
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 1.52mm and 10 to 2,000 Hz.	±1%
Bending test	IEC 60115-1 4.33 Pressing depth 2mm, 3 times	± 0.5%
Flammability	IEC 60115-1 4.35 Needle flame test 10s	No burning after 30s

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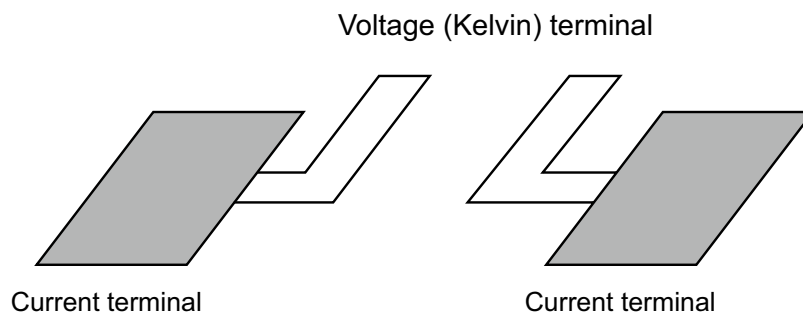
■ SUGGESTED PAD LAYOUT

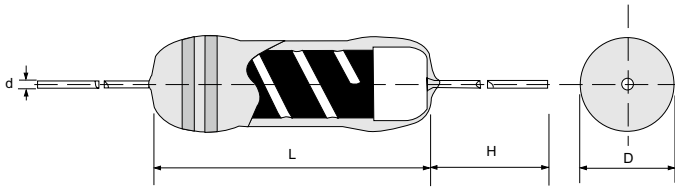


Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
CSM204	Reflow	1.3	1.6 ± 0.1	1.6
	Wave	1.5	1.5 ± 0.1	1.8
CSM101	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0
CSM201	Reflow	3.0	4.9 ± 0.3	3.7
	Wave	3.5	4.8 ± 0.3	4.0
CSM301	Reflow	4.0	6.2 ± 0.4	5.0
	Wave	4.5	6.0 ± 0.4	5.0

For better heat dissipation / lower heat resistance, increase W & L.

■ SUGGESTED PAD LAYOUT FOR KELVIN (4-WIRE) SENSING





Features

- Using our proprietary HeatSink™ technology, CSR series offers a better reliability than regular low-ohm resistors.
- Lead-free tin plated deoxygenized copper wire provides stable value of resistor during operation.
- Flame-proof coating available.
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000Pcs
CSR20	3.20 ± 1.0	1.9 ± 0.2	28 ± 3.0	0.45 ± 0.02	145 Grams
CSR25	6.50 ± 1.0	2.4 ± 0.2	26 ± 3.0	0.55 ± 0.03	220 Grams
CSR207	6.50 ± 1.0	2.4 ± 0.2	26 ± 3.0	0.55 ± 0.03	220 Grams
CSR51	9.00 ± 1.0	3.2 ± 0.2	26 ± 3.0	0.60 ± 0.03	340 Grams
CSR100	11.0 ± 1.0	4.5 ± 0.5	26 ± 3.0	0.70 ± 0.03	600 Grams
CSR200	13.5 ± 1.0	5.0 ± 0.5	30 ± 3.0	0.80 ± 0.03	1050 Grams
CSR300	15.5 ± 1.0	5.5 ± 0.5	30 ± 3.0	0.80 ± 0.03	1200 Grams
CSR400	19.0 ± 1.0	6.0 ± 0.5	30 ± 3.0	0.80 ± 0.03	1620 Grams
CSR500	19.0 ± 1.0	8.0 ± 0.5	30 ± 3.0	0.80 ± 0.03	3100 Grams

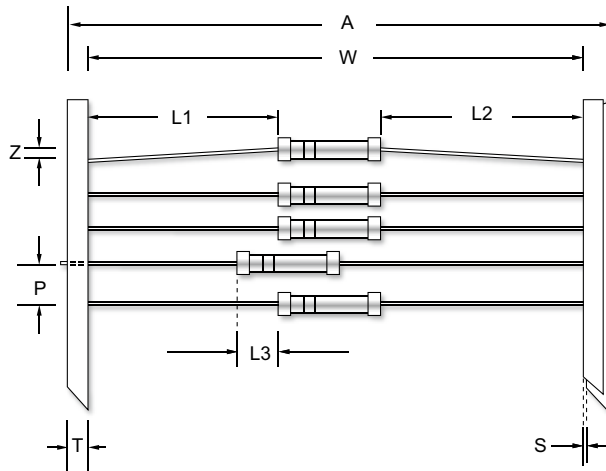
GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
CSR20	1/4W	200V	400V	68mΩ	510mΩ	±1%~5%	E-24/E-96
CSR25	1/3W	200V	400V	68mΩ	510mΩ	±1%~5%	E-24/E-96
CSR207	3/5W	200V	400V	68mΩ	510mΩ	±1%~5%	E-24/E-96
CSR51	1/2W	250V	500V	68mΩ	510mΩ	±1%~5%	E-24/E-96
CSR100	1W	250V	500V	68mΩ	510mΩ	±1%~5%	E-24/E-96
CSR200	2W	300V	600V	68mΩ	510mΩ	±1%~5%	E-24/E-96
CSR300	3W	350V	700V	68mΩ	510mΩ	±1%~5%	E-24/E-96
CSR400	4W	350V	700V	68mΩ	510mΩ	±1%~5%	E-24/E-96
CSR500	5W	500V	1000V	68mΩ	510mΩ	±1%~5%	E-24/E-96

Special sizes, values, and specifications not listed available on special order.

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■ TAPING/PACKING SPECIFICATIONS



Unit (mm)

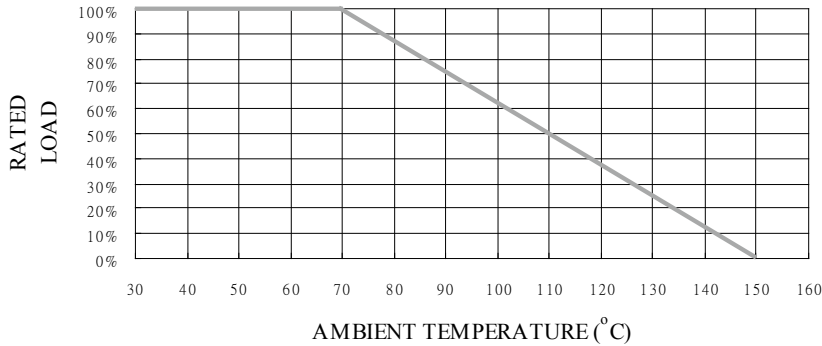
Type	A Max.	L1-L2 (Max.)	L3 (Max.)	P ±0.5	S (Max.)	T ±0.5	W ±1.5	Z (Max.)
CSR20	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
CSR25	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
CSR207	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
CSR51	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
CSR100	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
CSR200	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
CSR300	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
CSR400	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
CSR500	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2

Type No.	Packing	CSR20/25/207	CSR51	CSR100	CSR200	CSR300	CSR400	CSR500
Minimum Packing QTY (pcs)	Ammo pack	5000	2000	1000	500	500	500	400

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CSR

POWER DERATING CURVE



PART NUMBER

Example: CSR100JR330TKZTB1K0

CSR100	J	R330	TKZ	TB1K0
Type	Tolerance*	Resistance	TCR	Packaging
	F (1%) G (2%) J (5%)	0.33Ω 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.**	5-character code TB = Tape Box (pieces per box) <u>CSR20/25/207</u> 5K0 = 5,000 <u>CSR51</u> 2K0 = 2,000 <u>CSR100</u> 1K0 = 1,000 <u>CSR200/300/400</u> 500 = 500 <u>CSR500</u> 400 = 400

* Listed values may not be applicable to all resistance values. Please check with us before placing order.

** For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

TECHNICAL SUMMARY

Characteristics	Limits	
Dielectric Withstanding Voltage, VAC or DC	CSR20 CSR25/207 CSR51 CSR100/200/300/400/500	300 500 700 1000
Temperature Coefficient, PPM /°C*	±100, ± 200, ± 300	
Operating Temperature Range, °C	-55 ~ +150	
Insulation Resistance, MΩ	>10 ⁴	

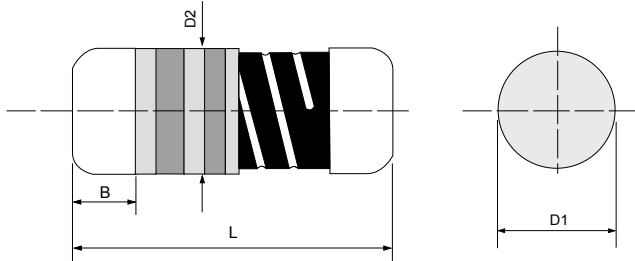
* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Overload	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±1%, 2%: ±0.75% ±5%: ±2%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±3%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±3%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 150°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +150°C 30minutes, 5 cycles	±2%

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EFP



Specifications Per

• IEC 60115-1

Features

- High power handling
- Superior reliability and stability
- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- SMD enabled structure with excellent solderability
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

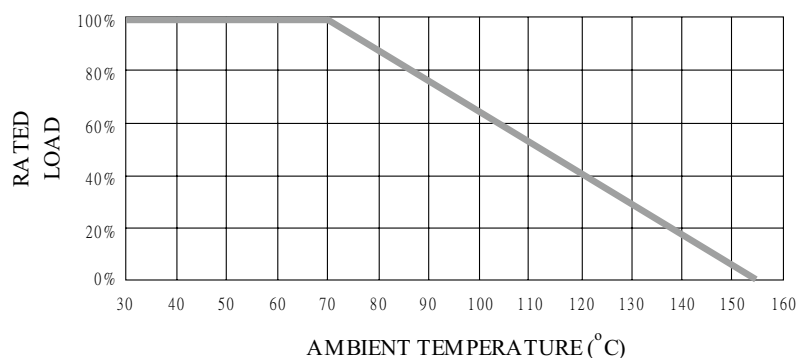
Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
EFP204	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/ -0.15	0.6 Min.	17 grams
EFP101	5.90 ± 0.2	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams
EFP201	8.50 ± 0.5	3.00 ± 0.2	D1+0.05/ -0.35	1.3 Min.	186 grams
EFP301	10.5 ± 0.5	4.00 ± 0.5	D1+0.05/ -0.45	1.6 Min.	446 grams
EFP401	12.6 ± 0.6	4.60 ± 0.5	D1+0.05/ -0.50	1.8 Min.	750 grams
EFP501	14.6 ± 0.6	5.10 ± 0.5	D1+0.05/ -0.50	2.0 Min.	1000 grams

GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
EFP204	1/2W	250V	500V	0, 0.51Ω	1MΩ	±0.5%~5%	E-192 / E-24
EFP101	1W	300V	600V	0, 0.51Ω	1MΩ	±0.5%~5%	E-192 / E-24
EFP201	2W	350V	700V	0, 0.51Ω	4.7MΩ	±0.5%~5%	E-192 / E-24
EFP301	3W	400V	800V	0, 0.51Ω	6.8MΩ	±0.5%~5%	E-192 / E-24
EFP401	4W	400V	800V	0, 0.51Ω	8.2MΩ	±0.5%~5%	E-192 / E-24
EFP501	5W	450V	900V	0, 0.51Ω	10MΩ	±0.5%~5%	E-192 / E-24

Special sizes, values, and specifications not listed available on special order.
For values between 10mΩ & 510mΩ, please see CSM series.

POWER DERATING CURVE



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EFP

TECHNICAL SUMMARY

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or VDC	EFP204: 300 EFP101: 500 EFP201: 700 EFP301, EFP401, EFP501: 1000
Temperature Coefficient, PPM / °C*	±200, ±400, ±600, ±800
Operating Temperature Range, °C	-55 ~ +155
Insulation Resistance, MΩ	>10 ⁴
Failure Rate in Time, pcs / 10 ⁹ device hours	<1
Tin Whisker (JESD201 Temperature Cycling & High Temp./ Humidity Storage), μm	<5

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

PART NUMBER

Example: EFP401J1M49TKZBK500

EFP401	J	1M49	TKZ	BK500
Type	Tolerance*	Resistance	TCR	Packaging
	D (0.5%) F (1%) G (2%) J (5%)	1.49MΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.**	Bulk 500 pieces 5-character code TR = Tape Reel (pieces per reel) <u>EFP204</u> 3K0 = 3,000 6K0 = 6,000*** 10K = 10,000*** <u>EFP101</u> 2K0 = 2,000 6K0 = 6,000*** 10K = 10,000*** <u>EFP201</u> 2K5 = 2,500 <u>EFP301</u> 2K0 = 2,000 BK = Bulk <u>EFP401/EFP501</u> BK + Quantity

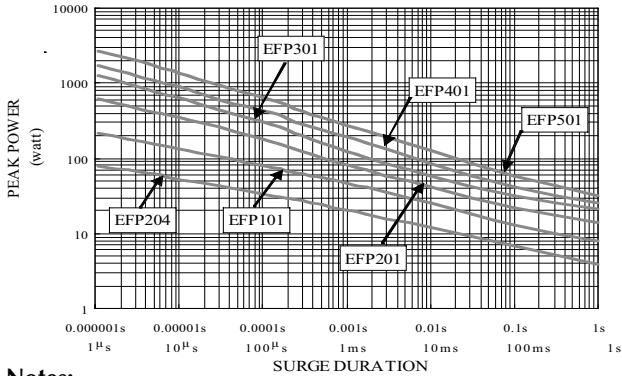
* Listed values may not be applicable to all resistance values. Please check with us before placing order.

** For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

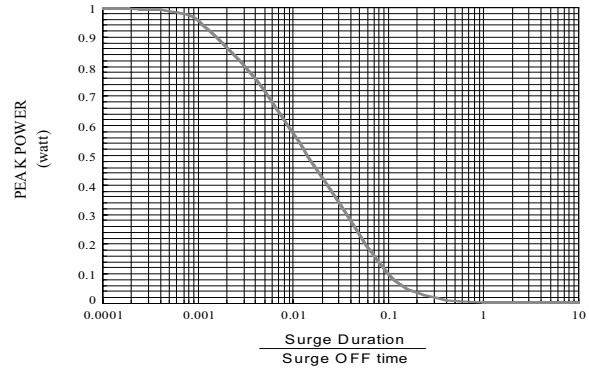
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■ SINGLE SURGE PERFORMANCE



■ SURGE POWER DERATING CURVE



Notes:

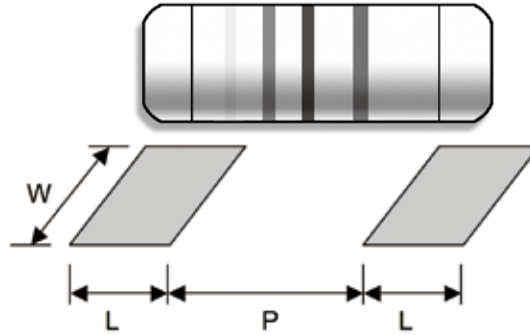
1. Above graph is accurate for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further by 1.18% per °C.
2. For applicable surge power in continuous-surge applications please see SURGE POWER DERATING CURVE above.

■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits	
Short Time Overload	IEC 60115-1 4.13 2 seconds 2.5x rated voltage (not over max. working voltage)	±0.5%, 1%: ± 2%: ±5%:	±0.5% ±0.8% ±2%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hrs with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%	
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%	
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds	±1%	
Periodic Electric Overload	IEC 60115-1 4.39 3.9x rated voltage (not over max. overload voltage) with 0.1s ON, 2.5s OFF for 1,000 cycles	±5%	
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C / (2±0.2) seconds with flux applied	95% min.coverage	
Thermal Endurance	IEC 60115-1 4.25.3 1,000 hours at 155°C without load	±2%	
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±2%	
Single pulse high voltage overload	IEC 60115-1 4.27 10 pulses of 10/700µs at 10x rated voltage (not over max. overload voltage) with interval of 60 sec.	±2%	
Electrostatic discharge (Human body model)	IEC 60115-1 4.38 3 positive & 3 negative discharges with 2KV for EFP204 or 4KV for EFP101, EFP201, EFP301, EFP401 & EFP501 (For continuous surge application please see Surge Performance paragraph)	±5%	
Climatic test	IEC 60115-1 4.23 4.23.2 - dry heat: 16 hours 155°C 4.23.3 - damp heat: 24 hours 55°C with 95% relative humidity 4.23.4 - cold: 2 hours -55°C 4.23.5 - negative air pressure: 2 hour 8.5kPa at (25±10)°C 4.23.6 - damp heat cyclic: 5 days 55°C with 95% relative humidity 4.23.7 - DC load: rated voltage at -55°C and 155°C each 1 Min.	±2%	
Flammability	IEC 60115-1 4.35 Needle flame test 10s	No burning after 30s	
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±1%	
Bending test	IEC 60115-1 4.33 Pressing depth 2mm, 3 times	±1%	

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■ SUGGESTED PAD LAYOUT



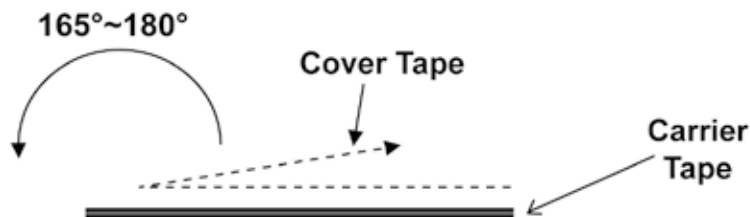
Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
EFP204	Reflow	1.3	1.6 ± 0.1	1.6
	Wave	1.5	1.5 ± 0.1	1.8
EFP101	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0
EFP201	Reflow	3.0	4.9 ± 0.3	3.7
	Wave	3.5	4.8 ± 0.3	4.0
EFP301	Reflow	4.0	6.2 ± 0.4	5.0
	Wave	4.5	6.0 ± 0.4	5.0
EFP401	Reflow	4.5	8.0 ± 0.4	5.5
	Wave	5.0	7.7 ± 0.4	5.5
EFP501	Reflow	5.0	9.3 ± 0.4	6.5
	Wave	5.0	9.0 ± 0.4	6.0

For better heat dissipation / lower heat resistance, increase W & L.

■ COVER TAPE PEELING SPECIFICATION

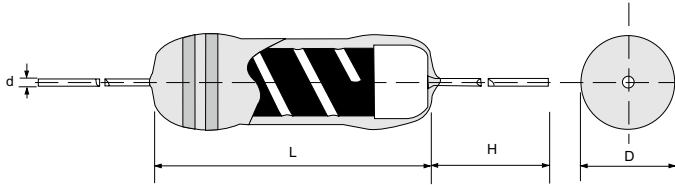
Recommended peeling force:

EFP204, EFP101: 50±5gf EFP201, EFP301: 70±10gf EFP401, EFP501: 80±10gf



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EFR



Specifications Per

• IEC 60115-4

Features

- Flameproof multi-layer coating equivalent to UL 94 V-0
- Flameproof feature equivalent to overload test UL 1412
- High power handling in small size
- Anti-surge capability
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

■ DIMENSIONS

Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000Pcs
EFR52	6.50 ± 1.0	2.4 ± 0.2	26 ± 3.0	0.55 ± 0.03	220 Grams
EFR207	6.50 ± 1.0	2.4 ± 0.2	26 ± 3.0	0.60 ± 0.03	220 Grams
EFR101	9.00 ± 1.0	3.2 ± 0.2	28 ± 3.0	0.60 ± 0.03	340 Grams
EFR201	11.0 ± 1.0	4.0 ± 0.5	28 ± 3.0	0.70 ± 0.03	500 Grams
EFR300	15.5 ± 1.0	5.5 ± 0.5	30 ± 3.0	0.80 ± 0.03	1200 Grams
EFR400	19.0 ± 1.0	6.0 ± 0.5	30 ± 3.0	0.80 ± 0.03	1600 Grams
EFR500	19.0 ± 1.0	8.0 ± 0.5	30 ± 3.0	0.80 ± 0.03	3100 Grams

■ GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
EFR52	1/2W	500V	700V	1Ω	1MΩ	±1%, ±2%, ±5%	E-96/E-48/E-24
EFR207	1W	500V	800V	1Ω	1MΩ	±1%, ±2%, ±5%	E-96/E-48/E-24
EFR101	1W	600V	900V	1Ω	1MΩ	±2%, ±5%	E-24/E-48
EFR201	2W	750V	1000V	1Ω	1MΩ	±2%, ±5%	E-24/E-48
EFR300	3W	800V	1200V	1Ω	560KΩ	±2%, ±5%	E-24/E-48
EFR400	4W	800V	1200V	1Ω	180KΩ	±2%, ±5%	E-24/E-48
EFR500	5W	800V	1200V	1Ω	180KΩ	±2%, ±5%	E-24/E-48

Special sizes, values, and specifications not listed available on special order.

Safety • Quality • Reliability
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■ PART NUMBER

Example: EFR101J100KTKZTB2K0

EFR101	J	100K	TKZ	TB2K0
Type	Tolerance*	Resistance	TCR	Packaging
	F (1%) G (2%) J (5%)	100KΩ 4-character code containing - 3 significant digits 1 letter multiplier OHM MULTIPLIER R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.**	5-character code TB = Tape Box (pieces per box) <u>EFR52/EFR207</u> 5K0 = 5,000 <u>EFR101</u> 2K0 = 2,000 <u>EFR201</u> 1K0 = 1,000 <u>EFR300/400</u> 500 = 500 <u>EFR500</u> 400 = 400

* Listed values may not be applicable across the product series/all resistance values. Please check with us before placing order.

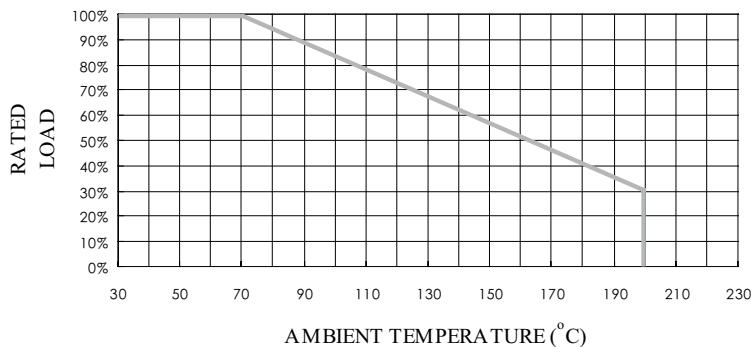
** For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

■ TECHNICAL SUMMARY

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or DC	500
Temperature Coefficient, PPM / °C*	±50, ±100, ±200, ±300, ±500
Operating Temperature Range, °C	-55 ~ +200
Insulation Resistance, MΩ	10 ⁴

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

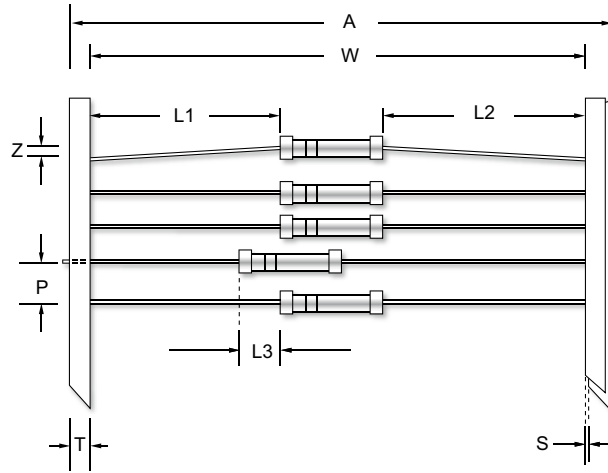
■ POWER DERATING CURVE



Safety • Quality • Reliability
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EFR

■ TAPING/PACKING SPECIFICATIONS



Unit (mm)

Type	A Max.	L1-L2 (Max.)	L3 (Max.)	P ±0.5	S (Max.)	T ±0.5	W ±1.5	Z (Max.)
EFR52	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
EFR207	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
EFR101	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
EFR201	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
EFR300	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
EFR400	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
EFR500 L option	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
	95	±1.5	1.0	10.0	0.8	6.0	77	1.2

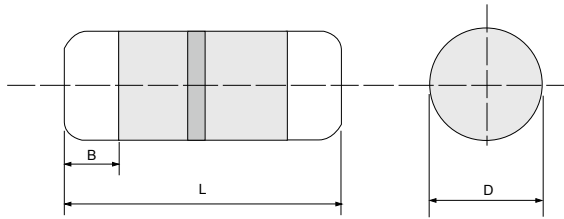
■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±2%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±1.5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	EFR52/207: ±1.5% EFR101/201: ±2.0% EFR300/400/500: ±5.0%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C / (2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 200°C without load	±2%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±2%
Terminal Strength	IEC 60115-1 4.16.2 2.5kg direct load for 10 seconds in the longitudinal direction of the terminal leads	±1%

ESM ESD Surge MELF Absorber

Safety • Quality • Reliability
Cost-Down via Innovation

ESM



Features

- Protects through sparking over the porous layer when surge exceeds the spark-over voltage
- Patented construction with reduced costs
- High insulation resistance, low capacitance, and fast response time
- RoHS and REACH compliant

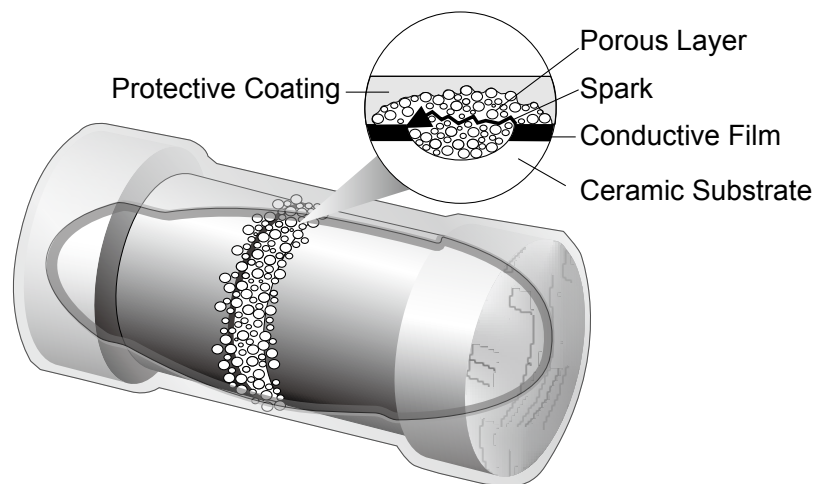
Applications

- Human body model ESD protection
- Telephone/Fax Machine/Modem Protection
- Signal Line Protection
- USB protection
- Ethernet protection
- Low voltage power protection
- Support products to comply with IEC61000-4-2, ISO10605 requirements, etc.

DIMENSIONS

Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
ESM204	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/-0.15	0.6 Min.	17 grams

Cross-Section View



Legal disclaimer: This international patent is covered by Paris Convention for the Protection of Industrial Property under World Intellectual Property Organization (WIPO). Plagiarism and imitation shall be severely punished.

GENERAL SPECIFICATIONS

Series	Type Name	Color Code	DC spark-over voltage
ESM	ESM204	White	1300V ± 30%

Special sizes, values, and specifications not listed available on special order.

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■ PART NUMBER

Example: ESM204N1300XXXTR3K0

ESM204	N	1300	XXX	TR3K0
Type	Tolerance	Spark-Over Voltage	TCR	Packaging
	N (30%)	1300V 4-character code	3-character code Parameter Not Applicable	5-character code TR = Tape Reel (pieces per reel) 3K0 = 3,000 6K0 = 6,000* 10K = 10,000*

*upon request

■ TECHNICAL SUMMARY

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or DC	500
Surge Current Capacity	60A @8/20µs (80A @2/10µs)
Operating Temperature Range, °C	-55 ~ +155
Insulation Resistance, MΩ (Measured with DC 500V)	> 100
Capacitance	≤ 1pF
Activation time	≤ 1ns

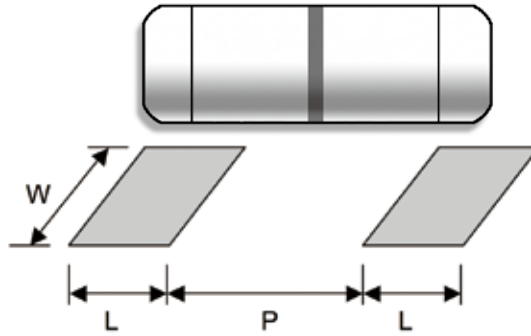
■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds	Rated value 40%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 1.52mm and 10 to 2,000 Hz.	Rated values still satisfied
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 155°C without load	Rated value 40%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	Rated value 40%
Surge Life	3000pF/ 10KV/ 0ohm, times = 300	No function failure

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ESM

■ SUGGESTED PAD LAYOUT



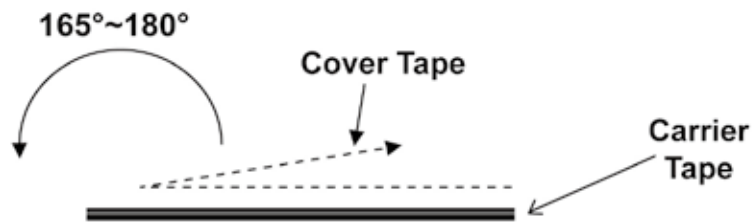
Type	Soldering mode	Pad Length (L, mm, min.)	Pad Spacing (P, mm)	Pad Width (W, mm, min.)
ESM204	Reflow	1.3	1.6 ± 0.1	1.6
	Wave	1.5	1.5 ± 0.1	1.8

For better heat dissipation / lower heat resistance, increase W & L.

■ COVER TAPE PEELING SPECIFICATION

Recommended peeling force:

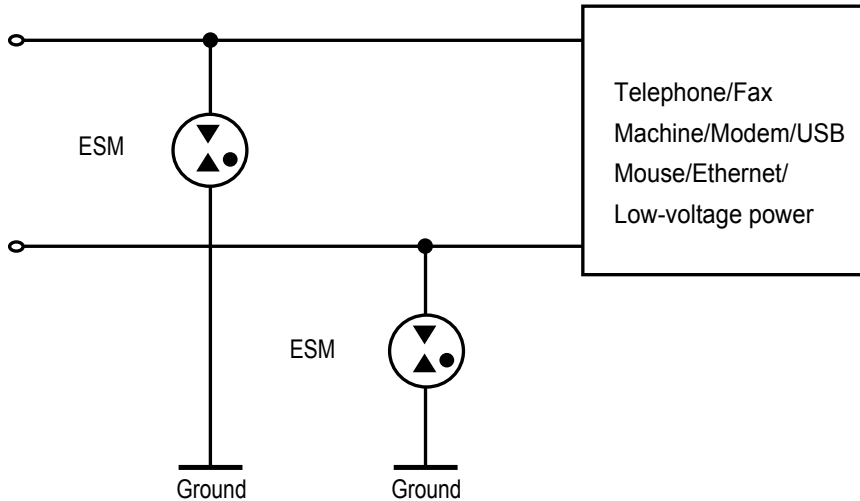
ESM204: 50±5gf



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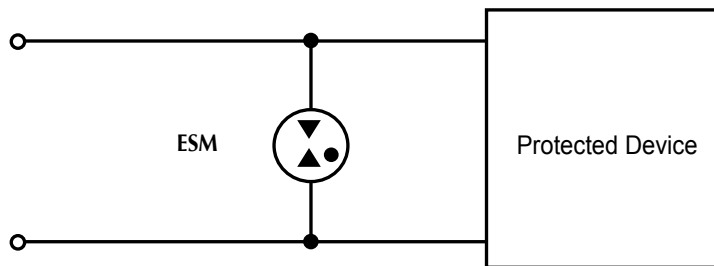
■ APPLICATIONS

Telephone/Fax Machine/Modem/USB/Mouse/Ethernet/Low-voltage power Protection (common-mode protection)



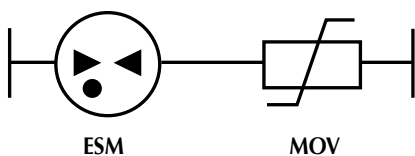
These ESM absorbers protect against common-mode interference voltages, i.e. surge voltages that appear in both exchange lines connecting to the ground. In the event of voltage overload, the ESM protects both exchange lines by conducting the surge current away to the ground.

Signal Line Protection (differential-mode protection)



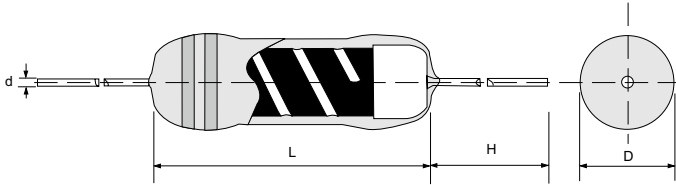
Signal circuits often run with no ground conductor. A ESM circuit located between the two signal lines offers differential mode protection by preventing the occurrence of large potential difference at the input of the equipment to be protected

Series of ESD Surge MELF Absorber (ESM) and Metal-Oxide Varistor (MOV)



Benefits:

1. Capacitance of this branch circuit would be reduced to pF level.
2. MOV has almost no current leakage.
3. MOV aging-related issue would be greatly improved,, increasing reliability of the circuit.



Specifications Per

- IEC 60115-1

Features

- Flameproof multi-layer coating equivalent to UL 94 V-0
- Flameproof feature equivalent to overload test UL 1412
- Color code per MIL & EIA standards
- Special tin-plated electrolytic copper lead wire
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

■ DIMENSIONS

Type	Body Length (L , mm)	Body Diameter (D, mm)	Lead Wire Length (H , mm)	Lead Wire Diameter (d , mm)	Net Weight Per 1000Pcs
FGE25	6.5 ± 0.5	2.4 ± 0.2	26 ± 3.0	0.55 ± 0.03	220 grams
FGE26	6.5 ± 0.5	2.4 ± 0.2	26 ± 3.0	0.55 ± 0.03	220 grams
FGE53	6.5 ± 0.5	2.4 ± 0.2	26 ± 3.0	0.55 ± 0.03	220 grams

■ GENERAL SPECIFICATIONS

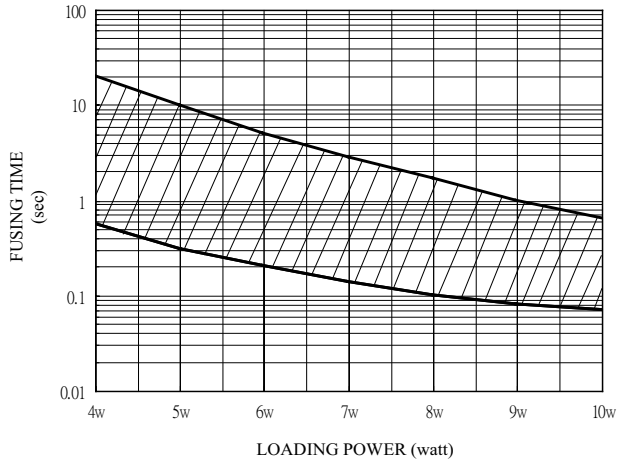
Type	Power Rating (at 70°C)	Maximum Working Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
FGE25	1/4W	250V	2.2Ω	15KΩ	±5%	E-24
FGE26	1/3W	250V	2.2Ω	15KΩ	±5%	E-24
FGE53	1/2W	350V	2.2Ω	10KΩ	±5%	E-24

Other resistance values and higher wattages available on request.

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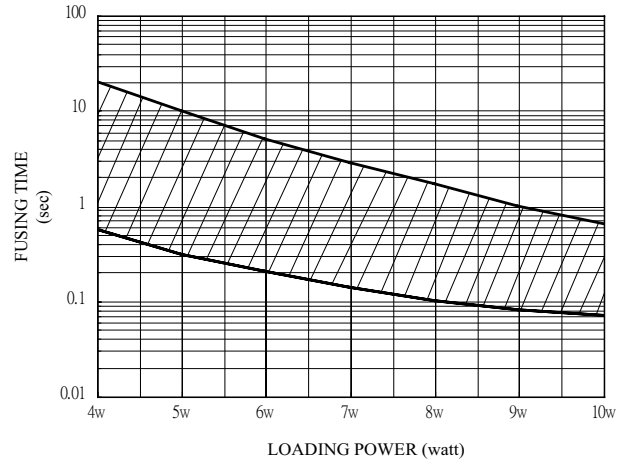
FGE25

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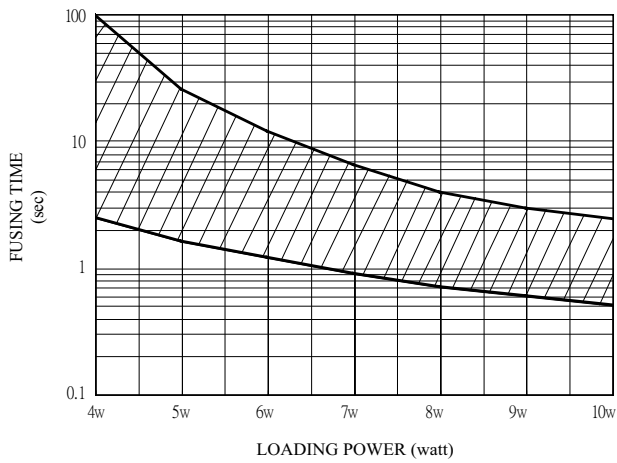
FGE26

FUSING CHARAC TERISTICS
USING CONST ANT VOLTAGE



FGE53

FUSING CHARAC TERISTICS
USING CONST ANT VOLTAGE



FGE

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Cost-Down via Innovation

FGE

■ PART NUMBER

Example: FGE53J10K0TKZTB5K0

FGE53	J	10K0	TKZ	TB5K0
Type	Tolerance	Resistance	TCR	Packaging
	J (5%)	10KΩ 4-character code containing - 3 significant digits 1 letter multiplier OHM MULTIPLIER R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.*	5-character code TB = Tape Box (pieces per box) <u>FGE25/26/53</u> 5K0 = 5,000

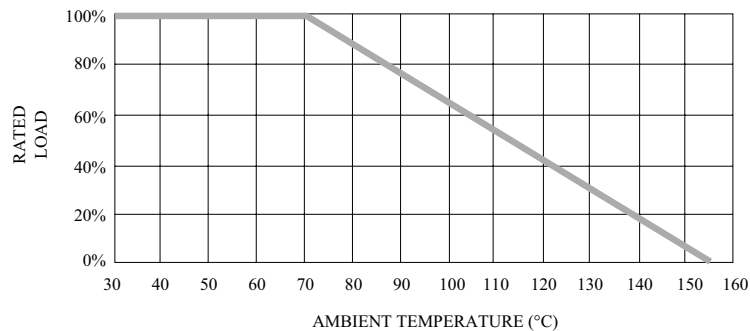
* For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

■ TECHNICAL SUMMARY

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or DC	500
Temperature Coefficient, PPM / °C*	±200
Operating Temperature Range, °C	-55 ~ +155
Insulation Resistance, MΩ	10 ⁴

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ POWER DERATING CURVE

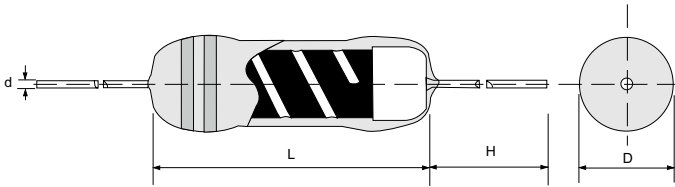


■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 1.52mm and 10 to 2,000 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 155°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±1%

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FGE



Specifications Per

• IEC 60115-1, IEC 60115-4

Features

- Flameproof multi-layer coating equivalent to UL 94 V-0
- Flameproof feature equivalent to overload test UL 1412
- Color code per MIL & EIA standards
- Special tin-plated electrolytic copper lead wire
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

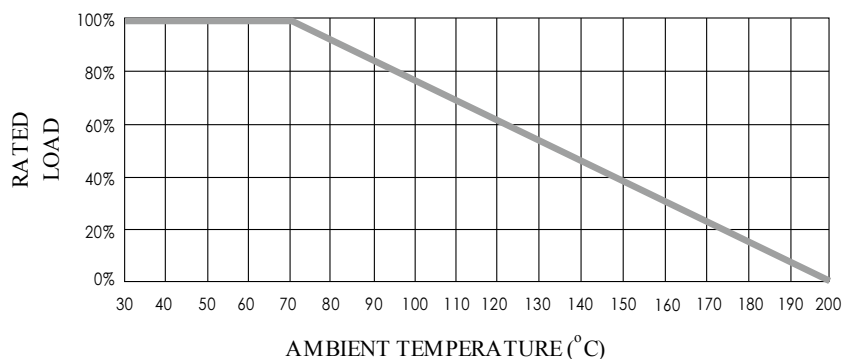
Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000Pcs
FGE50	9.00 ± 1.0	3.2 ± 0.2	28 ± 3.0	0.6 ± 0.03	340 Grams
FGE101	9.00 ± 1.0	3.2 ± 0.2	28 ± 3.0	0.6 ± 0.03	340 Grams
FGE100	11.0 ± 1.0	4.0 ± 0.5	28 ± 3.0	0.7 ± 0.03	500 grams
FGE201	11.0 ± 1.0	4.0 ± 0.5	28 ± 3.0	0.8 ± 0.03	510 grams
FGE200	13.5 ± 1.0	5.0 ± 0.5	30 ± 3.0	0.8 ± 0.03	1050 grams
FGE301	13.5 ± 1.0	5.0 ± 0.5	30 ± 3.0	0.8 ± 0.03	1050 grams

GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
FGE50	1/2W	300V	600V	2.2Ω	10KΩ	±5%	E-24
FGE101	1W	300V	600V	2.2Ω	10KΩ	±5%	E-24
FGE100	1W	350V	600V	2.2Ω	10KΩ	±5%	E-24
FGE201	2W	350V	600V	2.2Ω	10KΩ	±5%	E-24
FGE200	2W	350V	600V	2.2Ω	10KΩ	±5%	E-24
FGE301	3W	350V	700V	2.2Ω	10KΩ	±5%	E-24

* Please contact us for 3W type (FGE301), resistance values, sizes, or specifications not listed.

POWER DERATING CURVE



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■ PART NUMBER

Example: FGE101J10K0TKZTB2K0

FGE101	J	10K0	TKZ	TB2K0
Type	Tolerance	Resistance	TCR	Packaging
	J (5%)	10KΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.*	5-character code TB = Tape Box (pieces per box) <u>FGE50/101</u> 2K0 = 2,000 <u>FGE100/201/200</u> 1K0 = 1,000 <u>FGE301</u> 500 = 500

* For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

■ TECHNICAL SUMMARY

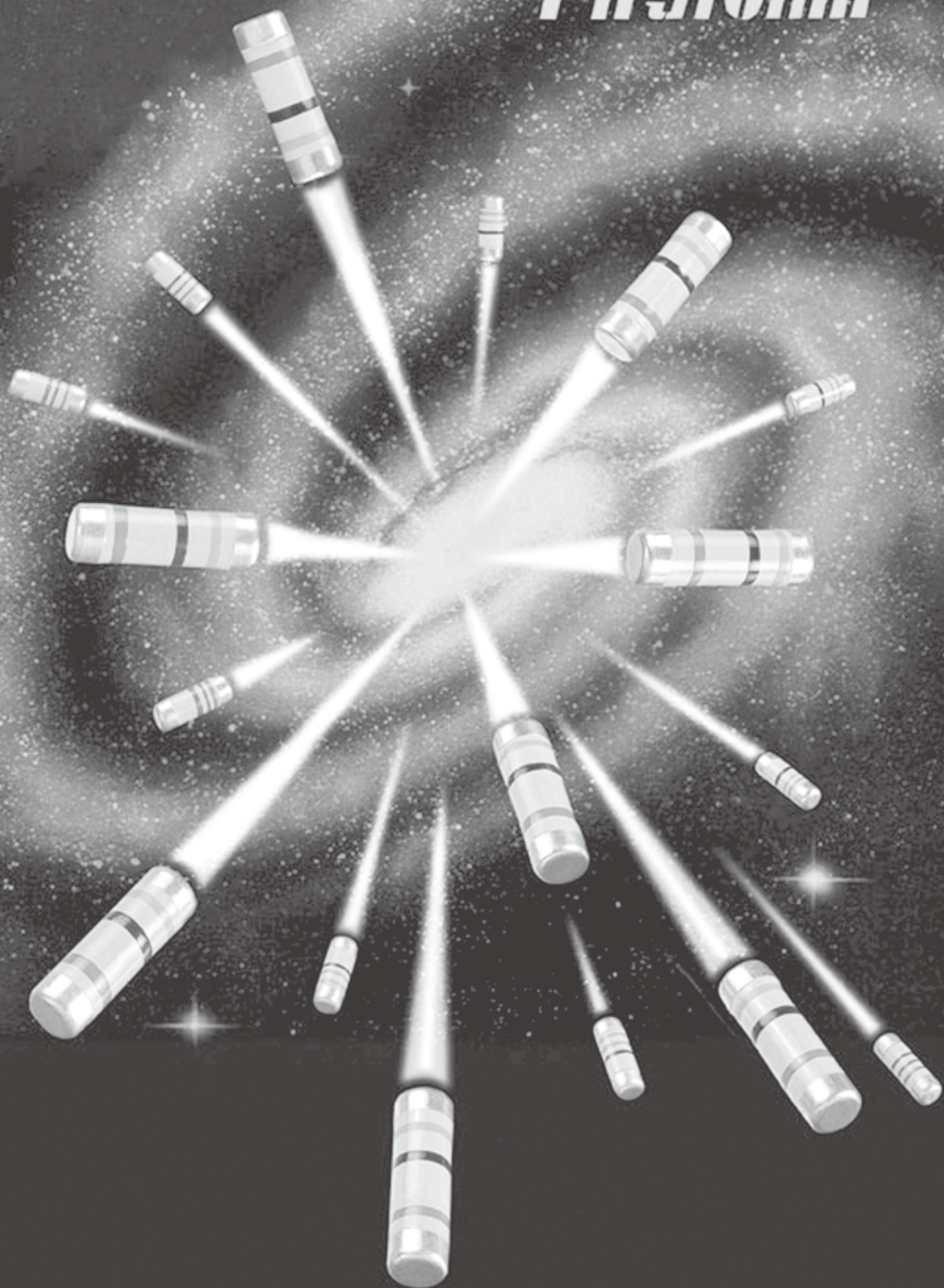
Characteristics	Limits	
Dielectric Withstanding Voltage, V AC or DC	FGE50 FGE101 FGE100 FGE200 / 201 / 301	300 350 500 700
Temperature Coefficient, PPM/°C*	FGE50 / 101 / 100 / 201	±200, ±400
	FGE200	±200
	FGE301	±400
Operating Temperature Range, °C	-55 ~ +200	
Insulation Resistance, MΩ	10 ⁴	
Fusing Condition, W	Interrupts in max. 60 seconds at below overload FGE50: 8 FGE101 / FGE100 / 201: 16 FGE200: 20 FGE301: 24	

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Overload	IEC 60115-1 4.13 2 seconds 2.5x rated voltage (not over max. overload voltage)	±5%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (230±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 1.52mm and 10 to 2,000 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 200°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±2%

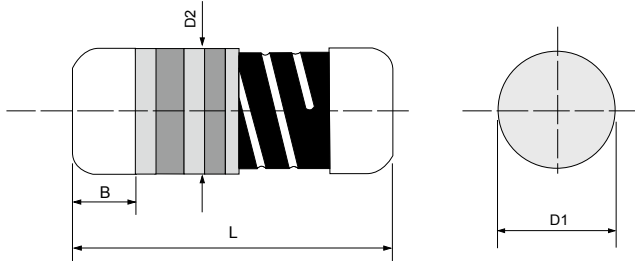
Firstohm®



FM Fusible MELF Resistor

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FM



Specifications Per

- IEC 60115-1
- EN140401-803

Features

- SMD enabled structure
- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- Excellent solderability termination
- RoHS and REACH compliant

DIMENSIONS

Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
FM26	5.90 ± 0.2	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams
FM53	5.90 ± 0.2	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams

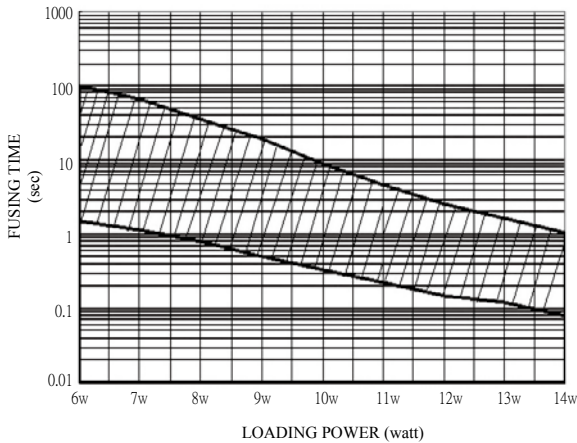
GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Max. Working Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Value
FM26	1/3W	250V	2.2Ω	10KΩ	±5%	E-24
FM53	1/2W	300V	2.2Ω	10KΩ	±5%	E-24

Special sizes, values, and specifications not listed available on special order.

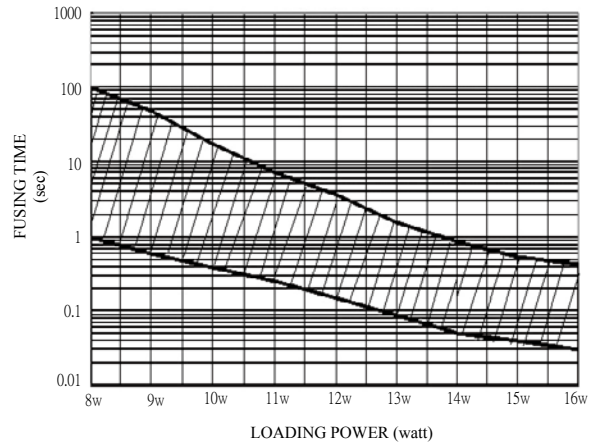
FM26

FUSING CHARACTERISTICS
USING CONSTANT VOLTAGE



FM53

FUSING CHARACTERISTICS
USING CONSTANT VOLTAGE



FM Fusible MELF Resistor

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■ PART NUMBER

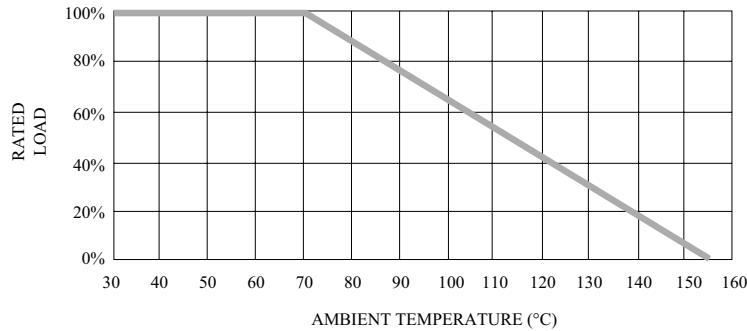
Example: FM53J10K0TKZTR2K0

FM53	J	10K0	TKZ	TR2K0
Type	Tolerance	Resistance	TCR	Packaging
	J (5%)	10KΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.*	5-character code TR = Tape Reel (pieces per reel) <u>FM26/FM53</u> 2K0 = 2,000 6K0 = 6,000** 10K = 10,000**

* For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

** upon request

■ POWER DERATING CURVE



■ TECHNICAL SUMMARY

Characteristics	Limits	
Dielectric Withstanding Voltage, VAC or DC	FM26 FM53	300
Temperature Coefficient, PPM / °C*	FM26 FM53	Typically ±200
Operating Temperature Range, °C	-55 ~ +155	
Insulation Resistance, MΩ	>10 ⁴	
Failure Rate in Time, pcs / 10 ⁹ device hours	<1	

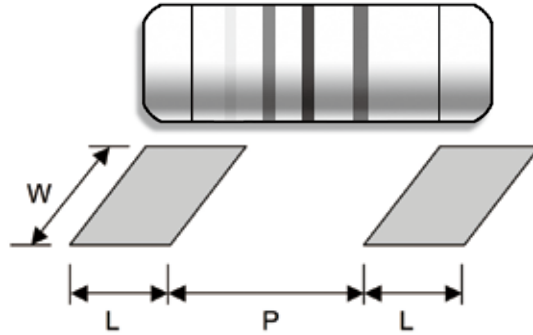
* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Overload	IEC 60115-1 4.13 2 seconds 2.5x rated voltage (not over max. overload voltage)	±5%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Dip the resistor into a solder bath measured of (260±5)°C and hold it for a 10±1 seconds	±1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 155°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±1%

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■ SUGGESTED PAD LAYOUT

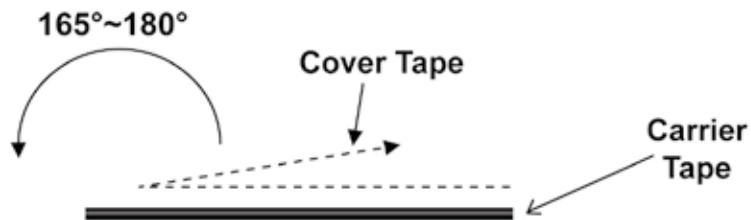


Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
FM26	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0
FM53	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0

For better heat dissipation / lower heat resistance, increase W & L.

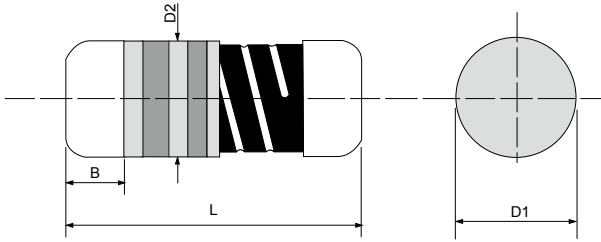
■ COVER TAPE PEELING SPECIFICATION

Recommended peeling force: 50±5gf



Safety • Quality • Reliability
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HFT



Specifications Per

- IEC 60115-1
- EN 140401-803

Features

- SMD enabled structure
- Superior frequency response
- Excellent solderability termination
- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
HFT102	2.10 ± 0.10	1.10 ± 0.1	D1+0.02/ -0.1	0.5 Min.	7 grams
HFT204	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/ -0.15	0.6 Min.	17 grams
HFT207	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams
HFT101	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams
HFT201	8.50 ± 0.50	3.00 ± 0.2	D1+0.05/ -0.35	1.3 Min.	186 grams

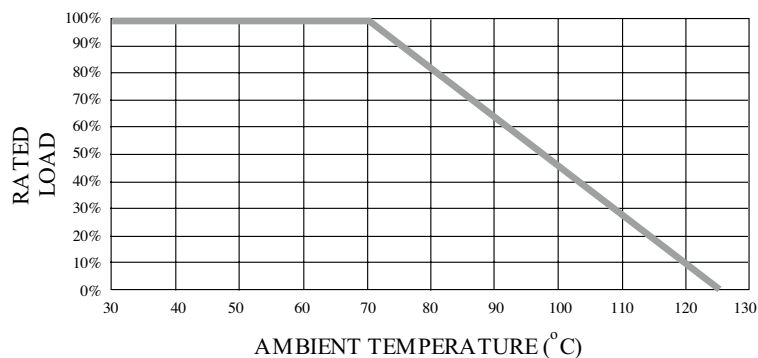
GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage*	Maximum Overload Voltage**	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
HFT102	1/5W	\sqrt{PxR}	$2.5x\sqrt{PxR}$	24.9Ω	75Ω	±0.1%~5%	E-24 / E-192
HFT204	1/4W	\sqrt{PxR}	$2.5x\sqrt{PxR}$	24.9Ω	75Ω	±0.1%~5%	E-24 / E-192
HFT207	1/3W	\sqrt{PxR}	$2.5x\sqrt{PxR}$	24.9Ω	75Ω	±0.1%~5%	E-24 / E-192
HFT101	1W	\sqrt{PxR}	$2.5x\sqrt{PxR}$	24.9Ω	75Ω	±0.1%~5%	E-24 / E-192
HFT201	2W	\sqrt{PxR}	$2.5x\sqrt{PxR}$	24.9Ω	75Ω	±0.1%~5%	E-24 / E-192

* Rated Continuous Maximum Working Voltage (RCWV) should be determined from $RCWV = \sqrt{\text{Power Rating} \times \text{Resistance Values}}$

** Short-time Overload (STOL) test should be determined from $STOL = 2.5 \times RCWV$

POWER DERATING CURVE



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■ PART NUMBER

Example: HFT204F50R0TKZTR3K0

HFT204	F	50R0	TKZ	TR3K0
Type	Tolerance*	Resistance	TCR	Packaging
	B (0.1%) C (0.25%) D(0.5%) F (1%) J (5%)	50Ω 4-character code containing - 3 significant digits 1 letter multiplier OHM MULTIPLIER R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.**	5-character code TR = Tape Reel (pieces per reel) <u>HFT102</u> 3K0 = 3,000 6K0 = 6,000 10K = 10,000 <u>HFT204</u> 3K0 = 3,000 6K0 = 6,000*** 10K = 10,000*** <u>HFT207/HFT101</u> 2K0 = 2,000 6K0 = 6,000*** 10K = 10,000*** <u>HFT201</u> 2K5 = 2,500

* Listed values may not be applicable to all resistance values. Please check with us before placing order.

** For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

*** upon request

■ TECHNICAL SUMMARY

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or DC	HFT102: 150V HFT204: 200V HFT207, HFT101: 500V HFT201: 700V
Temperature Coefficient, PPM / °C*	±50, ±100
Operating Temperature Range, °C	-55 ~ +125
Film Temperature, °C	125
Insulation Resistance, MΩ	>10 ⁴
Tin Whisker (JESD201 Temperature Cycling & High Temp. /Humidity Storage), μm	<5
Failure Rate in Time, pcs / 10 ⁹ device hours	<1

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

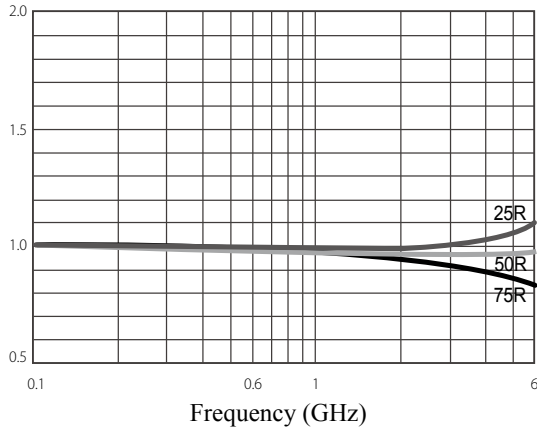
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■ FUNCTIONAL PERFORMANCE

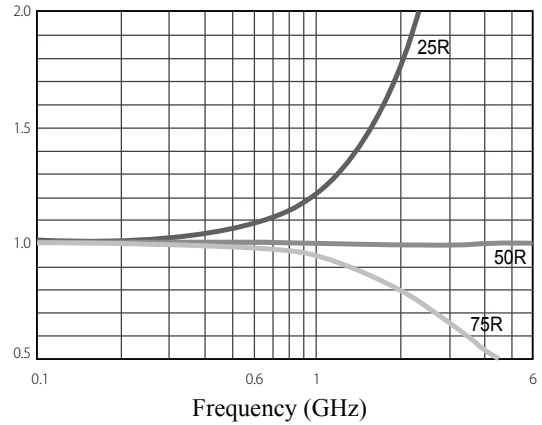
RF-BEHAVIOR

HFT

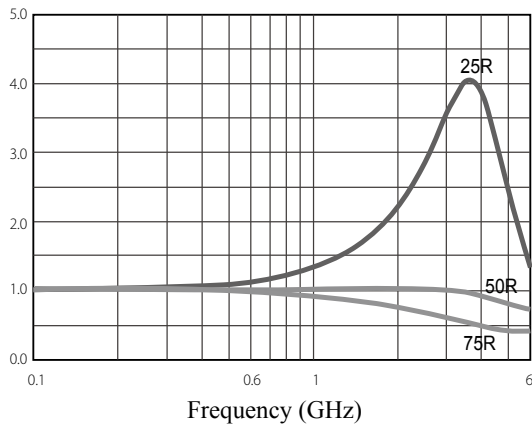
IZI/R for HFT102 MELF resistors



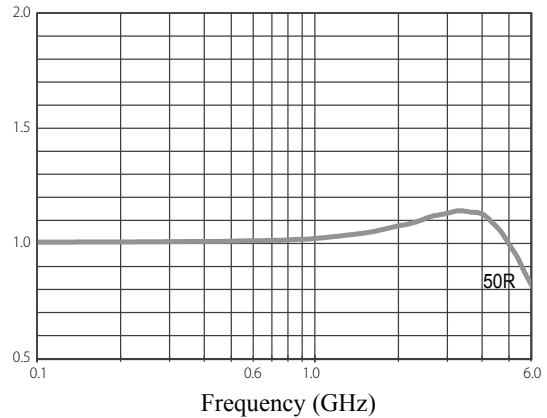
IZI/R for HFT204 MELF resistors



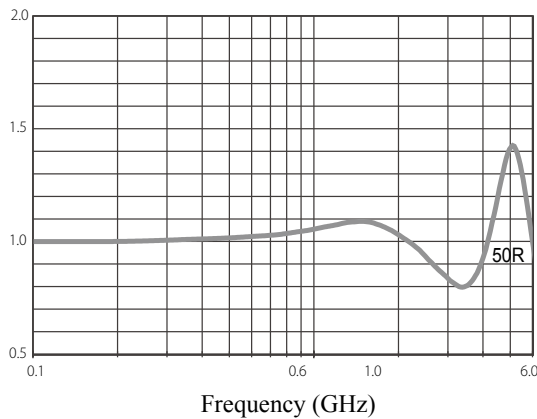
IZI/R for HFT207 MELF resistors



IZI/R for HFT101 MELF resistors



IZI/R for HFT201 MELF resistors

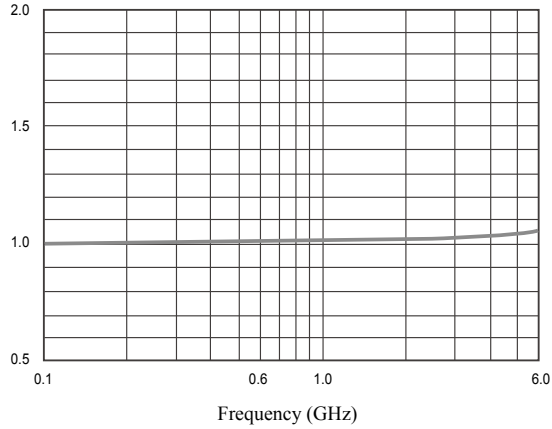


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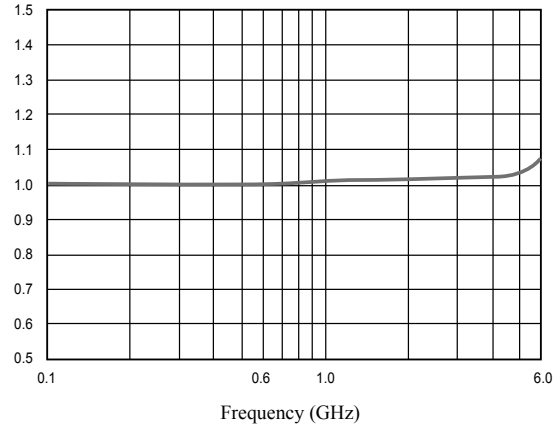
FUNCTIONAL PERFORMANCE

VSWR

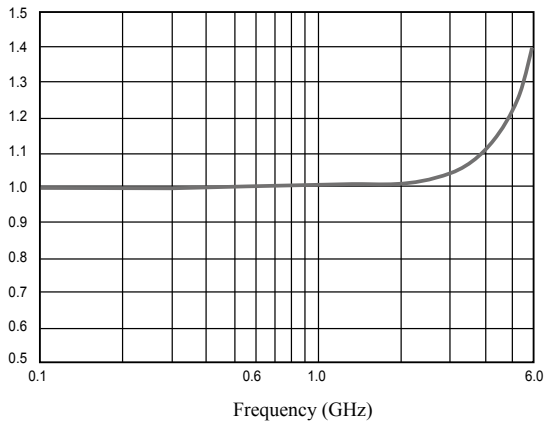
HFT102 50R MELF Resistor



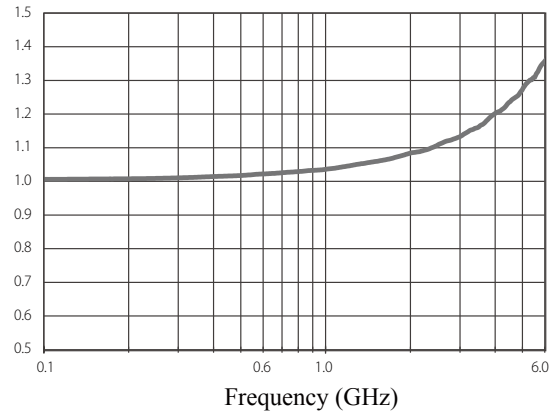
HFT204 50R MFLF Resistor



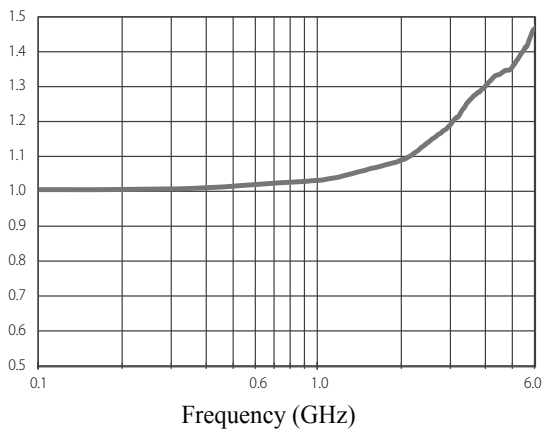
HFT207 50R MFLF Resistor



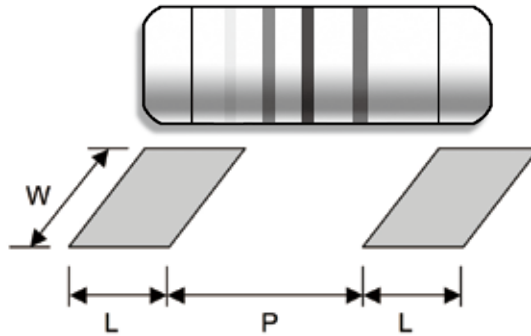
HFT101 50R MELF Resistor



HFT201 50R MELF Resistor



■ SUGGESTED PAD LAYOUT



Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
HFT102	Reflow	0.8	0.9 ± 0.05	1.3
	Wave	1.2	0.7 ± 0.05	1.3
HFT204	Reflow	1.3	1.6 ± 0.1	1.6
	Wave	1.5	1.5 ± 0.1	1.8
HFT207	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0
HFT101	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0
HFT201	Reflow	3.0	4.9 ± 0.3	3.7
	Wave	3.5	4.8 ± 0.3	4.0

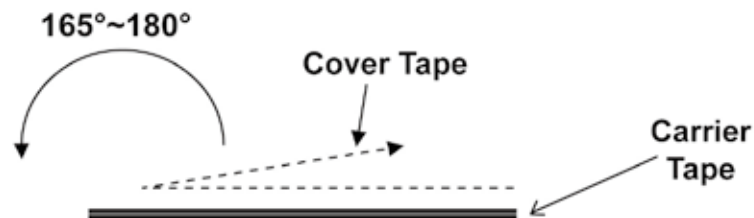
For better heat dissipation / lower heat resistance, increase W & L.

■ COVER TAPE PEELING SPECIFICATION

Recommended peeling force:

HFT102, HFT204, HFT207, HFT101: 50±5gf

HFT201: 70±10gf



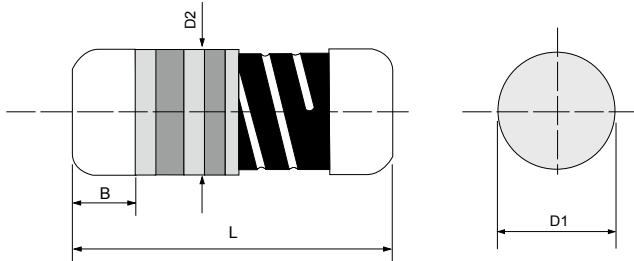
■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Overload	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±0.5%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±2%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±2%
Periodic Electric Overload	IEC 60115-1 4.39 3.9x rated voltage (not over max. overload voltage) with 0.1s ON, 2.5s OFF for 1,000 cycles	±2%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds	±0.5%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min. coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 1.52mm and 10 to 2,000 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 125°C without load	±2%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +125°C 30minutes, 5 cycles	±0.5%
Single pulse high voltage overload	IEC 60115-1 4.27 10 pulses of 10/700µs at 10x rated voltage with interval of 60 sec.	±1%
Electrostatic discharge (Human body model)	IEC 60115-1 4.38 3 positive & 3 negative discharges with 1.5KV for HFT102 or 2KV for HFT204 or 4KV for HFT207, HFT101, HFT201	±2%
Climatic test	IEC 60115-1 4.23 4.23.2 - dry heat: 16 hours 125°C 4.23.3 - damp heat: 24 hours 55°C with 95% relative humidity 4.23.4 - cold: 2 hours -55°C 4.23.5 - negative air pressure: 2 hour 8.5KPa at (25±10)°C 4.23.6 - damp heat cyclic: 5 days 55°C with 95% relative humidity 4.23.7 - DC load: rated voltage at -55°C and 125°C each 1 Min.	±1%
Bending test	IEC 60115-1 4.33 Pressing depth 2mm, 3 times	±0.25%
Flammability	IEC 60115-1 4.35 Needle flame test 10s	No burning after 30s

HVM High Voltage MELF Resistor

Safety • Quality • Reliability
Cost-Down via Innovation

HVM



Specifications Per

• IEC 60115-1

Features

- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- Handles much higher working voltage than general purpose resistors
- Pure tin-plated termination for excellent solderability
- SMD enabled structure
- Anti-surge features available
- VDE0860 Compliance.
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

■ DIMENSIONS

Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
HVM16	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/-0.15	0.6 Min.	17 grams
HVM25	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/-0.2	1.0 Min.	66 grams
HVM50	8.50 ± 0.50	3.00 ± 0.2	D1+0.05/-0.35	1.3 Min.	186 grams
HVM100	10.5 ± 0.50	4.00 ± 0.5	D1+0.05/-0.45	1.6 Min.	446 grams
HVM200	12.6 ± 0.60	4.60 ± 0.5	D1+0.05/-0.50	1.8 Min.	750 grams
HVM300	14.6 ± 0.60	5.10 ± 0.5	D1+0.05/-0.50	2.0 Min.	1000 grams

■ GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
HVM16	1/6W	600V	1,250V DC 900V RMS	56KΩ	22MΩ	±1%~±5%	E-24/E-96
HVM25	1/4W	1,250V DC 900V RMS	2,400V DC 1,800V RMS	91KΩ	24MΩ	±1%~±5%	E-24/E-96
HVM50	1/2W	2,800V DC 2,000V RMS	5,600V DC 4,000V RMS	100KΩ	33MΩ	±1%~±5%	E-24/E-96
HVM100	1W	4,200V DC 3,000V RMS	8,400V DC 6,000V RMS	100KΩ	68MΩ	±1%~±5%	E-24/E-96
HVM200	2W	6,300V DC 4,500V RMS	11,200V DC 8,000V RMS	100KΩ	68MΩ	±1%~±5%	E-24/E-96
HVM300	3W	8,400V DC 6,000V RMS	14,000V DC 10,000V RMS	100KΩ	68MΩ	±1%~±5%	E-24/E-96

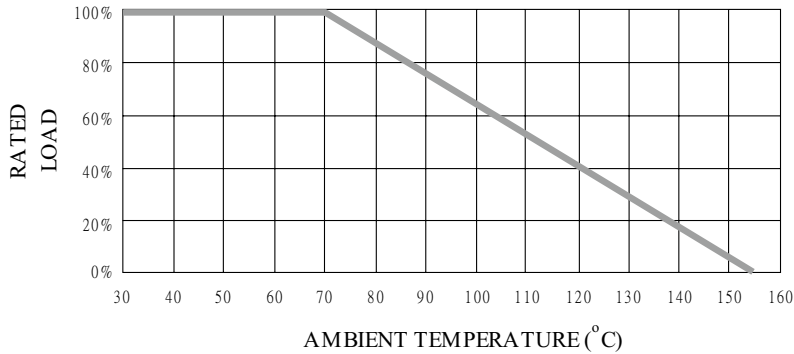
Special sizes, values, and specifications not listed available on special order.

HVM High Voltage MELF Resistor

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Cost-Down via Innovation

HVM

■ POWER DERATING CURVE



■ PART NUMBER

Example: HVM100J910KTKZTR2K0

HVM100	J	910K	TKZ	TR2K0
Type	Tolerance*	Resistance	TCR	Packaging
	F (1%) G (2%) J (5%)	910KΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.**	5-character code TR = Tape Reel (pieces per reel) HVM16 3K0 = 3,000 6K0 = 6,000*** 10K = 10,000*** HVM25 2K0 = 2,000 6K0 = 6,000*** 10K = 10,000*** HVM50 2K5 = 2,500 HVM100 2K0 = 2,000 BK = Bulk <u>HVM200/HVM300</u> BK + Quantity

* Listed values may not be applicable to all resistance values. Please check with us before placing order.

** For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

*** upon request

TECHNICAL SUMMARY

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or DC	HVM16: 300 HVM25: 500 HVM50: 700 HVM100, HVM200, HVM300: 1000
Temperature Coefficient, PPM / °C*	±200, ±400, ±800, ±1200
Operating Temperature Range, °C	-55 ~ +155
Insulation Resistance, MΩ	>10 ⁴
Failure Rate in Time, pcs / 10 ⁹ device hours	< 5
Tin Whisker (JESD201 Temperature Cycling & High Temp. /Humidity Storage), μm	< 5

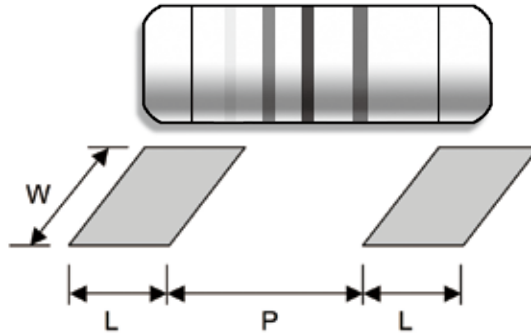
* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Overload	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±2%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±3%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±3%
Periodic Electric Overload	IEC 60115-1 4.39 3.9x rated voltage (not over max. overload voltage) with 0.1s ON, 2.5s OFF for 1,000 cycles	±2.5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds	±1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 155°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±2%
Single pulse high voltage overload	IEC 60115-1 4.27 10 pulses of 10/700μs at 10x rated voltage (not over max. overload voltage) with interval of 60 sec.	±2%
Electrostatic discharge (Human body model)	IEC 60115-1 4.38 3 positive & 3 negative discharges with 4KV source	±2.5%
Climatic test	IEC 60115-1 4.23 4.23.2 - dry heat: 16 hours 155°C 4.23.3 - damp heat: 24 hours 55°C with 95% relative humidity 4.23.4 - cold: 2 hours -55°C 4.23.5 - negative air pressure: 2 hour 8.5KPa at (25±10)°C 4.23.6 - damp heat cyclic: 5 days 55°C with 95% relative humidity 4.23.7 - DC load: rated voltage at -55°C and 155°C each 1 Min.	±2%
Bending test	IEC 60115-1 4.33 Pressing depth 2mm, 3 times	±1%
Flammability	IEC 60115-1 4.35 Needle flame test 10s	No burning after 30s

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■ SUGGESTED PAD LAYOUT



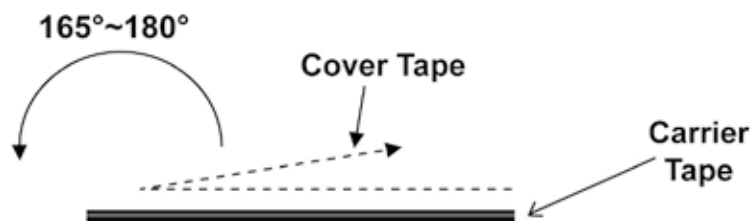
Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
HVM16	Reflow	1.3	1.6 ± 0.1	1.6
	Wave	1.5	1.5 ± 0.1	1.8
HVM25	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0
HVM50	Reflow	3.0	4.9 ± 0.3	3.7
	Wave	3.5	4.8 ± 0.3	4.0
HVM100	Reflow	4.0	6.2 ± 0.4	5.0
	Wave	4.5	6.0 ± 0.4	5.0
HVM200	Reflow	4.5	8.0 ± 0.4	5.5
	Wave	5.0	7.7 ± 0.4	5.5
HVM300	Reflow	5.0	9.3 ± 0.4	6.5
	Wave	5.0	9.0 ± 0.4	6.0

For better heat dissipation / lower heat resistance, increase W & L.

■ COVER TAPE PEELING SPECIFICATION

Recommended peeling force:

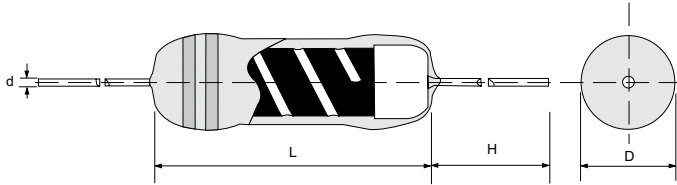
HVM16, HVM25: 50±5gf HVM50, HVM100: 70±10gf HVM200, HVM300: 80±10gf



HVR High Voltage Resistor

Safety • Quality • Reliability
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HVR



Features

- IEC60065 & UL1676 Compliant
- Special conductive film withstands high voltage
- Maximum working voltage far over that of general-purpose resistors
- Suitable for applications such as TV's, high voltage power supply, and high voltage detection.
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000Pcs
HVR25	6.50 ± 1.0	2.6 ± 0.3	26 ± 3.0	0.55 ± 0.03	300 Grams
HVR50	9.00 ± 1.0	3.2 ± 0.2	28 ± 3.0	0.60 ± 0.03	340 Grams
HVR100	15.5 ± 1.0	5.5 ± 0.5	30 ± 3.0	0.80 ± 0.03	1200 Grams
HVR200	19.0 ± 1.0	6.0 ± 0.5	30 ± 3.0	0.80 ± 0.03	1620 Grams
HVR300	24.0 ± 1.0	8.0 ± 0.5	30 ± 3.0	0.80 ± 0.03	3100 Grams

GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
HVR25	1/4W	1.6KV DC 1150V RMS	3KV DC 2KV RMS	91KΩ	24MΩ	± 5%	E-24
						± 1%	E-96
HVR50	1/2W	3.5KV DC 2.5KV RMS	7KV DC 5KV RMS	100KΩ	33MΩ	± 5%	E-24
						± 1%	E-96
HVR100	1W	10KV DC 7KV RMS	20KV DC 14KV RMS	100KΩ	68MΩ	± 5%	E-24
						± 1%	E-96
HVR200	2W	11KV DC 8KV RMS	20KV DC 15KV RMS	100KΩ	100MΩ	± 5%	E-24
						± 1%	E-96
HVR300	3W	12KV DC 8.5KV RMS	20KV DC 15KV RMS	100KΩ	100MΩ	± 5%	E-24
						± 1%	E-96

Other sizes and values available on request.

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■ PART NUMBER

Example: HVR200J10M0TKZTB500

HVR200	J	10M0	TKZ	TB500
Type	Tolerance*	Resistance	TCR	Packaging
	F (1%) G (2%) J (5%)	10MΩ 4-character code containing - 3 significant digits 1 letter multiplier OHM MULTIPLIER R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.**	5-character code TB = Tape Box (pieces per box) <u>HVR25/HVR50</u> 2K0 = 2,000 <u>HVR100/200</u> 500 = 500 <u>HVR300</u> 250 = 250

* Listed values may not be applicable across the product series/all resistance values. Please check with us before placing order.

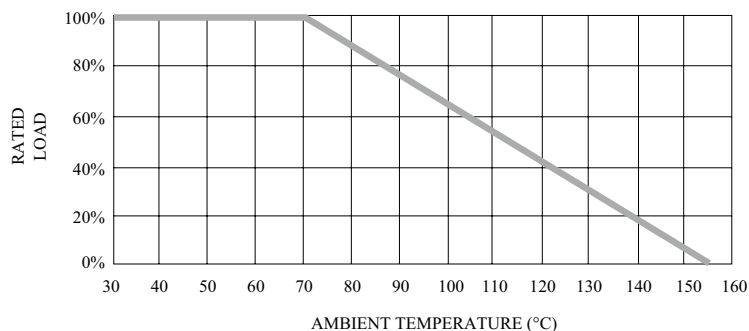
** For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

■ TECHNICAL SUMMARY

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or DC	HVR25: 500
	HVR50, HVR100: 700
	HVR200: 800
	HVR300: 1000
Temperature Coefficient, PPM / °C*	±200, ±400, ±800
Operating Temperature Range, °C	-55 ~ +155
Insulation Resistance, MΩ	>10 ⁴

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ POWER DERATING CURVE



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HVR

■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits						
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	± 1%						
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	± 5%						
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	± 5%						
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	± 1%						
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage						
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	± 1%						
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 155°C without load	± 1%						
Thermal Shock	IEC 60115-1 4.19 -55°C 30 minutes, +155°C 30minutes, 5 cycles	± 1%						
Surge Test	Surge voltage = $\sqrt{(100 \times P \times R)}$ DC P is power rating, R is resistance value, surge voltage is not more than listed at right. Surge duration = 1.2/50µs Period = 1 sec Number of surges = 5000	<table border="1"> <tr> <td>HVR25: 10KV</td> <td rowspan="5">± 5%</td> </tr> <tr> <td>HVR50: 30KV</td> </tr> <tr> <td>HVR100: 40KV</td> </tr> <tr> <td>HVR200: 40KV</td> </tr> <tr> <td>HVR300: 40KV</td> </tr> </table>	HVR25: 10KV	± 5%	HVR50: 30KV	HVR100: 40KV	HVR200: 40KV	HVR300: 40KV
HVR25: 10KV	± 5%							
HVR50: 30KV								
HVR100: 40KV								
HVR200: 40KV								
HVR300: 40KV								

SRM-201 withstands 51,840,000 surges at 30KV, in duration of 500 hours.



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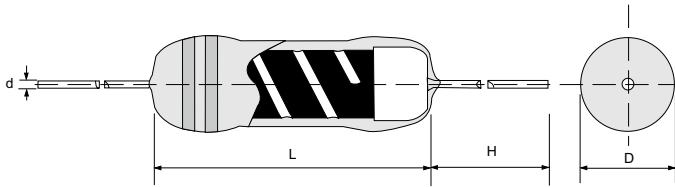
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TÜV ISO 9002 ISO 14001 / IECQ CERTIFIED FACTORY

HVR - High Voltage Resistor (High Power)

Safety • Quality • Reliability
Cost-Down via Innovation

HVR



Features

- Special conductive film withstands voltage far over the maximum working voltage of general-purpose resistors.
- Suitable for applications such as TV's, high voltage power supply, and high voltage detection.
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

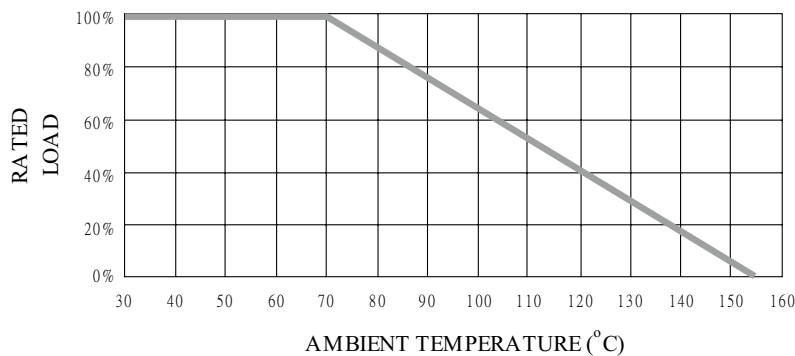
Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000 Pcs
HVR1000	66.0 ± 1.5	8 ± 0.5	39 ± 3.0	0.8 ± 0.03	8200 Grams
HVR1500	66.0 ± 1.5	8 ± 0.5	39 ± 3.0	0.8 ± 0.03	8200 Grams

GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
HVR1000	10W	35KV DC	50KV DC	100KΩ	100MΩ	± 5%	E-24
						± 1%	E-96
HVR1500	15W	35KV DC	50KV DC	100KΩ	100MΩ	± 5%	E-24
						± 1%	E-96

Other sizes and values available on request.

POWER DERATING CURVE



TECHNICAL SUMMARY

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or DC	1000
Temperature Coefficient, PPM / °C*	±800
Operating Temperature Range, °C	-55 ~ +155
Insulation Resistance, MΩ	>10 ⁴

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

HVR - High Voltage Resistor (High Power)

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Cost-Down via Innovation

HVR

■ PART NUMBER

Example: HVR1000J100KTKZBK100

HVR1000	J	100K	TKZ	BK100
Type	Tolerance*	Resistance	TCR	Packaging
	F (1%) G (2%) J (5%)	100KΩ 4-character code containing - 3 significant digits 1 letter multiplier OHM MULTIPLIER R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.**	Bulk 100 pieces 5-character code BK = Bulk BK + Quantity

* Listed values may not be applicable across the product series/all resistance values. Please check with us before placing order.

** For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

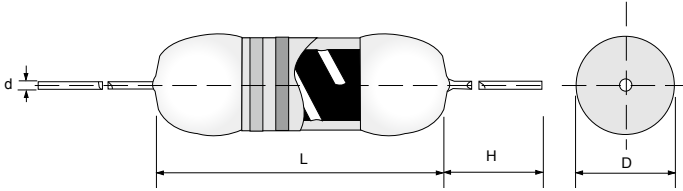
■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±2%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 1.52mm and 10 to 2,000 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 155°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±2%
Surge Test	Surge voltage = $\sqrt{(100 \times P \times R)}$ DC P is power rating, R is resistance value, surge voltage is not more than 80KV Surge duration = 1.2/50µs Period = 1 sec Number of surges = 5000	±5%

IG Ignition Fixed Resistor

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IG



Specifications Per

- IEC 60115-1
- MIL-R-10509

Features

- Special coating technique to ensure fast ignition
- Color code per MIL & EIA standards
- Special conductive film to fuse at high temperature
- Auto cut-off after fusing/no sustaining fire hazard
- Special tin-plated electrolytic copper lead wire for optimal ease of soldering and mounting
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

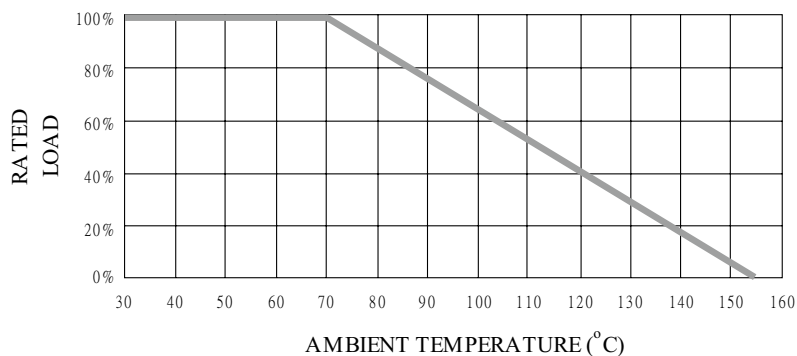
Type No.	Body Length (L , mm)	Body Diameter (D , mm)	Lead Wire Length (H , mm)	Lead Wire Diameter (d , mm)	Net Weight Per 1000Pcs
IG16	3.15 ± 0.2	1.7 ± 0.1	28 ± 3.0	0.45 ± 0.02	145 Grams

GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
IG16	1/6W	200V	400V	1Ω	150Ω	±5%	E-24

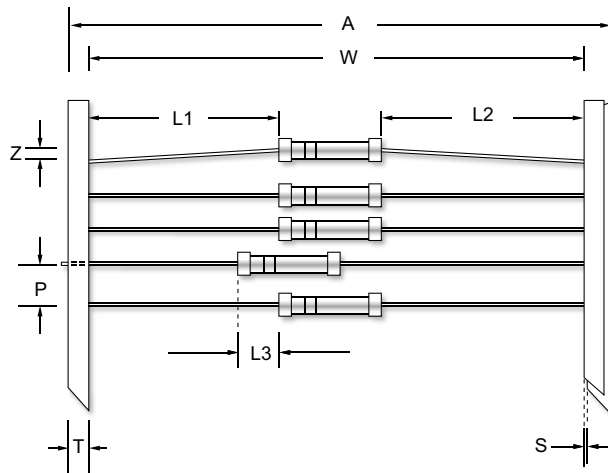
Other sizes and values available on request.

POWER DERATING CURVE



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■ TAPING/PACKING SPECIFICATIONS



Unit (mm)

Type No.	A Max.	L1-L2 (Max.)	L3 (Max.)	P ±0.5	S (Max.)	T ±0.5	W ±1.5	Z (Max.)
IG16	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2

Type No.	Packing Type	R16	R25
Minimum Packing QTY (pcs)	Ammo pack	5000	5000

■ PART NUMBER

Example: IG16J24R0TKZTB5K0

IG16	J	24R0	TKZ	TB5K0
Type	Tolerance J (5%)	Resistance 24Ω 4-character code containing - 3 significant digits 1 letter multiplier OHM MULTIPLIER R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	TCR 3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.*	Packaging 5-character code TB = Tape Box (pieces per box) IG16 5K0 = 5,000

* For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

■ TECHNICAL SUMMARY

Characteristics	Limits
Ignition Power, W	≥24W
Ignition Time, second(s)	< 1 second
Temperature Coefficient, PPM / °C*	±200 PPM/°C
Insulation Resistance, MΩ	>10 ⁴
Operating Temperature Range, °C	-55 ~ +155

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±0.5%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±2%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±2%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±0.5%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2+0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 1.52mm and 10 to 2,000 Hz.	±0.5%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 155°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±0.5%

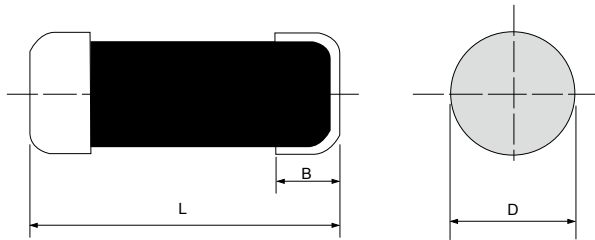
Firstohm®



ISC Ignition Noise Suppression Resistor (Ceramic Film Composite Type)

Safety • Quality • Reliability
Cost-Down via Innovation

ISC



Specifications Per

- IEC 60115-1

Features

- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- Dedicatedly designed for high-voltage spark ignition systems.
- Proprietary ceramic composite withstands high-voltage surge impacts with long-term stability. One of few sources in the world capable of manufacturing such type of resistor.
- RoHS and REACH compliant

■ DIMENSIONS

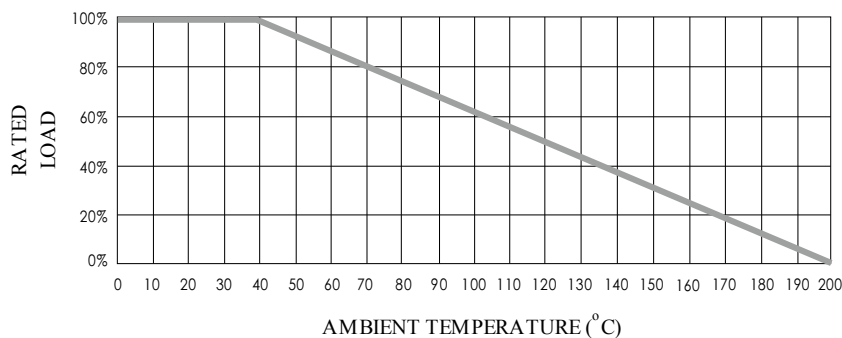
Type	Body Length (L, mm)	Body Diameter (D, mm)	Cap Length (B, mm)	Net Weight Per 1000 pcs
ISC20K	10.5± 1.0	4.0 ± 0.5	2.2 ± 0.3	390 grams
ISC25K	11.0 ± 1.0	3.5 ± 0.5	2.2 ± 0.3	400 grams
ISC50K	18.5 ± 1.0	4.5 ± 0.7	2.2 ± 0.3	700 grams
ISC50K1	22.5 ± 1.5	4.5 ± 0.7	2.2 ± 0.3	1300 grams

■ GENERAL SPECIFICATIONS

Type	Power Rating (at 40°C)	Maximum Working Voltage	Maximum Surge Load	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
ISC20K	0.5W	350V	25KV / 10nS	1KΩ	10KΩ	±5% ~ ±20%	E-6/E-24
ISC25K	0.5W	350V	25KV / 10nS	1KΩ	10KΩ	±5% ~ ±20%	E-6/E-24
ISC50K	2W	400V	50KV / 20nS	1KΩ	10KΩ	±5% ~ ±20%	E-6/E-24
ISC50K1	3W	450V	50KV / 30nS	1KΩ	10KΩ	±5% ~ ±20%	E-6/E-24

Special sizes, values, and specifications not listed available on special order.

■ POWER DERATING CURVE



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■ PART NUMBER

Example: ISC20KM5K00TKZBK500

ISC20K	M	5K00	TKZ	BK500
Type	Tolerance	Resistance	TCR	Packaging
	J (5%) K (10%) M (20%)	5KΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary Section of the datasheet.	Bulk 500 pieces 5-character code BK = Bulk BK + Quantity

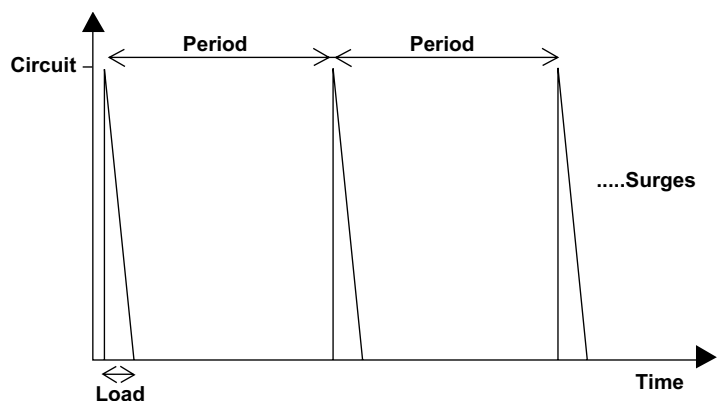
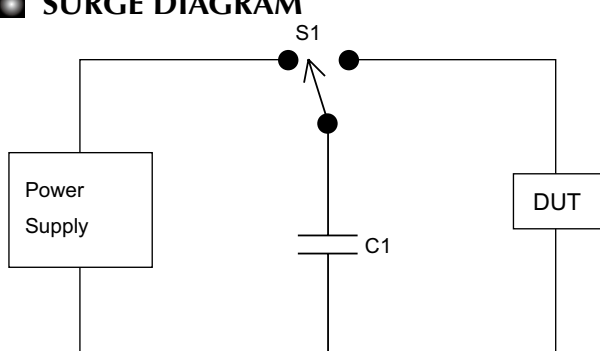
ISC

■ TECHNICAL SUMMARY

Characteristics	Limits	
Dielectric Withstanding Voltage, VAC or DC	ISC20K ISC25K ISC50K ISC50K1	500
Temperature Coefficient, PPM / °C*	±3300 (typical)	
Operating Temperature Range, °C	-55 ~ +200	
Insulation Resistance, MΩ	>10 ⁴	
Failure Rate in Time, pcs / 10 ⁹ device hours	<1	

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ SURGE DIAGRAM



S1: High-voltage insulated switch

C1: High-voltage variable capacitor

Power supply: Variable 0 ~ 50KV DC

DUT: Device Under Test.

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ISC

■ SURGE TEST

Type	Circuit	Load	Period	Surges
ISC20K	25KV	20nS	20mS	200,000
ISC25K	25KV	20nS	20mS	200,000
ISC50K	50KV	30nS	20mS	200,000
ISC50K1	50KV	45nS	20mS	200,000

■ PERFORMANCE SPECIFICATIONS

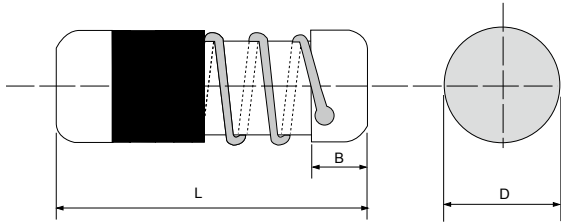
Characteristics	Test Conditions	Limits
Short Time Overload	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over 2X max. working voltage)	±2%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (40±2)°C	±5%
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±5%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 200°C without load	±5%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 500 cycles	±5%
Surge Test	200,000 impacts at period 20ms (3000rpm/1hour) according to the following chart.	±5%

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ISW



[*structure pending patent approval]
 Taiwan patent number: M530462
 Japan patent number: 3208923
 China patent number: 6433867
 Korean patent number: 20-0486309
 United States patent number: US9978483B2

Specifications Per

• IEC 60115-1

Features

- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- Enhanced weld spot is reliable against surge
- Dedicatedly designed for high-voltage spark ignition systems
- Enhanced weld spot is reliable against surge with long-term stability
- RoHS and REACH compliant

DIMENSIONS

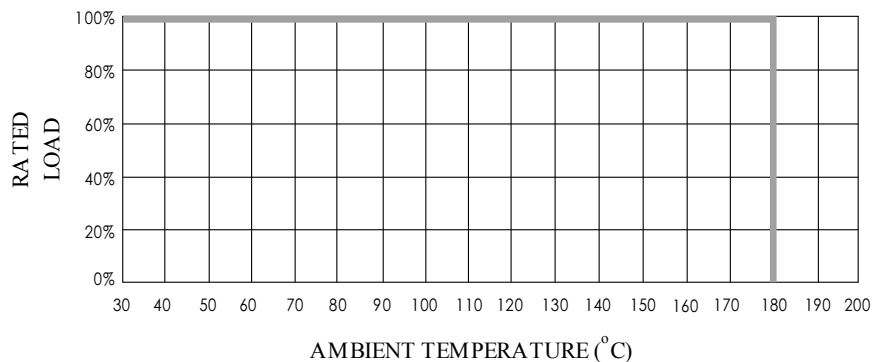
Type	Body Length (L, mm)	Body Diameter (D, mm)	Cap Length (B, mm)
ISW35K	16.0 ± 1.0	4.5 ± 0.7	2.2 ± 0.3
ISW50K	18.5 ± 1.0	4.5 ± 0.7	2.2 ± 0.3
ISW50K1	22.5 ± 1.5	4.5 ± 0.7	2.2 ± 0.3

GENERAL SPECIFICATIONS

Type	Nominal Power Rating (at 70°C)	Maximum Working Voltage	Maximum Surge Load	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Value
ISW35K	2W	350V	35KV / 20nS	1KΩ	3K3Ω	±5% ~ ± 20%	E-6/E-24
ISW50K	2W	400V	50KV / 20nS	1KΩ	4KΩ	±5% ~ ± 20%	E-6/E-24
ISW50K1	3W	450V	50KV / 30nS	1KΩ	5KΩ	±5% ~ ± 20%	E-6/E-24

Special sizes, values, and specifications not listed available on special order.

POWER DERATING CURVE



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■ PART NUMBER

Example: ISW50KM1K00TKZBK500

ISW50K	M	1K00	TKZ	BK500
Type	Tolerance	Resistance	TCR	Packaging
	J (5%) K (10%) M (20%)	1K Ω 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.	Bulk 500 pieces 5-character code BK = Bulk BK + Quantity

ISW

■ TECHNICAL SPECIFICATIONS

Characteristics	Limits	
Dielectric Withstanding Voltage, VAC or DC	ISW35K ISW50K ISW50K1	500
Temperature Coefficient, PPM / °C*	±300	
Operating Temperature Range, °C	-40 ~ +180	
Insulation Resistance, M Ω	10 ⁴	
Inductance Range, 2 MHz, μ H	5 to 50	
Failure Rate in Time, pcs / 10 ⁹ device hours	<1	

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ PERFORMANCE SPECIFICATIONS

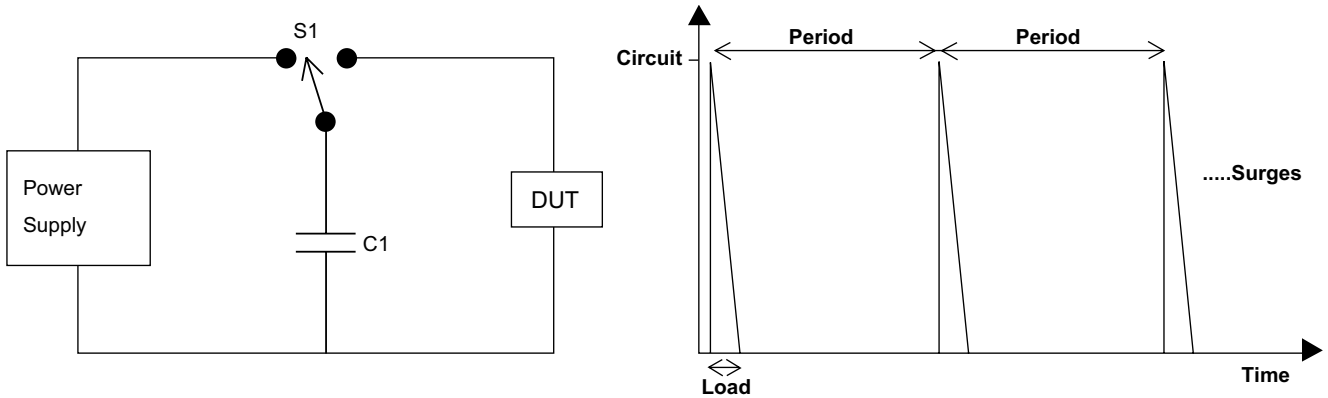
Characteristics	Test Conditions	Limits
Short Time Overload	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over 2X max. working voltage)	±2%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over working voltage) at (40±2)°C and (93±3)% relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±5%
Thermal Endurance	IEC 60115-1 4.25.3 1,000 hours at 180°C without load	±5%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±3%
Surge Test	200,000 impacts at period 20ms (3000rpm/1hour) according to the following chart.	±5%

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■ SURGE TEST

Type	Circuit	Load	Period	Surges
ISW35K	35KV	30nS	20mS	200,000
ISW50K	50KV	30nS	20mS	200,000
ISW50K1	50KV	45nS	20mS	200,000

■ SURGE DIAGRAM



S1: High-voltage insulated switch

C1: High-voltage variable capacitor

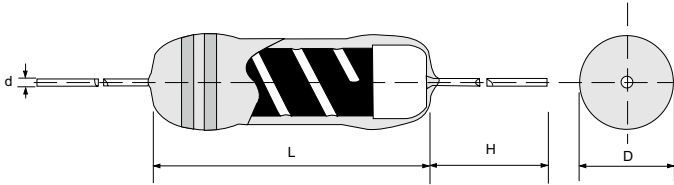
Power supply: Variable 0 ~ 50KV DC

DUT: Device Under Test.

M-Series Metal Film Fixed Resistor

Safety • Quality • Reliability
Cost-Down via Innovation

M-Series



Specifications Per

- IEC 60115-1
- MIL-R-10509

Features

- Conformal multi-layer coating
- Color code per MIL & EIA standards
- Special tin-plated electrolytic copper lead wire
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

■ DIMENSIONS

Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000Pcs
M16	3.20 ± 1.0	1.9 ± 0.2	28 ± 3.0	0.45 ± 0.02	145 Grams
M20	3.20 ± 1.0	1.9 ± 0.2	28 ± 3.0	0.45 ± 0.02	145 Grams
M25	6.50 ± 1.0	2.4 ± 0.2	26 ± 3.0	0.55 ± 0.03	220 Grams
M207	6.50 ± 1.0	2.4 ± 0.2	26 ± 3.0	0.55 ± 0.03	220 Grams
M51	9.00 ± 1.0	3.2 ± 0.2	26 ± 3.0	0.60 ± 0.03	340 Grams
M100	11.0 ± 1.0	4.5 ± 0.5	26 ± 3.0	0.70 ± 0.03	600 Grams
M200	15.5 ± 1.0	5.5 ± 0.5	26 ± 3.0	0.80 ± 0.03	1200 Grams

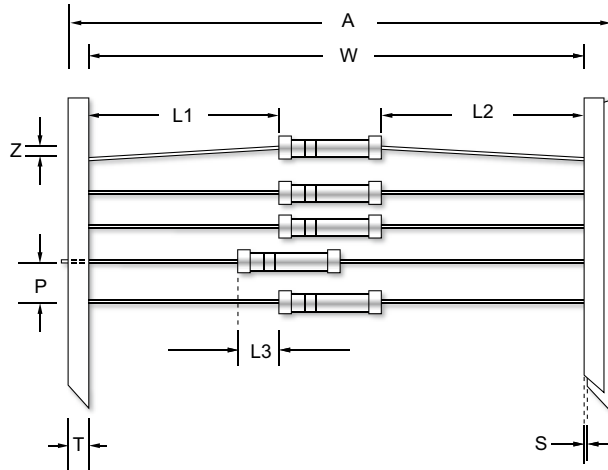
■ GENERAL SPECIFICATIONS

Type	Power Rating At 70°C	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
M16	1/6W	200V	400V	0.1Ω	10MΩ	±5%	E-24
				1Ω	1MΩ	±1%	E-96
				47Ω	510KΩ	±0.1%~0.5%	E-192
M20	1/4W	250V	400V	0.1Ω	10MΩ	±5%	E-24
				1Ω	1MΩ	±1%	E-96
				47Ω	510KΩ	±0.1%~0.5%	E-192
M25	1/4W	250V	500V	0.1Ω	10MΩ	±5%	E-24
				1Ω	1MΩ	±1%	E-96
				20Ω	1MΩ	±0.1%~0.5%	E-192
M207	3/5W	350V	700V	0.1Ω	10MΩ	±5%	E-24
				1Ω	1MΩ	±1%	E-96
				20Ω	1MΩ	±0.1%~0.5%	E-192
M51	1/2W	350V	700V	0.1Ω	10MΩ	±5%	E-24
				1Ω	1MΩ	±1%	E-96
				15Ω	1MΩ	±0.1%~0.5%	E-192
M100	1W	500V	1000V	0.1Ω	10MΩ	±5%	E-24
				1Ω	1MΩ	±1%	E-96
				10Ω	1MΩ	±0.1%~0.5%	E-192
M200	2W	500V	1000V	0.1Ω	10MΩ	±5%	E-24
				1Ω	1MΩ	±1%	E-96
				10Ω	1MΩ	±0.1%~0.5%	E-192

Special sizes, values, and specifications not listed available on special order.

Safety • Quality • Reliability
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■ TAPING/PACKING SPECIFICATIONS

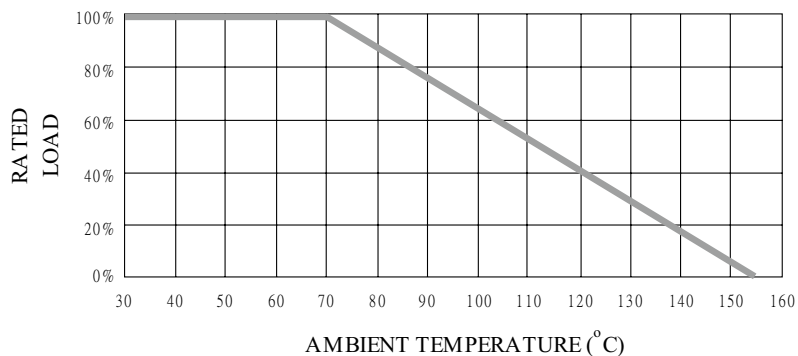


Unit (mm)

Type	A Max.	L1-L2 (Max.)	L3 (Max.)	P ±0.5	S (Max.)	T ±0.5	W ±1.5	Z (Max.)
M16	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
M20	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
M25	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
M207	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
M51	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
M100	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
M200	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2

Type	Packing Type	M16	M20	M25	M207	M51	M100	M200
Minimum Packing QTY (pcs)	Ammo pack	5000	5000	5000	5000	2000	1000	500

■ POWER DERATING CURVE



M-Series Metal Film Fixed Resistor

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M-Series

■ PART NUMBER

Example: M51F49K9TKRTB2K0

M51	F	49K9	TKR	TB2K0
Type	Tolerance*	Resistance	TCR*	Packaging
	B (0.1%) C (0.25%) D (0.5%) F (1%) G (2%) J (5%)	49.9KΩ 4-character code containing - 3 significant digits 1 letter multiplier OHM MULTIPLIER R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	50ppm 3-character code TKQ = ± 25ppm TKR = ± 50ppm TKS = ± 100ppm	5-character code TB = Tape Box (pieces per box) <u>M16/20/25/207</u> 5K0 = 5,000 <u>M51</u> 2K0 = 2,000 <u>M100</u> 1K0 = 1,000 <u>M200</u> 500 = 500

* Listed values may not be applicable across product types or to all resistance values. Please check with us before placing order.

■ TECHNICAL SUMMARY

Characteristics	Limits	
Dielectric Withstanding Voltage, VAC or DC	M16 / M20 M25 / M207 M51 M100 / M200	300 500 700 1000
Temperature Coefficient, PPM / °C*	±25, ±50, ±100	
Operating Temperature Range, °C	-55 ~ +155	
Insulation Resistance, MΩ	10 ⁴	

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

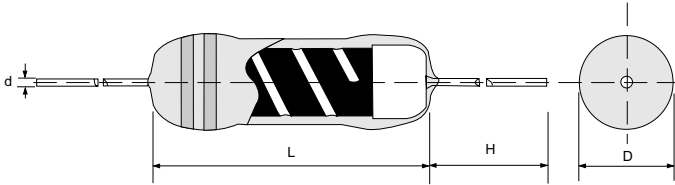
■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±0.2%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±0.75%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±0.75%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±0.2%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±0.1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 155°C without load	±0.2%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±0.2%

M-Series (S) MINIATURE SIZE Metal Film Fixed Power Resistor

Safety • Quality • Reliability
Cost-Down via Innovation

M-Series



Specifications Per

- IEC 60115-1
- MIL-R-10509

Features

- Conformal multi-layer coating (flame proof coating available)
- Color code per MIL & EIA standards
- Special tin-plated electrolytic copper lead wire
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

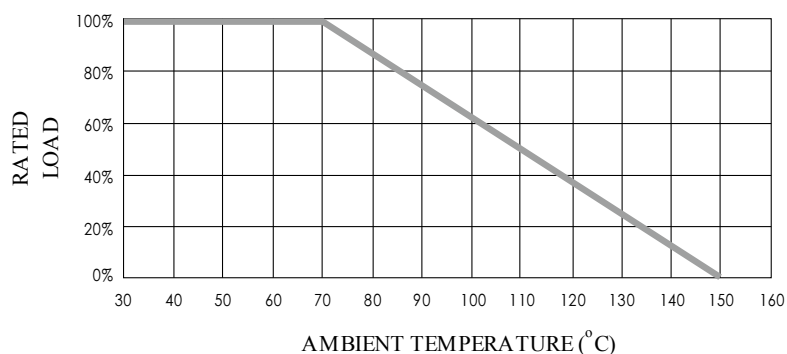
Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000Pcs
M100S	9.00 ± 1.0	3.2 ± 0.2	26 ± 3.0	0.60 ± 0.03	340 Grams
M200S	11.0 ± 1.0	4.5 ± 0.5	26 ± 3.0	0.70 ± 0.03	600 Grams
M300S	15.5 ± 1.0	5.5 ± 0.5	26 ± 3.0	0.80 ± 0.03	1200 Grams

GENERAL SPECIFICATIONS

Type	Power Rating At 70°C	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
M100S	1W	350V	700V	1Ω	1MΩ	±1%	E-96
M200S	2W	500V	1000V	1Ω	1MΩ	±1%	E-96
M300S	3W	500V	1000V	1Ω	1MΩ	±1%	E-96

Special sizes, values, and specifications not listed available on special order.

POWER DERATING CURVE



M-Series (S) MINIATURE SIZE Metal Film Fixed Power Resistor

Safety • Quality • Reliability
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■ PART NUMBER

Example: M100SF10K0TKSTB2K0

M100S	F	10K0	TKS	TB2K0
Type	Tolerance	Resistance	TCR*	Packaging
	F (1%)	10KΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	100ppm 3-character code TKR = ± 50ppm TKS = ± 100ppm	5-character code TB = Tape Box (pieces per box) M100S 2K0 = 2,000 M200S 1K0 = 1,000 M300S 500 = 500

* Listed values may not be applicable across product types or to all resistance values. Please check with us before placing order.

■ TECHNICAL SUMMARY

Characteristics	Limits	
	Dielectric Withstanding Voltage, V AC or DC	M100S M200S / M300S
Temperature Coefficient, PPM / °C*	±50, ±100	
Operating Temperature Range, °C	-55 ~ +150	
Insulation Resistance, MΩ	10 ⁴	

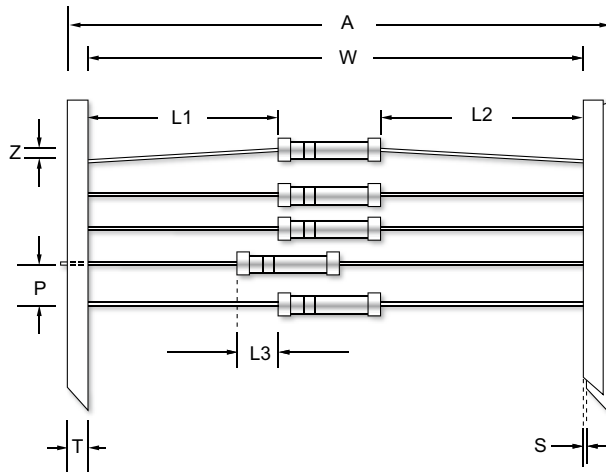
* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

M-Series (S) MINIATURE SIZE Metal Film Fixed Power Resistor

Safety • Quality • Reliability
Cost-Down via Innovation

M-Series

■ TAPING/PACKING SPECIFICATIONS



Unit (mm)

Type	A Max.	L1-L2 (Max.)	L3 (Max.)	P ±0.5	S (Max.)	T ±0.5	W ±1.5	Z (Max.)
M100S	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
M200S	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
M300S	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2

Type	Packing Type	M100S	M200S	M300S
Minimum Packing QTY (pcs)	Ammo pack	2000	1000	500

M-Series (S) MINIATURE SIZE Metal Film Fixed Power Resistor

Safety • Quality • Reliability
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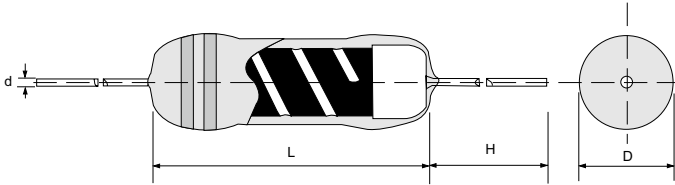
■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±2%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±2%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±1.5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 150°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +150°C 30minutes, 5 cycles	±2%

M-Series (T) MINIATURE SIZE Metal Film Fixed Power Resistor

Safety • Quality • Reliability
Cost-Down via Innovation

M-Series



Specifications Per

- IEC 60115-1
- MIL-R-10509

Features

- Conformal multi-layer coating (flame proof coating available)
- Color code per MIL & EIA standards
- Special tin-plated electrolytic copper lead wire
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

■ DIMENSIONS

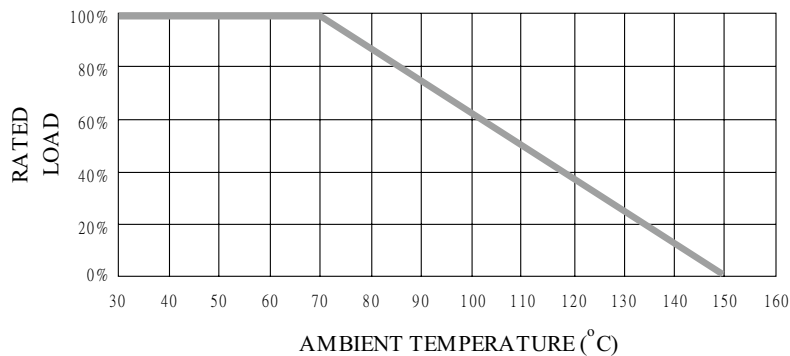
Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000Pcs
M204 M204T	3.2 ± 1.0	1.9 ± 0.2	28 ± 3.0	0.45 ± 0.02	145 Grams

■ GENERAL SPECIFICATIONS

Type	Power Rating At 70°C	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
M204	0.4W	200V	400V	1Ω	10MΩ	±1%, 5%	E-24/E-96
M204T	1/2W	250V	400V	1Ω	4.7MΩ	±1%, 5%	E-24/E-96

Special sizes, values, and specifications not listed available on special order.

■ POWER DERATING CURVE



M-Series (T) MINIATURE SIZE Metal Film Fixed Power Resistor

Safety • Quality • Reliability
Cost-Down via Innovation

■ PART NUMBER

Example: M204TF10K0TKSTB5K0

M204T	F	10K0	TKS	TB5K0
Type	Tolerance*	Resistance	TCR*	Packaging
	F (1%) J (5%)	10KΩ 4-character code containing - 3 significant digits 1 letter multiplier MULTIPLIER R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	100ppm 3-character code TKR = ± 50ppm TKS = ± 100ppm TKU = ± 250ppm	5-character code TB = Tape Box (pieces per box) <u>M204/M204T</u> 5K0 = 5,000

* Listed values may not be applicable across product types or to all resistance values. Please check with us before placing order.

■ TECHNICAL SUMMARY

Characteristics	Limits	
Dielectric Withstanding Voltage, V AC or DC	400	
Temperature Coefficient, PPM / °C*	M204	±50, ±100
	M204T	11Ω~1MΩ: ±100 1Ω~10Ω, 1M1~4M7Ω: ±250
Operating Temperature Range, °C	-55 ~ +150	
Insulation Resistance, MΩ	M204	10 ⁵ Min.
	M204T	10 ⁴ Min.

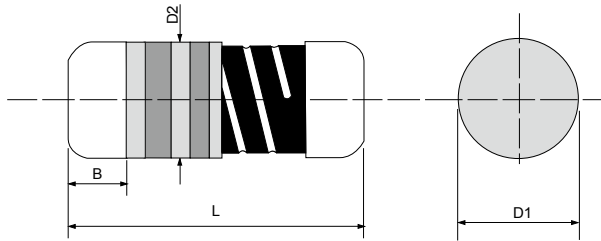
* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 2 seconds 2.5x rated voltage (not over max. overload voltage)	±1%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±2.5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±2.5%
Resistance To Soldering Heat	IEC 60115-1 4.18 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 150°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +150°C 30minutes, 5 cycles	±1%

MM Metal Film MELF Resistor

Safety • Quality • Reliability
Cost-Down via Innovation



Specifications Per

• IEC 60115-1 • EN140401-803

Features

- SMD enabled structure
- Excellent solderability termination
- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
MM16	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/-0.15	0.6 Min.	17 grams
MM204	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/-0.15	0.6 Min.	17 grams
MM207	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/-0.2	1.0 Min.	66 grams
MM52	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/-0.2	1.0 Min.	66 grams

GENERAL SPECIFICATIONS

Type	Power Rating At 70°C	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
MM16	1/6W	200V	400V	0, 0.51Ω	10MΩ	±1%	E-96
						±2%, ±5%	E-48/E-24
MM204	1/4W	200V	400V	0, 0.51Ω	10MΩ	±1%	E-96
						±2%, ±5%	E-48/E-24
MM207	1/3W	300V	500V	0, 0.51Ω	10MΩ	±1%	E-96
						±2%, ±5%	E-48/E-24
MM52	1/2W	300V	500V	0, 0.51Ω	10MΩ	±1%	E-96
						±2%, ±5%	E-48/E-24

For zero-ohm jumper, please see ZMM series. For 1m-510mΩ please see CSM series.
Special sizes and specifications available on request.

PART NUMBER

Example: MM204F162RTKRTR3K0

MM204	F	162R	TKR	TR3K0
Type	Tolerance*	Resistance	TCR*	Packaging
	F (1%) G (2%) J (5%)	162Ω 4-character code containing - 3 significant digits 1 letter multiplier OHM MULTIPLIER R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	50ppm 3-character code TKQ = ± 25ppm TKR = ± 50ppm TKS = ± 100ppm	5-character code TR = Tape Reel (pieces per reel) MM16/MM204 3K0 = 3,000 6K0 = 6,000** 10K = 10,000** MM207/MM52 2K0 = 2,000 6K0 = 6,000** 10K = 10,000**

* Listed values may not be applicable across product types or to all resistance values. Please check with us before placing order. **upon request

Safety • Quality • Reliability
Cost-Down via Innovation

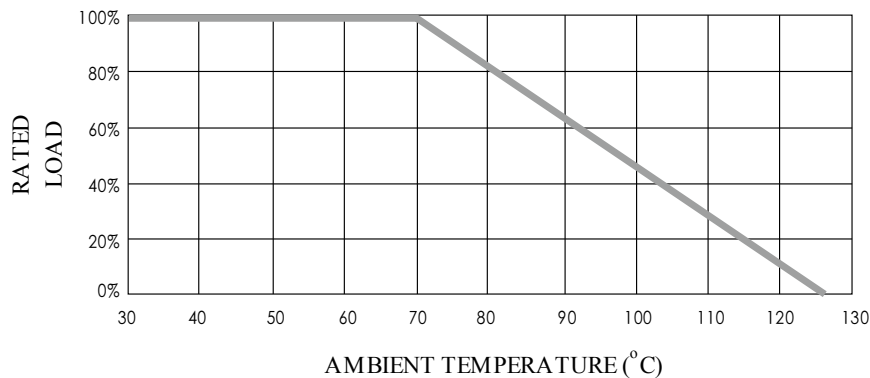
MM

TECHNICAL SUMMARY

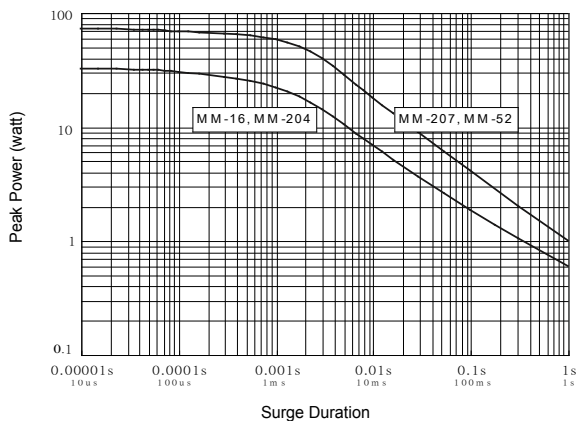
Characteristics	Ranges & Limits	
Operating Temperature Range, °C	-55 ~ +125	
Temperature Coefficient, PPM / °C*	±1%, ±2%	±25, ±50, ±100
	±5%	±100
Dielectric Withstanding Voltage, VAC or DC	MM16, MM204	200
	MM207, MM52	500
Insulation Resistance, MΩ	>10 ⁴	
Tin Whisker (JESD201 Temperature Cycling & High Temp. / Humidity Storage), μm	<5	
Failure Rate in Time, pcs / 10 ⁹ device hours	<1	

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

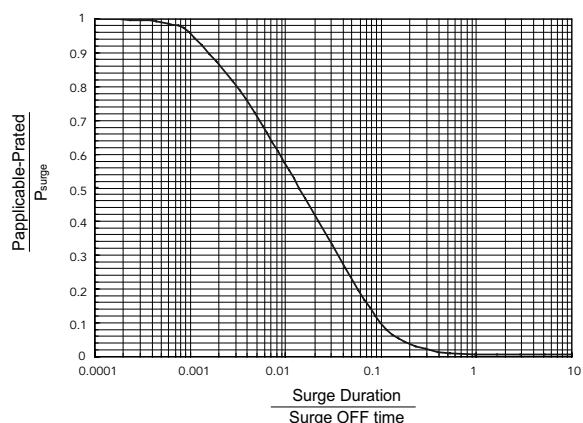
POWER DERATING CURVE



SINGLE SURGE PERFORMANCE



SURGE POWER DERATING CURVE



Notes:

• SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further linearly down to zero at 125°C.

• To determine applicable surge power in continuous-surge applications:

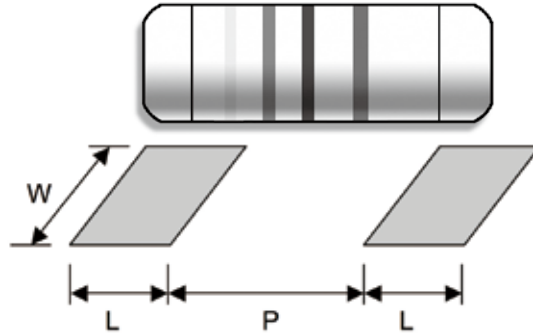
1. Identify allowable duration and peak power P_{surge} of single surge;
2. Determine ratio of surge duration/surge OFF time in application;
3. Calculate $P_{applicable}$ backwardly according to Y-axis of SURGE POWER DERATING CURVE.

PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits	
Short Time Overload	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	0.51Ω to 332KΩ	±0.25%
		>332KΩ	±0.5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hour OFF, at (70±2)°C	0.51Ω to 332KΩ	±0.75%
		>332KΩ	±1.0%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	0.51Ω to 332KΩ	±1.5%
		>332KΩ	±2.5%
Load Life In Humidity (accelerated mode)	IEC 60115-1 4.37 1,000 hours at 85°C and 85% relative humidity with 0.1x rated voltage (not over 100V)	0.51Ω to <100KΩ	±1.5%
		100KΩ to 332KΩ	±3.0%
		>332KΩ	±5.0%
Periodic Electric Overload	IEC 60115-1 4.39 3.9x rated voltage (not over max. overload voltage) with 0.1s ON, 2.5s OFF for 1,000 cycles	±1.0%	
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds	±0.5%	
Thermal Endurance	IEC 60115-1 4.25.3 1,000 hours without load	85°C	±0.75%
		125°C	±1.5%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +125°C 30minutes	5 cycles	±0.5%
		1,000 cycles	±1.5%
Single pulse high voltage overload	IEC 60115-1 4.27 • 5 pulses of 1.2/50µs at 10x rated voltage (not over 400V for MM16 & MM204; not over 500V for MM207 & MM52) with interval of 12 sec. • 10 pulses of 10/700µs at 10x rated voltage (not over 400V for MM16 & MM204; not over 500V for MM207 & MM52) with interval of 60 sec.	±0.5	
		±0.5	
Electrostatic discharge (Human body model)	IEC 60115-1 4.38 3 positive & 3 negative discharges with 2KV for MM16 & MM204 or 4KV for MM207 & MM52 (For continuous surge application please see Surge Performance paragraph)	±2.0	
Climatic test	IEC 60115-1 4.23 4.23.2 - dry heat: 16 hours 125°C 4.23.3 - damp heat: 24 hours 55°C with 95% relative humidity 4.23.4 - cold: 2 hours -55°C 4.23.5 - negative air pressure: 2 hour 8.5KPa at (25±10)°C 4.23.6 - damp heat cyclic: 5 days 55°C with 95% relative humidity 4.23.7 - DC load: rated voltage at -55°C and 125°C each 1 Min.	±1.0	
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage	
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 1.52mm and 10 to 2,000 Hz.	±1.0%	
Bending test	IEC 60115-1 4.33 Pressing depth 2mm, 3 times	±0.25%	
Flammability	IEC 60115-1 4.35 Needle flame test 10s	No burning after 30s	

Safety • Quality • Reliability
Cost-Down via Innovation

■ SUGGESTED PAD LAYOUT

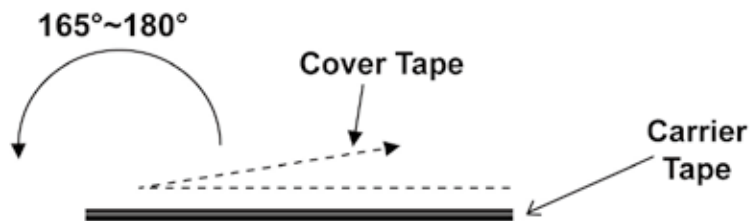


Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
MM16 MM204	Reflow	1.3	1.6 ± 0.1	1.6
	Wave	1.5	1.5 ± 0.1	1.8
MM207 MM52	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0

For better heat dissipation / lower heat resistance, increase W & L.

■ COVER TAPE PEELING SPECIFICATION

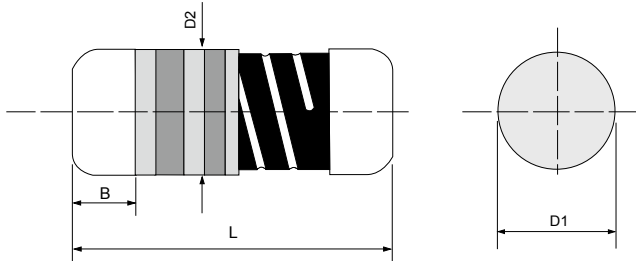
Recommended peeling force: 50±5gf



MM(V) – Metal Film MELF Resistor, Vehicle Grade

Safety • Quality • Reliability
Cost-Down via Innovation

MM(V)



Specifications Per

- IEC 60115-1
- EN140401-803
- AEC-Q200 Rev. D

Features

- AEC-Q200 Compliant
- Excellent solderability termination
- Anti-sulfuration test qualified
- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

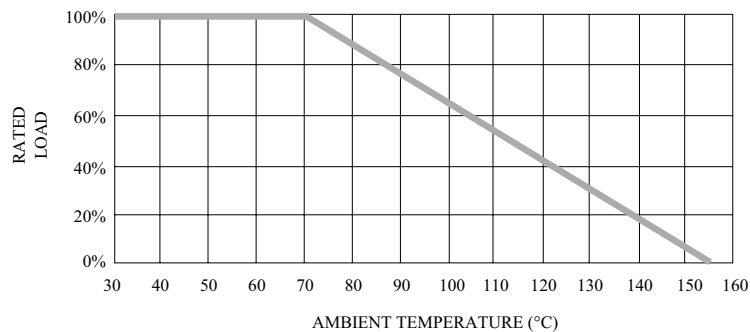
DIMENSIONS

Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
MM204V	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/ -0.15	0.6 Min.	17 grams
MM52V	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams

GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
MM204V	1/4W	200V	400V	0.47Ω	10MΩ	±1%	E-96
						±2%, ±5%	E-48/E-24
MM52V	1/2W	300V	500V	0.47Ω	10MΩ	±1%	E-96
						±2%, ±5%	E-48/E-24

POWER DERATING CURVE



MM(V) – Metal Film MELF Resistor, Vehicle Grade

Safety • Quality • Reliability
Cost-Down via Innovation

■ PART NUMBER

Example: MM204VF162RTKRTR3K0

MM204V	F	162R	TKR	TR3K0
Type	Tolerance*	Resistance	TC*	Packaging
	F (1%) G (2%) J (5%)	162Ω 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	50ppm 3-character code TKQ = ±25ppm TKR = ±50ppm TKS = ±100ppm	5-character code TR = Tape Reel (pieces per reel) <u>MM204V</u> 3K0 = 3,000 6K0 = 6,000** 10K = 10,000** <u>MM52V</u> 2K0 = 2,000 6K0 = 6,000** 10K = 10,000**

MM(V)

* Listed values may not be applicable across product types or to all resistance values. Please check with us before placing order. **upon request

■ TECHNICAL SUMMARY

Characteristics	Limits	
Operating Temperature Range, °C	-55 ~ +155	
Temperature Coefficient, PPM / °C*	±1%, ±2%	±25, ±50, ±100
	±5%	±100
Dielectric Withstanding Voltage, VAC or DC	MM204V	300
	MM52V	500
Insulation Resistance, MΩ	>10 ⁴	
Tin Whisker (JESD201 Temperature Cycling & High Temp. /Humidity Storage), μm	<5	
Failure Rate in Time, pcs / 10 ⁹ device hours	<1	

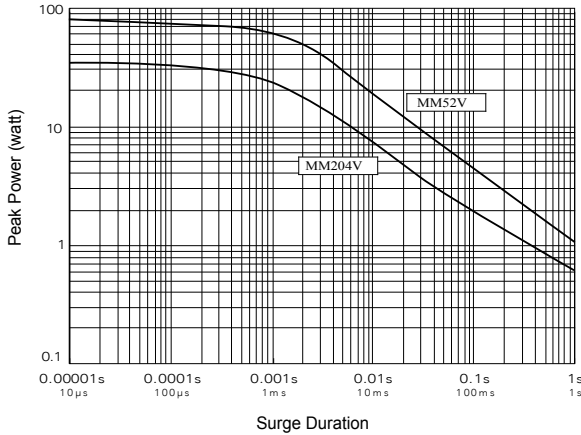
* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

PERFORMANCE SPECIFICATIONS

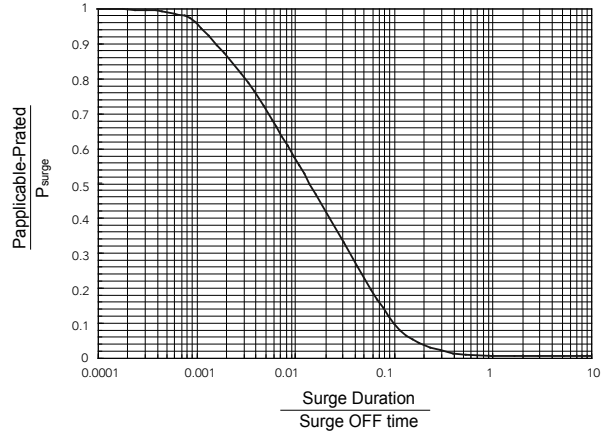
Characteristics	Test Conditions	Limits	
High Temperature Exposure (Storage)	AEC-Q200 REV D. Stress NO.3 (refer to MIL-STD-202 Method 108) 1,000 hours at 125°C without load	0.47Ω to <332KΩ	±0.5%
		332KΩ to 1MΩ	±0.75%
		>1MΩ	±1%
Temperature Cycling	AEC-Q200 REV D. Stress NO.4 (refer to IEC 60115-1 4.19/ JESD22 Method JA-104) -55°C 30minutes, +125°C 30minutes, 1,000 cycles	0.47Ω to 332KΩ	±1%
		>332KΩ	±2.5%
	Proprietary test specification FRC-AECQ-180702 20°C 30minutes, +120°C 30minutes, 1,000 cycles (Recommended solder paste composition:96.5% Sn, 3% Ag, 0.5% Cu)	Force of 1kg for 10 seconds and without distinct looseness of terminals	
Biased Humidity	AEC-Q200 REV D. Stress NO.7 (refer to IEC 60115-1 4.37/ MIL-STD-202 Method 103) 1,000 hours at 85°C and 85% relative humidity with 10% operating power (not over max. working voltage)	0.47Ω to <100KΩ	±1%
		100KΩ to 332KΩ	±2.5%
		>332KΩ	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at 70°C	0.47Ω to 332KΩ	±0.75%
		>332KΩ	±1%
		0.47Ω to <1Ω	±2%
	AEC-Q200 REV D. Stress NO.8 (refer to MIL-STD-202 Method 108) 1,000 hours at 125°C with de-rated continuous working voltage (not over max. working voltage)	1Ω to 332KΩ	±1.5%
		>332KΩ	±2.5%
Resistance to Solvents	AEC-Q200 REV D. Stress NO.12 (refer to MIL-STD-202 Method 215) Add Aqueous wash chemical-OKEM Clean or equivalent. Do not use banned solvents.	No visible damage on appearance and marking	
Mechanical Shock	AEC-Q200 REV D. Stress NO.13 (refer to MIL-STD-202 Method 213 Condition C) Three shocks in each direction shall be applied along the three mutually perpendicular axes of the test specimen. Peak value: 100 g's, Duration: 6 ms, Velocity change: 12.3 ft/s, Waveform: Half sine	±0.5%	
Vibration	AEC-Q200 REV D. Stress NO.14 (refer to MIL-STD-202 Method 204) 5 g's for 20 min., 12 cycles each of 3 orientations, Test from 10~2,000 Hz.	± 0.5%	
Resistance to Soldering Heat	AEC-Q200 REV D. Stress NO.15 (refer to IEC 60115-1 4.18.2/ MIL-STD-202 Method 210) Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds	±0.5%	
ESD	AEC-Q200 REV D. Stress NO.17 (refer to AEC-Q200-002/ ISO/DIS 10605) (150pF/ 2000Ohm discharge network) Human body model, 1 positive & 1 negative discharges with 2KV source	±0.5%	
Solderability	AEC-Q200 REV D. Stress NO.18 (refer to J-STD-002 or IEC 60115-1 4.17) Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min. coverage	
Flammability	AEC-Q200 REV D. Stress NO.20 (refer to UL-94) V-0 or V-1 are acceptable. Electrical test not required.	NO flaming	
Board Flex	AEC-Q200 REV D. Stress NO.21 (refer to AEC-Q200-005) 60 sec minimum holding time.	±0.5%	
Terminal Strength	AEC-Q200 REV D. Stress NO.22 (refer to AEC-Q200-006) Force of 1.8kg for 60 seconds	±0.5%	
Short Time Overload	IEC 60115-1 4.13 5 seconds 2.5x rated voltage(not over max. overload voltage)	0.47Ω to 332KΩ	±0.25%
		>332KΩ	± 0.5%
Climatic test	IEC 60115-1 4.23 4.23.2 - dry heat: 16 hours 155°C 4.23.3 - damp heat: 24 hours 55°C with 95% relative humidity 4.23.4 - cold: 2 hours -55°C 4.23.5 - negative air pressure: 2 hour 8.5KPa at (25±10)°C 4.23.6 - damp heat cyclic: 5 days 55°C with 95% relative humidity 4.23.7 - DC load: rated voltage at -55°C and 155°C each 1 Min.	±1%	
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	0.47Ω to 332KΩ	± 1.5%
		>332KΩ	± 2.5%
Single pulse high voltage overload	IEC 60115-1 4.27 5 pulses of 1.2/50μs at 10x rated voltage (not over max. overload voltage) with interval of 12 sec. 10 pulses of 10/700μs at 10x rated voltage (not over max. overload voltage) with interval of 60 sec.	±0.5%	
		±0.5%	
Periodic Electric Overload	IEC 60115-1 4.39 3.9x rated voltage (not over max. overload voltage) with 0.1s ON, 2.5s OFF for 1,000 cycles	±1%	
Anti-sulfuration test	EIA-977 (conditions B) 750 hours at (105±2)°C without load	±1%	±1%
		±2%	±2%
		±5%	±5%

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Cost-Down via Innovation

■ SINGLE SURGE PERFORMANCE



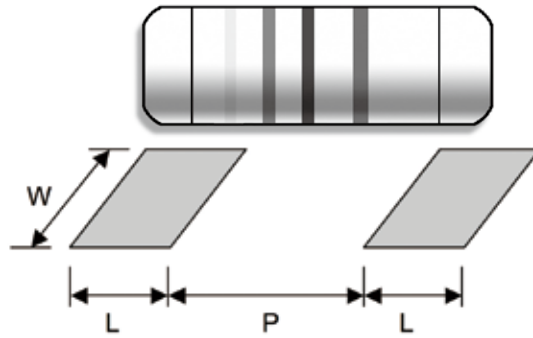
■ SURGE POWER DERATING CURVE



Notes:

- SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further linearly down to zero at 155°C.
- To determine applicable surge power in continuous-surge applications:
 1. Identify allowable duration and peak power P_{surge} of single surge;
 2. Determine ratio of surge duration/surge OFF time in application;
 3. Calculate $P_{applicable}$ backwardly according to Y-axis of SURGE POWER DERATING CURVE.

■ SUGGESTED PAD LAYOUT

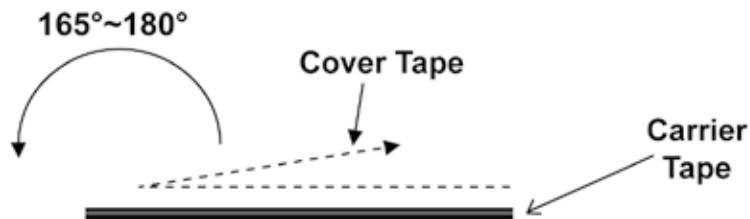


Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
MM204V	Reflow	1.3	1.6 ± 0.1	1.6
	Wave	1.5	1.5 ± 0.1	1.8
MM52V	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0

For better heat dissipation / lower heat resistance, increase W & L.

■ COVER TAPE PEELING SPECIFICATION

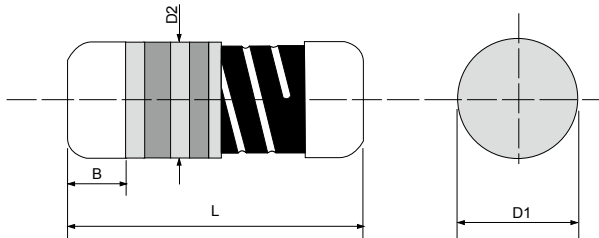
Recommended peeling force: 50gf±5gf



MM102 Metal Film MELF Resistor

Safety • Quality • Reliability
Cost-Down via Innovation

MM102



Specifications Per

- IEC 60115-1
- EN140401-803

Features

- AEC-Q200 Compliant
- SMD enabled structure
- Excellent solderability termination
- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering spot (B, mm)	Net Weight Per 1000 pcs
MM102	2.1 ± 0.1	1.1 ± 0.1	D1+0.02/-0.1	0.5 Min.	7 grams

GENERAL SPECIFICATIONS

Type	Power Rating at 70°C	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Value
MM102	0.2W	150V	300V	0Ω, 10Ω	221KΩ	±0.5%	E-192
				0.22Ω	2.2MΩ	±1%~±5%	E-24 / E-96

Special sizes and specifications available on request.

PART NUMBER

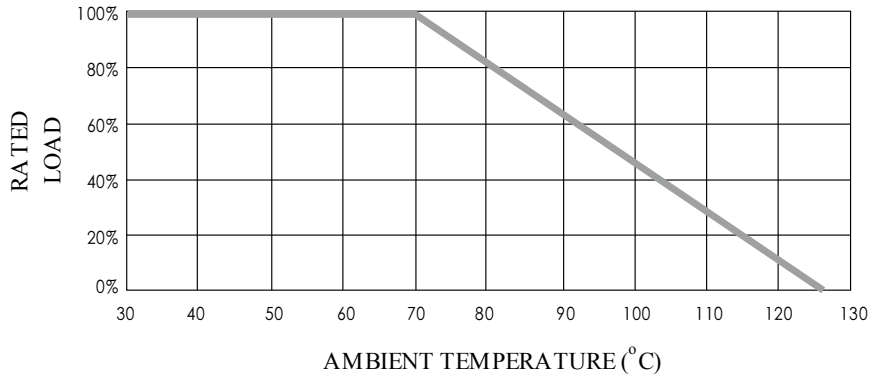
Example: MM102F162RTKRTR3K0

MM102	F	162R	TKR	TR3K0
Type	Tolerance*	Resistance	TCR	Packaging
	D (0.5%) F (1%) G (2%) J (5%)	162Ω 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	50ppm 3-character code Insert the corresponding Code for the temperature coefficient available for the specific product. TKQ = ±25PPM TKR = ±50PPM TKS = ±100PPM	5-character code TR=Tape Reel <u>MM102</u> 3K0 = 3,000 6K0 = 6,000 10K = 10,000

* May not be applicable to all product types or to all resistance values. Please check with us before placing order.

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■ POWER DERATING CURVE

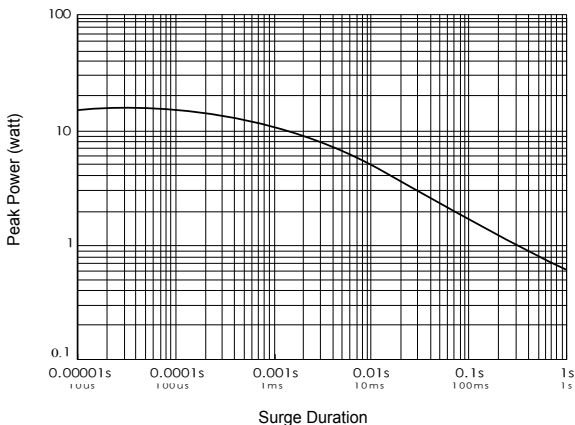


■ TECHNICAL SUMMARY

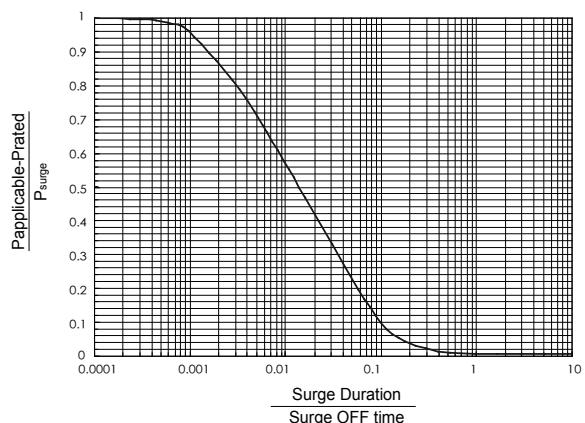
Characteristics	Limits	
Operating Temperature Range, °C	-55 ~ +125	
Temperature Coefficient, PPM / °C*	±0.5%, ±1%, ±2%	±25, ±50, ±100
	±5%	±100
Dielectric Withstanding Voltage, VAC or DC	150	
Insulation Resistance, MΩ	>10 ⁴	
Tin Whisker (JESD201 Temperature Cycling & High Temp./Humidity Storage), μm	<5	
Failure Rate in Time, pcs / 10 ⁹ device hours	<1	

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ SINGLE SURGE PERFORMANCE



■ SURGE POWER DERATING CURVE



Notes:

• SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further linearly down to zero at 125°C.

• To determine applicable surge power in continuous-surge applications:

1. Identify allowable duration and peak power P_{surge} of single surge;
2. Determine ratio of surge duration/surge OFF time in application;
3. Calculate P_{applicable} backwardly according to Y-axis of SURGE POWER DERATING CURVE.

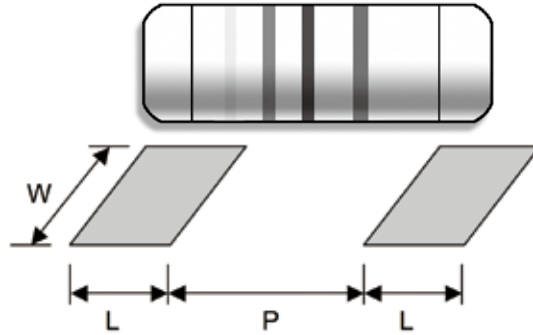
■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits	
Short Time Overload	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	0.22Ω to 221KΩ	± 0.5%
		>221KΩ	± 0.75%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	0.22Ω to 100Ω	± 5%
		>100Ω to 221KΩ	± 2.5%
		>221KΩ	± 3.0%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	0.22Ω to 100Ω	± 5%
		>100Ω	± 2.5%
Load Life In Humidity (accelerated mode)	IEC 60115-1 4.37 1,000 hours at 85°C and 85% relative humidity with 0.1x rated voltage (not over 100V)	0.22Ω to 100Ω	± 5%
		>100Ω to 221KΩ	± 3.5%
		>221KΩ	± 5%
Periodic Electric Overload	IEC 60115-1 4.39 3.9x rated voltage (not over max. overload voltage) with 0.1s ON, 2.5s OFF for 1,000 cycles	± 1.5%	
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds	0.22Ω to 100Ω	± 2.5%
		>100Ω	± 0.5%
Thermal Endurance	IEC 60115-1 4.25.3 1,000 hours at without load	125°C	0.22Ω to 100Ω ± 5.0%
			>100Ω to 221KΩ ± 1.5%
			>221KΩ ± 2.0%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +125°C 30minutes	5 cycles	±0.5%
		1,000 cycles	±2.0%
Single pulse high voltage overload	IEC 60115-1 4.27 • 5 pulses of 1.2/50μs at 10x rated voltage (not over max. overload voltage) with interval of 12 sec. • 10 pulses of 10/700μs at 10x rated voltage (not over max. overload voltage) with interval of 60 sec.	± 1.0%	
		± 1.0%	
Electrostatic discharge (Human body model)	IEC 60115-1 4.38 3 positive & 3 negative discharges with 1.5KV (For continuous surge application please see Surge Performance paragraph)	± 1.0%	
Climatic test	IEC 60115-1 4.23 4.23.2 - dry heat: 16 hours 125°C 4.23.3 - damp heat: 24 hours 55°C with 95% relative humidity 4.23.4 - cold: 2 hours -55°C 4.23.5 - negative air pressure: 2 hour 8.5KPa at (25±10)°C 4.23.6 - damp heat cyclic: 5 days 55°C with 95% relative humidity 4.23.7 - DC load: rated voltage at -55°C and 125°C each 1 Min.	± 2.0%	
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min. coverage	
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 1.52mm and 10 to 2,000 Hz.	±1.0%	
Bending test	IEC 60115-1 4.33 Pressing depth 2mm, 3 times	± 0.25%	
Flammability	IEC 60115-1 4.35 Needle flame test 10s	No burning after 30s	

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MM102

■ SUGGESTED PAD LAYOUT

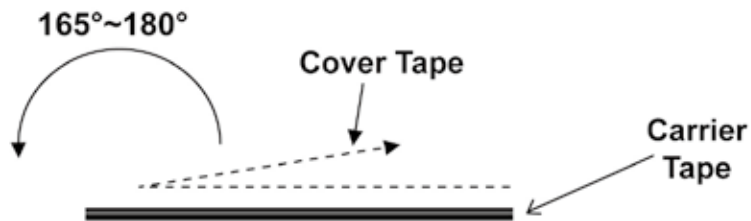


Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
MM102	Reflow	0.8	0.9 ± 0.05	1.3
	Wave	1.2	0.7 ± 0.05	1.5

For better heat dissipation / lower heat resistance, increase W & L.

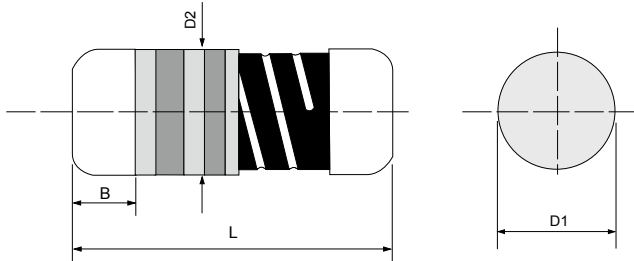
■ COVER TAPE PEELING SPECIFICATION

Recommended peeling force: 50gf±5gf



Safety • Quality • Reliability
Cost-Down via Innovation

MM(P)



Specifications Per

- IEC 60115-1
- EN 140401-803

Features

- SMD enabled structure
- Excellent solderability termination
- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
MM16P	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/ -0.15	0.6 Min.	17 grams
MM204P	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/ -0.15	0.6 Min.	17 grams
MM207P	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams
MM52P	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams

GENERAL SPECIFICATIONS

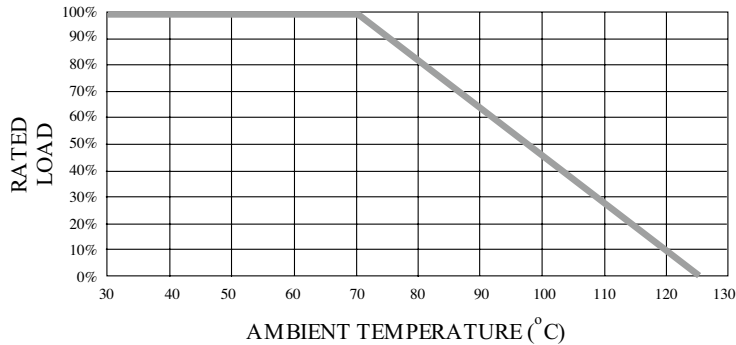
Type	Power Rating At 70°C	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
MM16P	1/6W	200V	400V	0.1Ω	100KΩ	±1%	E-96
						±2%, ±5%	E-48/E-24
MM204P	1/4W	200V	400V	0.1Ω	100KΩ	±1%	E-96
						±2%, ±5%	E-48/E-24
MM207P	1/3W	300V	500V	0.1Ω	330KΩ	±1%	E-96
						±2%, ±5%	E-48/E-24
MM52P	1/2W	300V	500V	0.1Ω	330KΩ	±1%	E-96
						±2%, ±5%	E-48/E-24

For zero-ohm jumper, please see ZMM series. For 10~510mΩ please see CSM series.
Special sizes, values, and specifications not listed available on special order.

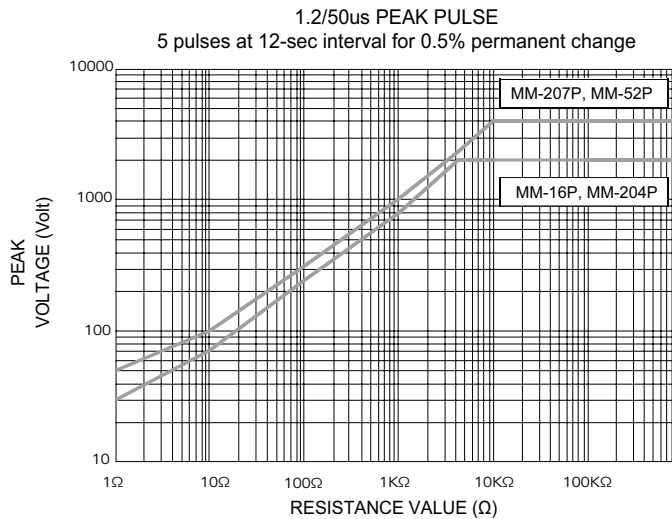
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MM(P)

POWER DERATING CURVE



SURGE PERFORMANCE



PART NUMBER

Example: MM52PJ10K0TKSTR2K0

MM52P	J	10K0	TKS	TR2K0
Type	Tolerance*	Resistance	TCR*	Packaging
	F (1%) G (2%) J (5%)	10KΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	100ppm 3-character code TKR = ± 50ppm TKS = ± 100ppm	5-character code TR = Tape Reel (pieces per reel) <u>MM16P/MM204P</u> 3K0 = 3,000 6K0 = 6,000** 10K = 10,000** <u>MM207P/MM52P</u> 2K0 = 2,000 6K0 = 6,000** 10K = 10,000**

* Listed values may not be applicable across product types or to all resistance values. Please check with us before placing order.
** upon request

TECHNICAL SUMMARY

Characteristics	Limits			
Dielectric Withstanding Voltage, VAC or DC	MM16P, MM204P: 200 MM207P, MM52P: 500			
Temperature Coefficient, PPM / °C*	±1%, ±2%		±50	
	±5%		±100	
Operating Temperature Range, °C	-55 ~ +125			
Film Temperature, °C	MM16P	MM204P	MM207P	MM52P
	125	125	125	140
Insulation Resistance, MΩ	>10 ⁴			
Tin Whisker (JESD201 Temperature Cycling & High Temp. / Humidity Storage), μm	< 5			
Failure Rate in Time, pcs / 10 ⁹ device hours	<1			

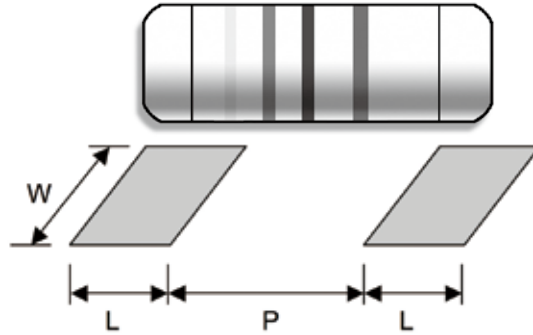
* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Overload	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±0.5%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±1.5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±1.5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds	±0.5%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 1.52mm and 10 to 2,000 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 125°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +125°C 30minutes, 5 cycles	±0.5%

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Cost-Down via Innovation

■ SUGGESTED PAD LAYOUT



MM(P)

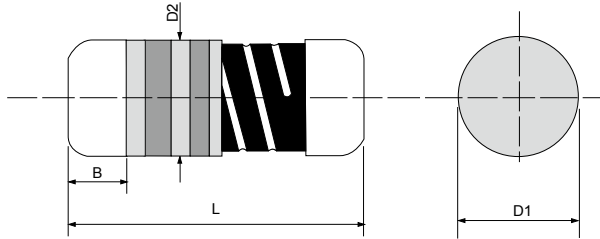
Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
MM16P MM204P	Reflow	1.3	1.6 ± 0.1	1.6
	Wave	1.5	1.5 ± 0.1	1.8
MM207P MM52P	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0

For better heat dissipation / lower heat resistance, increase W & L.

MMP – Metal Film MELF Precision Resistor

Safety • Quality • Reliability
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MMP



Specifications Per

- IEC 60115-1
- EN140401-803

Features

- SMD enabled structure
- Excellent solderability termination
- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

■ DIMENSIONS

Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
MMP16	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/ -0.15	0.6 Min.	17 grams
MMP204	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/ -0.15	0.6 Min.	17 grams
MMP207	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams
MMP52	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams
MMP101	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams

■ GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage (AC/DC)	Maximum Overload Voltage (AC/DC)	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
MMP16	1/6W	200V	400V	10Ω	1MΩ	± 0.5%	E-192
				22Ω	510KΩ	± 0.25%	
				43Ω	510KΩ	± 0.1%	
MMP204	1/4W	200V	400V	10Ω	1MΩ	± 0.5%	E-192
				22Ω	510KΩ	± 0.25%	
				43Ω	510KΩ	± 0.1%	
MMP207	1/3W	300V	500V	10Ω	1MΩ	± 0.5%	E-192
				15Ω	1MΩ	± 0.25%	
				33Ω	1MΩ	± 0.1%	
MMP52	1/2W	300V	500V	10Ω	1MΩ	± 0.5%	E-192
				15Ω	1MΩ	± 0.25%	
				33Ω	1MΩ	± 0.1%	
MMP101	1W	300V	500V	10Ω	1MΩ	± 0.5%	E-192
				22Ω	1MΩ	± 0.25%	
				43Ω	1MΩ	± 0.1%	

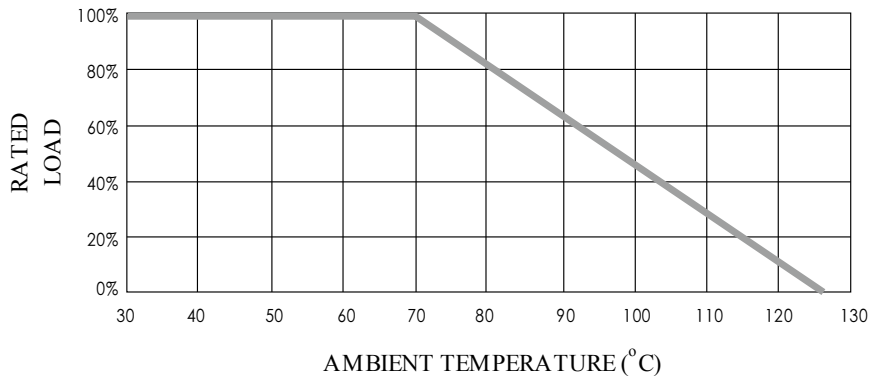
For zero-ohm jumper, please see ZMM series. For values between 10mΩ & 510mΩ, please see CSM series. Special sizes, values, and specifications not listed available on special order.

TECHNICAL SUMMARY

Characteristics	Ranges & Limits	
Operating Temperature Range, °C	-55 ~ +125	
Temperature Coefficient, PPM / °C*	±5, ±10, ±15, ±25, ±50 (See below for availability)	
Dielectric Withstanding Voltage, VAC or DC	MMP16, MMP204	300
	MMP207, MMP52, MMP101	500
Insulation Resistance, MΩ	>10 ⁴	
Failure Rate, pcs/10 ⁹ device hours	MMP16, MMP207	MMP204, MMP52, MMP101
	<1	<1.5
Tin Whisker (JESD201 Temperature Cycling & High Temp./Humidity Storage), μm	<5	

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

POWER DERATING CURVE



TEMPERATURE COEFFICIENT AVAILABILITY

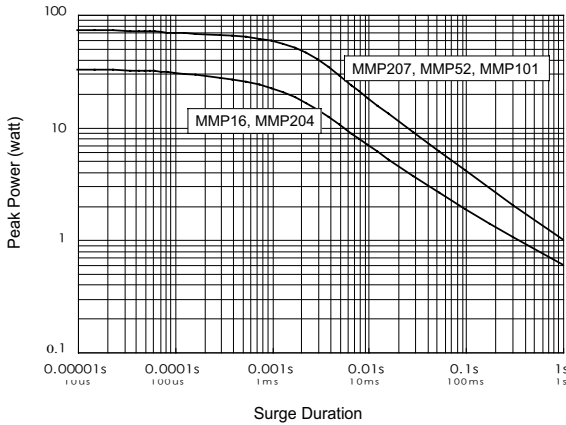
Specifications		Resistance Values Available				
TC	Tolerance	MMP16	MMP204	MMP207	MMP52	MMP101
±5 PPM / °C	±0.5%	100Ω~10KΩ		75Ω~15KΩ		
	±0.25%					
	±0.1%					
±10, ±15 PPM / °C	±0.5%	10Ω~510KΩ	10Ω~330KΩ	10Ω~750KΩ	10Ω~680KΩ	10Ω~680KΩ
	±0.25%	22Ω~510KΩ	22Ω~330KΩ	15Ω~680KΩ	15Ω~510KΩ	15Ω~510KΩ
	±0.1%	43Ω~510KΩ	43Ω~330KΩ	33Ω~680KΩ	33Ω~510KΩ	33Ω~510KΩ
±25 PPM / °C	±0.5%	10Ω~750KΩ		10Ω~1MΩ		
	±0.25%	22Ω~510KΩ		15Ω~1MΩ		
	±0.1%	43Ω~510KΩ		33Ω~1MΩ		
±50 PPM / °C	±0.5%	10Ω~1MΩ		10Ω~1MΩ		
	±0.25%	22Ω~510KΩ		15Ω~1MΩ		
	±0.1%	43Ω~510KΩ		33Ω~1MΩ		

MMP – Metal Film MELF Precision Resistor

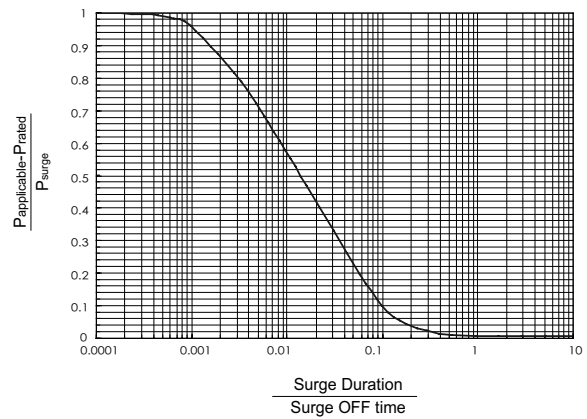
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MMP

■ SINGLE SURGE PERFORMANCE



■ SURGE POWER DERATING CURVE



Notes:

• SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further linearly down to zero at 125°C.

- To determine applicable surge power in continuous-surge applications:
 1. Identify allowable duration and peak power P_{surge} of single surge;
 2. Determine ratio of surge duration/surge OFF time in application;
 3. Calculate P_{applicable} backwardly according to Y-axis of SURGE POWER DERATING CURVE.

■ PART NUMBER

Example: MMP52B2K61TKQTR2K0

MMP52	B	2K61	TKQ	TR2K0
Type	Tolerance*	Resistance	TCR*	Packaging
	B (0.1%) C (0.25%) D (0.5%)	2.61KΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	25ppm 3-character code TKM = ± 5 ppm TKN = ± 10 ppm TKP = ± 15 ppm TKQ = ± 25 ppm TKR = ± 50 ppm	5-character code TR = Tape Reel (pieces per reel) <u>MMP16/MMP204</u> 3K0 = 3,000 6K0 = 6,000** 10K = 10,000** <u>MMP207/MMP52/</u> <u>MMP101</u> 2K0 = 2,000 6K0 = 6,000** 10K = 10,000**

* Listed values may not be applicable across product types or to all resistance values. Please check with us before placing order.

** upon request

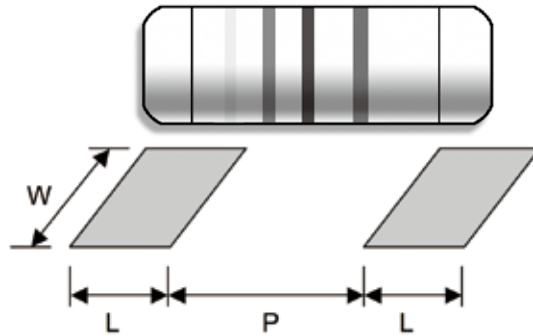
■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits	
Short Time Overload	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	± 0.25%	
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hrs with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	10Ω to 332KΩ	±0.5%
		>332KΩ	±0.75%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	10Ω to 332KΩ	±0.75%
		>332KΩ	±1.0%
Load Life In Humidity (accelerated mode)	IEC 60115-1 4.37 1,000 hours at 85°C and 85% relative humidity with 0.1x rated voltage (not over 100V)	10Ω to <10KΩ	±1.0%
		10KΩ to 332KΩ	±1.5%
		>332KΩ	±3.0%
Periodic Electric Overload	IEC 60115-1 4.39 3.9x rated voltage (not over max. overload voltage) with 0.1s ON, 2.5s OFF for 1,000 cycles	± 0.5%	
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds	± 0.5%	
Thermal Endurance	IEC 60115-1 4.25.3 1,000 hours without load	MMP16 MMP204 MMP207 MMP52	85°C ± 0.25%
			125°C ± 0.75%
		MMP101	85°C ± 0.5%
			125°C ± 1.0%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +125°C 30minutes	5 Cycles	± 0.25%
		1,000 Cycles	± 1.0%
Single pulse high voltage overload	IEC 60115-1 4.27 Severity no.4 10 pulses of 10/700µs at 10x rated voltage (not over max. overload voltage) with interval of 60 sec.	± 0.5%	
Electrostatic discharge (Human body model)	IEC 60115-1 4.38 3 positive & 3 negative discharges with 2KV for MMP16 & MMP204 or 4KV for MMP207 & MMP52 & MMP101 (For continuous surge application please see Surge Performance paragraph)	± 1.0%	
Climatic test	IEC 60115-1 4.23 4.23.2 - dry heat: 16 hours 125°C 4.23.3 - damp heat: 24 hours 55°C with 95% relative humidity 4.23.4 - cold: 2 hours -55°C 4.23.5 - negative air pressure: 2 hour 8.5KPa at (25±10)°C 4.23.6 - damp heat cyclic: 5 days 55°C with 95% relative humidity 4.23.7 - DC load: rated voltage at -55°C and 125°C each 1 Min.	± 1.0%	
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min. coverage	
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 1.52mm and 10 to 2,000 Hz.	± 1.0%	
Bending test	IEC 60115-1 4.33 Pressing depth 2mm, 3 times	± 0.25%	
Flammability	IEC 60115-1 4.35 Needle flame test 10s	No burning after 30s	

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■ SUGGESTED PAD LAYOUT

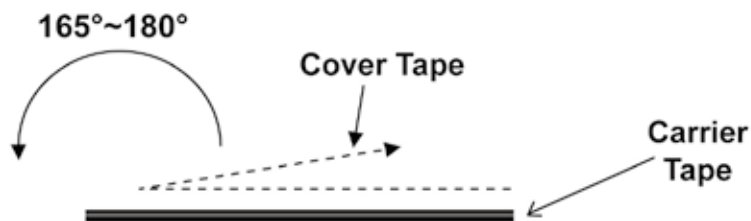


Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
MMP16 MMP204	Reflow	1.3	1.6 ± 0.1	1.6
	Wave	1.5	1.5 ± 0.1	1.8
MMP207 MMP52 MMP101	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0

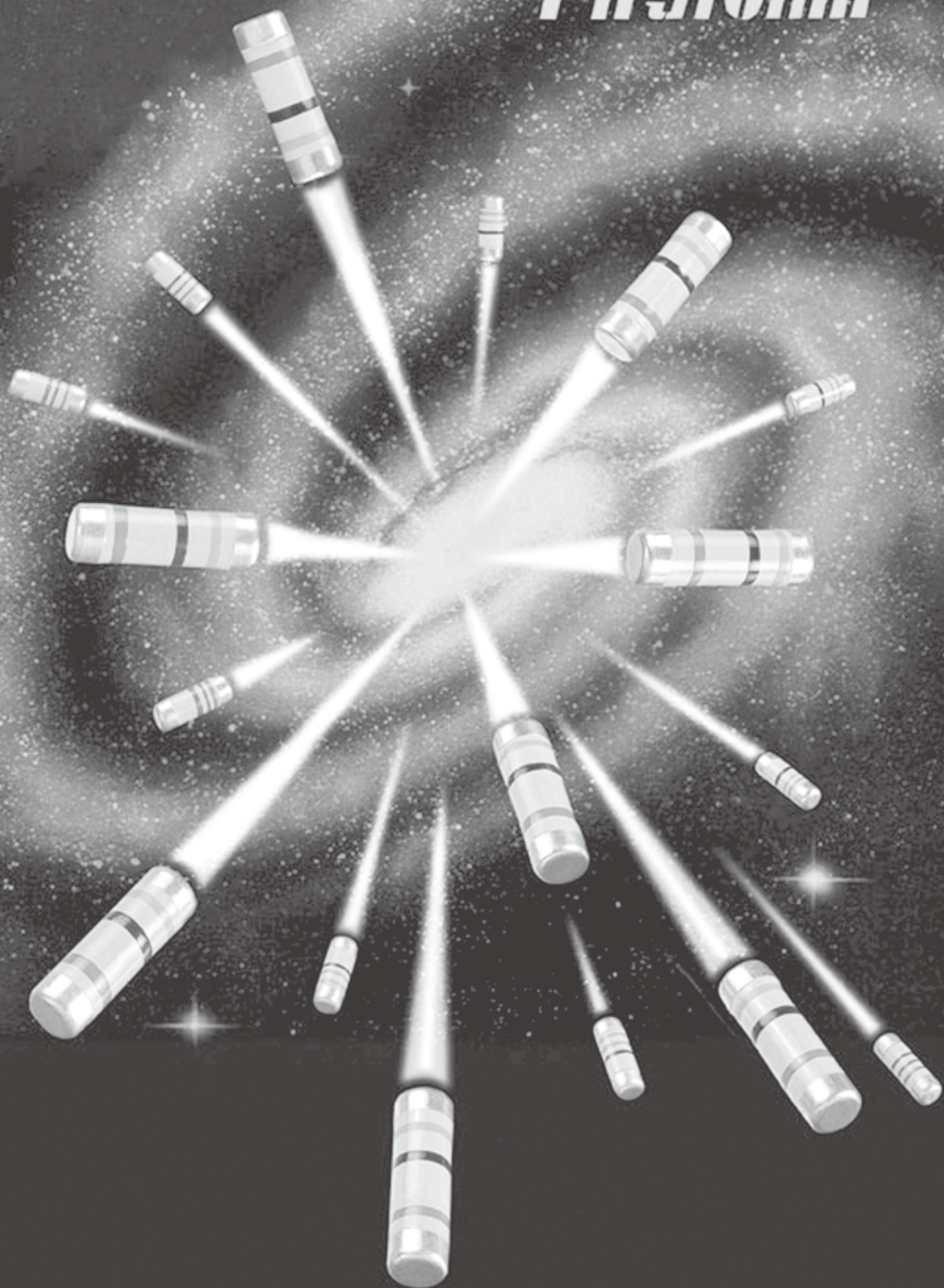
For better heat dissipation / lower heat resistance, increase W & L.

■ COVER TAPE PEELING SPECIFICATION

Recommended peeling force: 50±5gf

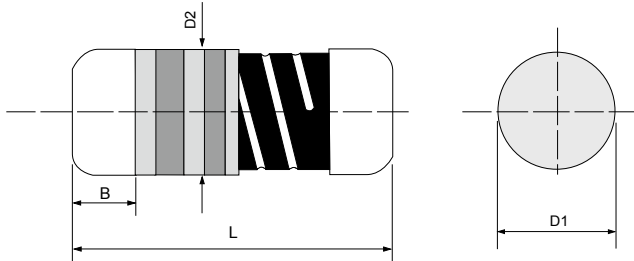


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MMP(V)



Specifications Per

- IEC 60115-1
- EN140401-803
- AEC-Q200 Rev. D

Features

- AEC-Q200 Compliant
- Excellent solderability termination
- Anti-sulfuration test qualified
- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

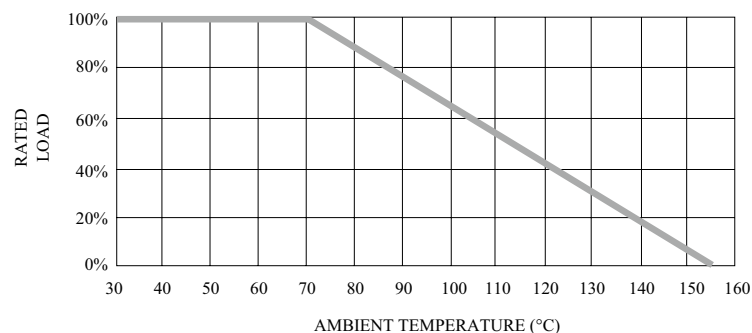
■ DIMENSIONS

Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
MMP204V	3.52 ± 0.15	1.35 ± 0.1	$D1+0.02/-0.15$	0.6 Min.	17 grams
MMP52V	5.90 ± 0.20	2.20 ± 0.1	$D1+0.02/-0.2$	1.0 Min.	66 grams

■ GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
MMP204V	1/4W	200V	400V	10Ω	1MΩ	±0.5%	E-192
				22Ω	1MΩ	±0.25%	
				43Ω	1MΩ	±0.1%	
MMP52V	1/2W	300V	500V	10Ω	1MΩ	±0.5%	E-192
				15Ω	1MΩ	±0.25%	
				33Ω	1MΩ	±0.1%	

■ POWER DERATING CURVE



MMP(V) – Metal Film MELF Precision Resistor, Vehicle Grade

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■ PART NUMBER

Example: MMP52VB2K61TKQTR2K0

MMP52V	B	2K61	TKQ	TR2K0
Type	Tolerance*	Resistance	TC*	Packaging
	B (0.1%) C (0.25%) D (0.5%)	2.61KΩ 4-character code containing - 3 significant digits 1 letter multiplier OHM MULTIPLIER R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	25ppm 3-character code TKM=±5PPM/°C TKN=±10PPM/°C TKP=±15PPM/°C TKQ=±25PPM/°C TKR=±50PPM/°C	5-character code TR = Tape Reel (pieces per reel) <u>MMP204V</u> 3K0 = 3,000 6K0 = 6,000 10K = 10,000 <u>MMP52V</u> 2K0 = 2,000 6K0 = 6,000 10K = 10,000

MMP(V)

* Listed values may not be applicable across product types or to all resistance values. Please check with us before placing order.
Please check with us before placing order. **upon request

■ TECHNICAL SUMMARY

Characteristics	Limits	
Operating Temperature Range, °C	-55 ~ +155	
Temperature Coefficient, PPM / °C*	±15, ±25, ±50 (See below for availability)	
Dielectric Withstanding Voltage, VAC or DC	MMP204V	300
	MMP52V	500
Insulation Resistance, MΩ	>10 ⁴	
Failure Rate, pcs/10 ⁹ device hours	<1.5	
Tin Whisker (JESD201 Temperature Cycling & High Temp. /Humidity Storage), μm	<5	

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ TEMPERATURE COEFFICIENT AVAILABILITY

TC	Tolerance	Specifications	
		Resistance Values Available	
		MMP204V	MMP52V
±15 PPM/°C	±0.5%	10Ω-330KΩ	10Ω-680KΩ
	±0.25%	22Ω-330KΩ	15Ω-510KΩ
	±0.1%	43Ω-330KΩ	33Ω-510KΩ
±25, ±50PPM/°C	±0.5%	10Ω-1MΩ	10Ω-1MΩ
	±0.25%	22Ω-1MΩ	15Ω-1MΩ
	±0.1%	43Ω-1MΩ	33Ω-1MΩ

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■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits	
High Temperature Exposure (Storage)	AEC-Q200 REV D. Stress NO.3 (refer to MIL-STD-202 Method 108) 1,000 hours at 125°C without load	10Ω to 332KΩ	± 0.5%
		>332KΩ	± 0.75%
Temperature Cycling	AEC-Q200 REV D. Stress NO.4 (refer to IEC 60115-1 4.19/ JESD22 Method JA-104) -55°C 30minutes, +125°C 30minutes, 1,000 cycles	10Ω to 332KΩ	± 0.5%
		>332KΩ	± 0.75%
	Proprietary test specification FRC-AECQ-180702 -20°C 30minutes, +120°C 30minutes, 1,000 cycles (Recommended solder paste composition:96.5% Sn, 3% Ag, 0.5% Cu)	Force of 1kg for 10 seconds and without distinct looseness of terminals	
Biased Humidity	AEC-Q200 REV D. Stress NO.7 (refer to IEC 60115-1 4.37/ MIL-STD-202 Method 103) 1,000 hours at 85°C and 85% relative humidity with 10% operating power (not over max. working voltage)	10Ω to < 10KΩ	± 0.75%
		10KΩ to 332KΩ	± 1.5%
		>332KΩ	± 2.5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at 70°C	10Ω to 332KΩ	± 0.5%
		>332KΩ	± 0.75%
	AEC-Q200 REV D. Stress NO.8 (refer to MIL-STD-202 Method 108) 1,000 hours at 125°C with de-rated continuous working voltage (not over max. working voltage)	10Ω to 332KΩ	± 1.5%
		>332KΩ	± 3%
Resistance to Solvents	AEC-Q200 REV D. Stress NO.12 (refer to MIL-STD-202 Method 215) Add Aqueous wash chemical-OKEM Clean or equivalent. Do not use banned solvents.	No visible damage on appearance and marking	
Mechanical Shock	AEC-Q200 REV D. Stress NO.13 (refer to MIL-STD-202 Method 213 Condition C) Three shocks in each direction shall be applied along the three mutually perpendicular axes of the test specimen. Peak value: 100 g's, Duration: 6 ms, Velocity change: 12.3 ft/s, Waveform: Half sine	±0.5%	
Vibration	AEC-Q200 REV D. Stress NO.14 (refer to MIL-STD-202 Method 204) 5 g's for 20 min., 12 cycles each of 3 orientations, Test from 10 - 2,000 Hz.	±0.5%	
Resistance to Soldering Heat	AEC-Q200 REV D. Stress NO.15 (refer to IEC 60115-1 4.18.2/ MIL-STD-202 Method 210) Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds)	±0.5%	
Anti-sulfuration test	EIA-977 (conditions B) 750 hours at (105±2)°C without load	±0.1%	±0.1%
		±0.25%	±0.25%
		±0.5%	±0.5%

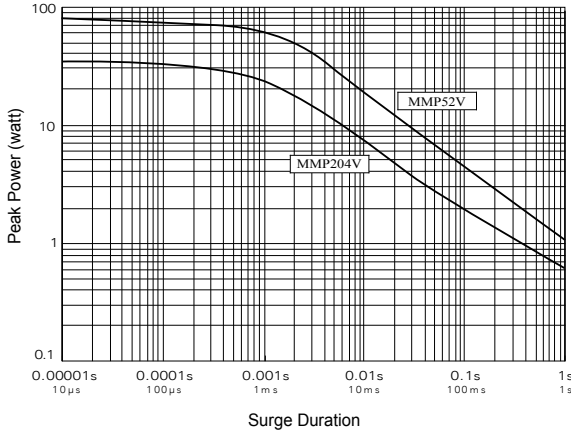
■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits	
ESD	AEC-Q200 REV D. Stress NO.17 (refer to AEC-Q200-002/ ISO/DIS 10605) (150pF/ 2000Ohm discharge network) Human body model, 1 positive & 1 negative discharges with 2KV source	±0.5%	
Solderability	AEC-Q200 REV D. Stress NO.18 (refer to J-STD-002 or IEC 60115-1 4.17) Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min. coverage	
Flammability	AEC-Q200 REV D. Stress NO.20 (refer to UL-94) V-0 or V-1 are acceptable. Electrical test not required.	NO flaming	
Board Flex	AEC-Q200 REV D. Stress NO.21 (refer to AEC-Q200-005) 60 sec minimum holding time.	±0.5%	
Terminal Strength	AEC-Q200 REV D. Stress NO.22 (refer to AEC-Q200-006) Force of 1.8kg for 60 seconds	±0.5%	
Short Time Overload	IEC 60115-1 4.13 5 seconds 2.5x rated voltage(not over max. overload voltage)	± 0.25%	
Climatic test	IEC 60115-1 4.23 4.23.2 - dry heat: 16 hours 155°C 4.23.3 - damp heat: 24 hours 55°C with 95% relative humidity 4.23.4 - cold: 2 hours -55°C 4.23.5 - negative air pressure: 2 hour 8.5KPa at (25±10)°C 4.23.6 - damp heat cyclic: 5 days 55°C with 95% relative humidity 4.23.7 - DC load: rated voltage at -55°C and 155°C each 1 Min.	±1%	
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	10Ω to 332KΩ	± 0.5%
		>332KΩ	± 0.75%
Single pulse high voltage overload	IEC 60115-1 4.27 5 pulses of 1.2/50μs at 10x rated voltage (not over max. overload voltage) with interval of 12 sec. 10 pulses of 10/700μs at 10x rated voltage (not over max. overload voltage) with interval of 60 sec.	±0.5%	
		±0.5%	
Periodic Electric Overload	IEC 60115-1 4.39 3.9x rated voltage (not over max. overload voltage) with 0.1s ON, 2.5s OFF for 1,000 cycles	±0.5%	

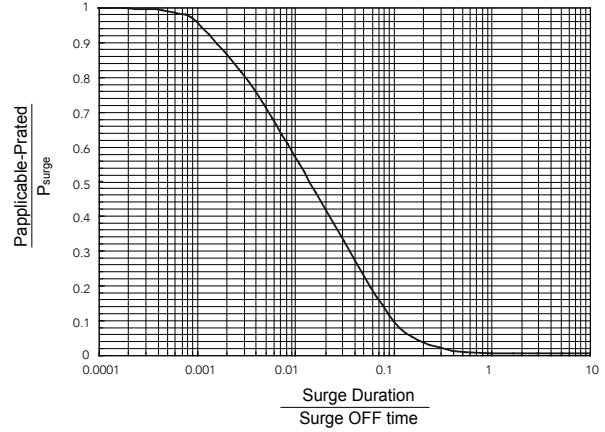
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MMP(V)

■ SINGLE SURGE PERFORMANCE



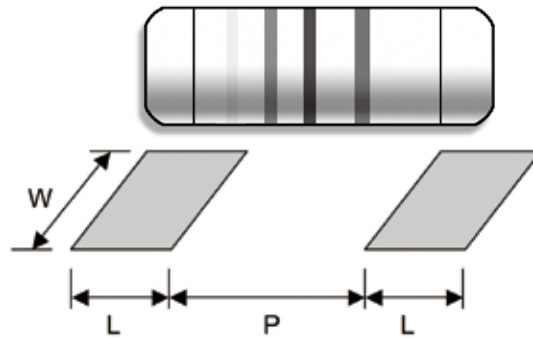
■ SURGE POWER DERATING CURVE



Notes:

- SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further linearly down to zero at 155°C.
- To determine applicable surge power in continuous-surge applications:
 1. Identify allowable duration and peak power P_{surge} of single surge;
 2. Determine ratio of surge duration/surge OFF time in application;
 3. Calculate $P_{applicable}$ backwardly according to Y-axis of SURGE POWER DERATING CURVE.

■ SUGGESTED PAD LAYOUT

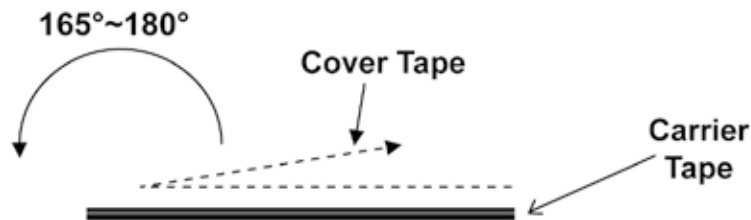


Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
MMP204V	Reflow	1.3	1.6 ± 0.1	1.6
	Wave	1.5	1.5 ± 0.1	1.8
MMP52V	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0

For better heat dissipation / lower heat resistance, increase W & L.

■ COVER TAPE PEELING SPECIFICATION

Recommended peeling force: 50gf±5gf



SRM-201 withstands 51,840,000 surges at 30KV, in duration of 500 hours.



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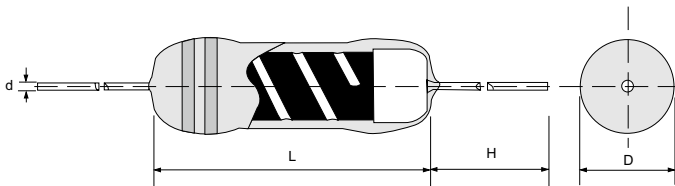
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TÜV ISO 9002 ISO 14001 / IECQ CERTIFIED FACTORY

MO Metal Oxide Film Fixed Resistor

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Specifications Per

- IEC 60115-4
- MIL-11804

Features

- Flameproof multi-layer coating equivalent to UL 94 V-0
- Flameproof feature equivalent to overload test UL 1412
- Solvent resistant
- Special tin-plated electrolytic copper lead wire
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

■ DIMENSIONS

Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000Pcs
MO50	9.00 ± 1.0	3.2 ± 0.2	28 ± 3.0	0.6 ± 0.03	340 Grams
MO100	11.0 ± 1.0	4.0 ± 0.5	28 ± 3.0	0.7 ± 0.03	500 Grams
MO200	13.5 ± 1.0	5.0 ± 0.5	30 ± 3.0	0.8 ± 0.03	1050 Grams
MO300	15.5 ± 1.0	5.5 ± 0.5	30 ± 3.0	0.8 ± 0.03	1200 Grams
MO400	19.0 ± 1.0	6.0 ± 0.5	30 ± 3.0	0.8 ± 0.03	1620 Grams
MO500	19.0 ± 1.0	8.0 ± 0.5	30 ± 3.0	0.8 ± 0.03	3100 Grams
MO600	24.0 ± 1.0	8.0 ± 0.5	30 ± 3.0	0.8 ± 0.03	3700 Grams
MO700	31.5 ± 1.0	8.0 ± 0.5	30 ± 3.0	0.8 ± 0.03	4000 Grams

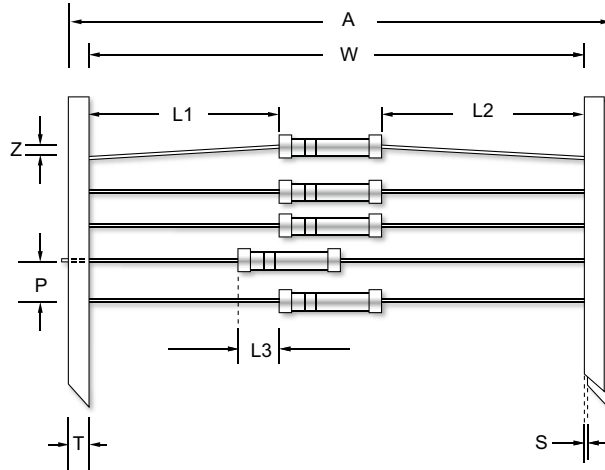
■ GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
MO50	1/2W	350V	600V	0.1Ω	120KΩ	±5%	E-24
MO100	1W	350V	600V	0.1Ω	120KΩ	±5%	E-24
MO200	2W	350V	700V	0.1Ω	150KΩ	±5%	E-24
MO300	3W	350V	700V	0.1Ω	150KΩ	±5%	E-24
MO400	4W	450V	800V	0.1Ω	180KΩ	±5%	E-24
MO500	5W	500V	1000V	0.1Ω	200KΩ	±5%	E-24
MO600	6W	500V	1000V	0.1Ω	220KΩ	±5%	E-24
MO700	7W	600V	1200V	0.22Ω	220KΩ	±5%	E-24

Special sizes, values, and specifications not listed available on special order.

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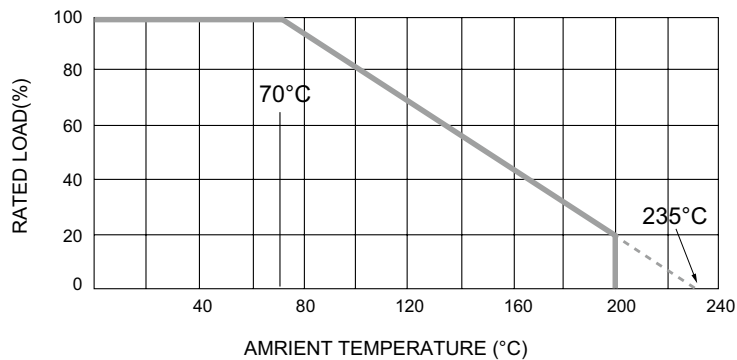
■ TAPING SPECIFICATIONS



Unit (mm)

Type	A (Max.)	L1-L2 (Max.)	L3 (Max.)	P ±0.5	S (Max.)	T ±0.5	W ±1.5	Z (Max.)
MO50	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
MO100	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
MO200	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
MO300	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
MO400	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
MO500	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
MO600	97	±1.5	1.0	10.0	0.8	6.0	83.0	1.2
MO700	97	±1.5	1.0	10.0	0.8	6.0	83.0	1.2

■ POWER DERATING CURVE

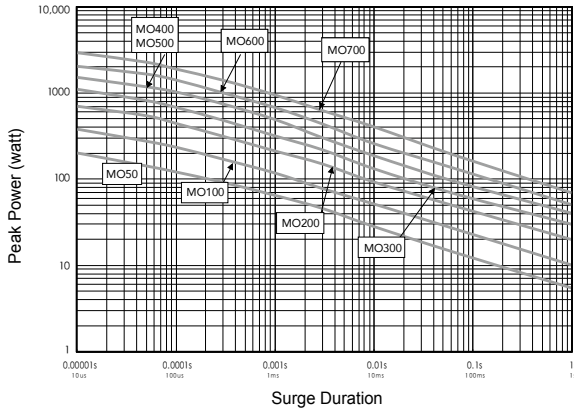


MO Metal Oxide Film Fixed Resistor

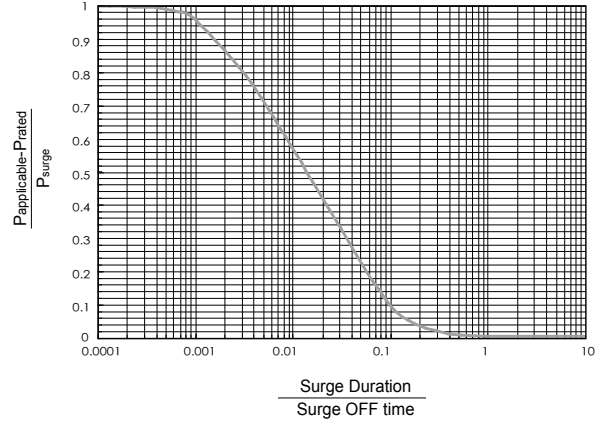
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MO

■ SINGLE SURGE PERFORMANCE



■ SURGE POWER DERATING CURVE



Notes:

• SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further linearly down to zero at 200°C.

- To determine applicable surge power in continuous-surge applications:
 1. Identify allowable duration and peak power P_{surge} of single surge;
 2. Determine ratio of surge duration/surge OFF time in application;
 3. Calculate $P_{applicable}$ backwardly according to Y-axis of SURGE POWER DERATING CURVE.

■ PART NUMBER

Example: MO200J10K0TKZTB500

MO200	J	10K0	TKZ	TB500
Type	Tolerance	Resistance	TCR	Packaging
	J (5%)	10KΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.*	5-character code TB = Tape Box (pieces per box) MO50 2K0 = 2,000 MO100 1K0 = 1,000 <u>MO200/300/400</u> 500 = 500 <u>MO500</u> 400 = 400 <u>MO600/700</u> 250 = 250 (Bulk Packaging Only)

* For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

■ TECHNICAL SUMMARY

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or DC	MO50: 350 MO100 / MO200: 600 MO300 to MO700 : 1000
Temperature Coefficient, PPM / °C*	Typically ±300
Operating Temperature Range, °C	-55~+200
Insulation Resistance, MΩ	10 ⁴

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

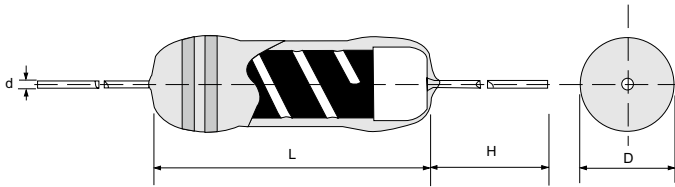
■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±1%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 1.52mm and 10 to 2,000 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 200°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +150°C 30minutes, 5 cycles	±2%

MO MINIATURE SIZE Metal Oxide Film Fixed Resistor

Safety • Quality • Reliability
Cost-Down via Innovation

MO



Specifications Per

- IEC 60115-4
- MIL-11804

Features

- Flameproof multi-layer coating equivalent to UL 94 V-0
- Flameproof feature equivalent to overload test UL 1412
- Solvent resistant
- Special tin-plated electrolytic copper lead wire
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

■ DIMENSIONS

Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000Pcs
MO51	6.50 ± 1.0	2.6 ± 0.2	26 ± 3.0	0.6 ± 0.03	300 Grams
MO101	9.00 ± 1.0	3.2 ± 0.5	28 ± 3.0	0.6 ± 0.03	340 Grams
MO201	11.0 ± 1.0	4.0 ± 0.5	28 ± 3.0	0.7 ± 0.03	500 Grams
MO301	13.5 ± 1.0	5.0 ± 0.5	30 ± 3.0	0.8 ± 0.03	1050 Grams
MO401	15.5 ± 1.0	5.5 ± 0.5	30 ± 3.0	0.8 ± 0.03	1200 Grams
MO501	19.0 ± 1.0	6.0 ± 0.5	30 ± 3.0	0.8 ± 0.03	1620 Grams
MO601	19.0 ± 1.0	8.0 ± 0.5	30 ± 3.0	0.8 ± 0.03	3100 Grams

■ GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
MO51	1/2W	250V	500V	0.1Ω	100KΩ	±5%	E-24
MO101	1W	300V	600V	0.1Ω	120KΩ	±5%	E-24
MO201	2W	350V	600V	0.1Ω	120KΩ	±5%	E-24
MO301	3W	350V	700V	0.1Ω	150KΩ	±5%	E-24
MO401	4W	350V	700V	0.1Ω	150KΩ	±5%	E-24
MO501	5W	450V	800V	0.1Ω	180KΩ	±5%	E-24
MO601	6W	500V	800V	0.1Ω	200KΩ	±5%	E-24

Special sizes, values, and specifications not listed available on special order.

Safety • Quality • Reliability
Cost-Down via Innovation

■ PART NUMBER

Example: MO301J10K0TKZTB500

MO301	J	10K0	TKZ	TB500
Type	Tolerance	Resistance	TCR	Packaging
	J (5%)	10KΩ 4-character code containing - 3 significant digits 1 letter multiplier OHM MULTIPLIER R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.*	5-character code TB = Tape Box (pieces per box) <u>MO51/MO101</u> 2K0 = 2,000 <u>MO201</u> 1K0 = 1,000 <u>MO301/401/501</u> 500 = 500 <u>MO601</u> 400 = 400

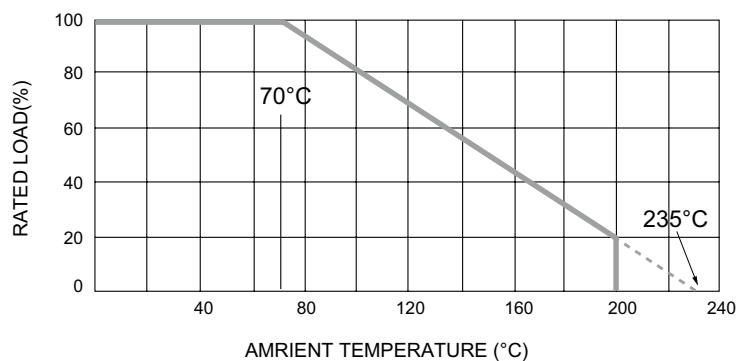
* For the availabilities of non-default temperature coefficient, please check with us.
Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

■ TECHNICAL SUMMARY

Characteristics	Limits	
Dielectric Withstanding Voltage, VAC or DC	MO51 MO101 MO201 to MO401 MO501 MO601	250V 300V 350V 450V 500V
Temperature Coefficient, PPM/°C*	Typically ±300	
Operating Temperature Range, °C	-55 ~ +200	
Insulation Resistance, MΩ	10 ⁴	

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

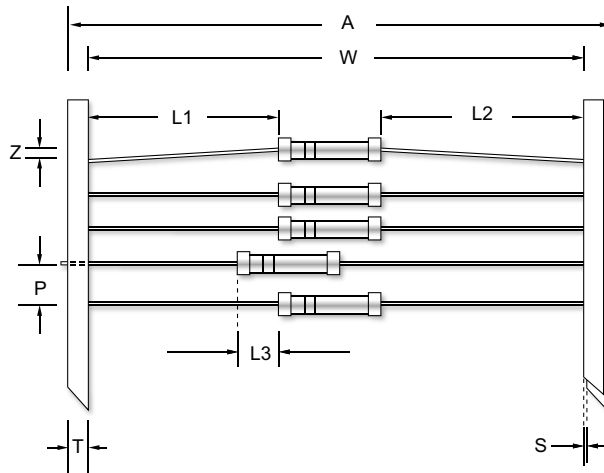
■ POWER DERATING CURVE



Safety • Quality • Reliability
Cost-Down via Innovation

MO

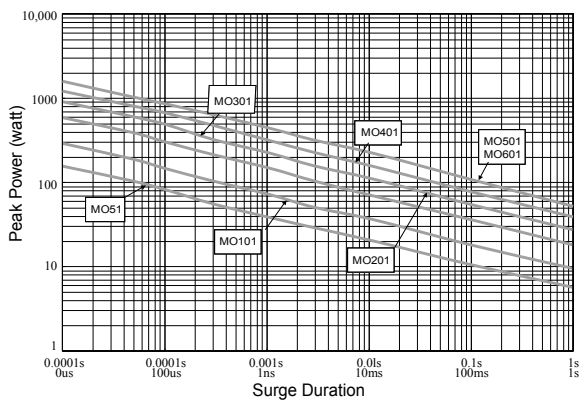
TAPING SPECIFICATIONS



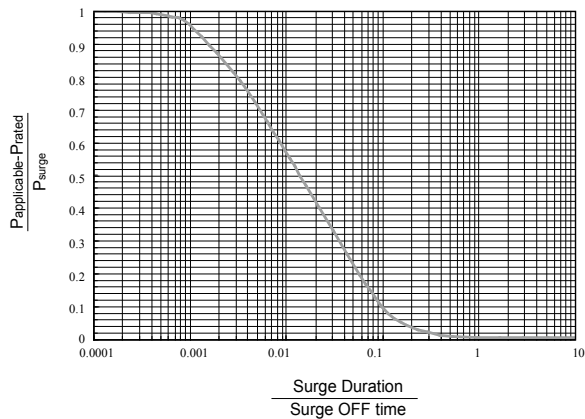
Unit (mm)

Type	A (Max.)	L1-L2 (Max.)	L3 (Max.)	P ±0.5	S (Max.)	T ±0.5	W ±1.5	Z (Max.)
MO51	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
MO101	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
MO201	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
MO301	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
MO401	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
MO501	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
MO601	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2

SINGLE SURGE PERFORMANCE



SURGE POWER DERATING CURVE



Notes:

- SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further linearly down to zero at 200°C.
- To determine applicable surge power in continuous-surge applications:
 1. Identify allowable duration and peak power P_{surge} of single surge;
 2. Determine ratio of surge duration/surge OFF time in application;
 3. Calculate $P_{applicable}$ backwardly according to Y-axis of SURGE POWER DERATING CURVE.

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Cost-Down via Innovation

■ PERFORMANCE SPECIFICATIONS

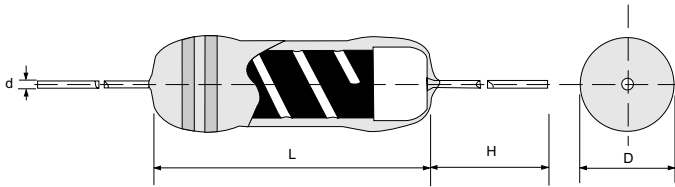
Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±1%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%
Solderability	MIL-STD-202 Method 208 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	MIL-STD-202 Method 204 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 1.52mm and 10 to 2,000 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 200°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +150°C 30minutes, 5 cycles	±1%

MO

MP Metal Film Precision Resistor

Safety • Quality • Reliability
Cost-Down via Innovation

MP



Specifications Per

- IEC 60115-1
- MIL R-10509

Features

- Conformal multi-layer coating
- Color code per MIL & EIA standards
- Special tin-plated electrolytic copper lead wire
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

■ DIMENSIONS

Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000Pcs
MP16	3.2 ± 1.0	1.9 ± 0.2	28 ± 3.0	0.45 ± 0.02	145 Grams
MP25	6.5 ± 1.0	2.4 ± 0.2	26 ± 3.0	0.55 ± 0.03	220 Grams
MP51	9.0 ± 1.0	3.2 ± 0.2	26 ± 3.0	0.60 ± 0.03	340 Grams

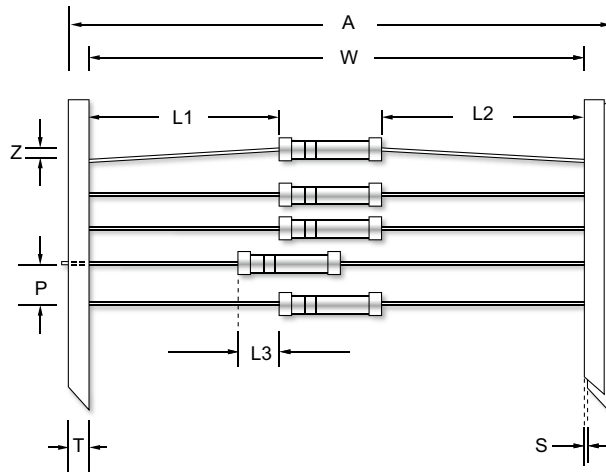
■ GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
MP16	1/6W	150V	300V	10Ω	500KΩ	±0.5%	E-192
						±0.25%	
						±0.1%	
						±0.05%	
MP25	1/4W	250V	500V	10Ω	1MΩ	±0.5%	E-192
						±0.25%	
						±0.1%	
						±0.05%	
MP51	1/2W	350V	700V	10Ω	1MΩ	±0.5%	E-192
						±0.25%	
						±0.1%	
						±0.05%	

Special sizes, values, and specifications not listed available on special order.

Safety • Quality • Reliability
Cost-Down via Innovation

■ TAPING SPECIFICATIONS



Unit (mm)

Type	A (Max.)	L1-L2 (Max.)	L3 (Max.)	P ±0.5	S (Max.)	T ±0.5	W ±1.5	Z (Max.)
MP16	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
MP25	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
MP51	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2

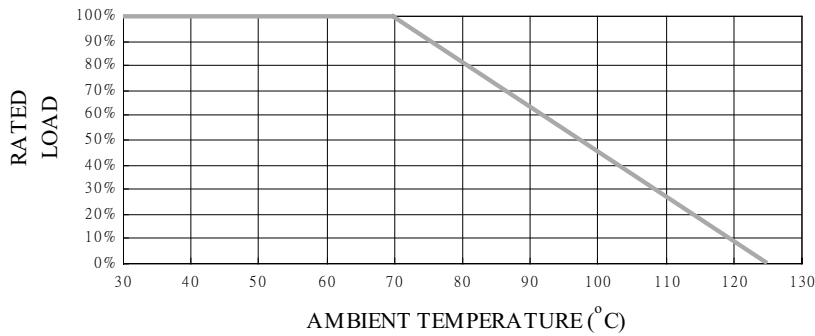
Type	Packing Type	MP16	MP25	MP51
Minimum Packing QTY (pcs)	Ammo pack	5000	5000	2000

MP

Safety • Quality • Reliability
Cost-Down via Innovation

MP

POWER DERATING CURVE



PART NUMBER

Example: MP25B49K9TKQTB5K0

MP25	B	49K9	TKQ	TB5K0
Type	Tolerance*	Resistance	TCR*	Packaging
	B (0.1%) C (0.25%) D (0.5%)	49.9KΩ 4-character code containing - 3 significant digits 1 letter multiplier OHM MULTIPLIER R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	25ppm 3-character code TKN = ± 10 ppm TKP = ± 15 ppm TKQ = ± 25 ppm TKR = ± 50 ppm	5-character code TB = Tape Box (pieces per box) MP16/MP25 5K0 = 5,000 MP51 2K0 = 2,000

* Listed values may not be applicable across product types or to all resistance values. Please check with us before placing order.

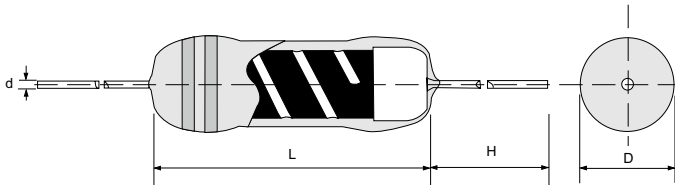
TECHNICAL SPECIFICATIONS

Characteristics	Limits	
Dielectric Withstanding Voltage, VAC or DC	MP16 MP25 MP51	300 500 700
Temperature Coefficient, PPM / °C*	±10, ±15, ±25, ±50	
Operating Temperature Range, °C	-55 ~ +125	
Insulation Resistance, MΩ	10 ⁴	

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±0.15%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±0.75%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±0.5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±0.15%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±0.1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 125°C without load	±0.15%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +125°C 30minutes, 5 cycles	±0.15%



Specifications Per

- IEC 60115-4
- MIL-11804

Features

- Special composite film on high grade ceramic substrate
- Flameproof multi-layer coating equivalent to UL 94 V-0
- Flameproof feature equivalent to overload test UL 1412
- Excellent anti-surge capability
- Absorbs pulse from city power line, direct crossing or inductive coupling
- Protects electric equipment or parts from accidental shock
- Low-cost alternative to wire-wound resistors
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000 Pcs
MSD25	6.50 ± 1.0	2.6 ± 0.2	26 ± 3.0	0.6 ± 0.03	300 Grams
MSD50	9.00 ± 1.0	3.2 ± 0.3	28 ± 3.0	0.6 ± 0.03	340 Grams
MSD100	11.0 ± 1.0	4.0 ± 0.5	28 ± 3.0	0.7 ± 0.03	500 Grams
MSD200	13.5 ± 1.0	5.0 ± 0.5	30 ± 3.0	0.8 ± 0.03	1050 Grams
MSD300	15.5 ± 1.0	5.5 ± 0.5	30 ± 3.0	0.8 ± 0.03	1200 Grams
MSD400	19.0 ± 1.0	6.0 ± 0.5	30 ± 3.0	0.8 ± 0.03	1600 Grams
MSD500	19.0 ± 1.0	8.0 ± 0.5	30 ± 3.0	0.8 ± 0.03	3100 Grams
MSD600	24.0 ± 1.0	8.0 ± 0.5	30 ± 3.0	0.8 ± 0.03	3700 Grams

GENERAL SPECIFICATIONS

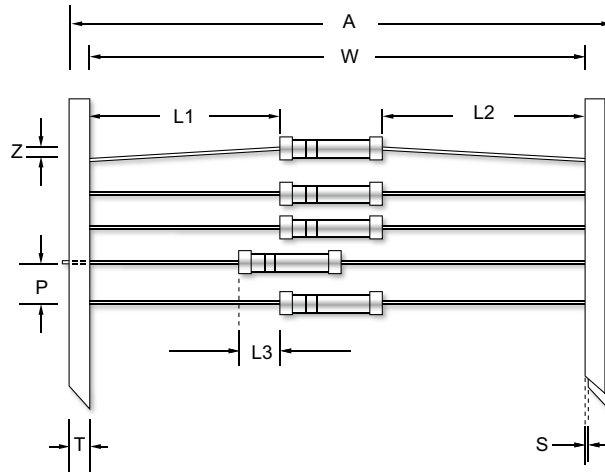
Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
MSD25	1/4W	250V	500V	0.1Ω	1MΩ	±5%	E-24
MSD50	1/2W	350V	500V	0.1Ω	120KΩ	±0.1~5%	E-192/E-24
MSD100	1W	350V	600V	0.1Ω	120KΩ	±0.1~5%	E-192/E-24
MSD200	2W	350V	600V	0.1Ω	150KΩ	±0.1~5%	E-192/E-24
MSD300	3W	350V	700V	0.1Ω	150KΩ	±0.1~5%	E-192/E-24
MSD400	4W	450V	700V	0.1Ω	180KΩ	±0.1~5%	E-192/E-24
MSD500	5W	500V	800V	0.1Ω	200KΩ	±0.1~5%	E-192/E-24
MSD600	6W	500V	1000V	0.1Ω	220KΩ	±0.1~5%	E-192/E-24

Special sizes, values, and specifications not listed available on special order.

Safety • Quality • Reliability
Cost-Down via Innovation

MSD

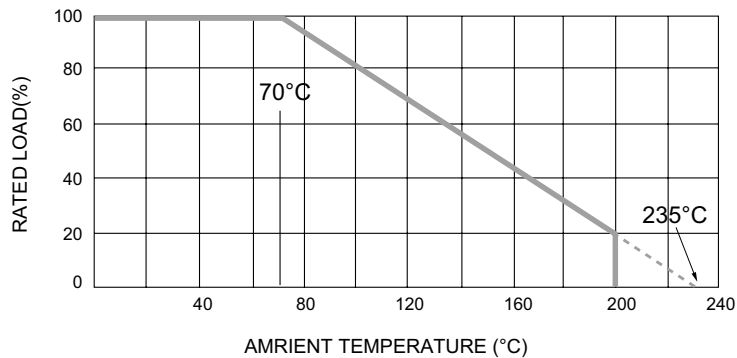
■ TAPING SPECIFICATIONS



Unit (mm)

Type	A (Max.)	L1-L2 (Max.)	L3 (Max.)	P ±0.5	S (Max.)	T ±0.5	W ±1.5	Z (Max.)
MSD25	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
MSD50	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
MSD100	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
MSD200	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
MSD300	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
MSD400	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
MSD500	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
MSD600	97	±1.5	1.0	10.0	0.8	6.0	83.0	1.2

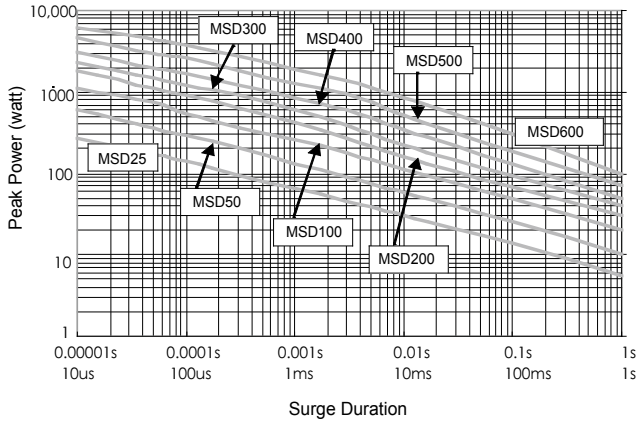
■ POWER DERATING CURVE



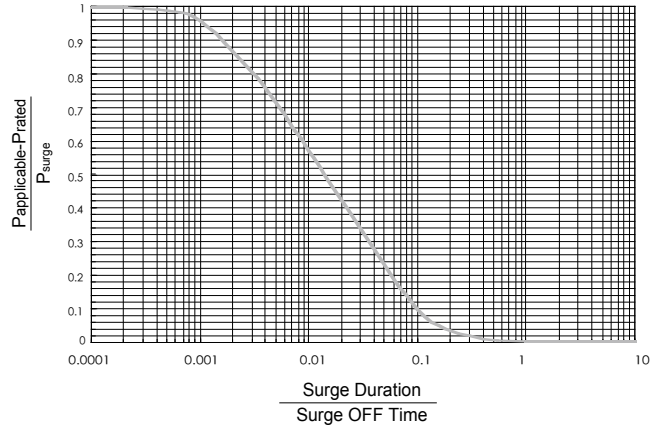
Safety • Quality • Reliability
Cost-Down via Innovation

MSD

■ SINGLE SURGE PERFORMANCE



■ SURGE POWER DERATING CURVE



Notes:

1. Above graph is accurate for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further by 0.62% per °C until 200°C.
2. For applicable surge power in continuous-surge applications please see SURGE POWER DERATING CURVE.

■ TECHNICAL SPECIFICATIONS

Characteristics	Limits	
Dielectric Withstanding Voltage, VAC or DC	1/4W	250
	1/2W	350
	1W to 2W	600
	3W to 6W	1000
Temperature Coefficient, PPM / °C*	Typically ±300	
Operating Temperature Range, °C	-55 ~ +200	
Insulation Resistance, MΩ	10 ⁴	

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ SURGE PERFORMANCE SPECIFICATIONS

Characteristics		Limits
Max. Surge Voltage	MSD50	4000V DC
	MSD100	5000V DC
	MSD200	6000V DC
	MSD300	7000V DC
	MSD400	7500V DC
	MSD500	8000V DC
	MSD600	9000V DC
	MSD1000	10000V DC
Surge Voltage = $\sqrt{(1200 \times P \times R)}$ DC P is power rating, R is resistance value, surge voltage is not more than 2 times of max. surge voltage. Surge spec = 1.2/50µs Period = 1 sec Number of surges = 50		±5%

MSD Pulse Safety Resistor

Safety • Quality • Reliability
Cost-Down via Innovation

■ PART NUMBER

Example: MSD200J10K0TKZTB500

MSD200	J	10K0	TKZ	TB500
Type	Tolerance*	Resistance	TCR	Packaging
	B (0.1%) D (0.5%) F (1%) J (5%)	10KΩ 4-character code containing - 3 significant digits 1 letter multiplier OHM MULTIPLIER R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.**	5-character code TB = Tape Box (pieces per box) <u>MSD25/MSD50</u> 2K0 = 2,000 <u>MSD100</u> 1K0 = 1,000 <u>MSD200/300/400</u> 500 = 500 <u>MSD500</u> 400 = 400 <u>MSD600</u> 250 = 250

* Listed values may not be applicable to all product types or to all resistance values. Please check with us before placing order.

** For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

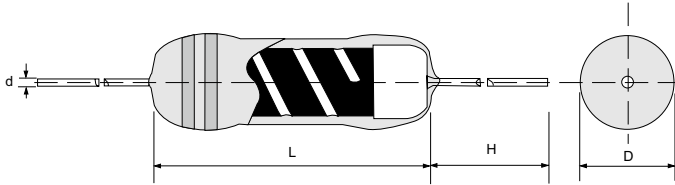
■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±1%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% \ relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min. coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 1.52mm and 10 to 2,000 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 200°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	1/4W 1/2~6W ±2% ±3%

MSD MINIATURE SIZE Pulse Safety Resistor

Safety • Quality • Reliability
Cost-Down via Innovation

MSD



Specifications Per

- IEC 60115-4
- MIL-11804

Features

- Special composite film on high grade ceramic substrate
- Flameproof multi-layer coating equivalent to UL 94 V-0
- Flameproof feature equivalent to overload test UL 1412
- Excellent anti-surge capability
- Absorbs pulse from city power line, direct crossing or inductive coupling
- Protects electric equipment or parts from accidental shock
- Low-cost alternative to wire-wound resistors
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000 Pcs
MSD51	6.50 ± 0.5	2.6 ± 0.2	28 ± 3.0	0.6 ± 0.03	300 Grams
MSD101	9.00 ± 1.0	3.2 ± 0.3	28 ± 3.0	0.6 ± 0.03	340 Grams
MSD201	11.0 ± 1.0	4.0 ± 0.5	28 ± 3.0	0.7 ± 0.03	500 Grams
MSD301	13.5 ± 1.0	5.0 ± 0.5	30 ± 3.0	0.8 ± 0.03	1050 Grams
MSD401	15.5 ± 1.0	5.5 ± 0.5	30 ± 3.0	0.8 ± 0.03	1200 Grams
MSD501	19.0 ± 1.0	6.0 ± 0.5	30 ± 3.0	0.8 ± 0.03	1620 Grams
MSD601	19.0 ± 1.0	8.0 ± 0.5	30 ± 3.0	0.8 ± 0.03	3100 Grams

GENERAL SPECIFICATIONS

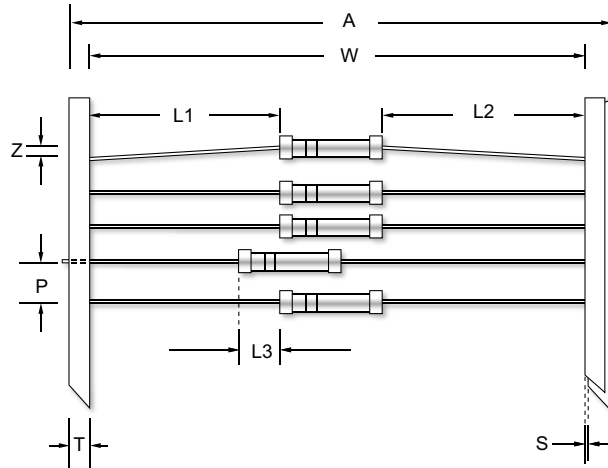
Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
MSD51	1/2W	350V	600V	0.1Ω	120KΩ	±0.1~5%	E-192/E-24
MSD101	1W	350V	600V	0.1Ω	120KΩ	±0.1~5%	E-192/E-24
MSD201	2W	350V	600V	0.1Ω	120KΩ	±0.1~5%	E-192/E-24
MSD301	3W	350V	700V	0.1Ω	150KΩ	±0.1~5%	E-192/E-24
MSD401	4W	350V	700V	0.1Ω	150KΩ	±0.1~5%	E-192/E-24
MSD501	5W	450V	800V	0.1Ω	180KΩ	±0.1~5%	E-192/E-24
MSD601	6W	500V	800V	0.1Ω	200KΩ	±0.1~5%	E-192/E-24

Special sizes, values, and specifications not listed available on special order.

Safety • Quality • Reliability
Cost-Down via Innovation

MSD

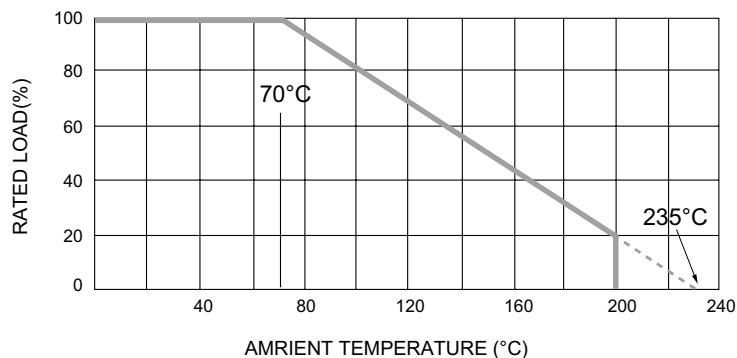
■ TAPING SPECIFICATIONS



Unit (mm)

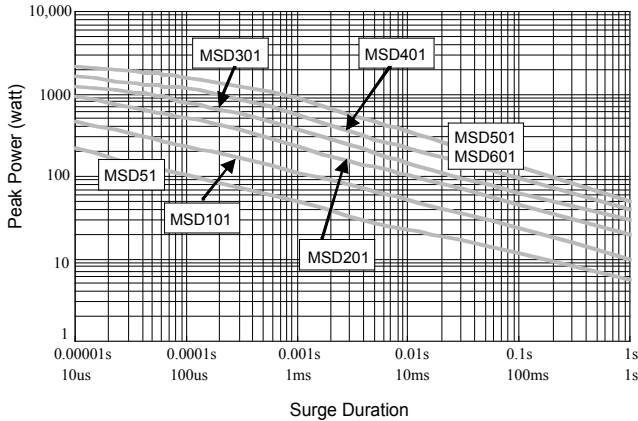
Type	A (Max.)	L1-L2 (Max.)	L3 (Max.)	P ±0.5	S (Max.)	T ±0.5	W ±1.5	Z (Max.)
MSD51	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
MSD101	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
MSD201	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
MSD301	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
MSD401	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
MSD501	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
MSD601	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2

■ POWER DERATING CURVE

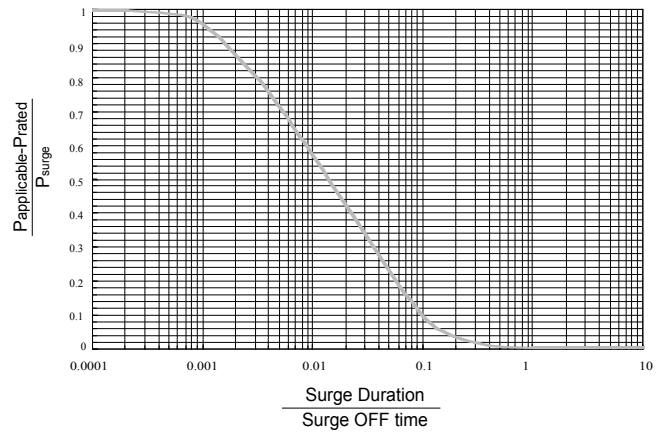


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■ SINGLE SURGE PERFORMANCE



■ SURGE POWER DERATING CURVE



Notes:

- Above graph is accurate for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further by 0.62% per °C until 200°C.
- For applicable surge power in continuous-surge applications please see SURGE POWER DERATING CURVE.

■ TECHNICAL SPECIFICATIONS

Characteristics	Limits	
Dielectric Withstanding Voltage, VAC or DC	1/2W 1W to 2W 3W to 6W	350 600 1000
Temperature Coefficient, PPM / °C*	Typically ±300	
Operating Temperature Range, °C	-55 ~ +200	
Insulation Resistance, MΩ	10 ⁴	

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ SURGE PERFORMANCE SPECIFICATIONS

Characteristics		Limits
Max. Surge Voltage	MSD51	3000V DC
	MSD101	4000V DC
	MSD201	5000V DC
	MSD301	5500V DC
	MSD401	6000V DC
	MSD501	6500V DC
	MSD601	7000V DC
Surge Voltage = $\sqrt{(1000 \times P \times R)}$ DC P is power rating, R is resistance value, surge voltage is not more than 2 times of max. surge voltage. Surge spec = 1.2/50μs Period = 1 sec Number of surges = 50		±5%

MSD MINIATURE SIZE Pulse Safety Resistor

Safety • Quality • Reliability
Cost-Down via Innovation

■ PART NUMBER

Example: MSD301J10K0TKZTB500

MSD301	J	10K0	TKZ	TB500
Type	Tolerance*	Resistance	TCR	Packaging
	B (0.1%) D (0.5%) F (1%) J (5%)	10KΩ 4-character code containing - 3 significant digits 1 letter multiplier OHM MULTIPLIER R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.**	5-character code TB = Tape Box (pieces per box) <u>MSD51/MSD101</u> 2K0 = 2,000 <u>MSD201</u> 1K0 = 1,000 <u>MSD301/401/501</u> 500 = 500 <u>MSD601</u> 400 = 400

* Listed values may not be applicable to all product types or to all resistance values. Please check with us before placing order.

** For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

■ PERFORMANCE SPECIFICATIONS

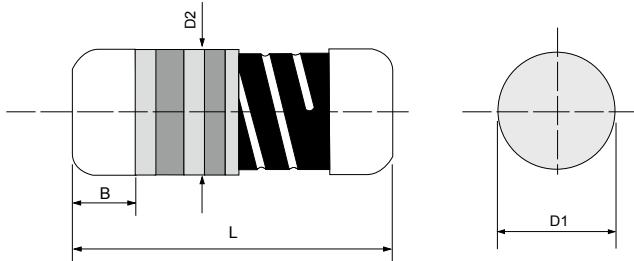
Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±1%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 1.52mm and 10 to 2,000 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 200°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±1%

MSD

MVM Medium Voltage MELF Resistor

Safety • Quality • Reliability
Cost-Down via Innovation

MVM



Specifications Per

- IEC 60115-1
- EN 140401-803

Features

- Handles much higher working voltage than general purpose resistors
- Pure tin-plated termination for excellent solderability
- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- SMD enabled structure
- Anti-surge feature available
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

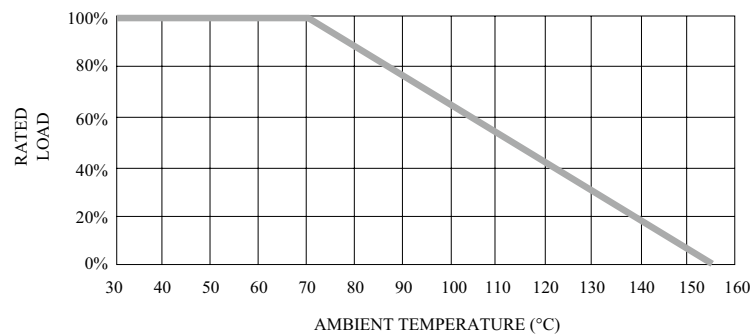
■ DIMENSIONS

Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
MVM204	3.52 ± 0.15	1.35 ± 0.1	D+0.05/ -0.15	0.6 Min.	17 grams
MVM101	5.90 ± 0.20	2.20 ± 0.1	D+0.05/ -0.2	1.0 Min.	66 grams

■ GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
MVM204	2/5W	750V DC 600V RMS	1,000V DC 800V RMS	340KΩ	40MΩ	±1~5%	E-24 / E-96
MVM101	1W	1,000V DC 700V RMS	2,000V DC 1,400V RMS	340KΩ	30MΩ	±1~5%	E-24 / E-96

■ POWER DERATING CURVE



MVM Medium Voltage MELF Resistor

Safety • Quality • Reliability
Cost-Down via Innovation

■ PART NUMBER

Example: MVM204J40M0TKZTR3K0

MVM204	J	40M0	TKZ	TR3K0
Type	Tolerance*	Resistance	TCR	Packaging
	F (1%) G (2%) J (5%)	40MΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary Section of the datasheet.**	5-character code TR = Tape Reel (pieces per reel) <u>MVM204</u> 3K0 = 3,000 6K0 = 6,000 10K = 10,000 <u>MVM101</u> 2K0 = 2,000 6K0 = 6,000*** 10K = 10,000***

* Listed values may not be applicable to all resistance values. Please check with us before placing order.

** For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

*** upon request

■ TECHNICAL SUMMARY

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or DC	MVM204: 300 MVM101: 500
Temperature Coefficient, PPM / °C*	±200, ±400, ±800, ±1200
Operating Temperature Range, °C	-55 ~ +155
Insulation Resistance, MΩ	>10 ⁴
Failure Rate in Time, pcs / 10 ⁹ device hours	<5
Tin Whisker (JESD201 Temperature Cycling & High Temp. /Humidity Storage), μm	<5

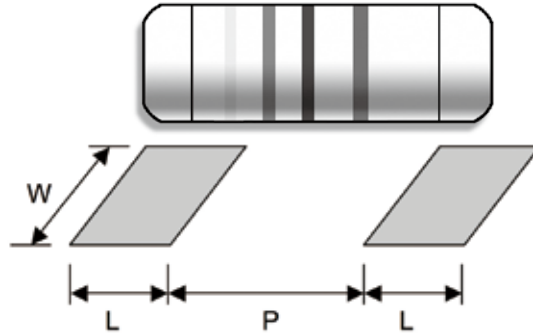
* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Overload	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±2.5%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±3%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±3%
Periodic Electric Overload	IEC 60115-1 4.39 3.9x rated voltage (not over max. overload voltage) with 0.1s ON, 2.5s OFF for 1,000 cycles	±2.5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Dip the resistor into a solder bath having a temperature of (260±5)°C and hold it for a 10±1 seconds	±1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% Min. coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000hoursat155°C withoutload	±5%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±2%
Single pulse high voltage overload	IEC 60115-1 4.27 5 pulses of 1.2/50µs at 10x rated voltage (not over max. overload voltage) with interval of 12 sec.	±2%
Electrostatic discharge (Human body model)	IEC 60115-1 4.38 3 positive & 3 negative discharges with 2KV for MVM16 or 4KV for MVM25 (For continuous surge application please see Surge Performance paragraph)	±2.5%
Climatic test	IEC 60115-1 4.23 4.23.2 - dry heat: 16 hours 155°C 4.23.3 - damp heat: 24 hours 55°C with 95% relative humidity 4.23.4 - cold: 2 hours -55°C 4.23.5 - negative air pressure: 2 hour 8.5KPa at (25±10)°C 4.23.6 - damp heat cyclic: 5 days 55°C with 95% relative humidity 4.23.7 - DC load: rated voltage at -55°C and 155°C each 1 min.	±2%
Bending test	IEC 60115-1 4.33 Pressing depth 2mm, 3 times	±1%

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Cost-Down via Innovation

■ SUGGESTED PAD LAYOUT



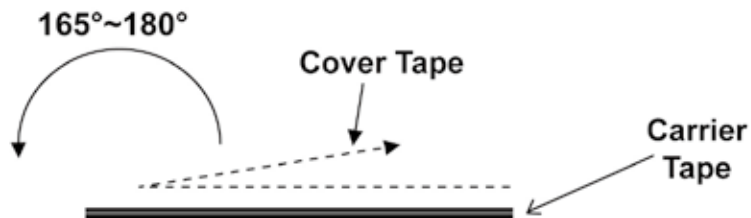
Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
MVM204	Reflow	1.3	1.6 ± 0.1	1.6
	Wave	1.5	1.5 ± 0.1	1.8
MVM101	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0

For better heat dissipation / lower heat resistance, increase W & L.

■ COVER TAPE PEELING SPECIFICATION

Recommended peeling force:

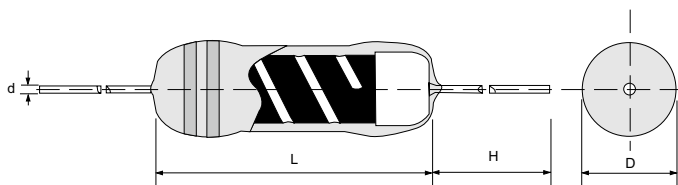
MVM204, MVM101: 50±5gf



MVR Medium Voltage Resistor

Safety • Quality • Reliability
Cost-Down via Innovation

MVR



Specifications Per

- IEC 60115-1
- MIL-R-10509

Features

- Higher working voltage with improved reliability
- Proprietary conductive film
- Especially suitable for SMPS & lighting devices
- Low-cost alternative to metal-glazed resistors
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000Pcs
MVR20	3.20 ± 1.0	1.9 ± 0.2	28 ± 3.0	0.45 ± 0.03	145 Grams
MVR25	6.50 ± 1.0	2.4 ± 0.2	26 ± 3.0	0.55 ± 0.03	220 Grams
MVR51	9.00 ± 1.0	3.2 ± 0.2	26 ± 3.0	0.60 ± 0.03	340 Grams
MVR100	11.0 ± 1.0	4.5 ± 0.5	26 ± 3.0	0.70 ± 0.03	600 Grams
MVR200	15.5 ± 1.0	5.5 ± 0.5	26 ± 3.0	0.80 ± 0.03	1200 Grams

GENERAL SPECIFICATIONS

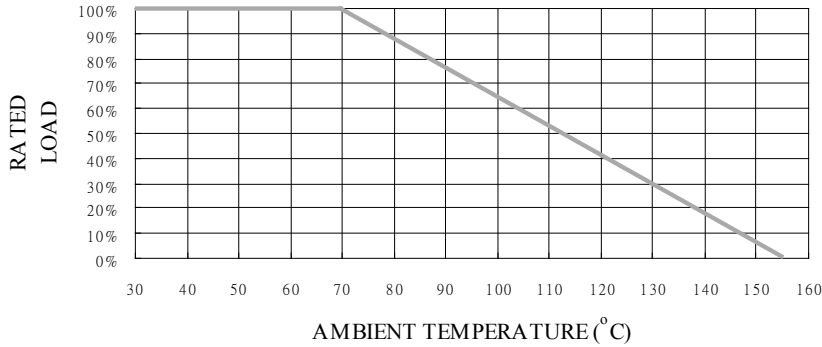
Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
MVR20	1/4W	550V DC 400V RMS	1.1KV DC 800V RMS	47KΩ	33MΩ	±0.1%~ 5%	E-192/E-24
MVR25	1/4W	1.1KV DC 800V RMS	2.2KV DC 1.6KV RMS	47KΩ	33MΩ	±0.1%~ 5%	E-192/E-24
MVR51	1/2W	2.3KV DC 1.6KV RMS	4.6KV DC 3.2KV RMS	47KΩ	68MΩ	±0.1%~ 5%	E-192/E-24
MVR100	1W	4KV DC 2.8KV RMS	8KV DC 5.6KV RMS	47KΩ	100MΩ	±0.1%~ 5%	E-192/E-24
MVR200	2W	7KV DC 5KV RMS	14KV DC 10KV RMS	47KΩ	100MΩ	±0.1%~ 5%	E-192/E-24

Special sizes, values, and specifications not listed available on special order.

MVR Medium Voltage Resistor

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■ POWER DERATING CURVE



MVR

■ PART NUMBER

Example: MVR100J470KTKZTB1K0

MVR100	J	470K	TKZ	TB1K0
Type	Tolerance*	Resistance	TCR	Packaging
	B (0.1%) C (0.25%) D (0.5%) F (1%) J (5%)	470KΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.**	5-character code TB = Tape Box (pieces per box) <u>MVR20/MVR25</u> 5K0 = 5,000 <u>MVR51</u> 2K0 = 2,000 <u>MVR100</u> 1K0 = 1,000 <u>MVR200</u> 500 = 500

* Listed values may not be applicable to all product types or to all resistance values. Please check with us before placing order.

** For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

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MVR

TECHNICAL SPECIFICATIONS

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or DC	MVR20: 300 MVR25: 500 MVR51: 700 MVR100/MVR200: 1000
Temperature Coefficient, PPM / °C*	±100, ±200, ±400, ±800
Operating Temperature Range, °C	-55 ~ +155
Insulation Resistance, MΩ	>10 ⁴

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

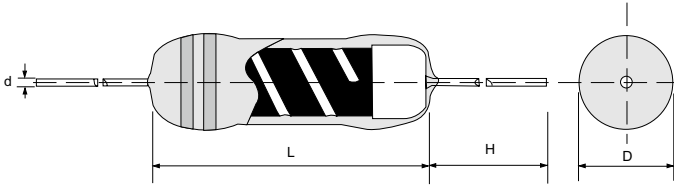
PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±1%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±3%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±3%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 155°C without load	±5%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±2%

Firstohm®



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Specifications Per

- IEC 60115-1
- MIL-R-10509

Features

- Conformal multi-layer coating
- Low temperature coefficient and tolerances
- Excellent stability
- Superior power handling
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

■ DIMENSIONS

Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000 Pcs
PMA204	3.20 ± 1.0	1.9 ± 0.2	28 ± 3.0	0.45 ± 0.02	145 Grams
PMA204T	3.20 ± 1.0	1.9 ± 0.2	28 ± 3.0	0.45 ± 0.02	145 Grams
PMA25	6.50 ± 1.0	2.4 ± 0.2	26 ± 3.0	0.55 ± 0.03	220 Grams
PMA207	6.50 ± 1.0	2.4 ± 0.2	26 ± 3.0	0.55 ± 0.03	220 Grams
PMA70	9.00 ± 1.0	3.2 ± 0.2	26 ± 3.0	0.60 ± 0.03	340 Grams
PMA100	11.0 ± 1.0	4.5 ± 0.5	26 ± 3.0	0.70 ± 0.03	600 Grams
PMA120	15.5 ± 1.0	5.5 ± 0.5	26 ± 3.0	0.80 ± 0.03	1200 Grams

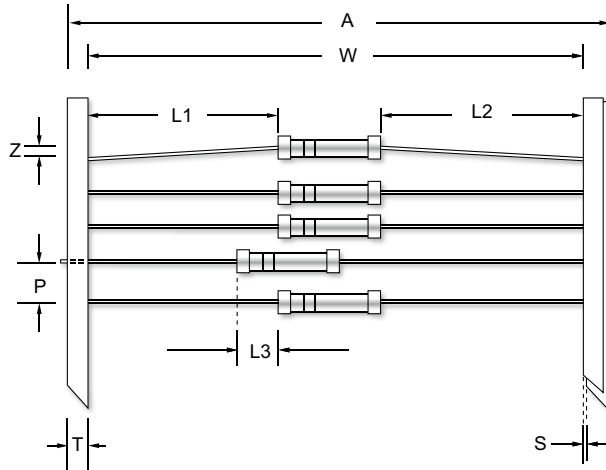
■ GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
PMA204	0.4W	250V	500V	10Ω	1MΩ	±0.1~5%	E-24~192
PMA204T	0.5W	250V	500V	10Ω	330KΩ	±0.1~5%	E-24~192
PMA25	0.25W	350V	600V	10Ω	1MΩ	±0.1~5%	E-24~192
PMA207	0.6W	350V	600V	1Ω	4.7MΩ	±0.1~5%	E-24~192
PMA70	0.7W	350V	600V	10Ω	1MΩ	±0.1~5%	E-24~192
PMA100	1.0W	500V	1000V	10Ω	1MΩ	±0.1~5%	E-24~192
PMA120	1.2W	600V	1000V	10Ω	1MΩ	±0.1~5%	E-24~192

Special sizes, values, and specifications not listed available on special order.

Safety • Quality • Reliability
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■ TAPING/PACKING SPECIFICATIONS

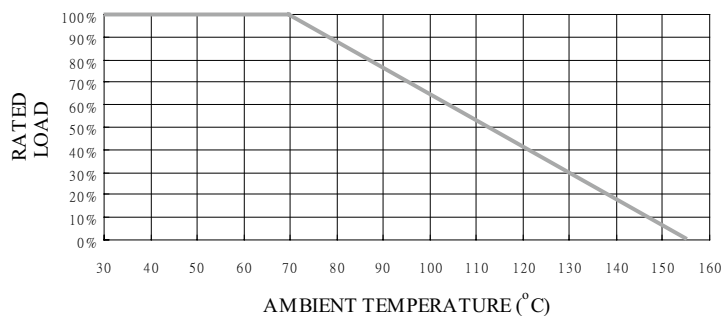


Unit (mm)

Type	A (Max.)	L1-L2 (Max.)	L3 (Max.)	P ±0.5	S (Max.)	T ±0.5	W ±1.5	Z (Max.)
PMA204	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
PMA204T	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
PMA25	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
PMA207	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
PMA70	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
PMA100	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
PMA120	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2

Type	Packing Type	PMA204	PMA204T	PMA25	PMA207	PMA70	PMA100	PMA120
Minimum Packing QTY (pcs)	Ammo pack	5000	5000	5000	5000	2000	1000	500

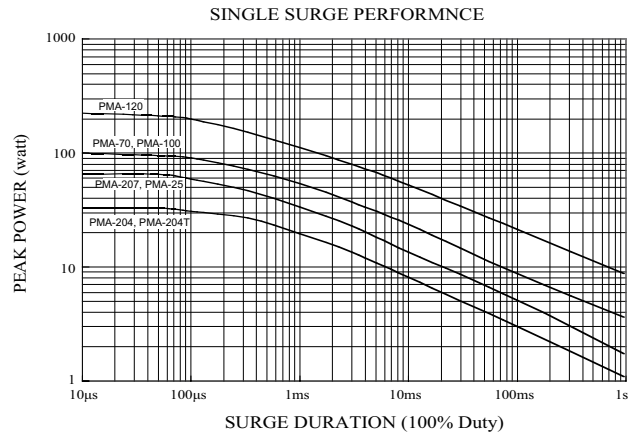
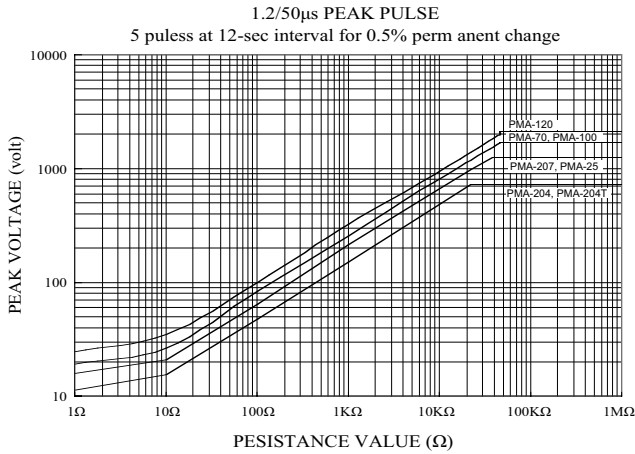
■ POWER DERATING CURVE



Safety • Quality • Reliability
Cost-Down via Innovation

PMA

■ SURGE PERFORMANCE



■ PART NUMBER

Example: PMA204B10K0TKQTB5K0

PMA204	B	10K0	TKQ	TB5K0
Type	Tolerance*	Resistance	TCR*	Packaging
	B (0.1%) C (0.25%) D (0.5%) F (1%) G (2%) J (5%)	10KΩ 4-character code containing - 3 significant digits 1 letter multiplier OHM MULTIPLIER R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	25ppm 3-character code TKM = ± 5 ppm TKN = ± 10 ppm TKP = ± 15 ppm TKQ = ± 25 ppm TKR = ± 50 ppm TKS = ± 100 ppm	5-character code TB = Tape Box (pieces per box) <u>PM204/PMA204T/</u> <u>PMA25/PMA207</u> 5K0 = 5,000 <u>PMA70</u> 2K0 = 2,000 <u>PMA100</u> 1K0 = 1,000 <u>PMA120</u> 500 = 500

* Listed values may not be applicable across product types or to all resistance values. Please check with us before placing order.

TECHNICAL SUMMARY

Characteristics	Limits				
	PMA204 PMA204T	PMA25 PMA207	PMA70	PMA100	PMA120
Dielectric Withstanding Voltage, VAC	300	500	700	700	700
Thermal Resistance, K/W	<170	<145	<120	<95	<75
Axial Terminal Strength, N	>30	>45	>60	>70	>70
Temperature Coefficient, PPM / °C*	±5, ±10, ±15, ±20, ±25, ±50, ±100				
Operating Temperature Range, °C	-55 ~ +155				
Insulation Resistance, MΩ	>10 ⁵				
Failure Rate	<1 pcs / 10 ⁹ Device Hours				

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

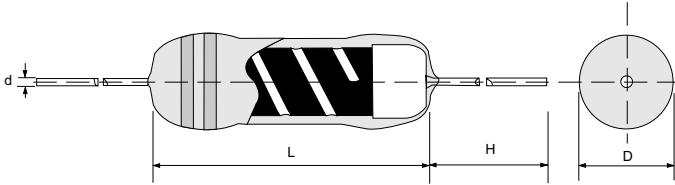
PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 6.25 times of rated power 2 seconds for PMA204 & 204T, 5 seconds for other sizes	±0.5%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±1%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±1%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±0.5%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±0.5%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 155°C without load	±0.5%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±0.5%

PPR Pulse Protective Resistor

Safety • Quality • Reliability
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PPR



Features

- Application: high-frequency, sharp-impulse circuits.
- To protect active components in missile detonators, triac switching circuits, etc.
- Offer every better aspect of performance than carbon composition resistor.
- No "sintering effect" caused by high surge that greatly decreases resistance value.
- Replaces carbon composition resistor.
- Conformal multi-layer non-flammable coating.
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

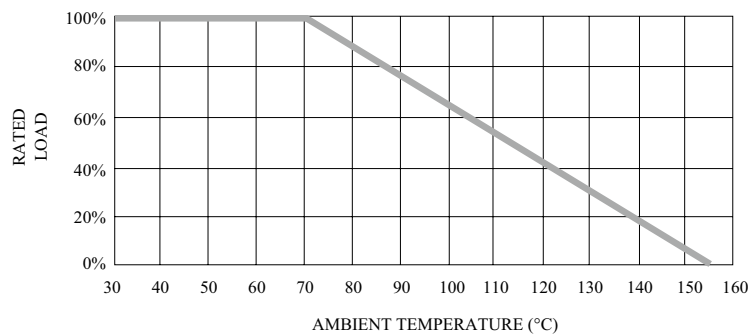
Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000 Pcs
PPR25	6.50 ± 1.0	2.6 ± 0.3	26 ± 3.0	0.55 ± 0.02	300 Grams
PPR52	6.50 ± 1.0	2.6 ± 0.3	26 ± 3.0	0.55 ± 0.02	300 Grams
PPR51	9.00 ± 1.0	3.2 ± 0.2	26 ± 3.0	0.70 ± 0.03	340 Grams
PPR100	11.0 ± 1.0	4.0 ± 0.5	28 ± 3.0	0.70 ± 0.03	500 Grams
PPR200	13.5 ± 1.0	5.0 ± 0.5	30 ± 3.0	0.80 ± 0.03	1050 Grams

GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Permissible Surge Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
PPR25	1/4W	250V	7KV	10Ω	4.7MΩ	±5%	E-24
PPR52	1/2W	250V	7KV	10Ω	4.7MΩ	±5%	E-24
PPR51	1/2W	350V	10KV	2.2Ω	4.7MΩ	±5%	E-24
PPR100	1W	350V	15KV	10Ω	4.7MΩ	±5%	E-24
PPR200	2W	400V	20KV	10Ω	4.7MΩ	±5%	E-24

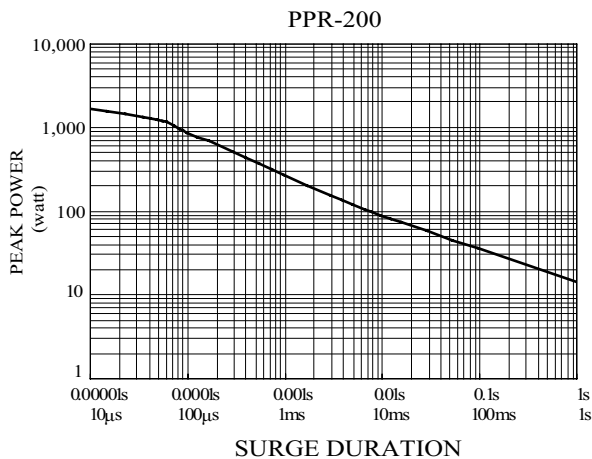
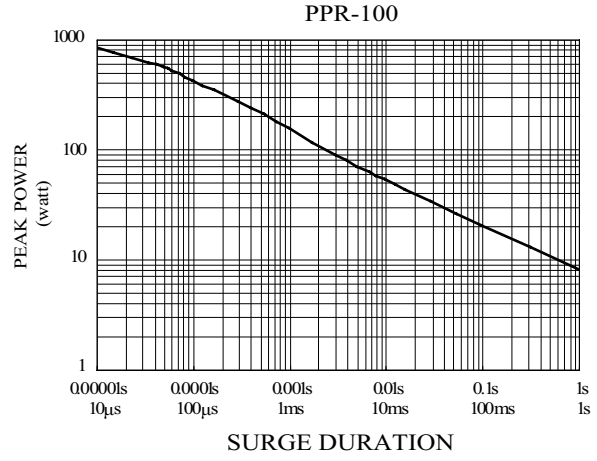
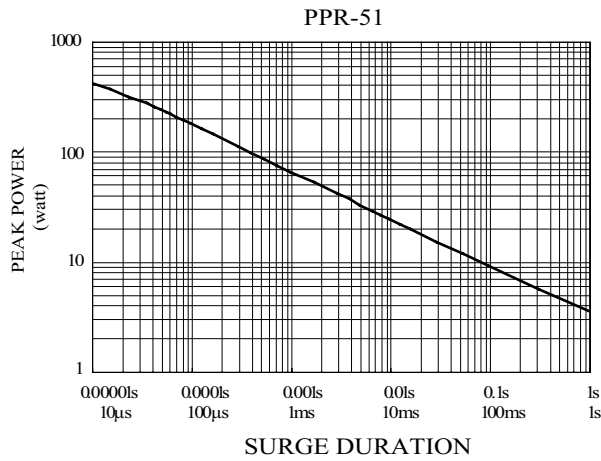
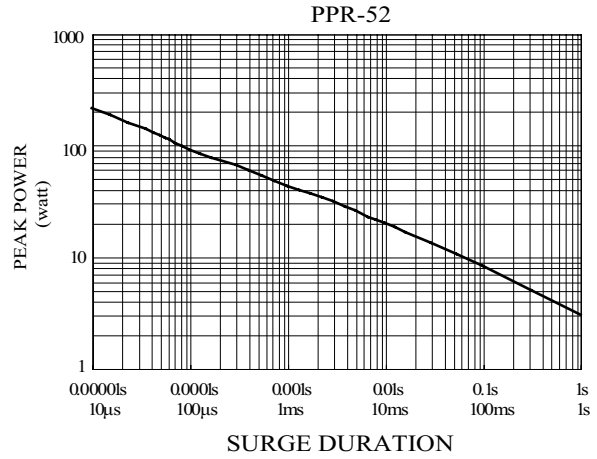
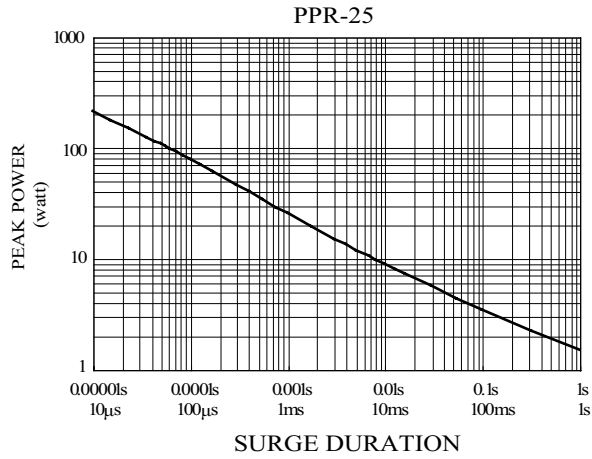
Special sizes, values, and specifications not listed available on special order.

POWER DERATING CURVE



Safety • Quality • Reliability
Cost-Down via Innovation

■ SINGLE SURGE PERFORMANCE

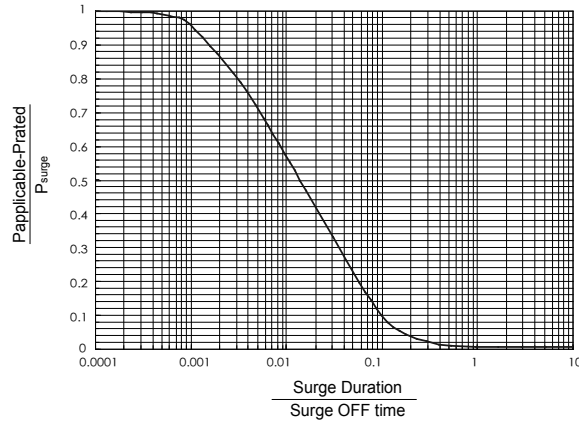


PPR

Safety • Quality • Reliability
Cost-Down via Innovation

PPR

■ SURGE POWER DERATING CURVE



Notes:

- SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further linearly down to zero at 155°C.
- To determine applicable surge power in continuous-surge applications:
 1. Identify allowable duration and peak power P_{surge} of single surge;
 2. Determine ratio of surge duration/surge OFF time in application;
 3. Calculate $P_{applicable}$ backwardly according to Y-axis of SURGE POWER DERATING CURVE.

■ TECHNICAL SUMMARY

Characteristics	Limits	
Dielectric Withstanding Voltage, VAC or DC	PPR25/ 52/ 51/ 100 :	600
	PPR200:	700
Temperature Coefficient, PPM / °C*	±750, ±1200	
Operating Temperature Range, °C	-55 ~ +155	
Insulation Resistance, MΩ	>10 ⁴	

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ PART NUMBER

Example: PPR200J10K0TKZTB500

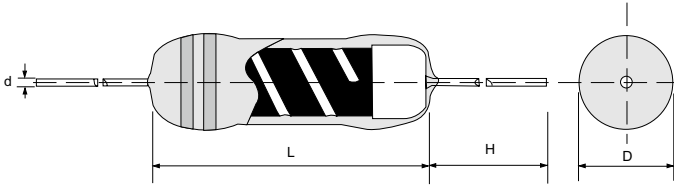
PPR200	J	10K0	TKZ	TB500
Type	Tolerance	Resistance	TCR	Packaging
	J (5%)	10KΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.*	5-character code TB = Tape Box (pieces per box) <u>PPR25/PPR52/</u> <u>PPR51</u> 2K0 = 2,000 <u>PPR100</u> 1K0 = 1,000 <u>PPR200</u> 500 = 500

* For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits		
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over 2X max. working voltage)	±1%		
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%		
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%		
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%		
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage		
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±1%		
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 155°C without load	±1%		
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±2%		
Surge Test	Surge voltage = $\sqrt{(2400 \times P \times R)}$ DC P is power rating, R is resistance value, surge voltage is not more than listed at right. Surge spec = 1.2/50µs Period = 12 sec Number of surges = 50	PPR25	7KV	±5%
		PPR52	7KV	
		PPR51	10KV	
		PPR100	15KV	
		PPR200	20KV	

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Specifications Per

- IEC 60115-4
- MIL-11804

Features

- Designed to replace cement resistors
- Reduces assembly cost with feasibility auto insertion
- Enhanced conductive film absorbs pulse noise
- Superior-grade ceramic core dissipates heat efficiently
- Flameproof multi-layer coating equivalent to UL 94 V-0
- Flameproof feature equivalent to overload test UL 1412
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

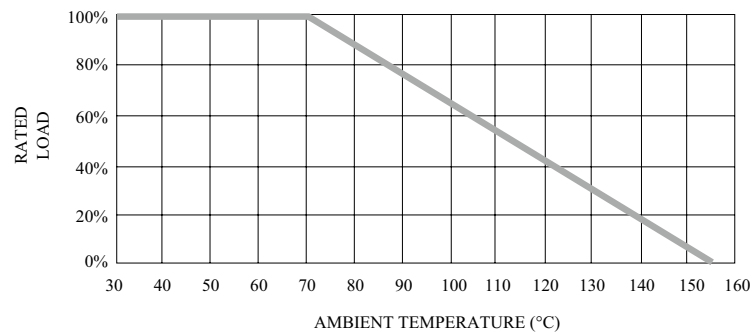
Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000 Pcs
PSR650	24.0 ± 1.0	8.0 ± 0.5	35 ± 3.0	0.8 ± 0.03	3700 Grams

GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Maximum Permissible Surge Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
PSR650	6W	550V	1100V	20KV	1Ω	4.7MΩ	±5%	E-24

Special sizes, values, and specifications not listed available on special order.

POWER DERATING CURVE



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■ PART NUMBER

Example: PSR650J10K0TKZTB400

PSR650	J	10K0	TKZ	TB400
Type	Tolerance	Resistance	TCR	Packaging
	J (5%)	10KΩ 4-character code containing - 3 significant digits 1 letter multiplier OHM MULTIPLIER R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.*	5-character code TB = Tape Box (pieces per box) PSR650 400 = 400

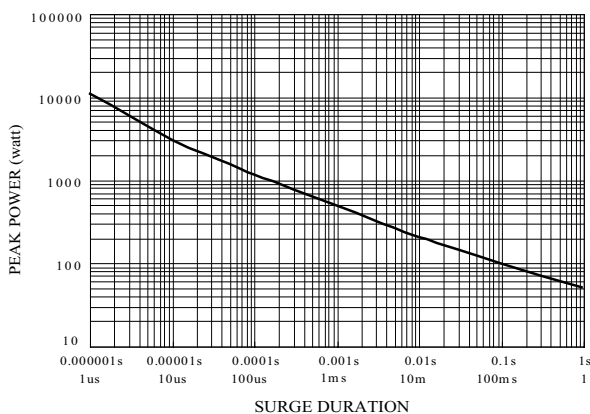
* For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

■ TECHNICAL SUMMARY

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or DC	1000
Temperature Coefficient, PPM / °C*	±750, ±1200
Operating Temperature Range, °C	-55 ~ +155
Insulation Resistance, MΩ	>10 ⁴

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

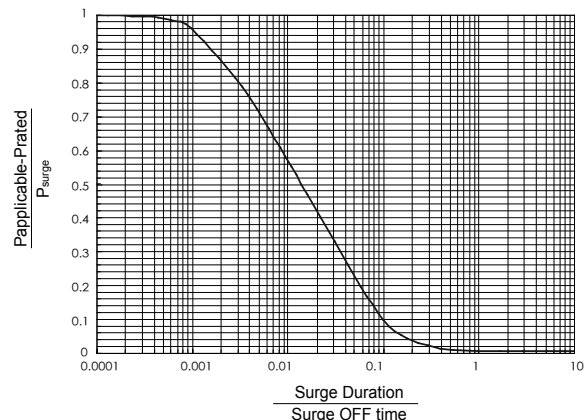
■ SINGLE SURGE PERFORMANCE



Notes:

- SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further linearly down to zero at 155°C.
- To determine applicable surge power in continuous-surge applications:
 1. Identify allowable duration and peak power P_{surge} of single surge;
 2. Determine ratio of surge duration/surge OFF time in application;
 3. Calculate $P_{applicable}$ backwardly according to Y-axis of SURGE POWER DERATING CURVE.

■ SURGE POWER DERATING CURVE



■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits	
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over 2X max. working voltage)	±2%	
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%	
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%	
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%	
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage	
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±1%	
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 155°C without load	±2%	
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±2%	
Surge Test	Surge voltage = $\sqrt{(1200 \times P \times R)}$ DC P is power rating, R is resistance value, surge voltage is not more than listed at right. Surge spec = 1.2/50µs Period = 12 sec Number of surges = 50	20KV	±5%

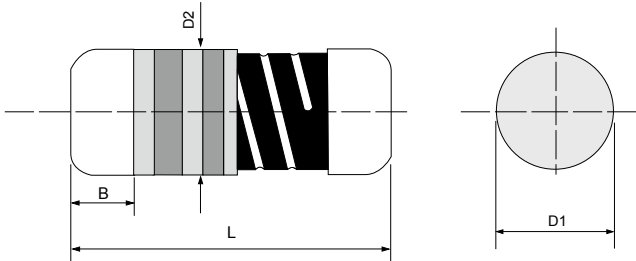
Firstohm®



PVM – Pulse Load High Voltage MELF Resistor

Safety • Quality • Reliability
Cost-Down via Innovation

PVM



Specifications Per

- IEC 60115-1
- EN 140401-803

Features

- IEC60065 & UL1676 Compliant
- SMD enabled structure
- Anti-surge feature available
- Pure tin-plated termination for excellent solderability
- Proprietary thin film handles much higher working voltage than general purpose resistors
- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

■ DIMENSIONS

Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
PVM204	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/ -0.15	0.6 Min.	17 grams
PVM52	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.15	1.0 Min.	66 grams

■ GENERAL SPECIFICATIONS

Type	Power Rating At 70°C	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
PVM204	1/4W	500V	800V	300KΩ	10MΩ	±1%~±5%	E-96/E-24
PVM52	1/2W	600V	900V	300KΩ	10MΩ	±1%~±5%	E-96/E-24

PVM – Pulse Load High Voltage MELF Resistor

Safety • Quality • Reliability
Cost-Down via Innovation

■ PART NUMBER

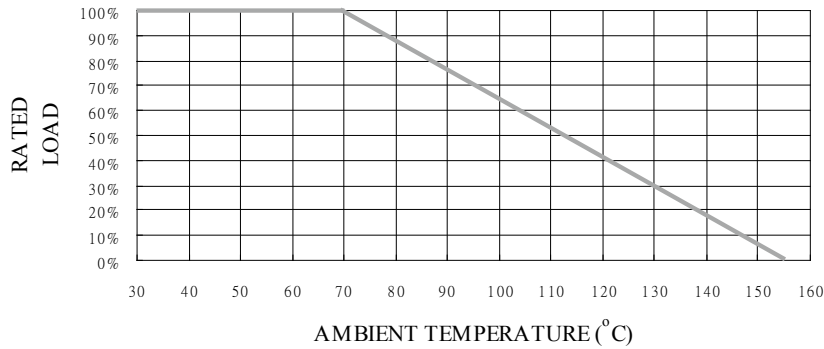
Example: PVM204F1M00TKZTR3K0

PVM204	F	1M00	TKZ	TR3K0
Type	Tolerance F (1%) G (2%) J (5%)	Resistance 1KΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	TCR 3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.	Packaging 5-character code TR = Tape Reel (pieces per reel) <u>PVM204</u> 3K0 = 3,000 6K0 = 6,000*** 10K = 10,000*** <u>PVM52</u> 2K0 = 2,000 6K0 = 6,000*** 10K = 10,000***

PVM

* Listed values may not be applicable across product types or to all resistance values. Please check with us before placing order.
 ** For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.
 *** upon request

■ POWER DERATING CURVE



■ TECHNICAL SUMMARY

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or DC	300
Temperature Coefficient, PPM /°C*	±50, ±100
Operating Temperature Range, °C	-55 ~ +155
Insulation Resistance, MΩ	>10 ⁴
Failure Rate in Time, pcs / 10 ⁹ device hours	<1
Tin Whisker (JESD201 Temperature Cycling & High Temp. /Humidity Storage), μm	<5

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

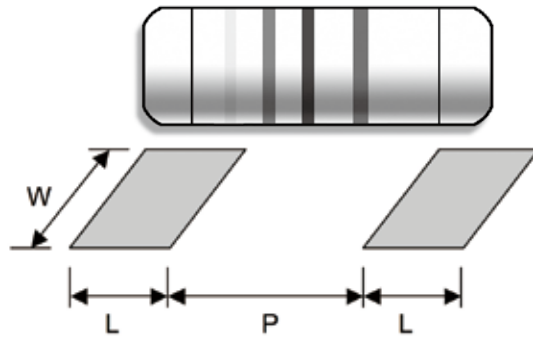
■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±0.5%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±1%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±1%
Periodic Electric Overload	IEC 60115-1 4.39 3.9x rated voltage (not over max. overload voltage) with 0.1s ON, 2.5s OFF for 1,000 cycles	±2.5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds	±0.5%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 155°C without load	±2%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±0.5%
Single pulse high voltage overload	IEC 60115-1 4.27 5 pulses of 12/50µs at 10x rated voltage (not over max. overload voltage) with interval of 12 sec.	±1.5%
	10 pulses of 10/700µs at 10x rated voltage (not over max. overload voltage) with interval of 60 sec.	±1.5%
Electrostatic discharge (Human body model)	IEC 60115-1 4.38 3 positive & 3 negative discharges with 2KV source	±2.5%
Climatic test	IEC 60115-1 4.23 4.23.2 - dry heat: 16 hours 155°C 4.23.3 - damp heat: 24 hours 55°C with 95% relative humidity 4.23.4 - cold: 2 hours -55°C 4.23.5 - negative air pressure: 2 hour 8.5KPa at (25±10)°C 4.23.6 - damp heat cyclic: 5 days 55°C with 95% relative humidity 4.23.7 - DC load: rated voltage at -55°C and 155°C each 1 Min.	±1%
Bending test	IEC 60115-1 4.33 Pressing depth 2mm, 3 times	±0.5%

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PVM

■ SUGGESTED PAD LAYOUT

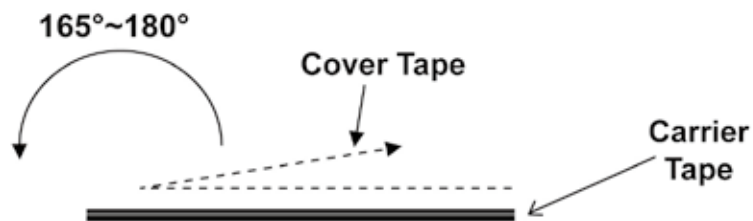


Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
PVM204	Reflow	1.3	1.6 ± 0.1	1.6
	Wave	1.5	1.5 ± 0.1	1.8
PVM52	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0

For better heat dissipation / lower heat resistance, increase W & L.

■ COVER TAPE PEELING SPECIFICATION

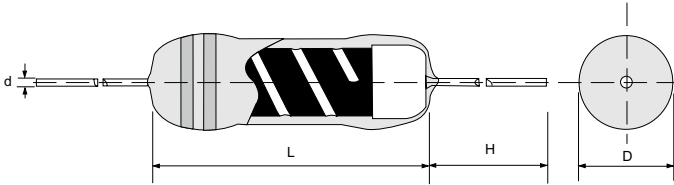
Recommended peeling force: 50±5gf



PWR Power Metal Film Resistor

Safety • Quality • Reliability
Cost-Down via Innovation

PWR



Specifications Per

- IEC 60115-1
- MIL-R-10509

Features

- Conformal multi-layer coating
- Color code per MIL & EIA standards
- Special tin-plated electrolytic copper lead wire
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

■ DIMENSIONS

Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000 Pcs
PWR01	6.50 ± 1.0	2.4 ± 0.2	26 ± 3.0	0.60 ± 0.02	220 Grams
PWR02	11.0 ± 1.0	4.0 ± 0.5	28 ± 3.0	0.80 ± 0.03	220 Grams

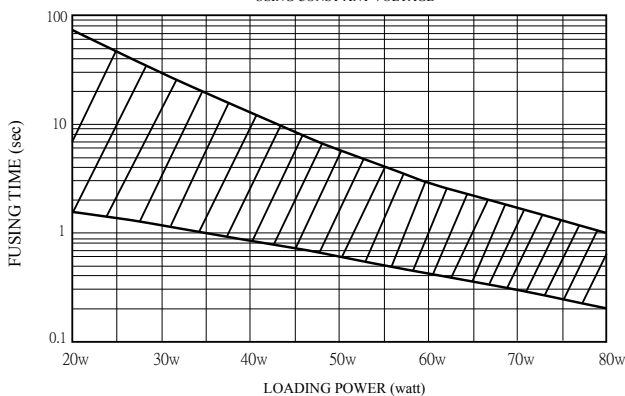
■ GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
PWR01	0.6W	350V	500V	0.22Ω	0.91Ω	±5%	E-24
	1W	350V	500V	1Ω	1MΩ	±5%	E-24
PWR02	1.2W	500V	700V	0.33Ω	0.91Ω	±5%	E-24
	2W	500V	700V	1Ω	1MΩ	±5%	E-24

Special sizes, values, and specifications not listed available on special order.

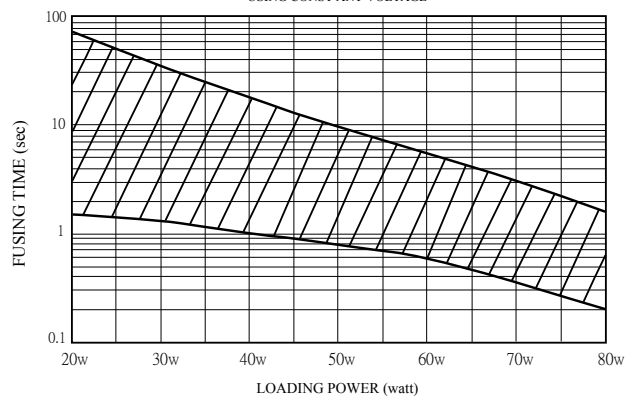
PWR01

FUSING CHARACTERISTICS
USING CONSTANT VOLTAGE



PWR02

FUSING CHARACTERISTICS
USING CONSTANT VOLTAGE



PWR Power Metal Film Resistor

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■ PART NUMBER

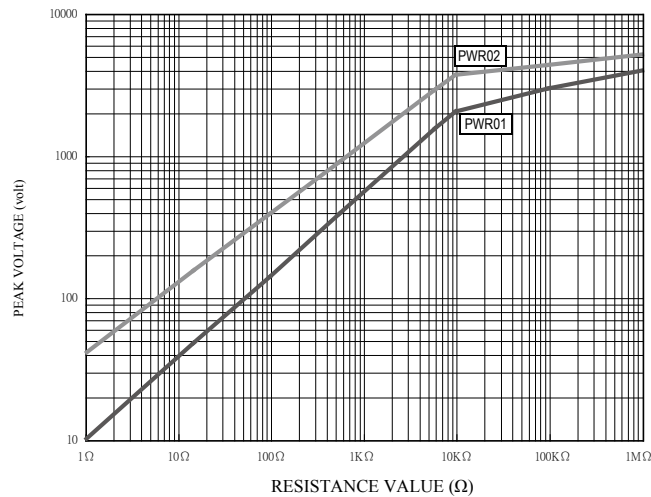
Example: PWR01J10K0TKZTB5K0

PWR01	J	10K0	TKZ	TB5K0
Type	Tolerance	Resistance	TCR	Packaging
	J (5%)	10KΩ 4-character code containing - 3 significant digits 1 letter multiplier OHM MULTIPLIER R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.*	5-character code TB = Tape Box (pieces per box) PWR01 5K0 = 5,000 PWR02 1K0 = 1,000

* For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

■ SURGE PERFORMANCE

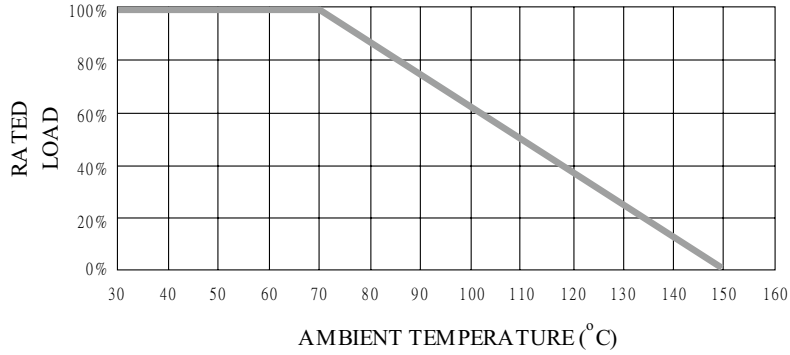
1.2/50us PEAK PULSE
5 pulses at 12-sec interval for 0.5% permanent change



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PWR

■ POWER DERATING CURVE



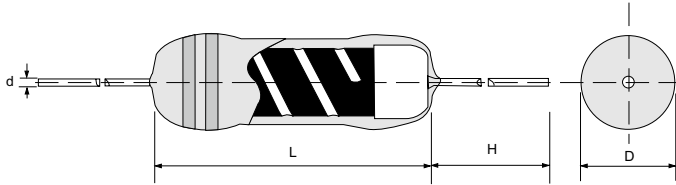
■ TECHNICAL SUMMARY

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or DC	500
Temperature Coefficient, PPM / °C*	±250
Operating Temperature Range, °C	-55 ~ +150
Insulation Resistance, MΩ	10 ⁴

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±3%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 1.52mm and 10 to 2,000 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 150°C without load	±3%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +150°C 30minutes, 5 cycles	±3%



Specifications Per

• IEC 60115-1, IEC 60115-4

Features

- Advanced multi-functional design
- Cut-off on overload or accidental short circuit
- Transient withstanding for power-line coupling
- Flameproof multi-layer coating equivalent to UL 94 V-0
- Flameproof feature equivalent to overload test UL 1412
- Possible alternative to wire-wound resistors
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

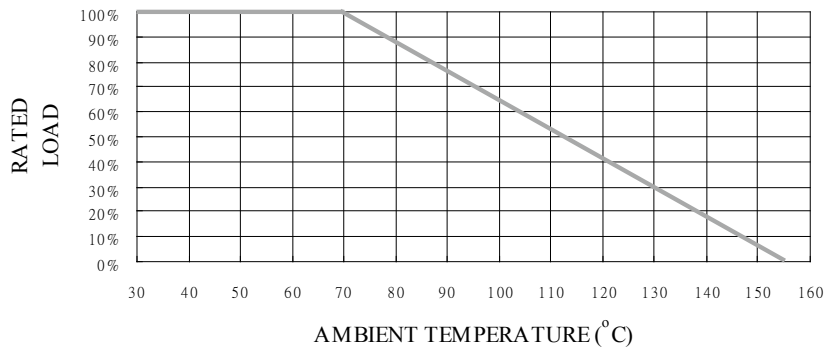
Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000 Pcs
SCP50	9.00 ± 1.0	3.2 ± 0.2	28 ± 3.0	0.6 ± 0.03	340 Grams
SCP101	9.00 ± 1.0	3.2 ± 0.2	28 ± 3.0	0.6 ± 0.03	340 Grams
SCP201	11.0 ± 1.0	4.0 ± 0.5	28 ± 3.0	0.8 ± 0.03	510 grams
SCP301	13.5 ± 1.0	5.0 ± 0.5	30 ± 3.0	0.8 ± 0.03	1050 grams

GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
SCP50	1/2W	350V	600V	2.2Ω	3.3KΩ	±5%	E-24
SCP101	1W	350V	700V	2.2Ω	3.3KΩ	±5%	E-24
SCP201	2W	350V	700V	2.2Ω	3.3KΩ	±5%	E-24
SCP301	3W	350V	700V	2.2Ω	10KΩ	±5%	E-24

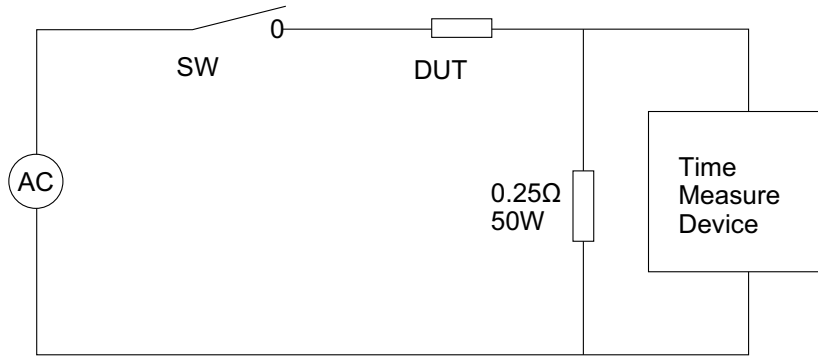
*Please contact us for resistance values, sizes, or specifications not listed.

POWER DERATING CURVE



■ FUSING TEST SCHEME

When the SW is closed, time measure device will start to count the fusing time, and the DUT (Device Under Test) will fuse without flame.



■ TECHNICAL SPECIFICATIONS

Characteristics		Limits	
Dielectric Withstanding Voltage, VAC or DC		SCP50/101 SCP201/301	350 700
Temperature Coefficient, PPM / °C*		Typically±400	
Operating Temperature Range, °C		-55 ~ +155	
Fusing Condition	SCP50	Interrupts in max. 60 seconds at 12W overload	
	SCP101	Interrupts in max. 60 seconds at 16W overload	
	SCP201	Interrupts in max. 60 seconds at 20W overload	
	SCP301	Interrupts in max. 60 seconds at 30W overload	
Insulation Resistance, MΩ		10 ⁴ Min.	

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ PART NUMBER

Example: SCP50J10K0TKZTB2K0

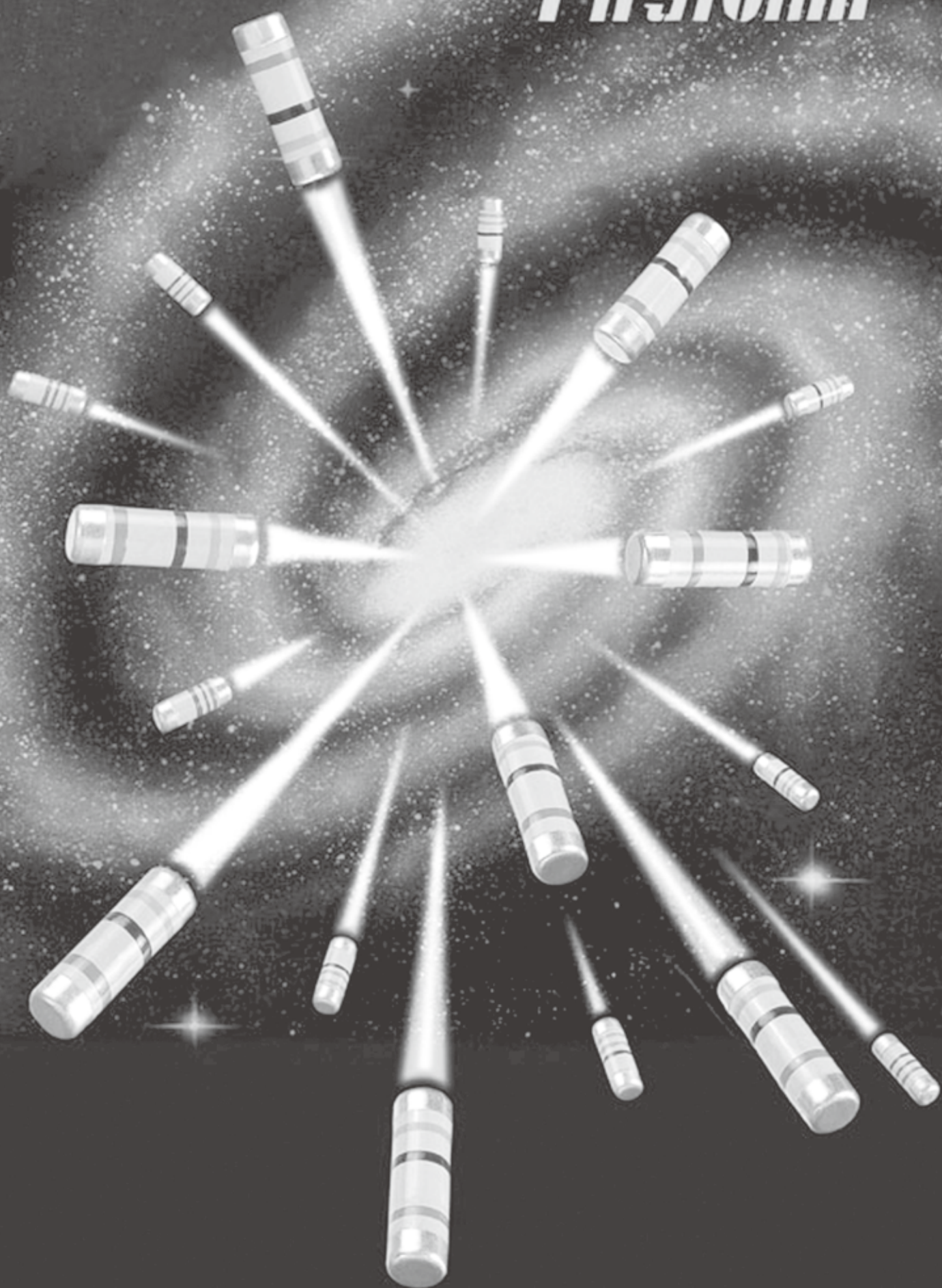
SCP50	J	10K0	TKZ	TB2K0
Type	Tolerance	Resistance	TCR	Packaging
	J (5%)	10KΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.*	5-character code TB = Tape Box (pieces per box) <u>SCP50/SCP101</u> 2K0 = 2,000 <u>SCP201</u> 1K0 = 1,000 <u>SCP301</u> 500 = 500

* For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

■ PERFORMANCE SPECIFICATIONS

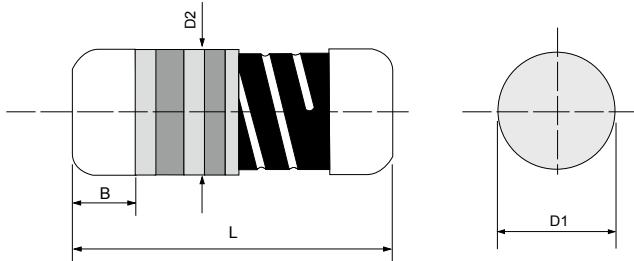
Characteristics	Test Conditions	Limits
Short Time Overload	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±3%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 155°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±2%

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Specifications Per

• IEC 60115-1

Features

- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- Low temperature coefficient and tolerances
- Excellent stability
- Superior power handling
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
SFP204	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/ -0.15	0.6 Min.	17 grams
SFP101	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.15	1.0 Min.	66 grams
SFP201	8.50 ± 0.50	3.00 ± 0.2	D1+0.02/ -0.15	1.3 Min.	186 grams
SFP301	10.5 ± 0.50	4.00 ± 0.5	D1+0.02/ -0.15	1.6 Min.	446 grams

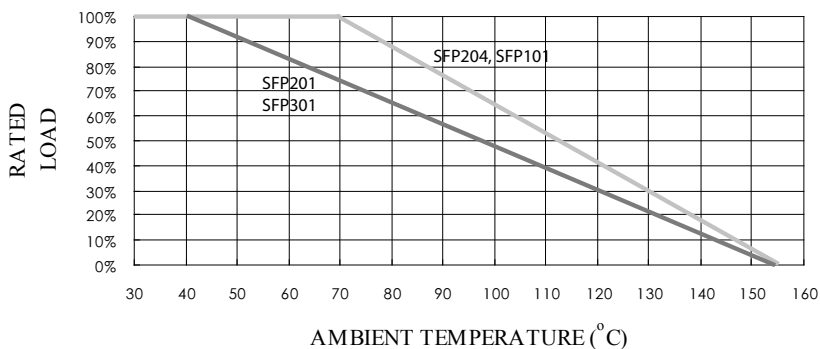
GENERAL SPECIFICATIONS

Type	Power Rating*	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
SFP204	0.4W	200V	400V	0Ω, 0.5Ω	10MΩ	±0.5%~5%	E-192/E-24
SFP101	1W	350V	700V	0Ω, 0.5Ω	10MΩ	±0.5%~5%	E-192/E-24
SFP201	2W	400V	800V	0Ω, 0.5Ω	1MΩ	±0.5%~5%	E-192/E-24
SFP301	3W	400V	800V	0Ω, 0.5Ω	1MΩ	±0.5%~5%	E-192/E-24

* At 70°C, with the exception of SFP201 and SFP301, derating of which starts at 40°C. Please refer to the Power Derating Curve.

* Special sizes, values, and specifications not listed available on special order.

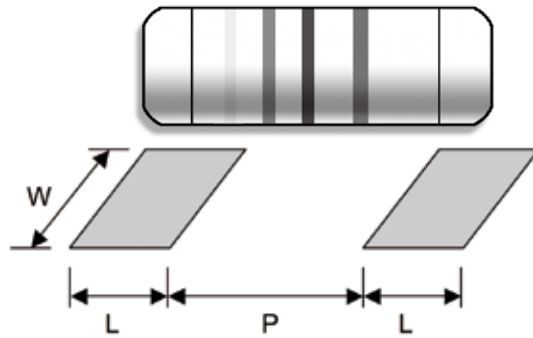
POWER DERATING CURVE



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■ SUGGESTED PAD LAYOUT

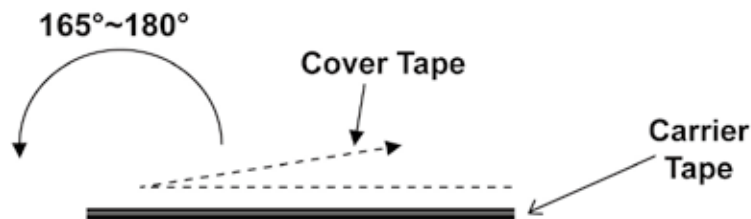


Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
SFP204	Reflow	1.3	1.6 ± 0.1	1.6
	Wave	1.5	1.5 ± 0.1	1.8
SFP101	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0
SFP201	Reflow	3.0	4.9 ± 0.3	3.7
	Wave	3.5	4.8 ± 0.3	4.0
SFP301	Reflow	4.0	6.2 ± 0.4	5.0
	Wave	4.5	6.0 ± 0.4	5.0

For better heat dissipation / lower heat resistance, increase W & L.

■ COVER TAPE PEELING SPECIFICATION

Recommended peeling force: SFP204, SFP101: 50±5gf SFP201, SFP301: 70±10gf



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■ PART NUMBER

Example: SFP101F46R4TKSTR2K0

SFP101	F	46R4	TKS	TR2K0
Type	Tolerance*	Resistance	TCR*	Packaging
	D(0.5%) F (1%) J (5%)	46.4Ω 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	100ppm 3-character code TKQ = ± 25 ppm TKR = ± 50 ppm TKS = ± 100 ppm TK2 = ± 200 ppm	5-character code TR = Tape Reel (pieces per reel) <u>SFP204</u> 3K0 = 3,000 6K0 = 6,000** 10K = 10,000** <u>SFP101</u> 2K0 = 2,000 6K0 = 6,000** 10K = 10,000** <u>SFP201</u> 2K5 = 2,500 <u>SFP301</u> 2K0 = 2,000

* Listed values may not be applicable across product types or to all resistance values. Please check with us before placing order.

** upon request

■ TECHNICAL SUMMARY

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or DC	SFP204: 200 SFP101: 500 SFP201: 700 SFP301: 1000
Temperature Coefficient, PPM / °C*	±25, ±50, ±100, ±200
Operating Temperature Range, °C	-55 ~ +155
Insulation Resistance, MΩ	>10 ⁴
Failure Rate in Time, pcs / 10 ⁹ device hours	<5
Tin Whisker (JESD201 Temperature Cycling & High Temp. / Humidity Storage), μm	<5

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

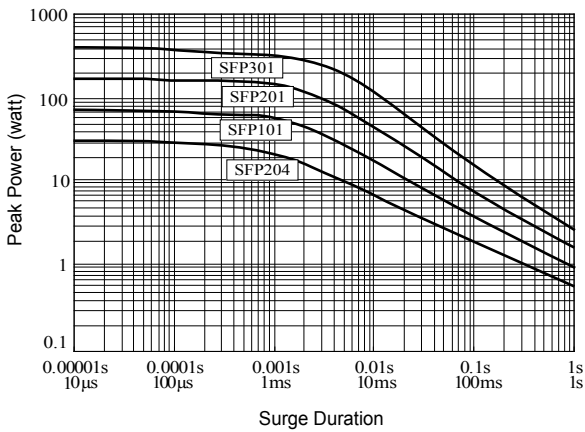
■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Overload	IEC 60115-1 4.13 2 seconds 2.5x rated voltage (not over max. overload voltage)	±0.5%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±3.0%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C for SFP204, SFP101 ; (40±2)°C for SFP201 and SFP301.	±3.0%
Periodic Electric Overload	IEC 60115-1 4.39 3.9x rated voltage (not over max. overload voltage) with 0.1s ON, 2.5s OFF for 1,000 cycles	±1.5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds	±0.5%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±1.0%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 155°C without load	±2.0%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±0.25%
Single pulse high voltage overload	IEC 60115-1 4.27 10 pulses of 10/700µs at 10x rated voltage (not over max. overload voltage) with interval of 60 sec.	±0.75%
Electrostatic discharge (Human body model)	IEC 60115-1 4.38 3 positive & 3 negative discharges with 2KV for SFP204 or 4KV for SFP101, SFP201 & SFP301 (For continuous surge application please see Surge Performance paragraph)	±1.5%
Climatic test	IEC 60115-1 4.23 4.23.2 - dry heat: 16 hours 155°C 4.23.3 - damp heat: 24 hours 55°C with 95% relative humidity 4.23.4 - cold: 2 hours -55°C 4.23.5 - negative air pressure: 2 hour 8.5KPa at (25±10)°C 4.23.6 - damp heat cyclic: 5 days 55°C with 95% relative humidity 4.23.7 - DC load: rated voltage at -55°C and 155°C each 1 Min.	±1.0%
Bending test	IEC 60115-1 4.33 Pressing depth 2mm, 3 times	±0.5%
Flammability	IEC 60115-1 4.35 Needle flame test 10s	No burning after 30s

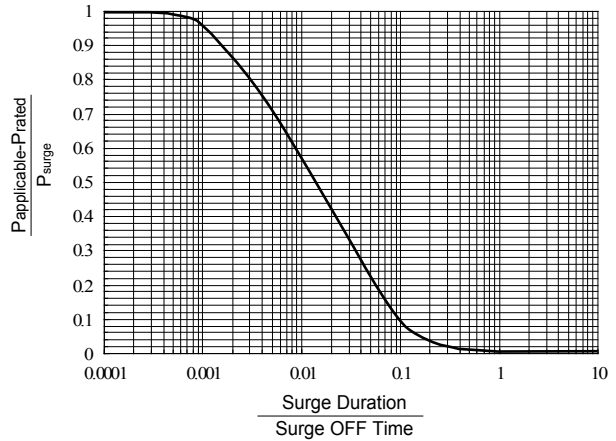
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■ SINGLE SURGE PERFORMANCE

SINGLE SURGE PERFORMANCE



SURGE POWER DERATING CURVE



Notes:

- SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further linearly down to zero at 155°C.
- To determine applicable surge power in continuous-surge applications:
 1. Identify allowable duration and peak power P_{surge} of single surge;
 2. Determine ratio of surge duration/surge OFF time in application;
 3. Calculate P_{applicable} backwardly according to Y-axis of SURGE POWER DERATING CURVE.

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SRM-201 withstands 51,840,000 surges at 30KV, in duration of 500 hours.



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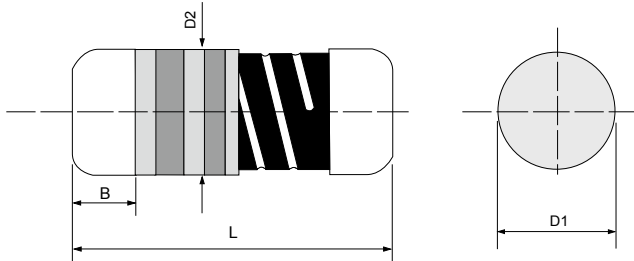
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TÜV ISO 9002 ISO 14001 / IECQ CERTIFIED FACTORY

SFP(V) – Stabilized Film Power MELF Resistor, Vehicle Grade

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SFP(V)



Specifications Per

- IEC 60115-1
- AEC-Q200 Rev. D

Features

- AEC-Q200 Compliant
- Low temperature coefficient and tolerances
- Excellent stability
- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- Superior power handling
- Anti-sulfuration test qualified
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

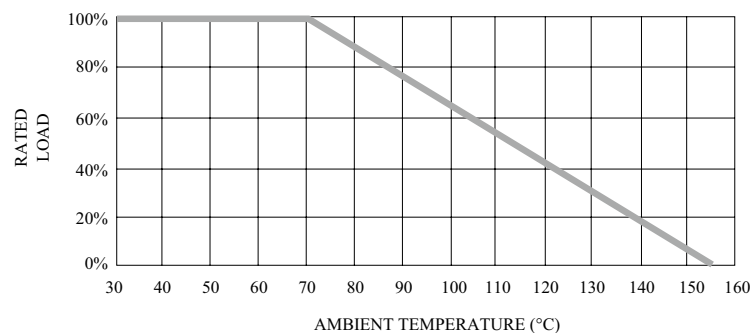
DIMENSIONS

Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
SFP204V	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/ -0.15	0.6 Min.	17 grams
SFP101V	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams
SFP201V	8.50 ± 0.50	3.00 ± 0.2	D1+0.05/ -0.35	1.3 Min.	186 grams
SFP301V	10.50 ± 0.50	4.00 ± 0.5	D1+0.05/ -0.45	1.6 Min.	446 grams

GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
SFP204V	0.4W	200V	400V	0.22Ω	1MΩ	±1% ~ ±5%	E-24 / E-96
SFP101V	1W	350V	700V	0.5Ω	1MΩ	±1% ~ ±5%	E-24 / E-96
SFP201V	2W	400V	800V	0.5Ω	1MΩ	±1% ~ ±5%	E-24 / E-96
SFP301V	3W	400V	800V	0.5Ω	1MΩ	±1% ~ ±5%	E-24 / E-96

POWER DERATING CURVE



SFP(V) – Stabilized Film Power MELF Resistor, Vehicle Grade

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■ PART NUMBER

Example: SFP204VF33R0TKQTR3K0

SFP204V	F	33R0	TKQ	TR3K0
Type	Tolerance*	Resistance	TC*	Packaging
	F (1%) G (2%) J (5%)	33R 4-character code containing - 3 significant digits 1 letter multiplier OHM MULTIPLIER R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	25ppm 3-character code TKQ=±25PPM/°C TKR=±50PPM/°C	5-character code TR = Tape Reel (pieces per reel) SFP204V 3K0 = 3,000 6K0 = 6,000** 10K = 10,000** SFP101V 2K0 = 2,000 6K0 = 6,000** 10K = 10,000** SFP201V 2K5 = 2,500 SFP301V 2K0 = 2,000

* Listed values may not be applicable across product types or to all resistance values. Please check with us before placing order.
Please check with us before placing order. **upon request

■ TECHNICAL SUMMARY

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or DC	SFP204V: 200 SFP101V: 500 SFP201V: 700 SFP301V: 1000
Temperature Coefficient, PPM / °C*	±25, ±50
Operating Temperature Range, °C	-55 ~ +155
Insulation Resistance, MΩ	>10 ⁴
Failure Rate in Time, pcs / 10 ⁹ device hours	<5
Tin Whisker (JESD201 Temperature Cycling & High Temp. /Humidity Storage), μm	<5

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits	
High Temperature Exposure (Storage)	IEC 60115-1 4.25.3 1,000 hours at 155°C without load	<1Ω	±5%
		1Ω to <332KΩ	±2%
		332KΩ to 1MΩ	±5%
	AEC-Q200 REV D. Stress NO.3 (refer to MIL-STD-202 Method 108) 1,000 hours at 125°C without load	± 1.5%	
Temperature Cycling	AEC-Q200 REV D. Stress NO.4 (refer to IEC 60115-1 4.19/ JESD22 Method JA-104) -55°C 30minutes, +125°C 30minutes, 1,000 cycles	±1%	
	Proprietary test specification FRC-AECQ-180702 -20°C 30minutes, +120°C 30minutes, 1,000 cycles (Recommended solder paste composition:96.5% Sn, 3% Ag, 0.5% Cu)	Force of 1kg for 10 secs and without distinct looseness of terminals	
Biased Humidity	AEC-Q200 REV D. Stress NO.7 (refer to IEC 60115-1 4.37/ MIL-STD-202 Method 103) 1,000 hours at 85°C and 85% relative humidity with 10% operating power (not over max. working voltage)	< 10KΩ	±1.5%
		10KΩ to <332KΩ	±2%
		332KΩ to 1MΩ	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at 70°C	± 3%	
	AEC-Q200 REV D. Stress NO.8 (refer to MIL-STD-202 Method 108) 1,000 hours at 125°C with de-rated continuous working voltage (not over max. working voltage)	± 5%	
Resistance to Solvents	AEC-Q200 REV D. Stress NO.12 (refer to MIL-STD-202 Method 215) Add Aqueous wash chemical-OKEM Clean or equivalent. Do not use banned solvents.	No visible damage on appearance and marking	
Mechanical Shock	AEC-Q200 REV D. Stress NO.13 (refer to MIL-STD-202 Method 213 Condition C) Three shocks in each direction shall be applied along the three mutually perpendicular axes of the test specimen. Peak value: 100 g's, Duration: 6 ms, Velocity change: 12.3 ft/s, Waveform: Half sine	±0.5%	
Vibration	AEC-Q200 REV D. Stress NO.14 (refer to MIL-STD-202 Method 204) 5 g's for 20 min., 12 cycles each of 3 orientations, Test from 10 - 2,000 Hz.	±0.5%	
Resistance to Soldering Heat	AEC-Q200 REV D. Stress NO.15 (refer to IEC 60115-1 4.18.2/ MIL-STD-202 Method 210) Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds	±0.5%	
Anti-sulfuration test	EIA-977 (conditions B) 750 hours at (105±2)°C without load	±1%	±1%
		±5%	±5%

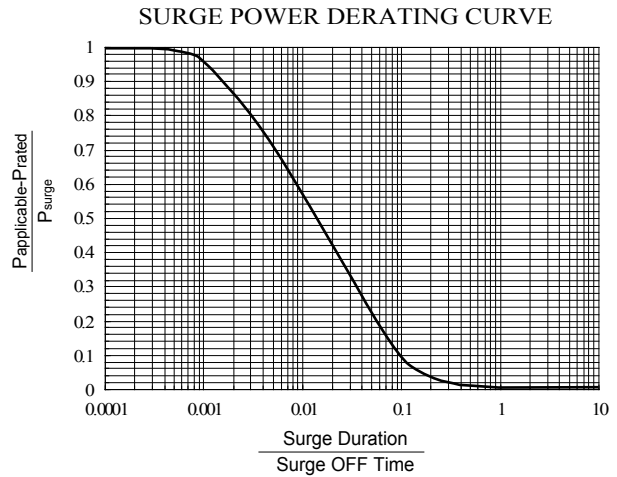
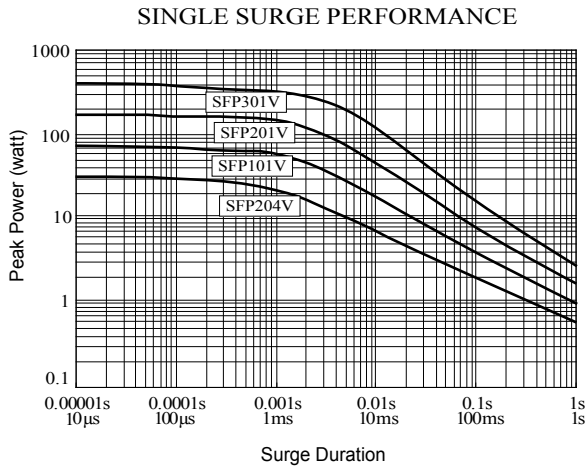
PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
ESD	AEC-Q200 REV D. Stress NO.17 (refer to AEC-Q200-002/ ISO/DIS 10605) (150pF/ 2000Ohm discharge network) Human body model, 1 positive & 1 negative discharges with 2KV source	±0.5%
Solderability	AEC-Q200 REV D. Stress NO.18 (refer to J-STD-002 or IEC 60115-1 4.17) Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min. coverage
Flammability	AEC-Q200 REV D. Stress NO.20 (refer to UL-94) V-0 or V-1 are acceptable. Electrical test not required.	NO flaming
Board Flex	AEC-Q200 REV D. Stress NO.21 (refer to AEC-Q200-005) 60 sec minimum holding time.	±0.5%
Terminal Strength	AEC-Q200 REV D. Stress NO.22 (refer to AEC-Q200-006) Force of 1.8kg for 60 seconds	±0.5%
Short Time Overload	IEC 60115-1 4.13 2 seconds 2.5x rated voltage(not over max. working voltage)	± 0.5%
Climatic test	IEC 60115-1 4.23 4.23.2 - dry heat: 16 hours 155°C 4.23.3 - damp heat: 24 hours 55°C with 95% relative humidity 4.23.4 - cold: 2 hours -55°C 4.23.5 - negative air pressure: 2 hour 8.5kPa at (25±10)°C 4.23.6 - damp heat cyclic: 5 days 55°C with 95% relative humidity 4.23.7 - DC load: rated voltage at -55°C and 155°C each 1 Min.	±1%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	± 3%
Single pulse high voltage overload	IEC 60115-1 4.27 5 pulses of 1.2/50µs at 10x rated voltage (not over max. overload voltage) with interval of 12 sec.	±0.75%
	10 pulses of 10/700µs at 10x rated voltage (not over max. overload voltage) with interval of 60 sec.	±0.75%
Periodic Electric Overload	IEC 60115-1 4.39 3.9x rated voltage (not over max. overload voltage) with 0.1s ON, 2.5s OFF for 1,000 cycles	±1%

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■ SINGLE SURGE PERFORMANCE

SFP(V)

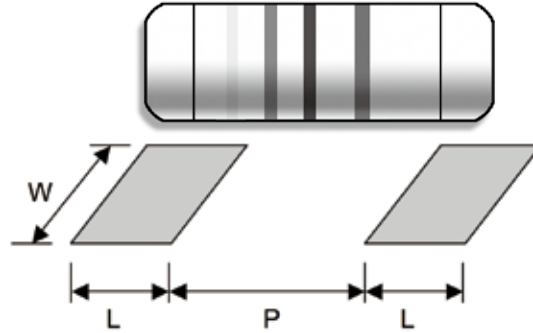


Notes:

- SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further linearly down to zero at 155°C.
- To determine applicable surge power in continuous-surge applications:
 1. Identify allowable duration and peak power P_{surge} of single surge;
 2. Determine ratio of surge duration/surge OFF time in application;
 3. Calculate $P_{applicable}$ backwardly according to Y-axis of SURGE POWER DERATING CURVE.

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■ SUGGESTED PAD LAYOUT



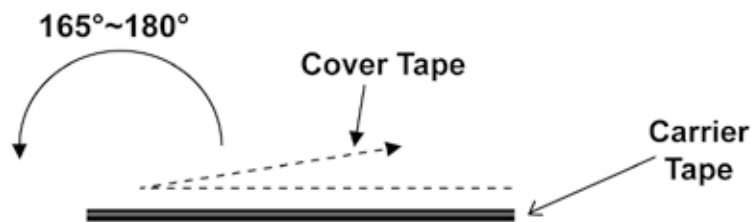
Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
SFP204V	Reflow	1.3	1.6 ± 0.1	1.6
	Wave	1.5	1.5 ± 0.1	1.8
SFP101V	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0
SFP201V	Reflow	3.0	4.9 ± 0.3	3.7
	Wave	3.5	4.8 ± 0.3	4.0
SFP301V	Reflow	4.0	6.2 ± 0.4	5.0
	Wave	4.5	6.0 ± 0.4	5.0

For better heat dissipation / lower heat resistance, increase W & L.

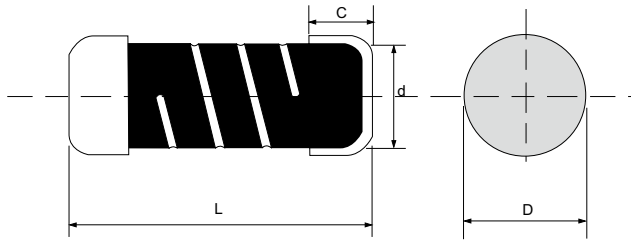
■ COVER TAPE PEELING SPECIFICATION

Recommended peeling force:

SFP204V, SFP101V: 50±5gf SFP201V, SFP301V: 70±10gf



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Features

- Specially treated metal caps withstand abrasions, impacts, and corruptions, so as to reduce contact resistance during operation.
- Conductive film is enhanced to withstand abrasions, impacts, and corruptions as well.
- Suitable for clip-in (embedded) application like switches with neon indicators, neon/LED modules, LED display array, etc.
- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- Protective coating is optional
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

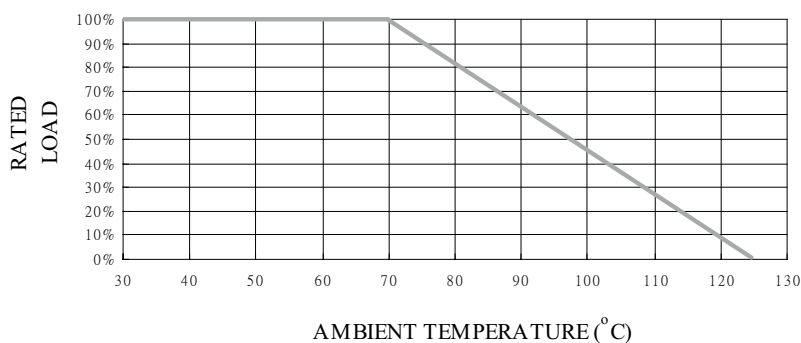
Type	Body Length (L, mm)	Core Diameter (d, mm)	Body Diameter (D, mm)
SL16	3.52 ± 0.15	1.0 ± 0.05	1.35 ± 0.1
SL25	5.90 ± 0.20	1.7 ± 0.10	2.20 ± 0.1
SL51	8.50 ± 0.50	2.6 ± 0.10	3.00 ± 0.2

GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Resistance Range	Tolerance
SL16	1/6W	225VAC rms	350VAC rms	1Ω ~ 1MΩ	±5%, ±10%
SL25	1/4W	300VAC rms	600VAC rms	1Ω ~ 4.7MΩ	±5%, ±10%
SL51	1/2W	350VAC rms	700VAC rms	10Ω ~ 9.1MΩ	±5%, ±10%

Special sizes, values, and specifications not listed available on special order.

POWER DERATING CURVE



■ PART NUMBER

Example: SL204K10K0TKZBK5K0

SL16	K	10K0	TKZ	BK5K0
Type	Tolerance J (5%) K (10%)	Resistance 10KΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	TCR 3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.*	Packaging Bulk 5000 pieces 5-character code BK = Bulk BK + Quantity

* For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

■ TECHNICAL SPECIFICATIONS

Characteristics	Limits
Temperature Coefficient, PPM / °C*	+200~-800
Operating Temperature Range, °C	-55 ~ +125

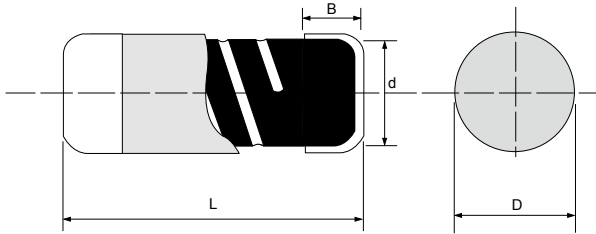
* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ PERFORMANCE SPECIFICATIONS

Tests Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±1%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds	±1%
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 125°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +125°C 30minutes, 5 cycles	±2%

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SLC



Features

- Specially treated metal caps withstand abrasions, impacts and corrosions, so as to reduce contact resistance during operation.
- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

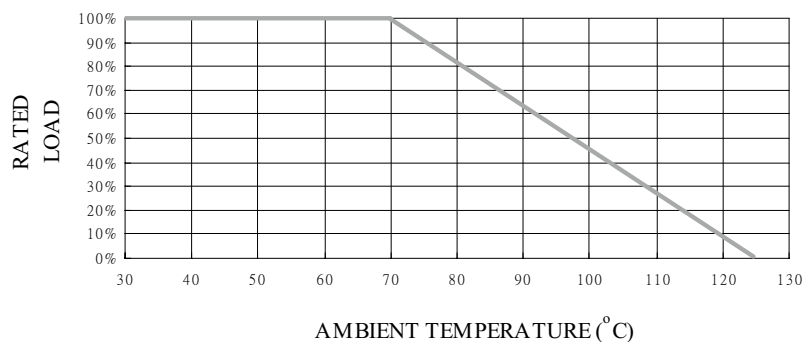
Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
SLC16	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/ -0.15	0.6 Min.	17 grams
SLC25	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams
SLC51	8.50 ± 0.50	3.00 ± 0.2	D1+0.05/ -0.35	1.3 Min.	186 grams

ELECTRICAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Tolerance	Resistance Range
SLC16	1/6W	225VAC rms	350VAC rms	±5%, ±10%	1Ω ~ 1MΩ
SLC25	1/3W	300VAC rms	600VAC rms	±5%, ±10%	1Ω ~ 4.7MΩ
SLC51	1/2W	350VAC rms	700VAC rms	±5%, ±10%	10Ω ~ 9.1MΩ

Special sizes, values, and specifications not listed available on special order.

POWER DERATING CURVE



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■ PART NUMBER

Example: SLC25K10K0TKZBK500

SLC25	K	10K0	TKZ	BK500
Type	Tolerance	Resistance	TCR	Packaging
	J (5%) K (10%)	10KΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.*	Bulk 500 pieces 5-character code BK = Bulk BK + Quantity

* For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

■ TECHNICAL SPECIFICATIONS

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or DC	250
Temperature Coefficient, PPM / °C*	-800 ~ +200
Operating Temperature Range, °C	-55 ~ +125
Insulation Resistance, MΩ	>10 ²

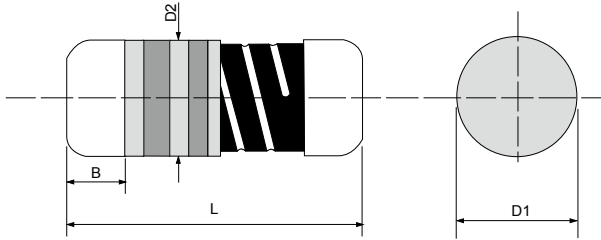
* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±1%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds	±1%
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 125°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +125°C 30minutes, 5 cycles	±2%

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SM



Specifications Per

• IEC 60115-1 60115-2 • EN 140401-803

Features

- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- SMD enabled Structure with excellent solderability
- Excellent solderability termination
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

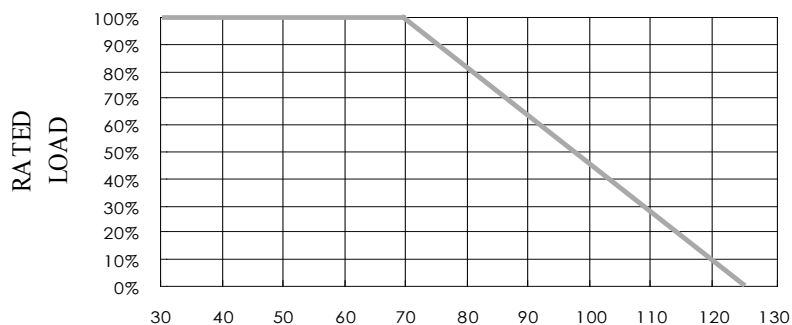
Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
SM16	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/ -0.15	0.6 Min.	17 grams
SM204	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/ -0.15	0.6 Min.	17 grams
SM207	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams
SM52	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams

GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
SM16	1/6W	200V	400V	0.51Ω	10MΩ	±1%	E-96
						±2%, ±5%	E-48/E-24
SM204	1/4W	200V	400V	0.51Ω	10MΩ	±1%	E-96
						±2%, ±5%	E-48/E-24
SM207	1/3W	250V	500V	0.51Ω	10MΩ	±1%	E-96
						±2%, ±5%	E-48/E-24
SM52	1/2W	250V	500V	0.51Ω	10MΩ	±1%	E-96
						±2%, ±5%	E-48/E-24

For zero-ohm jumper, please see ZMM series. For 10m~510mΩ, please see CSM series. Special sizes, values, and specifications not listed available on special order.

POWER DERATING CURVE

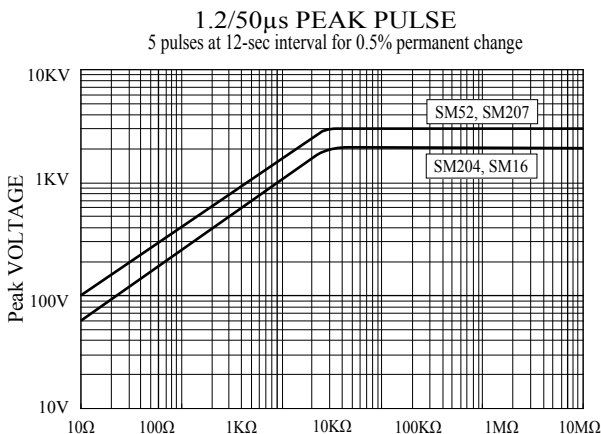
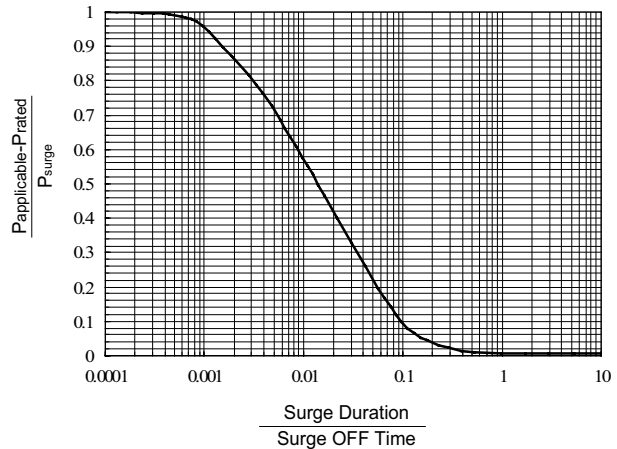
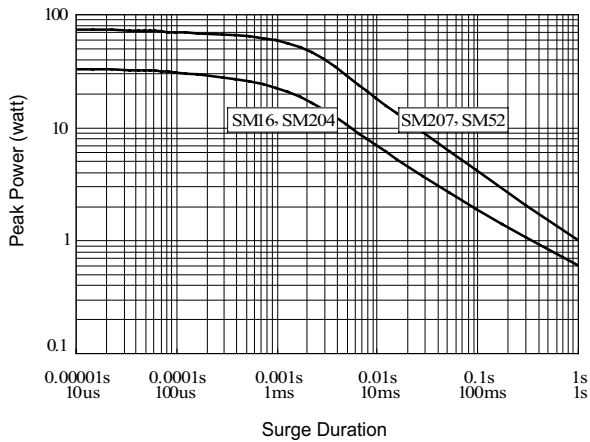


TECHNICAL SUMMARY

Characteristics	Ranges & Limits	
Operating Temperature Range, °C	-55 ~ +125	
Temperature Coefficient, PPM / °C*	±1%, ±2%	±25, ±50, ±100
	±5%	±100
Dielectric Withstanding Voltage, VAC or DC	SM16, SM204	200
	SM207, SM52	500
Insulation Resistance, MΩ	>10 ⁴	
Failure Rate, pcs/10 ⁹ device hours	<0.1	
Thermal Resistance, K/W	<220	
Tin Whisker (JESD201 Temperature Cycling & High Temp./Humidity Storage), μm	<5	

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

SINGLE SURGE PERFORMANCE



Notes:

- SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further linearly down to zero at 125°C.
- To determine applicable surge power in continuous-surge applications:
 - Identify allowable duration and peak power P_{surge} of single surge;
 - Determine ratio of surge duration/surge OFF time in application;
 - Calculate P_{applicable} backwardly according to Y-axis of SURGE POWER DERATING CURVE.

■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits		
Short Time Overload	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	0.51Ω to 332KΩ	±0.075%	
		>332KΩ	±0.35%	
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1000 hrs with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	1,000 hours	±0.5%	
		8,000 hours	<10Ω	±1%
			10Ω to <10KΩ	±0.75%
			10KΩ to 332KΩ	±1.5%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	>332KΩ	±2.5%	
		<1Ω	±1.0%	
		1Ω to 332KΩ	±0.5%	
Load Life In Humidity (accelerated mode)	IEC 60115-1 4.37 1,000 hours at 85°C and 85% relative humidity with 0.1x rated voltage (not over 100V)	>332KΩ	±2.0%	
		<1Ω	±1.0%	
		1Ω to <10KΩ	±0.5%	
Periodic Electric Overload	IEC 60115-1 4.39 3.9x rated voltage (not over max. overload voltage) with 0.1s ON, 2.5s OFF for 1,000 cycles	10KΩ to 332KΩ	±2%	
		>332KΩ	±5.0%	
		<1Ω	±1.0%	
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds	±0.5%		
		<1Ω	±0.25%	
		1Ω to 332KΩ	±0.15%	
Thermal Endurance	IEC 60115-1 4.25.3 1,000 hours without load	85°C	>332KΩ	±0.35%
			<1Ω	±0.25%
			1Ω to 100Ω	±0.1%
		125°C	>100Ω to 332KΩ	±0.3%
			> 332KΩ	±0.75%
			<1Ω	±0.5%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +125°C 30minutes	5 cycles	1Ω to 100Ω	±0.25%
			>100Ω to 332KΩ	±0.5%
			> 332KΩ	±1.0%
		1,000 cycles	<1Ω	±0.15%
			1Ω to 332KΩ	±0.05%
			> 332KΩ	±0.15%
Single pulse high voltage overload	IEC 60115-1 4.27 • 5 pulses of 1.2/50μs at 10x rated voltage (not over 400V for SM16 & SM204; not over 500V for SM207 & SM52) with interval of 12 sec. • 10 pulses of 10/700μs at 10x rated voltage (not over 400V for SM16 & SM204; not over 500V for SM207 & SM52) with interval of 60 sec.	<1Ω	±0.5%	
		1Ω to 332KΩ	±0.2%	
Electrostatic discharge (Human body model)	IEC 60115-1 4.38 3 positive & 3 negative discharges with 2KV for SM16 & SM204 or 4KV for SM207 & SM52 (For continuous surge application please see Surge Performance paragraph)	> 332KΩ	±0.15%	
		<1Ω	±0.5%	
Climatic test	IEC 60115-1 4.23 4.23.2 - dry heat: 16 hours 125°C 4.23.3 - damp heat: 24 hours 55°C with 95% relative humidity 4.23.4 - cold: 2 hours -55°C 4.23.5 - negative air pressure: 2 hour 8.5kPa at (25±10)°C 4.23.6 - damp heat cyclic: 5 days 55°C with 95% relative humidity 4.23.7 - DC load: rated voltage at -55°C and 125°C each for 1 min.	5 cycles	±0.25%	
		1,000 cycles	±0.25%	
		±0.5%		
		±0.5%		
		±0.5%		
		±0.5%		
		±0.5%		
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage		
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 1.52mm and 10 to 2,000 Hz.	±0.15%		
Bending test	IEC 60115-1 4.33 Pressing depth 2mm, 3 times	±0.15%		
Flammability	IEC 60115-1 4.35 Needle flame test 10s	No burning after 30s		

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SM

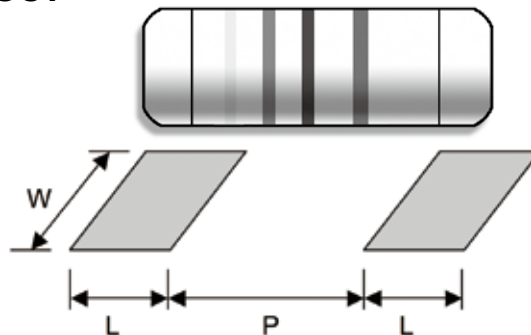
■ PART NUMBER

Example: SM204F84K5TKRTR3K0

SM204	F	84K5	TKR	TR3K0
Type	Tolerance*	Resistance	TCR*	Packaging
	F (1%) G (2%) J (5%)	84.5KΩ 4-character code containing - 3 significant digits 1 letter multiplier OHM MULTIPLIER R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	50ppm 3-character code TKQ = ± 25ppm TKR = ± 50ppm TKS = ± 100ppm	5-character code TR = Tape Reel (pieces per reel) <u>SM16/SM204</u> 3K0 = 3,000 6K0 = 6,000** 10K = 10,000** <u>SM207/SM52</u> 2K0 = 2,000 6K0 = 6,000** 10K = 10,000**

* For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

■ SUGGESTED PAD LAYOUT

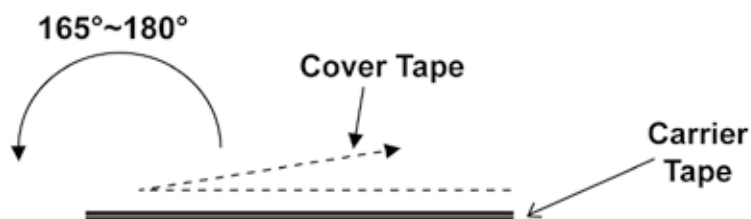


Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
SM16 SM204	Reflow	1.3	1.6 ± 0.1	1.6
	Wave	1.5	1.5 ± 0.1	1.8
SM207 SM52	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0

For better heat dissipation / lower heat resistance, increase W & L.

■ COVER TAPE PEELING SPECIFICATION

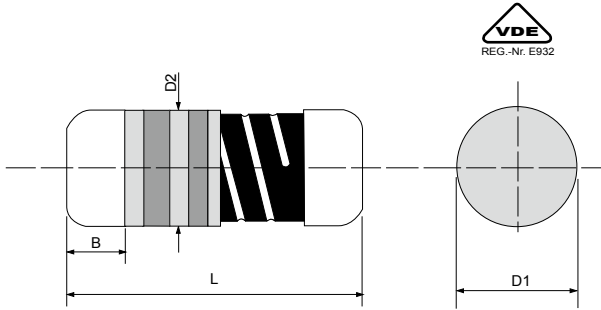
Recommended peeling force: 50±gf



SRM Surge Resistant MELF Resistor

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SRM



VDE license number 40043961

Specifications Per

- IEC 60115-1
- AEC-Q200 Rev.D

Features

- AEC-Q200 Compliant
- Anti-sulfuration test qualified
- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- MELF packaging yet capable of high power handling
- Special conductive film enhances anti-surge capability
- Absorbs harmful surge which damages precious devices or components
- SMD-enabled alternative to carbon composition resistors
- Approved to the safety requirement of VDE0860, IEC 60065 clause 14.2a & UL 1676, except SRM204 & SRM204T type
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
SRM204	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/ -0.15	0.6 Min.	17 grams
SRM204T	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/ -0.15	0.6 Min.	17 grams
SRM207	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams
SRM207P	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams
SRM101	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams
SRM101T	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams
SRM201	8.50 ± 0.50	3.00 ± 0.2	D1+0.05/ -0.35	1.3 Min.	186 grams
SRM301	10.5 ± 0.50	4.00 ± 0.5	D1+0.05/ -0.45	1.6 Min.	446 grams

GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Permissible Surge Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
SRM204	1/4W	400V	2,000V	1Ω	1MΩ	±1%~±5%	E-24/E-96
SRM204T	1/2W	450V	4,000V	1Ω	10MΩ	±1%~±5%	E-24/E-96
SRM207	1/2W	600V	6,000V	1Ω	2M2Ω	±1%~±5%	E-24/E-96
SRM207P	1/2W	600V	8,000 V	0.1Ω	2M2Ω	±1%~±5%	E-24/E-96
SRM101	1W	600V	8,000 V	0.1Ω	2M2Ω	±1%~±5%	E-24/E-96
SRM101T	1W	600V	10,000 V	0.1Ω	2M2Ω	±1%~±5%	E-24/E-96
SRM201	2W	700V	9,000V	0.1Ω	2M2Ω	±1%~±5%	E-24/E-96
SRM301	3W	800V	10,000V	0.1Ω	2M2Ω	±1%~±5%	E-24/E-96

Special sizes, values, and specifications not listed available on special order.
For resistance values outside the specified ranges, please contact us.

SRM Surge Resistant MELF Resistor

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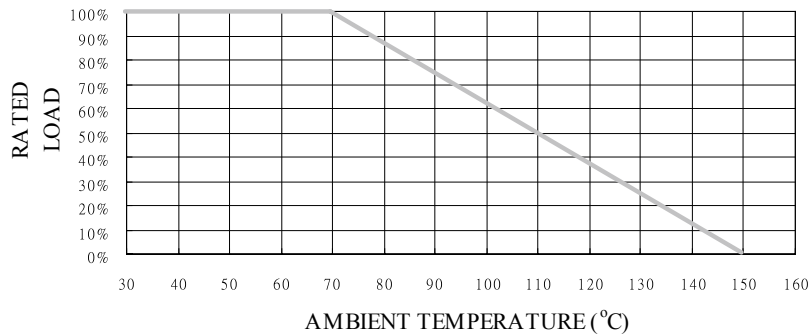
■ PART NUMBER

Example: SRM204TF16R2TKZTR3K0

SRM204T	F	16R2	TKZ	TR3K0
Type	Tolerance*	Resistance	TCR	Packaging
	F(1%) G(2%) J(5%)	16.2Ω 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.**	5-character code TR = Tape Reel (pieces per reel) <u>SRM204/SRM204T</u> 3K0 = 3,000 6K0 = 6,000*** 10K = 10,000*** <u>SRM207/SRM207P</u> <u>SRM101/SRM101T</u> 2K0 = 2,000 6K0 = 6,000*** 10K = 10,000*** <u>SRM201</u> 2K5 = 2,500 <u>SRM301</u> 2K0 = 2,000

* Listed values may not be applicable across product types or to all resistance values. Please check with us before placing order.
** For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.
*** upon request

■ POWER DERATING CURVE



■ TECHNICAL SUMMARY

Characteristics	Ranges & Limits	
Dielectric Withstanding Voltage, VAC or DC	SRM204T SRM204/207/207P/101 SRM201/101T SRM301	300 350 500 800
Temperature Coefficient, PPM / °C*	±200, ±400, ±800, ±1200	
Operating Temperature Range, °C	-55 ~ +150	
Insulation Resistance, MΩ	>10 ⁴	
Tin Whisker (JESD201 Temperature Cycling & High Temp. /Humidity Storage), μm	<5	
Failure Rate in Time, pcs / 10 ⁹ device hours	<1.5	

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

SRM

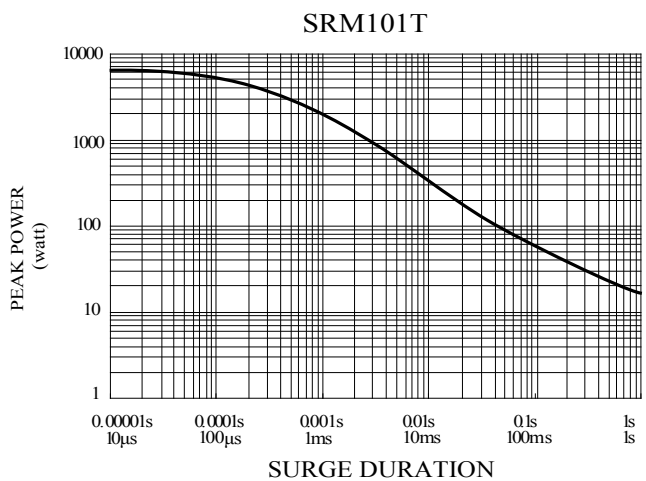
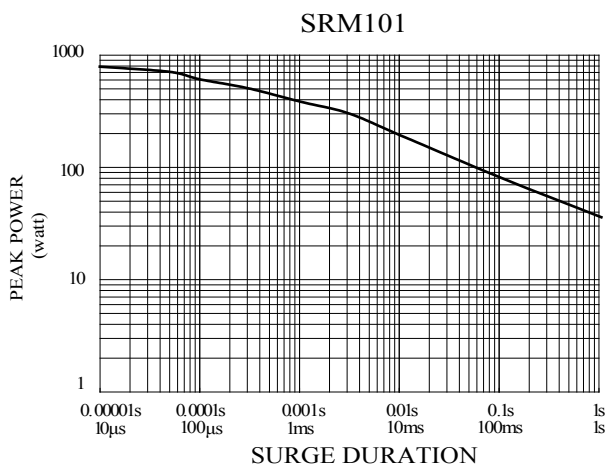
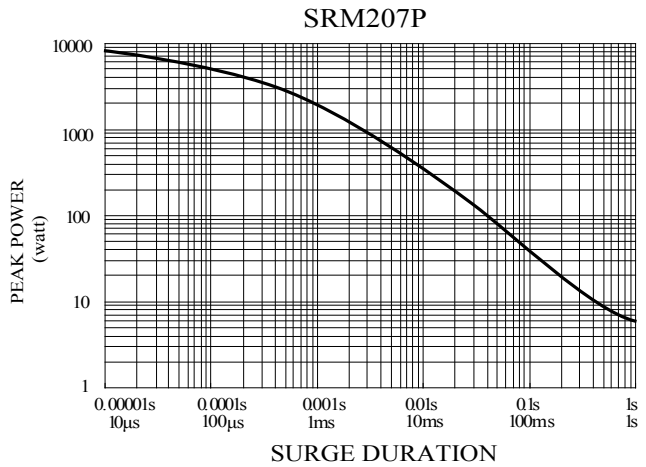
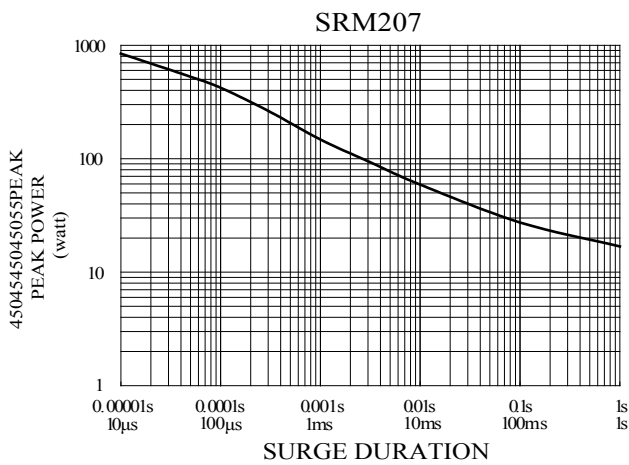
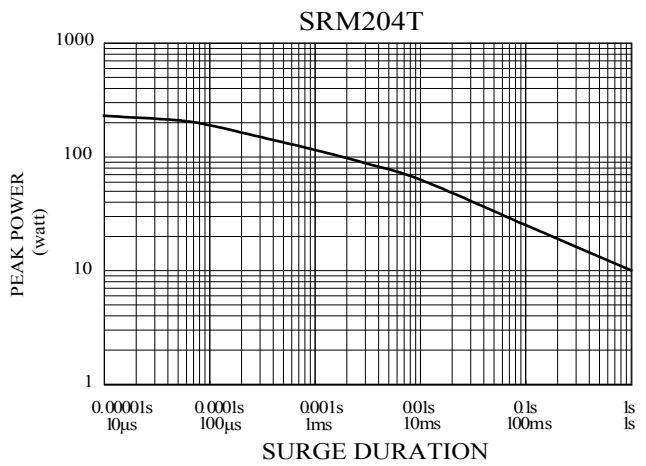
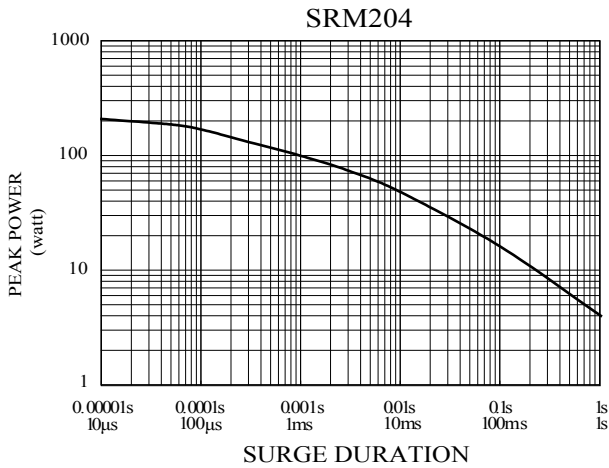
PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits		
High Temperature Exposure	AEC-Q200 REV D. Stress NO.3 (refer to IEC 60115-1 4.25.3/ MIL-STD-202 Method 108) 1,000 hours at 150°C without load	±2.5%		
Temperature Cycling	AEC-Q200 REV D. Stress NO.4 (refer to IEC 60115-1 4.19/ JESD22 Method JA-104) -55°C 30minutes, +125°C 30minutes, 1,000 cycles	±2%		
	Proprietary test specification FRC-AECQ-180702 -20°C 30minutes, +120°C 30minutes, 1,000 cycles (Recommended solder paste composition: 96.5% Sn, 3% Ag, 0.5% Cu)	Force of 1kg for 10 secs and without distinct looseness of terminals		
Biased Humidity	AEC-Q200 REV D. Stress NO.7 (refer to IEC 60115-1 4.37/ MIL-STD-202 Method 103) 1,000 hours at 85°C and 85% relative humidity with 10% operating power	±5%		
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at 70°C	±5%		
	AEC-Q200 REV D. Stress NO.8 (refer to MIL-STD-202 Method 108) 1,000 hours at 125°C with de-rated continuous working voltage	±5%		
Resistance to Solvents	AEC-Q200 REV D. Stress NO.12 (refer to MIL-STD-202 Method 215) Add Aqueous wash chemical-OKEM Clean or equivalent. Do not use banned solvents.	No visible damage on appearance and marking		
Mechanical Shock	AEC-Q200 REV D. Stress NO.13 (refer to MIL-STD-202 Method 213 Condition C) Three shocks in each direction shall be applied along the three mutually perpendicular axes of the test specimen. Peak value: 100 g's, Duration: 6 ms, Velocity change: 12.3 ft/s, Waveform: Half sine	±0.5%		
Vibration	AEC-Q200 REV D. Stress NO.14 (refer to MIL-STD-202 Method 204) 5 g's for 20 min., 12 cycles each of 3 orientations, Test from 10 - 2,000 Hz.	±0.5%		
Resistance to Soldering Heat	AEC-Q200 REV D. Stress NO.15 (refer to IEC 60115-1 4.18.2/ MIL-STD-202 Method 210) Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds	±1%		
ESD	AEC-Q200 REV D. Stress NO.17 (refer to AEC-Q200-002/ ISO/DIS 10605) (150pF/ 2000Ohm discharge network) Human body model, 1 positive & 1 negative discharges with 2KV source	±0.5%		
Solderability	AEC-Q200 REV D. Stress NO.18 (refer to J-STD-002 or IEC 60115-1 4.17) Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min. covered		
Flammability	AEC-Q200 REV D. Stress NO.20 (refer to UL-94) V-0 or V-1 are acceptable. Electrical test not required.	NO flaming		
Board Flex	AEC-Q200 REV D. Stress NO.21 (refer to AEC-Q200-005) 60 sec minimum holding time.	±0.5%		
Terminal Strength	AEC-Q200 REV D. Stress NO.22 (refer to AEC-Q200-006) Force of 1.8kg for 60 seconds	±0.5%		
Short Time Overload	IEC 60115-1 4.13 2 seconds 2.5x rated voltage (not over max. working voltage)	±2%		
Climatic test	IEC 60115-1 4.23 4.23.2 - dry heat: 16 hours 150°C 4.23.3 - damp heat: 24 hours 55°C with 95% relative humidity 4.23.4 - cold: 2 hours -55°C 4.23.5 - negative air pressure: 2 hour 8.5KPa at (25±10)°C 4.23.6 - damp heat cyclic: 5 days 55°C with 95% relative humidity 4.23.7 - DC load: rated voltage at -55°C and 150°C each 1 Min.	±2%		
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%		
Single pulse high voltage overload	IEC 60115-1 4.27 10 pulses of 10/700µs at 10x rated voltage (not over 2x max. working voltage) with interval of 60 sec.	±1%		
Periodic Electric Overload	IEC 60115-1 4.39 3.9x rated voltage (not over 2X max. working voltage) with 0.1s ON, 2.5s OFF for 1,000 cycles	±1%		
Surge Test	Proprietary test specification FRC-TR-010113 = $\sqrt{(6000 \times P \times R)}$ DC P is power rating, R is resistance value, surge voltage is not more than listed at right Surge spec = 1.2/50µs Period = 12 sec Number of surges = 5	SRM204	2KV	±5%
		SRM204T	4KV	
		SRM207	6KV	
		SRM101/207P	8KV	
		SRM201	9KV	
SRM301/101T	10KV			
Anti-sulfuration test	EIA-977 (conditions B) 750 hours at (105±2)°C without load	±1%	±1%	
		±2%	±2%	
		±5%	±5%	

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Cost-Down via Innovation

■ SINGLE SURGE PERFORMANCE

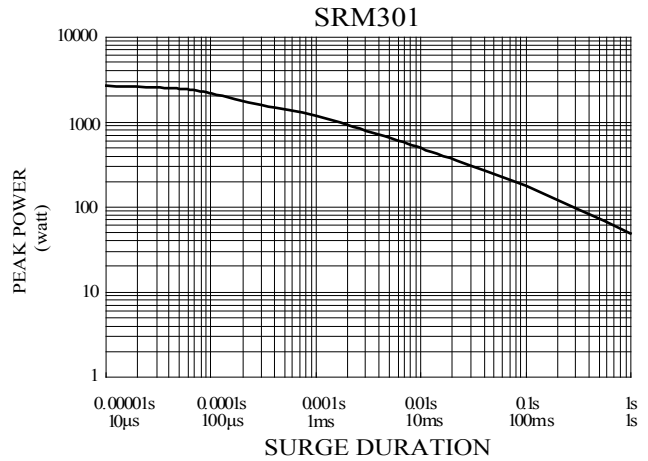
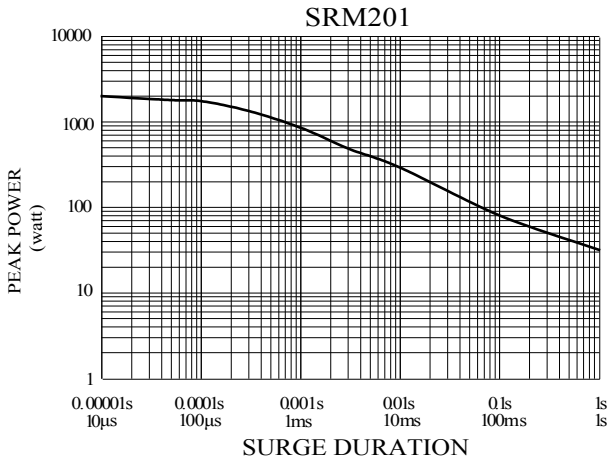
SRM



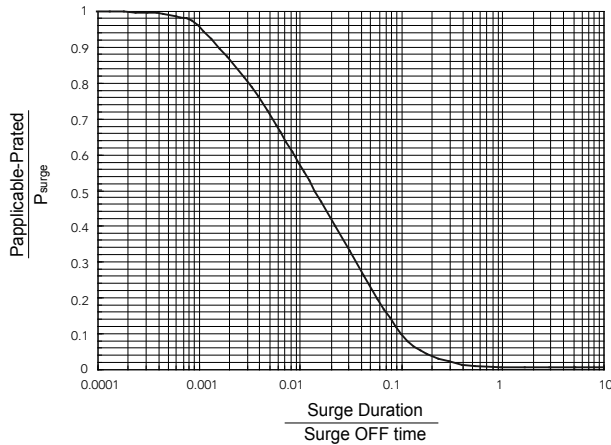
Safety • Quality • Reliability
Cost-Down via Innovation

SRM

■ SINGLE SURGE PERFORMANCE



■ SURGE POWER DERATING CURVE

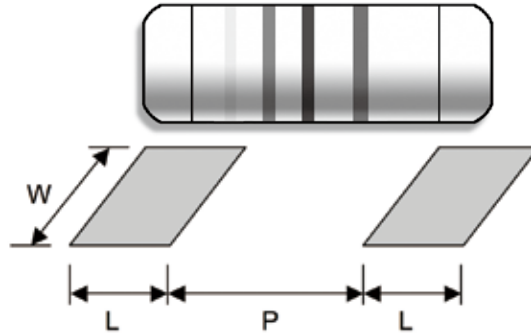


Notes:

- SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further linearly down to zero at 150 °C.
- To determine applicable surge power in continuous-surge applications:
 1. Identify allowable duration and peak power P_{surge} of single surge;
 2. Determine ratio of surge duration/surge OFF time in application;
 3. Calculate $P_{applicable}$ backwardly according to Y-axis of SURGE POWER DERATING CURVE.

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■ SUGGESTED PAD LAYOUT



SRM

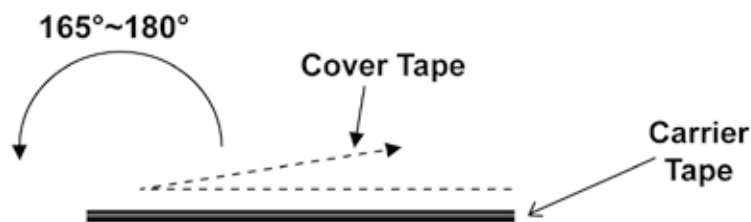
Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
SRM204/SRM204T	Reflow	1.3	1.6 ± 0.1	1.6
	Wave	1.5	1.5 ± 0.1	1.8
SRM207/207P	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0
SRM101/101T	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0
SRM201	Reflow	3.0	4.9 ± 0.3	3.7
	Wave	3.5	4.8 ± 0.3	4.0
SRM301	Reflow	4.0	6.2 ± 0.4	5.0
	Wave	4.5	6.0 ± 0.4	5.0

For better heat dissipation / lower heat resistance, increase W & L.

■ COVER TAPE PEELING SPECIFICATION

Recommended peeling force:

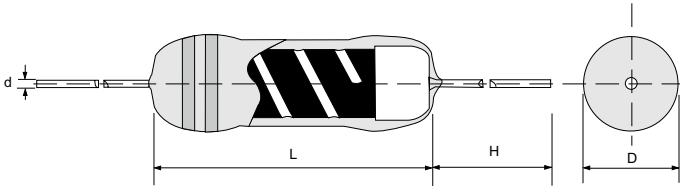
SRM204, SRM204T, SRM207, SRM207P, SRM101, SRM101T: 50±5gf SRM201, SRM301: 70±10gf



SSR Surge Safety Resistor

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SSR



Features

- Designed to replace carbon or ceramic composition resistor, SSR series is applied in high-surge applications such as fuel ignition systems, power charging/ discharging circuits, TV sets, etc, to absorb harmful surge energy, so to prevent hazard of fire and circuit damage caused by surge energy with a flame-proof coating.
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000 Pcs
SSR25	6.50 ± 1.0	2.6 ± 0.3	26 ± 3.0	0.55 ± 0.02	300 Grams
SSR51	9.00 ± 1.0	3.2 ± 0.2	26 ± 3.0	0.60 ± 0.03	340 Grams
SSR100	11.0 ± 1.0	4.0 ± 0.5	28 ± 3.0	0.70 ± 0.03	500 Grams
SSR200	15.5 ± 1.0	5.0 ± 0.5	30 ± 3.0	0.80 ± 0.03	1150 Grams
SSR300	15.5 ± 1.0	5.5 ± 0.5	30 ± 3.0	0.80 ± 0.03	1200 Grams

GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Permissible Surge Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
SSR25	1/4W	250V	10KV	10Ω	180KΩ	±5%	E-24
SSR51	1/2W	300V	15KV	10Ω	220KΩ	±5%	E-24
SSR100	1W	350V	20KV	10Ω	220KΩ	±5%	E-24
SSR200	2W	400V	22.5KV	10Ω	240KΩ	±5%	E-24
SSR300	3W	400V	25KV	10Ω	240KΩ	±5%	E-24

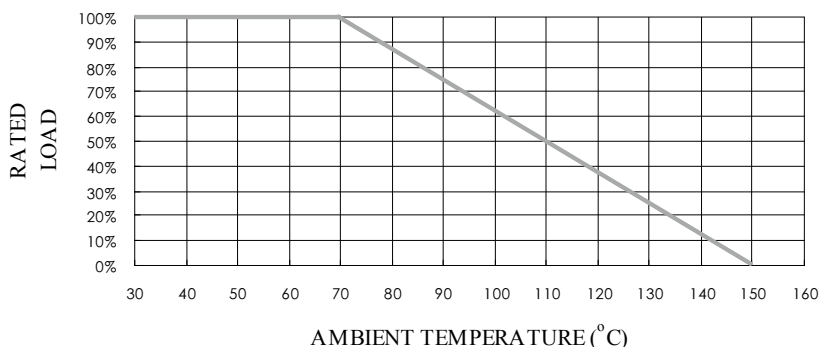
Special sizes, values, and specifications not listed available on special order.

TECHNICAL SUMMARY

Characteristics	Limits	
Dielectric Withstanding Voltage, VAC or DC	SSR25 /51 /100 SSR200 SSR300	600 700 800
Temperature Coefficient, PPM / °C*	SSR25 /100 /200 /300: SSR51:	±600 ±750
Operating Temperature Range, °C	-55 ~ +150	
Insulation Resistance, MΩ	>10 ⁴	

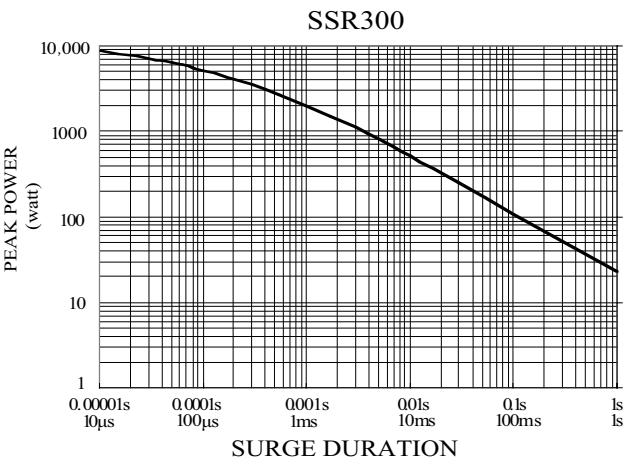
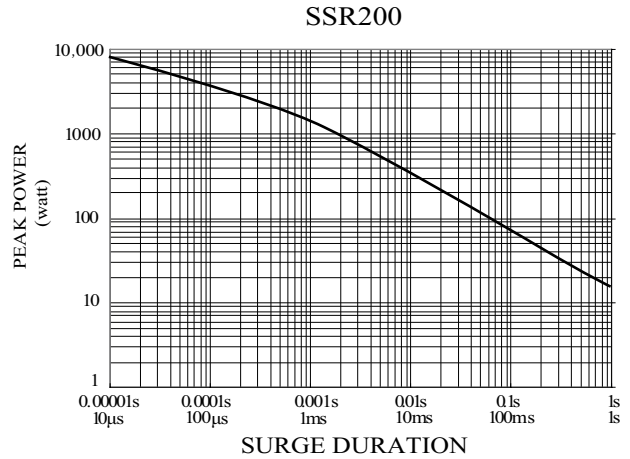
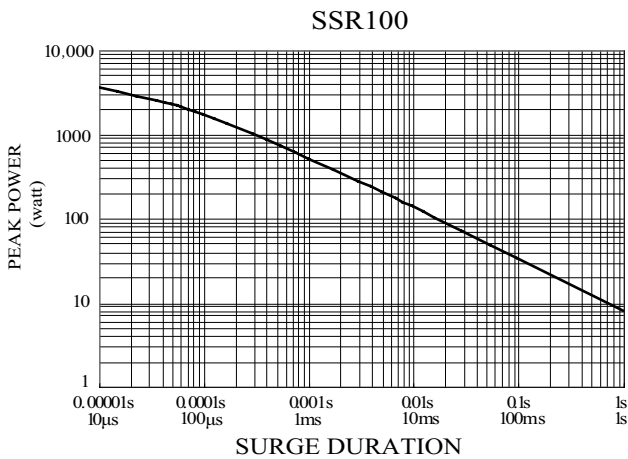
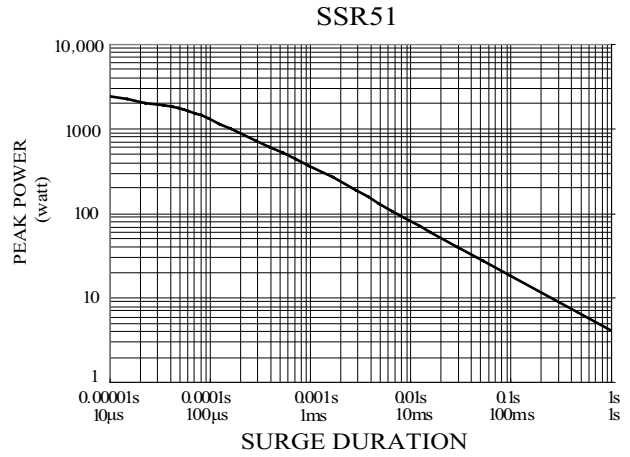
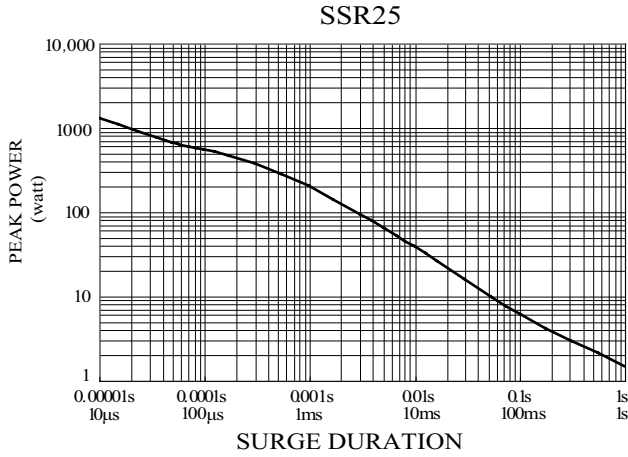
* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

POWER DERATING CURVE



Safety • Quality • Reliability
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■ SINGLE SURGE PERFORMANCE

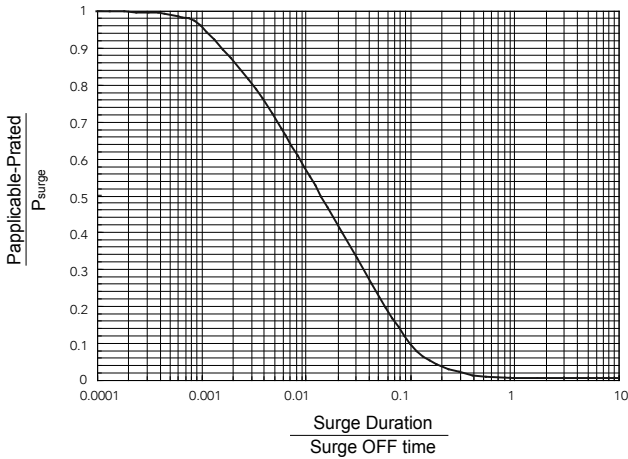


SSR

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Cost-Down via Innovation

SSR

■ SURGE POWER DERATING CURVE



Notes:

- SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further linearly down to zero at 150 °C.
- To determine applicable surge power in continuous-surge applications:
 1. Identify allowable duration and peak power P_{surge} of single surge;
 2. Determine ratio of surge duration/surge OFF time in application;
 3. Calculate P_{applicable} backwardly according to Y-axis of SURGE POWER DERATING CURVE.

■ PART NUMBER

Example: SSR200J10K0TKZTB500

SSR200	J	10K0	TKZ	TB500
Type	Tolerance	Resistance	TCR	Packaging
	J (5%)	10KΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.*	5-character code TB = Tape Box (pieces per box) <u>SSR25/SSR51</u> 2K0 = 2,000 <u>SSR100</u> 1K0 = 1,000 <u>SSR200/300</u> 500 = 500

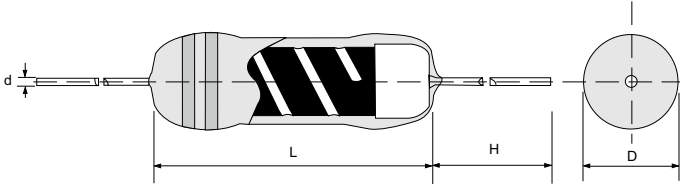
* For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits		
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over 2X max. working voltage)	±1%		
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%		
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%		
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%		
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage		
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 1.52mm and 10 to 2,000 Hz.	±1%		
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 150°C without load	±2.5%		
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +150°C 30minutes, 5 cycles	±2%		
Surge Test	Surge voltage = $\sqrt{(6000 \times P \times R)}$ DC P is power rating, R is resistance value, surge voltage is not more than listed at right. Surge spec = 1.2/50µs Period = 12 sec Number of surges = 3000	SSR25	10 KV	±5%
		SSR51	15 KV	
		SSR100	20 KV	
		SSR200	22.5 KV	
		SSR300	25 KV	

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SSR



Features

- Designed to replace carbon or ceramic composition resistor, SSR series is applied in high-surge applications such as fuel ignition systems, power charging/ discharging circuits, TV sets, etc, to absorb harmful surge energy, so to prevent hazard of fire and circuit damage caused by surge energy with a flame-proof coating.
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000 Pcs
SSR400	19.0 ± 1.0	6.0 ± 0.5	30 ± 3.0	0.8 ± 0.03	1600 Grams
SSR500	24.0 ± 1.0	8.0 ± 0.5	30 ± 3.0	0.8 ± 0.03	3700 Grams

GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Permissible Surge Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
SSR400	4W	500V	30KV	10Ω	270KΩ	±5%	E-24
SSR500	5W	600V	35KV	10Ω	330KΩ	±5%	E-24

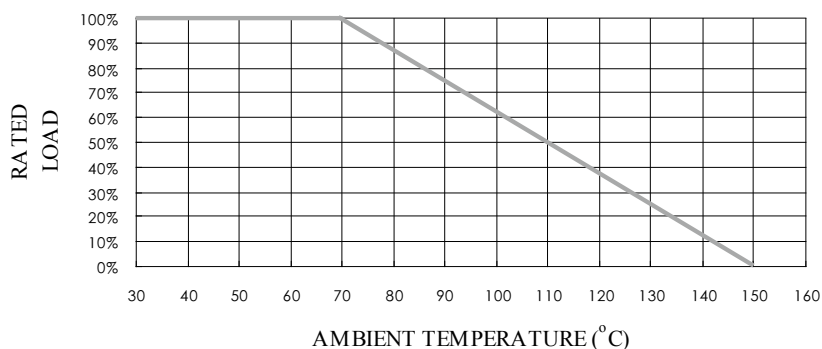
Special sizes, values, and specifications not listed available on special order.

TECHNICAL SPECIFICATIONS

Characteristics	Limits	
Dielectric Withstanding Voltage, VAC or DC	800	
Temperature Coefficient, PPM / °C*	SSR400	±750
	SSR500	±600
Operating Temperature Range, °C	-55 ~ +150	
Insulation Resistance, MΩ	10 ⁴	

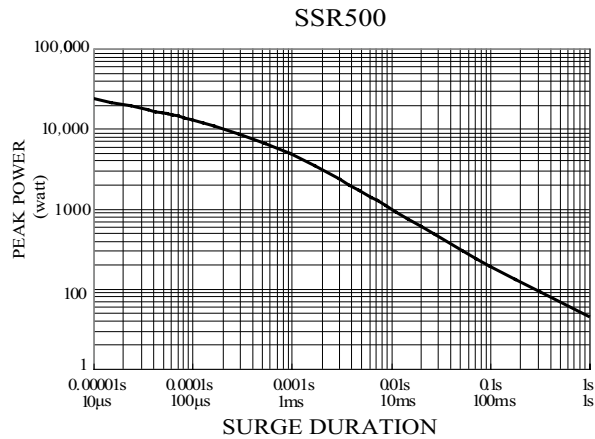
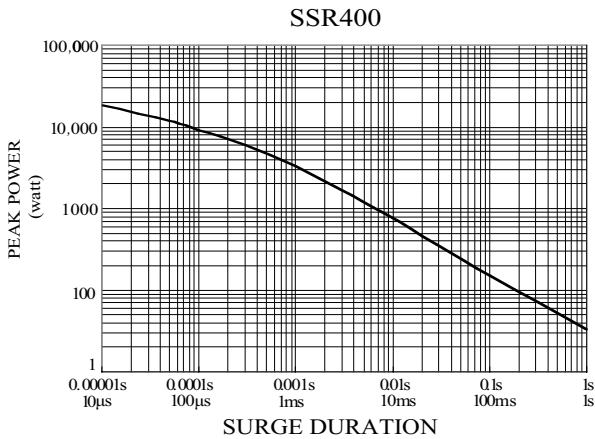
* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

POWER DERATING CURVE

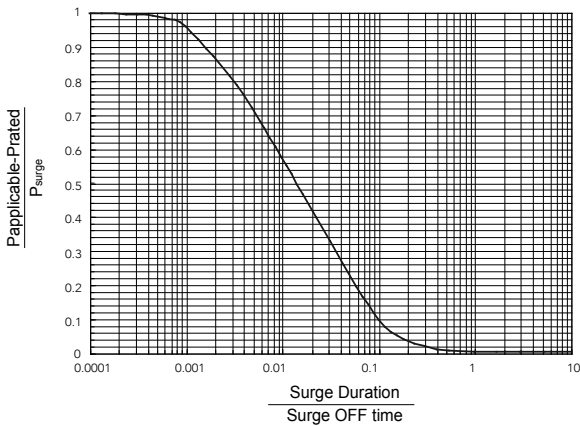


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■ SINGLE SURGE PERFORMANCE



■ SURGE POWER DERATING CURVE



Notes:

- SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further linearly down to zero at 150°C.
- To determine applicable surge power in continuous-surge applications:
 1. Identify allowable duration and peak power P_{surge} of single surge;
 2. Determine ratio of surge duration/surge OFF time in application;
 3. Calculate $P_{applicable}$ backwardly according to Y-axis of SURGE POWER DERATING CURVE.

SSR

SSR – Surge Safety Resistor High Power

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■ PART NUMBER

Example: SSR400J10K0TKZTB400

SSR400	J	10K0	TKZ	TB400
Type	Tolerance	Resistance	TCR	Packaging
	J (5%)	10KΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.*	5-character code TB = Tape Box (pieces per box) SSR400 500 = 500 SSR500 250 = 250

* For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits					
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over 2X max. working voltage)	±2%					
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%					
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%					
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%					
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage					
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 1.52mm and 10 to 2,000 Hz.	±1%					
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 150°C without load	±2.5%					
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +150°C 30minutes, 5 cycles	±3%					
Surge Test	Surge voltage = $\sqrt{(6000 \times P \times R)}$ DC P is power rating, R is resistance value, surge voltage is not more than listed at right. Surge spec = 1.2/50µs Period = 12 sec Number of surges = 3000	<table border="1"> <tr> <td>SSR400</td> <td>30 KV</td> <td rowspan="2">±5%</td> </tr> <tr> <td>SSR500</td> <td>35 KV</td> </tr> </table>	SSR400	30 KV	±5%	SSR500	35 KV
SSR400	30 KV	±5%					
SSR500	35 KV						

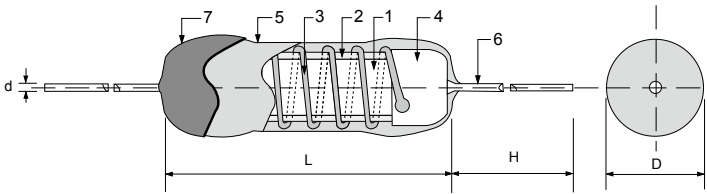
Firstohm®



SSWA – Superior Anti-Surge Wire Wound Axial Resistors

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SSWA



Features

- Worldwide patent pending
- Special composite wire-wound structure enhances anti-surge capability
- Conforms to ANSI/AAMI EC53/ IEC 60601-2-27:2011(R)2016
- Optimal quality and reliability for electrocardiogram (ECG) monitor (3/5/10 leads) applications
- Flameproof multi-layer coating equivalent to UL 94 V-0
- RoHS/ REACH compliant
- Low TCR against the other ceramic resistor

Applications

- ECG cables

■ DIMENSIONS

No	Parts	Materials
1	Conductive Ceramic Rod	With Conductive Film or Rod
2	Flame Proof Insulation Layer	Silicone
3	Resistive Wire	Nickel Chromium Alloy
4	Cap	Base Metal:Fe Plating:Sn / Cu
5	Flame Proof Coating	Silicone
6	Lead Wire	Tin Clad Copper Wire
7	Heat Shrinkable Tube (Flame-retarded)	Polyolefin

■ DIMENSIONS

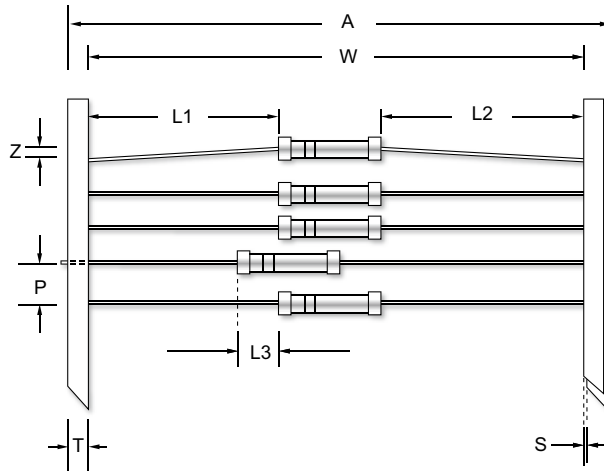
Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)
SSWA03T	15.5 ± 1.0	5.5±0.5	28 ± 3.0	0.7 ± 0.03

■ GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Max. Working Voltage	Resistance	Resistance Tolerance	Available Resistance Values
SSWA03T	3W	54.77V	1KΩ	±5%, ±10%	E-24, E-12

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■ TAPING/PACKING SPECIFICATIONS



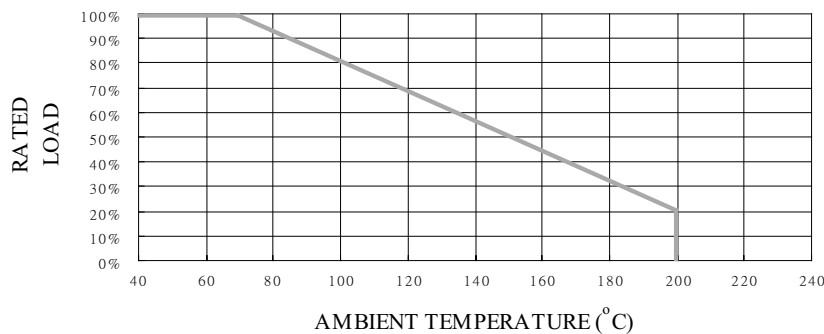
Unit (mm)

Type	A (Max.)	L1-L2 (Max.)	L3 (Max.)	P ±0.5	S (Max.)	T ±0.5	W ±1.5	Z (Max.)
SSWA03T	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2

■ TECHNICAL SPECIFICATIONS

Characteristics	Limits
Dielectric Withstanding Voltage, VAC or DC	300
Temperature Coefficient, PPM / °C	±200
Operating Temperature Range, °C	-55 ~ +200
Insulation Resistance, MΩ	10 ⁴

■ POWER DERATING CURVE



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SSWA

■ PART NUMBER

Example: SSWA03TJ1K00TKZTB500

SSWA03T	J	1K00	TKZ	TB500
Type	Tolerance	Resistance	TCR	Packaging
	J (5%) K (10%)	1KΩ 4-character code containing - 3 significant digits 1 letter multiplier <u>MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient.	5-character code TB = Tape Box (pieces per Box) 500 = 500

* For the availabilities of non-default temperature coefficient, please check with us.

■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage	±5%
Load Life	IEC 60115-1 4.25.1 Rated load 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±2.5%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min. coverage
Vibration	IEC 60115 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±2%
Thermal Endurance	IEC 60115-1 4.25.3 1,000 hours at 125°C without load	±5%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±3%
ESD	IEC 61000-4-2 Human body model, 3 pos. 3 neg. Discharges 15KV	±2%
ECG Test	ANSI/AAMI EC53/ IEC 60601-2-27 Defibrillation pulse = 5KV Period = 60 sec Number of pulses = 10	±10%

SRM-201 withstands 51,840,000 surges at 30KV, in duration of 500 hours.



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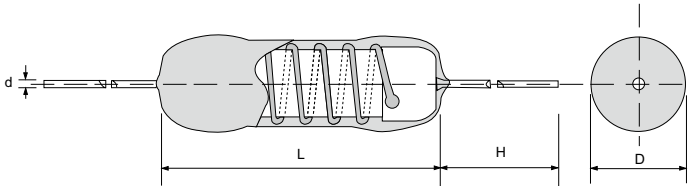
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TÜV ISO 9002 ISO 14001 / IECQ CERTIFIED FACTORY

Safety • Quality • Reliability
Cost-Down via Innovation

SWA



[*structure pending patent approval]

Taiwan patent number: M530462

Japan patent number: 3208923

China patent number: 6433867

Korean patent number: 20-0486309

United States patent number: US9978483B2

Specifications Per

• IEC 60115-1, 60115-4

Features

- Flameproof multi-layer coating equivalent to UL 94 V-0
- Flameproof feature equivalent to overload test UL 1412
- Enhanced weld spot is reliable against surge
- Special tin-plated electrolytic copper lead wire
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency
- SWA series is applied in high surge applications such as high rush current protection for power capacitor, motor start-up protection, car & motorcycle engine ignition, etc. to absorb harmful surge energy, so to prevent hazard of circuit damage caused by surge energy

DIMENSIONS

Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)
SWA01	11.0 ± 1.0	4.5 ± 0.5	28 ± 3.0	0.7 ± 0.03
SWA02	13.5 ± 1.0	5.0 ± 0.5	30 ± 3.0	0.8 ± 0.03
SWA03	15.5 ± 1.0	5.5 ± 0.5	30 ± 3.0	0.8 ± 0.03

GENERAL SPECIFICATIONS

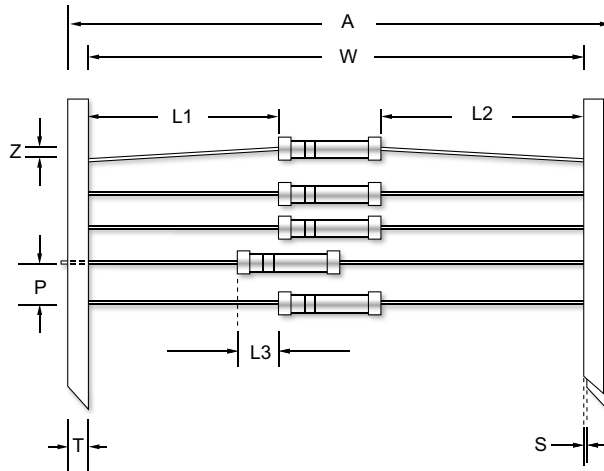
Type	Power Rating (at 70°C)	Maximum Working Voltage*	Maximum Overload Voltage**	Maximum Permissible Surge Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
SWA01	1W	$\sqrt{P \times R}$	$2.5 \times \sqrt{P \times R}$	9KV	0.1 Ω	1.2KΩ	± 5%	E-24
SWA02	2W	$\sqrt{P \times R}$	$2.5 \times \sqrt{P \times R}$	10KV	0.1 Ω	1.2KΩ	± 5%	E-24
SWA03	3W	$\sqrt{P \times R}$	$2.5 \times \sqrt{P \times R}$	12KV	0.1 Ω	1.2KΩ	± 5%	E-24

* Rated Continuous Maximum Working Voltage (RCWV) should be determined from $RCWV = \sqrt{\text{Power Rating} \times \text{Resistance Values}}$

** Short-time Overload (STOL) test should be determined from $STOL = 2.5 \times RCWV$

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■ TAPING/PACKING SPECIFICATIONS



Unit (mm)

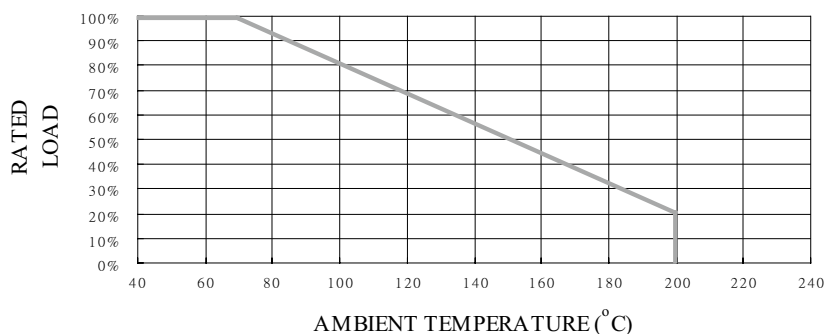
Type	A (Max.)	L1-L2 (Max.)	L3 (Max.)	P ±0.5	S (Max.)	T ±0.5	W ±1.5	Z (Max.)
SWA01	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
SWA02	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
SWA03	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2

■ TECHNICAL SPECIFICATIONS

Characteristics	Limits	
Dielectric Withstanding Voltage, VAC or DC	SWA01 / SWA02	600
	SWA03	1000
Temperature Coefficient, PPM / °C*	±100, ±300	
Operating Temperature Range, °C	-55 ~ +200	
Insulation Resistance, MΩ	10 ⁴	

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ POWER DERATING CURVE



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SWA

■ PART NUMBER

Example: SWA01J100RTKZTB1K0

SWA01	J	100R	TKZ	TB1K0
Type	Tolerance	Resistance	TCR	Packaging
	J (5%)	100Ω 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.*	5-character code TB = Tape Box (pieces per box) SWA01 1K0 = 1,000 <u>SWA02/SWA03</u> 500 = 500

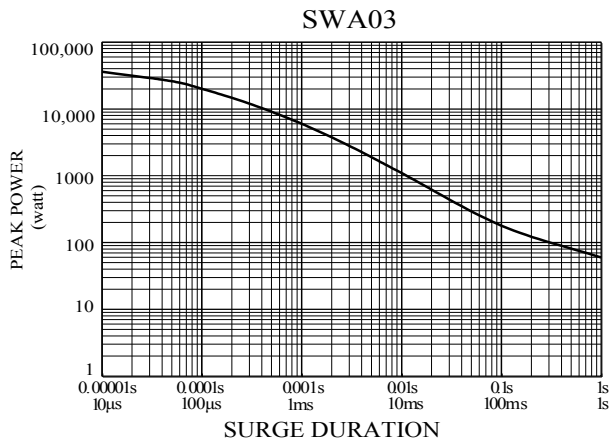
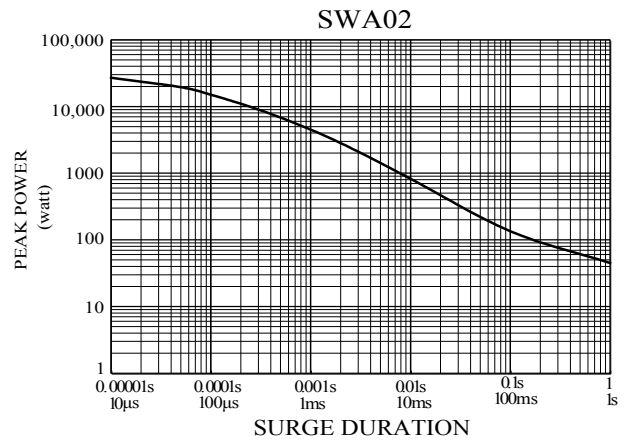
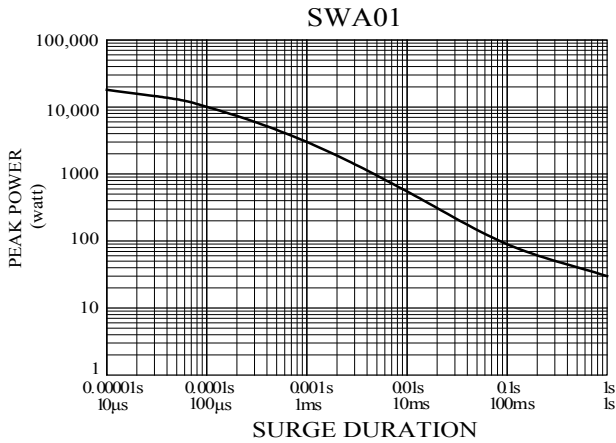
* For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

■ PERFORMANCE SPECIFICATIONS

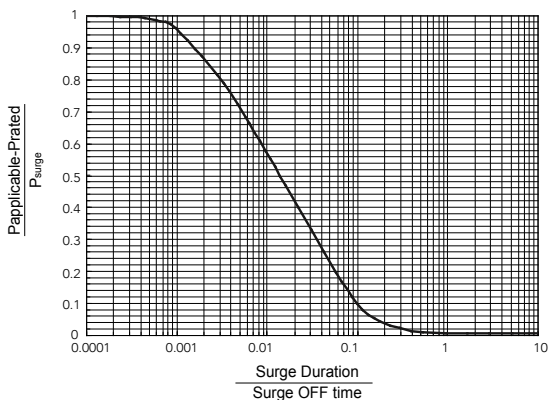
Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±2%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated (not over max. working voltage) load at (40±2)°C and (93±3)% relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min. coverage
Vibration	IEC 60115 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 200°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±3%
Surge Test	Surge voltage = $\sqrt{(12,000 PR)}$ DC P is power rating, R is resistance value, surge voltage is not more than listed at right. Surge spec = 1.2/50µs Period = 60 sec Number of surges = 100	±5%

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■ SINGLE SURGE PERFORMANCE



■ SURGE POWER DERATING CURVE



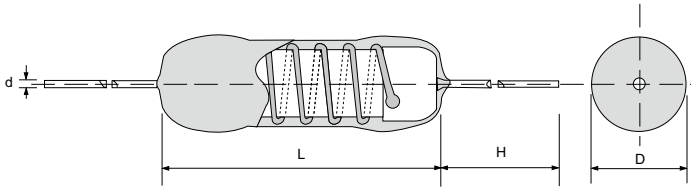
Notes:

- SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further linearly down to zero at 150 °C.
- To determine applicable surge power in continuous-surge applications:
 1. Identify allowable duration and peak power P_{surge} of single surge;
 2. Determine ratio of surge duration/surge OFF time in application;
 3. Calculate $P_{applicable}$ backwardly according to Y-axis of SURGE POWER DERATING CURVE.

SWA

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Cost-Down via Innovation

SWAT



[*structure pending patent approval]
Taiwan patent number: I637420
United States patent number: US10170266B2

Applications

- Lighting devices
- Motor start-up protection
- Power supplies & Power adapters
- High rush current protection for power capacitor

Specifications Per

- IEC 60115-1, 60115-4

Features

- Worldwide patent pending
- Enhanced welded spot is reliable against surge
- Fast-acting fuse device for high-power applications
- Advanced combined anti- surge & fast-fuse structure
- Flameproof multi-layer coating equivalent to UL 94 V-0
- Flameproof feature equivalent to overload test UL 1412
- Thermal fuse to protect against over-heating in electronic products
- RoHS / REACH Compliant
- Reflow-soldering safe
- Low TC to ensure stable power output

DIMENSIONS

Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)
SWAT01	11.0 ± 1.0	4.5 ± 0.5	28 ± 3.0	0.7 ± 0.03
SWAT02	13.5 ± 1.0	5.0 ± 0.5	30 ± 3.0	0.8 ± 0.03
SWAT03	15.5 ± 1.0	5.5 ± 0.5	30 ± 3.0	0.8 ± 0.03

GENERAL SPECIFICATIONS

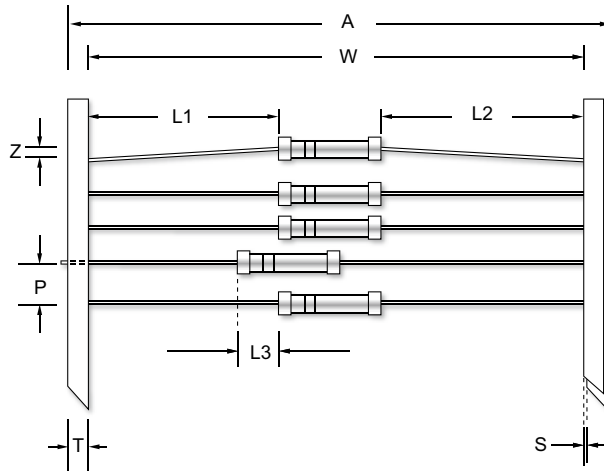
Type	Power Rating (at 70°C)	Maximum Working Voltage*	Maximum Overload Voltage**	Maximum Permissible Surge Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
SWAT01	1W	$\sqrt{P \times R}$	$2.5 \times \sqrt{P \times R}$	9KV	1 Ω	470Ω	± 5%	E-24
SWAT02	2W	$\sqrt{P \times R}$	$2.5 \times \sqrt{P \times R}$	10KV	1 Ω	470Ω	± 5%	E-24
SWAT03	3W	$\sqrt{P \times R}$	$2.5 \times \sqrt{P \times R}$	12KV	1 Ω	470Ω	± 5%	E-24

* Rated Continuous Maximum Working Voltage (RCWV) should be determined from $RCWV = \sqrt{\text{Power Rating} \times \text{Resistance Values}}$

** Short-time Overload (STOL) test should be determined from $STOL = 2.5 \times RCWV$

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■ TAPING/PACKING SPECIFICATIONS



Unit (mm)

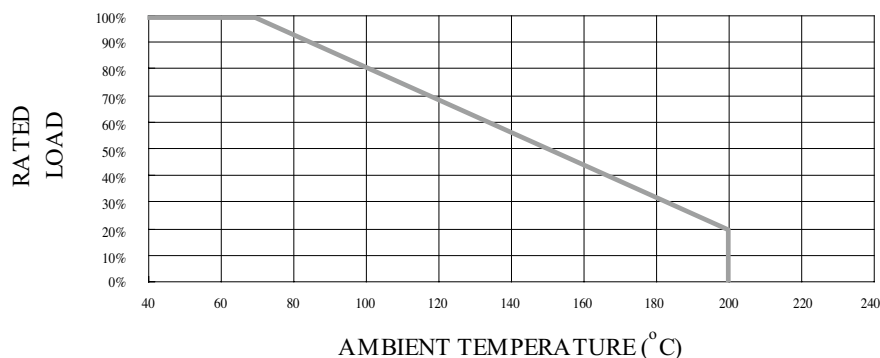
Type	A (Max.)	L1-L2 (Max.)	L3 (Max.)	P ±0.5	S (Max.)	T ±0.5	W ±1.5	Z (Max.)
SWAT01	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
SWAT02	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
SWAT03	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2

■ TECHNICAL SPECIFICATIONS

Characteristics		Limits
Dielectric Withstanding Voltage, VAC or DC	SWAT01 / SWAT02	600
	SWAT03	1000
Temperature Coefficient, PPM / °C*	±100, ±300	
Operating Temperature Range, °C	-55 ~ +200	
Insulation Resistance, MΩ	10 ⁴	
Fusing Characteristics	constant voltage	Interrupts in max. 10 seconds at 40 times rated power
	thermal fuse	Interrupts in max. 5 minutes at 3.5 times rated amp at 265°C (special request)

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ POWER DERATING CURVE



SWAT - Anti-Surge Wire Wound Fast-Fuse Resistors

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SWAT

■ PART NUMBER

Example: SWAT01J10R0TKZTB1K0

SWAT01	J	10R0	TKZ	TB1K0
Type	Tolerance	Resistance	TCR	Packaging
	J (5%)	10Ω 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.*	5-character code TB = Tape Box (pieces per box) SWAT01 1K0 = 1,000 <u>SWAT02/SWAT03</u> 500 = 500

* For the availabilities of non-default temperature coefficient, please check with us.

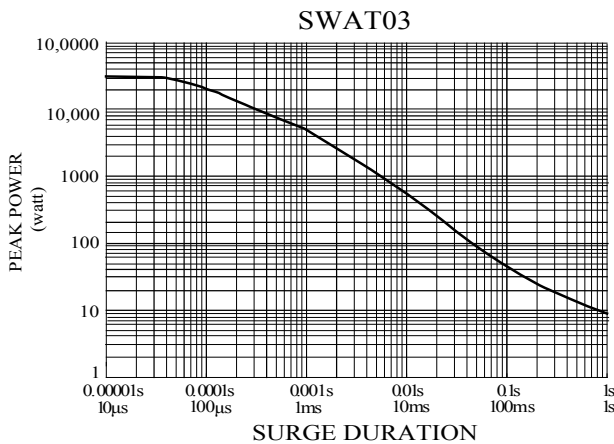
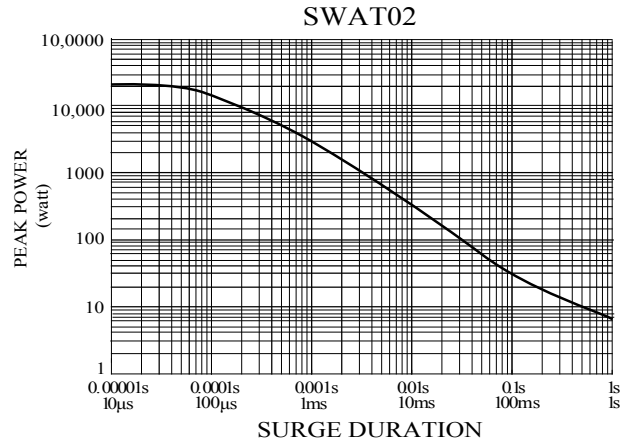
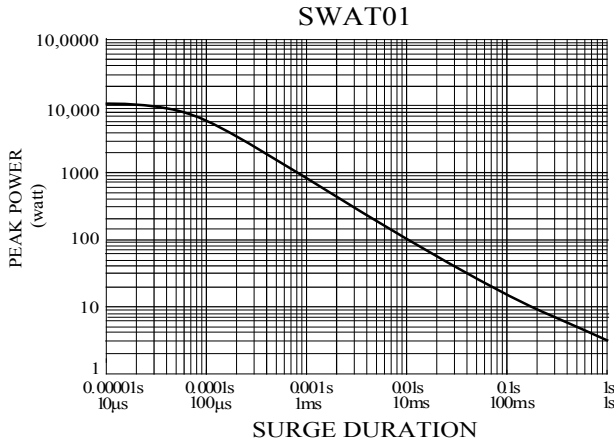
■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage	±3%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load at (40±2)°C and (93±3)% relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±2.5%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min. coverage
Vibration	IEC 60115 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±2%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 125°C without load	±5%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±5%
Surge Test	Surge voltage = $\sqrt{(9,000 PR)}$ DC P is power rating, R is resistance value, surge voltage is not more than listed at right. Surge spec = 1.2/50µs Period = 60 sec Number of surges = 10	±5%

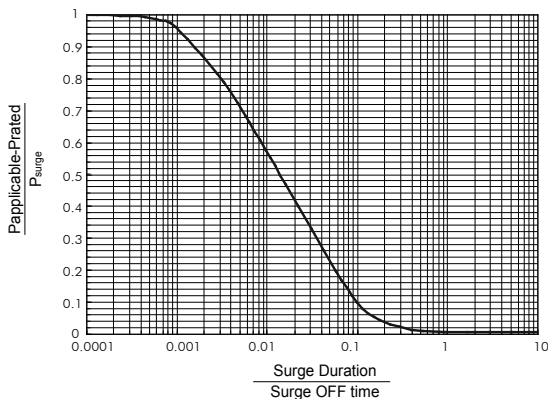
Safety • Quality • Reliability
Cost-Down via Innovation

SWAT

■ SINGLE SURGE PERFORMANCE



■ SURGE POWER DERATING CURVE

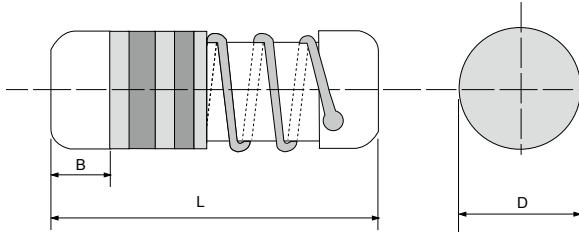


Notes:

- SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further linearly down to zero at 150 °C.
- To determine applicable surge power in continuous-surge applications:
 1. Identify allowable duration and peak power P_{surge} of single surge;
 2. Determine ratio of surge duration/surge OFF time in application;
 3. Calculate $P_{applicable}$ backwardly according to Y-axis of SURGE POWER DERATING CURVE.

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Cost-Down via Innovation

SWM



[*structure pending patent approval]
Taiwan patent number: M530462
Japan patent number: 3208923
China patent number: 6433867
Korean patent number: 20-0486309
United States patent number: US9978483B2

Specifications Per

• IEC 60115-1, 60115-4

Features

- AEC-Q200 Compliant
- SMD enabled structure
- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- Flameproof multi-layer coating equivalent to UL 94 V-0
- Flameproof feature equivalent to overload test UL 1412
- Enhanced weld spot is reliable against surge
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency
- SWM series is applied in high surge applications such as high rush current protection for power capacitor, motor start-up protection, car & motorcycle engine ignition, etc. to absorb harmful surge energy, so to prevent hazard of circuit damage caused by surge energy

DIMENSIONS

Type	Body Length (L, mm)	Body Diameter (D, mm)	Soldering Spot (B, mm)
SWM100	8.50 ± 0.5	3.0 ± 0.2	1.3 Min.
SWM200	10.5 ± 0.5	4.0 ± 0.5	1.6 Min.
SWM300	12.6 ± 0.6	4.6 ± 0.5	1.8 Min.
SWM400	14.6 ± 0.6	5.1 ± 0.5	2.0 Min.

GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage*	Maximum Overload Voltage**	Maximum Permissible Surge Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
SWM100	1W	$\sqrt{P \times R}$	$2.5 \times \sqrt{P \times R}$	7.5KV	1 Ω	1.2KΩ	± 5%	E-24
SWM200	2W	$\sqrt{P \times R}$	$2.5 \times \sqrt{P \times R}$	8.5KV	1 Ω	1.2KΩ	± 5%	E-24
SWM300	3W	$\sqrt{P \times R}$	$2.5 \times \sqrt{P \times R}$	9KV	1 Ω	1.2KΩ	± 5%	E-24
SWM400	4W	$\sqrt{P \times R}$	$2.5 \times \sqrt{P \times R}$	11KV	1 Ω	1.2KΩ	± 5%	E-24

* Rated Continuous Maximum Working Voltage (RCWV) should be determined from $RCWV = \sqrt{\text{Power Rating} \times \text{Resistance Values}}$

** Short-time Overload (STOL) test should be determined from $STOL = 2.5 \times RCWV$

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Cost-Down via Innovation

■ PART NUMBER

Example: SWM200J100RTKZBK2K0

SWM200	J	100R	TKZ	BK2K0
Type	Tolerance	Resistance	TCR	Packaging
	J (5%)	100Ω 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.*	5-character code TR= Tape Reel (pieces per reel) SWM100 2K5=2,500 SWM200 2K0=2,000 BK = Bulk SWM100/SWM200 SWM300/SWM400 BK + Quantity

SWM

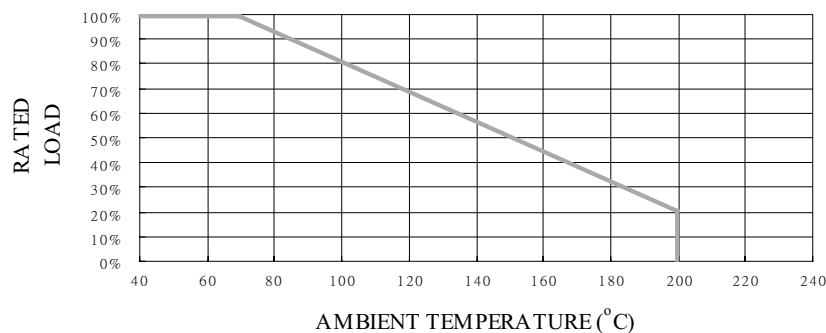
* For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

■ TECHNICAL SPECIFICATIONS

Characteristics	Limits	
Dielectric Withstanding Voltage, VAC or DC	SWM100 / SWM200 / SWM300	700
	SWM400	1000
Temperature Coefficient, PPM / °C*	±100, ±300	
Operating Temperature Range, °C	-55 ~ +200	
Insulation Resistance, MΩ	10 ⁴	
Failure Rate in Time, pcs / 10 ⁹ device hours	<0.5	

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ POWER DERATING CURVE



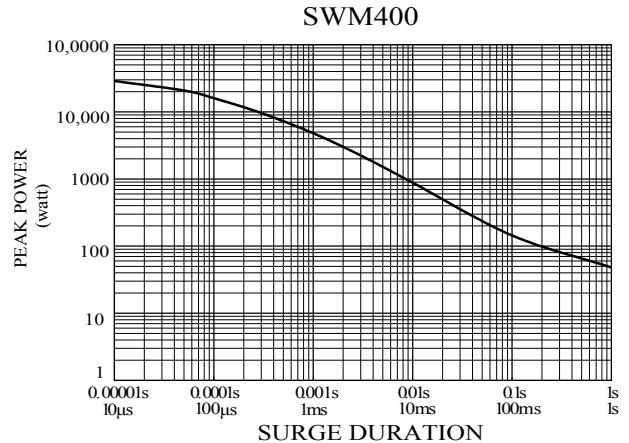
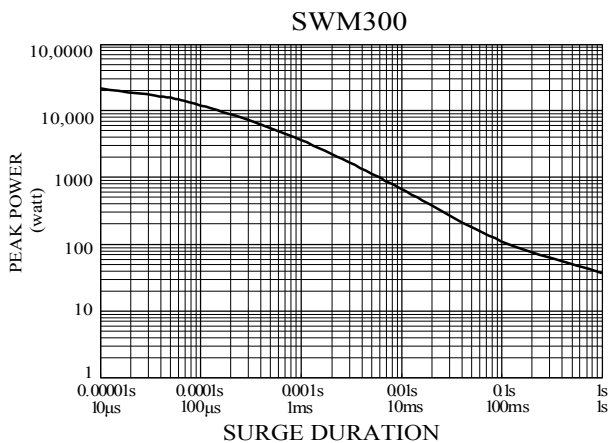
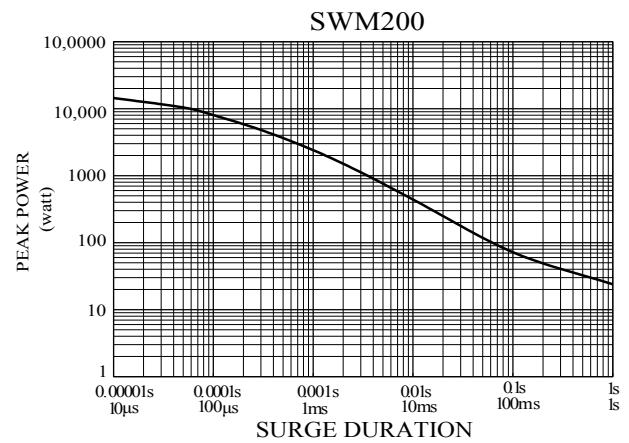
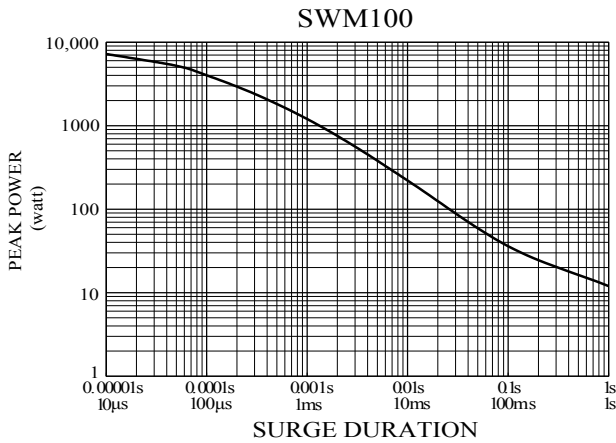
■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±2%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds	±1.5%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (230±3)°C/(2±0.2) seconds with flux applied	95% min. coverage
Vibration	IEC 60115 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 200°C without load	±3%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±3%
Surge Test	Surge voltage = $\sqrt{(10,000 PR)}$ DC P is power rating, R is resistance value, surge voltage is not more than listed at right. Surge spec = 1.2/50µs Period = 60 sec Number of surges = 100	±5%

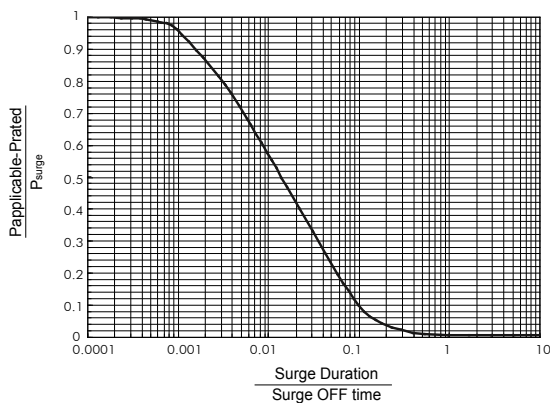
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Cost-Down via Innovation

SWM

■ SINGLE SURGE PERFORMANCE



■ SURGE POWER DERATING CURVE



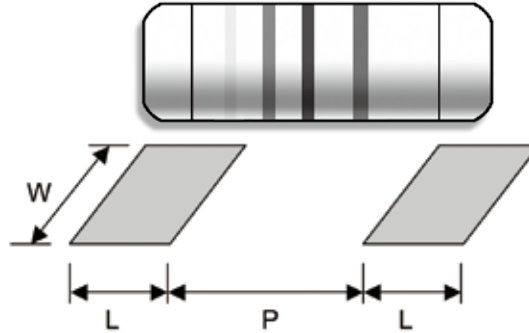
Notes:

- SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further linearly down to zero at 150 °C.
- To determine applicable surge power in continuous-surge applications:
 1. Identify allowable duration and peak power P_{surge} of single surge;
 2. Determine ratio of surge duration/surge OFF time in application;
 3. Calculate $P_{applicable}$ backwardly according to Y-axis of SURGE POWER DERATING CURVE.

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■ SUGGESTED PAD LAYOUT



Type	Soldering Mode*	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
SWM100	Reflow (Solder thickness recommended)	3.0	4.9 ± 0.3	3.7
	Wave	3.5	4.8 ± 0.3	4.0
SWM200	Reflow (Solder thickness recommended)	4.0	6.2 ± 0.4	5.0
	Wave	4.5	6.0 ± 0.4	5.0
SWM300	Reflow (Solder thickness recommended)	4.5	8.0 ± 0.4	5.5
	Wave	5.0	7.7 ± 0.4	5.5
SWM400	Reflow (Solder thickness recommended)	5.0	9.3 ± 0.4	6.5
	Wave	5.0	9.0 ± 0.4	6.0

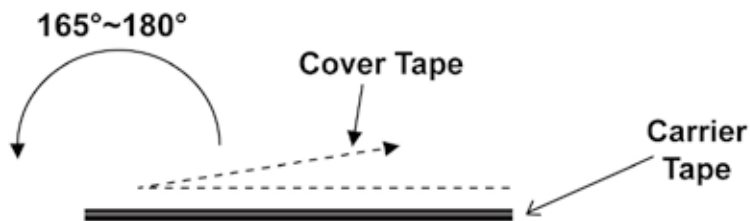
For better heat dissipation / lower heat resistance, increase W & L.
*Wave soldering is highly recommended for all SWM types.

■ COVER TAPE PEELING SPECIFICATION

Recommended peeling force:

SWM100, SWM200: 70±10gf

SWM300, SWM400: 80±10gf

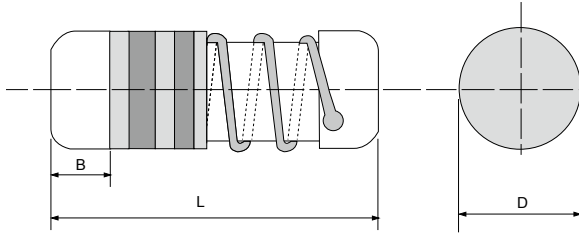


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SWMT



[*structure pending patent approval]
Taiwan patent number: I637420
United States patent number: US10170266B2

Applications

- Lighting devices
- Motor start-up protection
- Power supplies & Power adapters
- High rush current protection for power capacitor

Specifications Per

- IEC 60115-1, 60115-4

Features

- Worldwide patent pending
- Enhanced welded spot is reliable against surge
- Fast-acting fuse device for high-power applications
- Advanced combined anti- surge & fast-fuse structure
- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- Flameproof multi-layer coating equivalent to UL 94 V-0
- Flameproof feature equivalent to overload test UL 1412
- Thermal fuse to protect against over-heating in electronic products
- SMD enabled structure
- RoHS / REACH Compliant

DIMENSIONS

Type	Body Length (L, mm)	Body Diameter (D, mm)	Soldering Spot (B, mm)
SWMT100	8.50 ± 0.5	3.0 ± 0.2	1.3 Min.
SWMT200	10.5 ± 0.5	4.0 ± 0.5	1.6 Min.
SWMT300	12.6 ± 0.6	4.6 ± 0.5	1.8 Min.
SWMT400	14.6 ± 0.6	5.1 ± 0.5	2.0 Min.

GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage*	Maximum Overload Voltage**	Maximum Permissible Surge Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
SWMT100	1W	$\sqrt{P \times R}$	$2.5 \times \sqrt{P \times R}$	7.5KV	1 Ω	470Ω	± 5%	E-24
SWMT200	2W	$\sqrt{P \times R}$	$2.5 \times \sqrt{P \times R}$	8.5KV	1 Ω	470Ω	± 5%	E-24
SWMT300	3W	$\sqrt{P \times R}$	$2.5 \times \sqrt{P \times R}$	9KV	1 Ω	470Ω	± 5%	E-24
SWMT400	4W	$\sqrt{P \times R}$	$2.5 \times \sqrt{P \times R}$	11KV	1 Ω	470Ω	± 5%	E-24

* Rated Continuous Maximum Working Voltage (RCWV) should be determined from $RCWV = \sqrt{\text{Power Rating} \times \text{Resistance Values}}$

** Short-time Overload (STOL) test should be determined from $STOL = 2.5 \times RCWV$

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■ PART NUMBER

Example: SWMT200J2R80TKZBK2K0

SWMT200	J	2R80	TKZ	BK2K0
Type	Tolerance	Resistance	TCR	Packaging
	J (5%)	2.8Ω 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.*	5-character code TR= Tape Reel (pieces per reel) <u>SWMT100</u> 2K5=2,500 <u>SWMT200</u> 2K0=2,000 BK = Bulk <u>SWMT100/SWMT200</u> <u>SWMT300/SWMT400</u> BK + Quantity

SWMT

* For the availabilities of non-default temperature coefficient, please check with us.

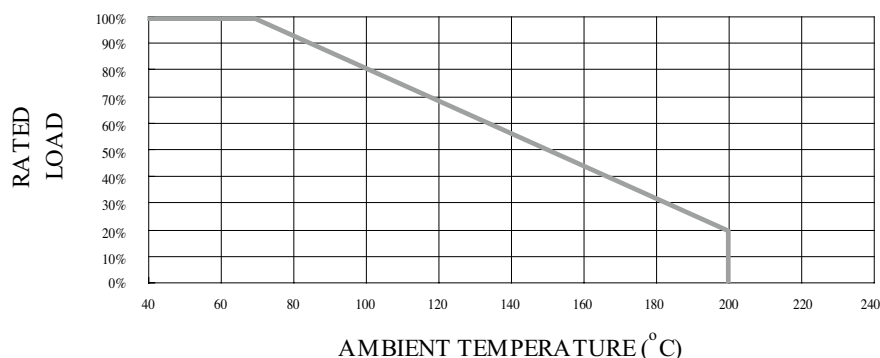
■ TECHNICAL SPECIFICATIONS

Characteristics		Limits
Dielectric Withstanding Voltage, VAC or DC	SWMT100 / SWMT200 / SWMT300	700
	SWMT400	1000
Temperature Coefficient, PPM / °C*	±120	
Operating Temperature Range, °C	-55 ~ +200	
Insulation Resistance, MΩ	10 ⁴	
Fusing Characteristics**	constant voltage	Interrupts in max. 10 seconds at 40 times rated power
	thermal fuse	Interrupts in max. 5 minutes at 3.5 times rated amp at 265°C (special request)

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

** Recommended to install a fuse holder if fusing function is required

■ POWER DERATING CURVE



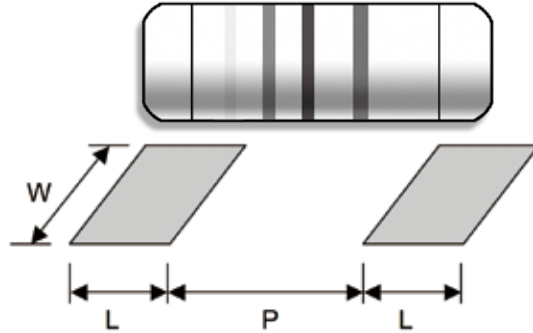
■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±3%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds	±3%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (230±3)°C/(2±0.2) seconds with flux applied	95% min. coverage
Vibration	IEC 60115 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±2%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 125°C without load	±5%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±5%
Surge Test	Surge voltage = $\sqrt{8,000 PR}$ DC P is power rating, R is resistance value, surge voltage is not more than listed at right. Surge spec = 1.2/50µs Period = 60 sec Number of surges = 10	±5%

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SWMT

■ SUGGESTED PAD LAYOUT



Type	Soldering Mode*	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
SWMT100	Reflow (Solder thickness recommended)	3.0	4.9 ± 0.3	3.7
	Wave	3.5	4.8 ± 0.3	4.0
SWMT200	Reflow (Solder thickness recommended)	4.0	6.2 ± 0.4	5.0
	Wave	4.5	6.0 ± 0.4	5.0
SWMT300	Reflow (Solder thickness recommended)	4.5	8.0 ± 0.4	5.5
	Wave	5.0	7.7 ± 0.4	5.5
SWMT400	Reflow (Solder thickness recommended)	5.0	9.3 ± 0.4	6.5
	Wave	5.0	9.0 ± 0.4	6.0

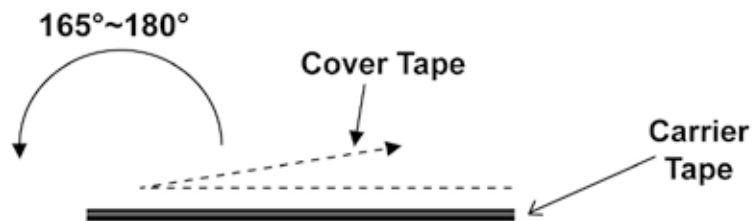
For better heat dissipation / lower heat resistance, increase W & L.
*Wave soldering is highly recommended for all SWMT types.

■ COVER TAPE PEELING SPECIFICATION

Recommended peeling force:

SWMT100, SWMT200: 70±10gf

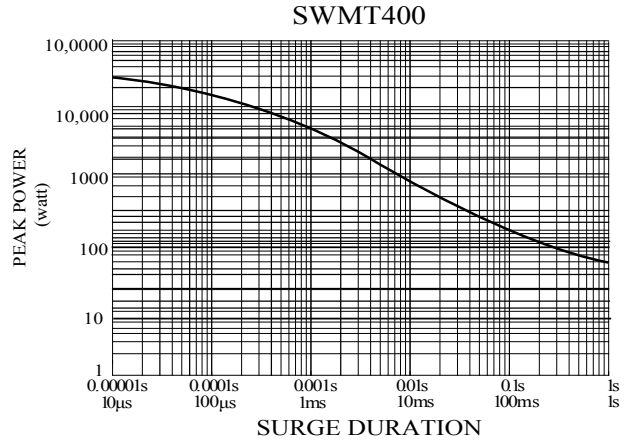
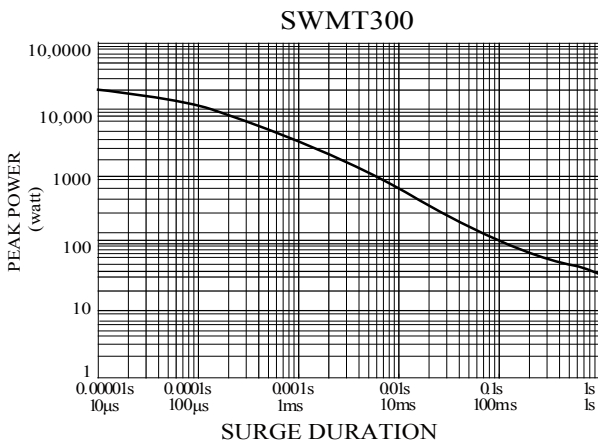
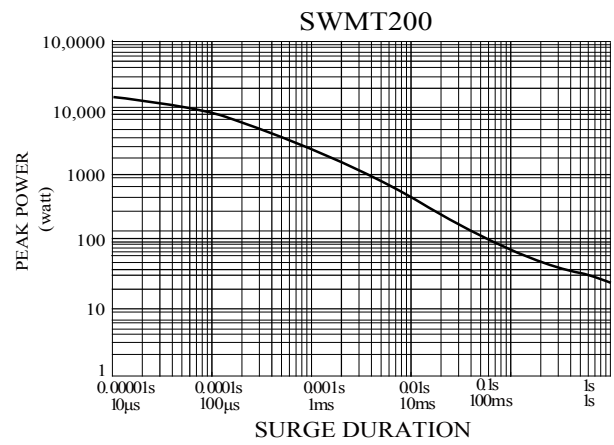
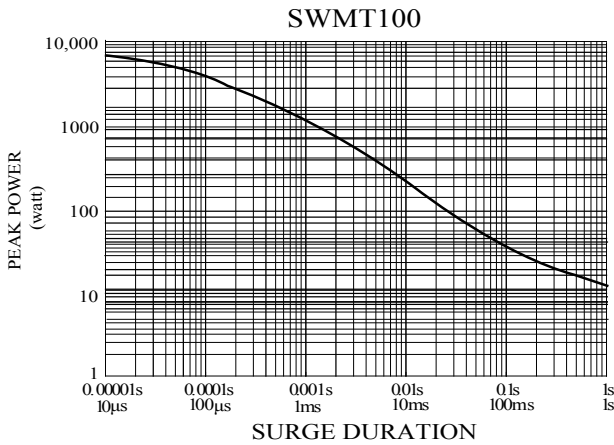
SWMT300, SWMT400: 80±10gf



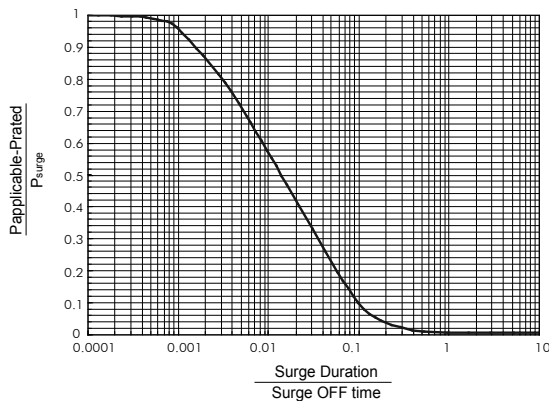
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SWMT

■ SINGLE SURGE PERFORMANCE



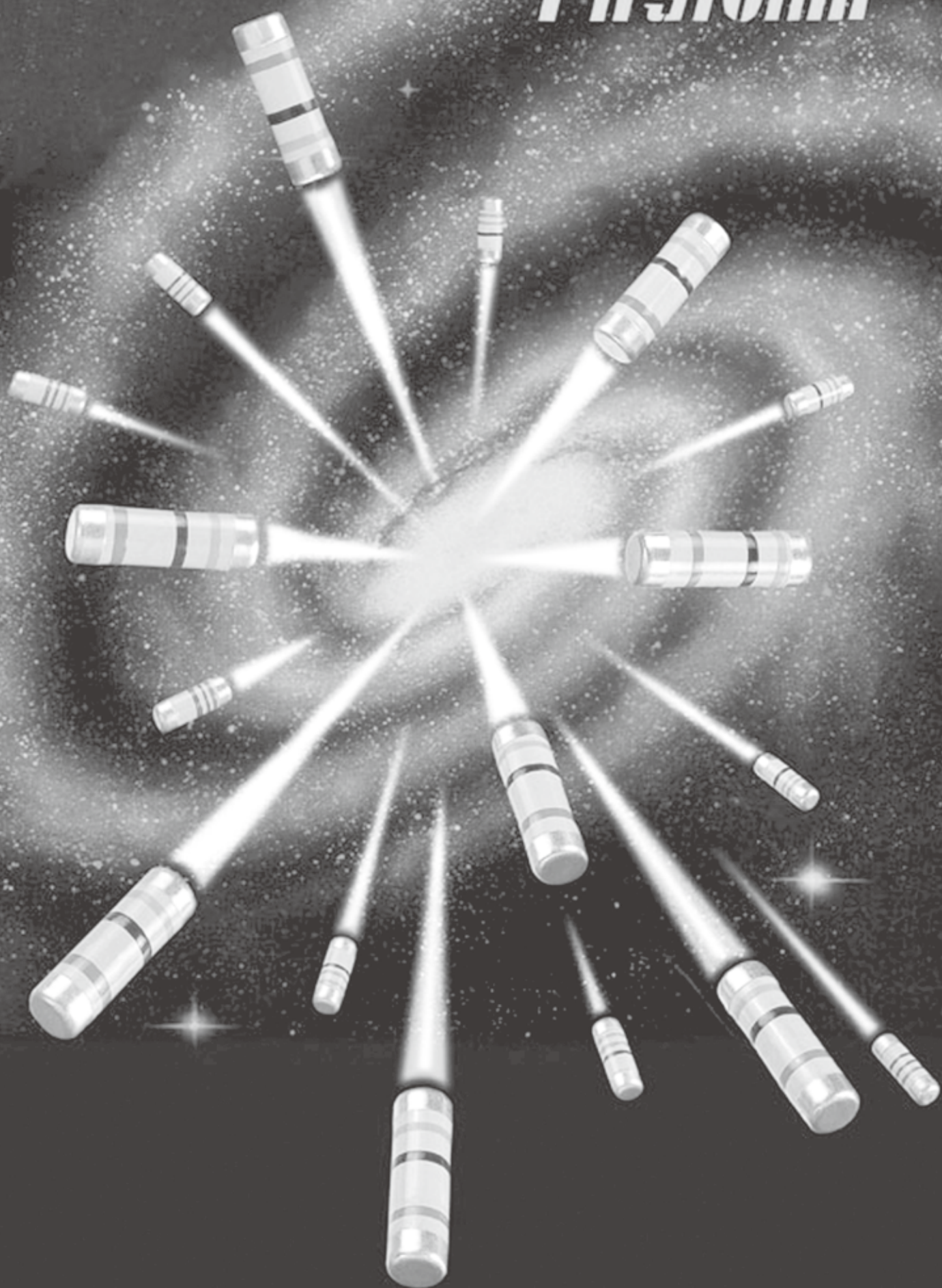
■ SURGE POWER DERATING CURVE

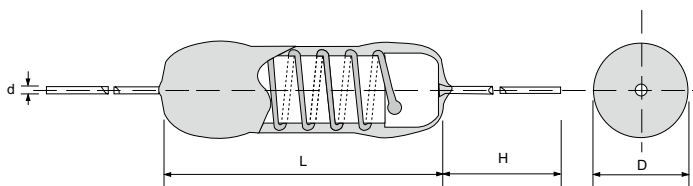


Notes:

- SINGLE SURGE PERFORMANCE graph is good for NON REPETITIVE applications operating in an ambient temperature of 70°C or less. For temperatures above 70°C, the graph power must be derated further linearly down to zero at 150 °C.
- To determine applicable surge power in continuous-surge applications:
 1. Identify allowable duration and peak power P_{surge} of single surge;
 2. Determine ratio of surge duration/surge OFF time in application;
 3. Calculate $P_{applicable}$ backwardly according to Y-axis of SURGE POWER DERATING CURVE.

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Specifications Per

• IEC 60115-1, IEC 60115-4

Features

- Flameproof multi-layer coating equivalent to UL 94 V-0
- Flameproof feature equivalent to overload test UL 1412
- Color code per MIL & EIA standards
- Special tin-plated electrolytic copper lead wire
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

■ DIMENSIONS

Type	Body		Leadwire	
	Length (L, mm)	Diameter (D, mm)	Length (H, mm)	Diameter (d, mm)
WA051	8.80 ± 1.0	3.2 ± 0.2	28 ± 3.0	0.6 ± 0.03
WA01	11.0 ± 1.0	4.0 ± 0.5	28 ± 3.0	0.7 ± 0.03
WA02	13.5 ± 1.0	5.0 ± 0.5	30 ± 3.0	0.8 ± 0.03
WA03	15.5 ± 1.0	5.5 ± 0.5	30 ± 3.0	0.8 ± 0.03
WA04/WA05	19.0 ± 1.0	6.0 ± 0.5	30 ± 3.0	0.8 ± 0.03
WA06	24.0 ± 1.0	8.0 ± 0.5	35 ± 3.0	0.8 ± 0.03
WA07/WA08	31.5 ± 1.0	8.0 ± 0.5	30 ± 3.0	0.8 ± 0.03

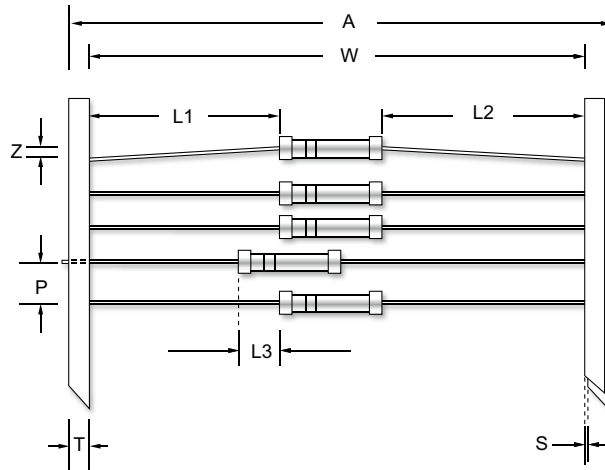
■ GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance
WA051	1/2W	350V	600V	0.1Ω	390Ω	±2%, ±5%
WA01	1W	350V	600V	0.1Ω	449Ω	±2%, ±5%
WA02	2W	350V	700V	0.1Ω	549Ω	±2%, ±5%
WA03	3W	350V	700V	0.1Ω	1KΩ	±2%, ±5%
WA04/WA05	4W / 5W	450V	800V	0.1Ω	1K5Ω	±2%, ±5%
WA06	6W	500V	1000V	0.1Ω	3K3Ω	±2%, ±5%
WA07/WA08	7W / 8W	600V	1200V	0.1Ω	3K3Ω	±2%, ±5%

Special sizes, values, and specifications not listed available on special order.

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■ TAPING/PACKING SPECIFICATIONS



Unit (mm)

Type	A Max.	L1-L2 (Max.)	L3 (Max.)	P ±0.5	S (Max.)	T ±0.5	W ±1.5	Z (Max.)
WA051	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
WA01	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
WA02	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
WA03	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
WA04/WA05	76	±1.5	1.0	10.0	0.8	6.0	63.5	1.2
WA06	97	±1.5	1.0	10.0	0.8	6.0	83.0	1.2
WA07/WA08	97	±1.5	1.0	10.0	0.8	6.0	83.0	1.2

■ TECHNICAL SPECIFICATIONS

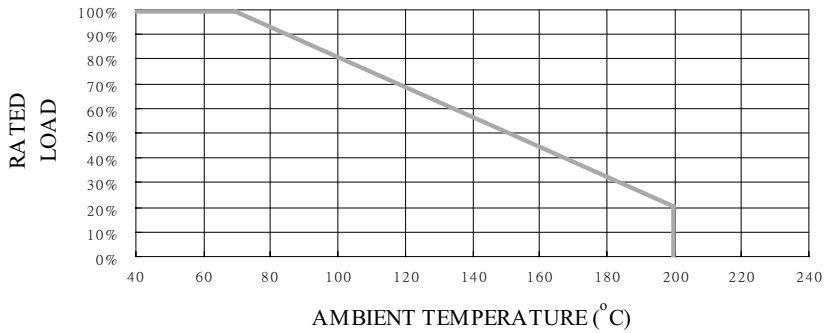
Characteristics	Limits	
Dielectric Withstanding Voltage, VAC or DC	WA051 WA01 / WA02 WA03 / WA04 / WA05 / WA06 / WA07 / WA08	350 600 1000
Temperature Coefficient 1/2W to 8W, PPM / °C*	±100, ±300	
Operating Temperature Range, °C	-55 ~ +200	
Insulation Resistance, MΩ	10 ⁴	

* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

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WA

■ POWER DERATING CURVE



■ PART NUMBER

Example: WA051J100RTKZTB2K0

WA051	J	100R	TKZ	TB2K0
Type	Tolerance	Resistance	TCR	Packaging
	G (2%) J (5%)	100Ω 4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.*	5-character code TB = Tape Box (pieces per box) WA051 2K0 = 2,000 WA01 1K0 = 1,000 <u>WA02/WA03/</u> <u>WA04/WA05</u> 500 = 500 <u>WA06/WA07</u> WA08 250 = 250

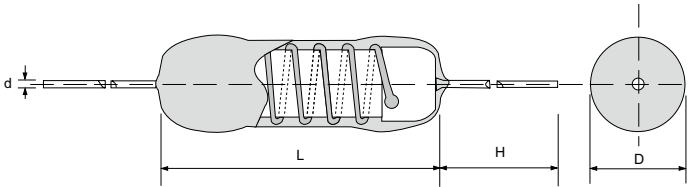
* For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

■ PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±1%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 200°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±2%

Safety • Quality • Reliability
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WA



Specifications Per

• IEC 60115-1, IEC 60115-4

Features

- Flameproof multi-layer coating equivalent to UL 94 V-0
- Flameproof feature equivalent to overload test UL 1412
- Color code per MIL & EIA standards
- Special tin-plated electrolytic copper lead wire
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

DIMENSIONS

Type	Body		Leadwire	
	Length (L, mm)	Diameter (D, mm)	Length (H, mm)	Diameter (d, mm)
WA01S	8.80 ± 1.0	3.2 ± 0.2	28 ± 3.0	0.6 ± 0.03
WA02S	11.0 ± 1.0	4.0 ± 0.5	28 ± 3.0	0.7 ± 0.03
WA03S	13.5 ± 1.0	5.0 ± 0.5	30 ± 3.0	0.8 ± 0.03
WA04S	15.5 ± 1.0	5.5 ± 0.5	30 ± 3.0	0.8 ± 0.03
WA05S / WA06S	19.0 ± 1.0	6.0 ± 0.5	30 ± 3.0	0.8 ± 0.03

GENERAL SPECIFICATIONS

Type	Power Rating (at 70°C)	Maximum Working Voltage	Maximum Overload Voltage	Minimum Resistance	Maximum Resistance	Resistance Tolerance	Available Resistance Values
WA01S	1W	350V	600V	0.1Ω	390Ω	± 2%, ±5%	E-48/E-24
WA02S	2W	350V	700V	0.1Ω	449Ω	± 2%, ±5%	E-48/E-24
WA03S	3W	350V	700V	0.1Ω	549Ω	± 2%, ±5%	E-48/E-24
WA04S	4W	350V	700V	0.1Ω	1KΩ	± 2%, ±5%	E-48/E-24
WA05S WA06S	5W / 6W	450V	800V	0.1Ω	1K5Ω	± 2%, ±5%	E-48/E-24

Special sizes, values, and specifications not listed available on special order.

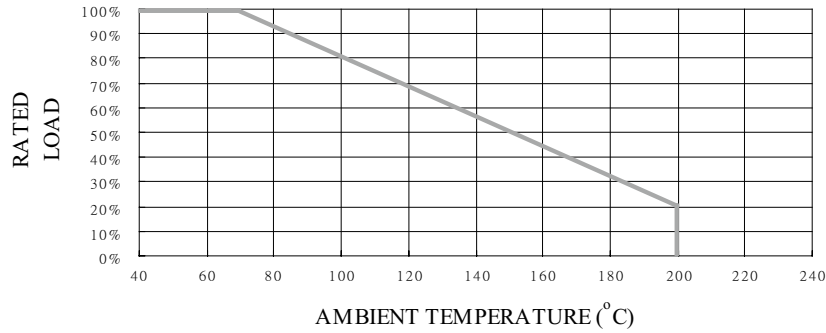
PART NUMBER

Example: WA03SJ100RTKZTB500

WA03S	J	100R	TKZ	TB500
Type	Tolerance	Resistance	TCR	Packaging
	G (2%) J (5%)	100Ω 4-character code containing - 3 significant digits 1 letter multiplier OHM MULTIPLIER R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the Technical Summary section of the datasheet.*	5-character code TB = Tape Box (pieces per box) WA01S 2K0 = 2,000 WA02S 1K0 = 1,000 WA03S/WA04S WA05S/WA06S 500 = 500

* For the availabilities of non-default temperature coefficient, please check with us. Reference for TCR letter codes can be found in section (4) of Part Number Construction in the Appendices.

POWER DERATING CURVE



TECHNICAL SUMMARY

Characteristics	Limits	
Dielectric Withstanding Voltage, VAC or DC	WA01S WA02S / WA03S WA04S / WA05S / WA06S	350 600 1000
Temperature Coefficient, PPM / °C*	Typically ±300	
Operating Temperature Range, °C	-55 ~ +200	
Insulation Resistance, MΩ	10 ⁴	

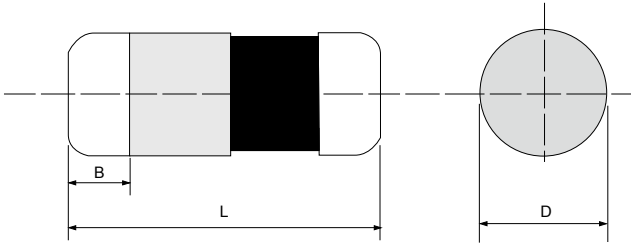
* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

PERFORMANCE SPECIFICATIONS

Characteristics	Test Conditions	Limits
Short Time Over Load	IEC 60115-1 4.13 5 seconds 2.5x rated voltage (not over max. overload voltage)	±1%
Load Life In Humidity	IEC 60115-1 4.24 56 days rated load (not over max. working voltage) at (40±2)°C and (93±3)% relative humidity	±5%
Load Life	IEC 60115-1 4.25.1 Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at (70±2)°C	±5%
Resistance To Soldering Heat	IEC 60115-1 4.18.2 Leads immersed till 3mm from the body in (260±5)°C solder for 10±1 seconds	±1%
Solderability	IEC 60115-1 4.17.2 Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min.coverage
Vibration	IEC 60115-1 4.22 Six hours in each parallel and axial direction with a simple harmonic motion having an amplitude of 0.75mm and 10 to 500 Hz.	±1%
Thermal Endurance	IEC 60115-1 4.25.3 1000 hours at 200°C without load	±1%
Thermal Shock	IEC 60115-1 4.19 -55°C 30minutes, +155°C 30minutes, 5 cycles	±2%

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ZMM



Specifications Per

- IEC 60115-1, IEC 60115-2

Features

- Excellent in heat dissipation than chip resistor
- Stronger mechanical structure to seismic vibration and thermal shock
- SMD enable structure
- Excellent solderability termination
- Stable metal film construction
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

■ DIMENSIONS

Type	Body Length (L, mm)	Cap Diameter (D1, mm)	Body Diameter (D2, mm)	Soldering Spot (B, mm)	Net Weight Per 1000 pcs
ZMM204	3.52 ± 0.15	1.35 ± 0.1	D1+0.02/ -0.15	0.6 Min.	17 grams
ZMM207	5.90 ± 0.20	2.20 ± 0.1	D1+0.02/ -0.2	1.0 Min.	66 grams

■ GENERAL SPECIFICATIONS

Type	Maximum Resistance	Maximum Current
ZMM204	20mΩ	2A
ZMM207	20mΩ	4A

Special value available on request.

■ TECHNICAL SPECIFICATIONS

Characteristics	Limits	
	ZMM204	ZMM207
Insulation Voltage (1min)	>500V AC	>700V AC
Insulation Resistance	>10 ¹¹ Ω	>10 ¹¹ Ω
Operating Temperature	-55 ~ +125°C	-55 ~ +125°C
Failure Rate in Time, pcs / 10 ⁹ device hours	<1.5	

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ZMM

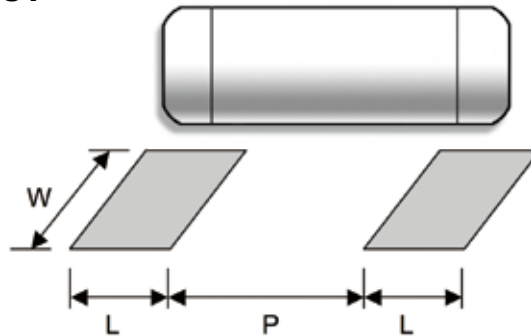
■ PART NUMBER

Example: ZMM204ZR000TKZTR3K0

ZMM204	Z	R000	TKZ	TR3K0
Type	Tolerance Z (Jumper)	Resistance* 0Ω 4-character code	TCR 3-character code TKZ= Default Product Temperature Coefficient	Packaging 5-character code TR = Tape Reel (pieces per reel) ZMM204 3K0 = 3,000 6K0 = 6,000** 10K = 10,000** ZMM207 2K0 = 2,000 6K0 = 6,000** 10K = 10,000**

* Please refer to the General Specifications section of ZMM datasheet for information on maximum resistance value. **upon request

■ SUGGESTED PAD LAYOUT



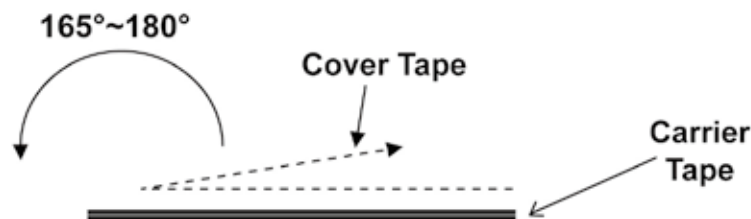
Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
ZMM204	Reflow	1.3	1.6 ± 0.1	1.6
	Wave	1.5	1.5 ± 0.1	1.8
ZMM207	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0

For better heat dissipation / lower heat resistance, increase W & L.

■ COVER TAPE PEELING SPECIFICATION

Recommended peeling force:

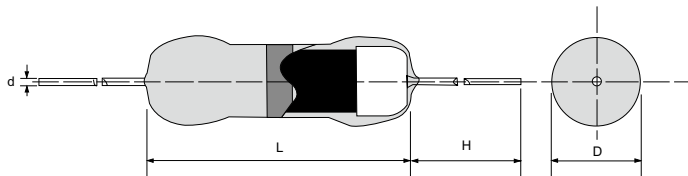
ZMM204, ZMM207: 50±5gf



ZOM Zero Ohm Metal Film Resistor

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ZOM



Features

- Conformal multi-layer coating against humidity
- Very low resistance
- Stable metal film construction
- Special tin-plated deoxygenized copper wire for resistance stabilization during operation
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

■ DIMENSIONS

Type	Body Length (L, mm)	Body Diameter (D, mm)	Lead Wire Length (H, mm)	Lead Wire Diameter (d, mm)	Net Weight Per 1000Pcs
ZOM204	3.2 ± 1.0	1.8 ± 0.2	28 ± 1.0	0.5 ± 0.03	145 Grams
ZOM207	6.5 ± 0.7	2.4 ± 0.2	26 ± 1.0	0.6 ± 0.03	220 Grams

■ GENERAL SPECIFICATIONS

Type	Maximum Resistance	Maximum Current
ZOM204	10mΩ	3A
ZOM207	10mΩ	5A

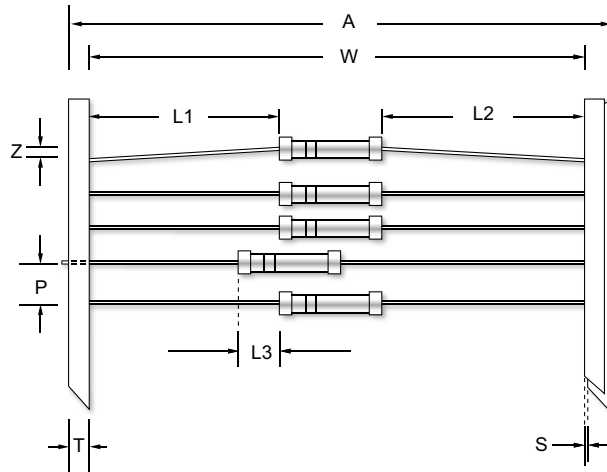
Special sizes, values, and specifications not listed available on special order.

■ TECHNICAL SPECIFICATIONS

Characteristics	Limits	
	ZOM204	ZOM207
Insulation Voltage (1min)	>500V AC	>700V AC
Insulation Resistance	>10 ¹¹ Ω	>10 ¹¹ Ω
Operating Temperature	-55 ~ +155 °C	-55 ~ +155 °C
Terminal Strength	>30N	>50N
Failure Rate	<10pcs out of 10 ⁹ device hours	<10pcs out of 10 ⁹ device hours

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■ TAPING/PACKING SPECIFICATIONS



Unit (mm)

Type	A Max.	L1-L2 (Max.)	L3 (Max.)	P ±0.5	S (Max.)	T ±0.5	W ±1.5	Z (Max.)
ZOM204	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2
ZOM207	65	±1.0	0.5	5.0	0.8	6.0	52.5	1.2

Type No.	Packing Type	ZOM204	ZOM207
Minimum Packing QTY (pcs)	Ammo pack	5000	5000

■ PART NUMBER

Example: ZOM207ZR000TKZTB5K0

ZOM207	Z	R000	TKZ	TB5K0
Type	Tolerance Z (Jumper)	Resistance* 0Ω 4-character code	TCR 3-character code TKZ = Default Product Temperature Coefficient.	Packaging 5-character code TB = Tape Box (pieces per box) ZOM204/ZOM207 5K0 = 5,000

* Please refer to the General Specifications section of ZOM datasheet for information on maximum resistance value.

ZOM

SRM-201 withstands 51,840,000 surges at 30KV, in duration of 500 hours.



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TÜV ISO 9002 ISO 14001 / IECQ CERTIFIED FACTORY

Appendices

Resistance Values to IEC-Standard

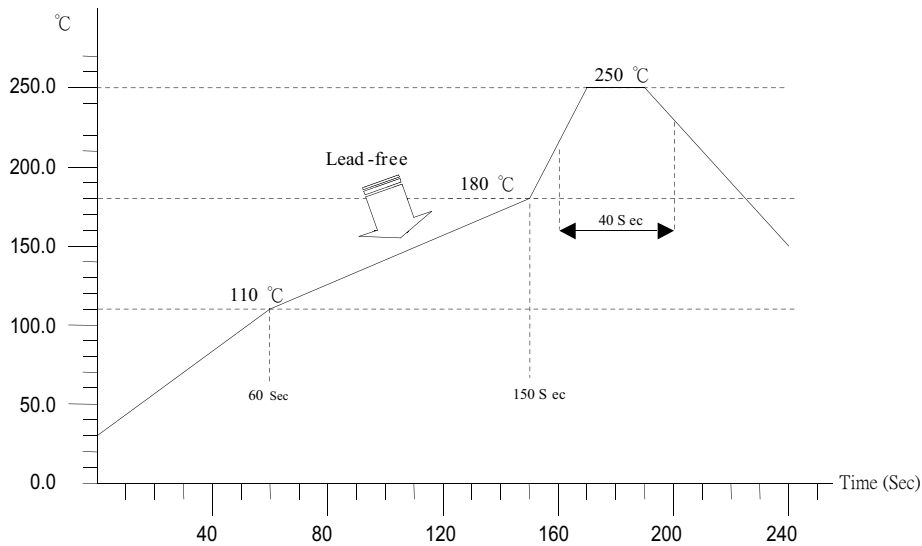
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E12 10%	E24 5%	E48 2%	E96 1%	E192 ≤0.5%	E12 10%	E24 5%	E48 2%	E96 1%	E192 0.5%	E12 10%	E24 5%	E48 2%	E96 1%	E192 ≤0.5%
100	100	100	100	100	220	220			218					481
				101				221	221			487	487	487
			102	102					223					493
				104			226	226	226				499	499
		105	105	105					229					505
				106				232	232	510	511	511	511	511
			107	107					234					517
				109			237	237	237				523	523
	110	110	110	110		240			240					530
				111				243	243			536	536	536
			113	113					246					542
				114			249	249	249				549	549
		115	115	115					252					556
				117				255	255	560	560	562	562	562
			118	118					258					569
120	120			120			261	261	261				576	576
		121	121	121					264					583
				123				267	267			590	590	590
			124	124	270	270			271					597
				126			274	274	274				604	604
		127	127	127					277					612
				129				280	280	620	619	619	619	619
	130		130	130					284					626
				132			287	287	287				634	634
		133	133	133					291					642
				135				294	294			649	649	649
			137	137					298					657
				138		300	301	301	301				665	665
		140	140	140					305					673
				142				309	309	680	680	681	681	681
				143					312					690
				145			316	316	316				698	698
		147	147	147					320					706
				149				324	324			715	715	715
150	150		150	150					328					723
				152	330	330	332	332	332				732	732
		154	154	154					336					741
				156				340	340	750	750	750	750	750
			158	158					344					759
	160			160			348	348	348				768	768
		162	162	162					352					777
				164				357	357			787	787	787
			165	165		360			361					796
				167			365	365	365				806	806
		169	169	169					370	820	820			816
				172				374	374			825	825	825
				174					379					835
				176			383	383	383				845	845
		178	178	178					388					856
180	180			180	390	390		392	392			866	866	866
			182	182					397					876
				184			402	402	402				887	887
		187	187	187					407					898
				189				412	412	910	909	909	909	909
			191	191					417					920
				193			422	422	422				931	931
		196	196	196		430			427					942
				198				432	432			953	953	953
			200	200					437					965
	200			203			442	442	442				976	976
		205	205	205					448					988
				208				453	453					
			210	210					459					
			210	210			464	464	464					
				213	470	470			470					
		215	215	215					475					

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SMD RESISTOR SOLDERING PROFILE FOR LEAD-FREE TERMINATION

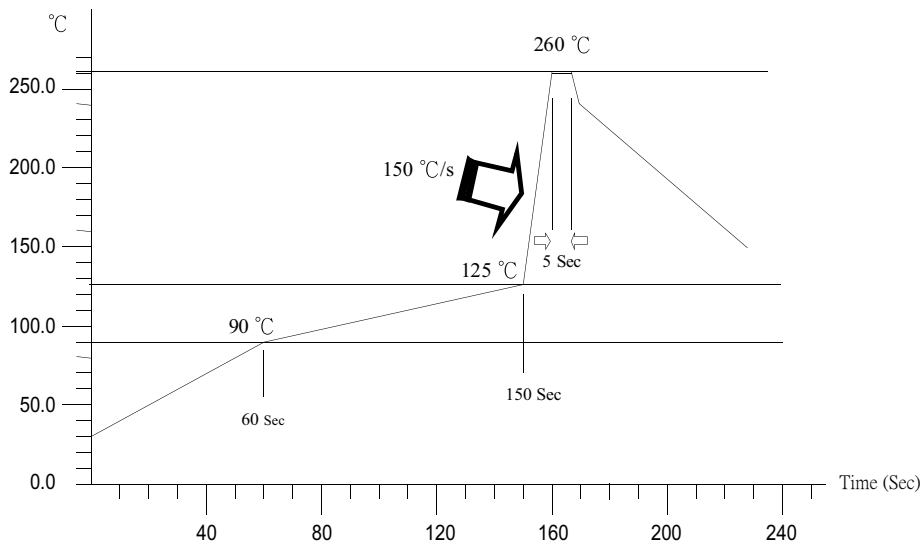
REFLOW SOLDERING



RECOMMENDATIONS

PRE-HEATING	OVER 120 SEC
RAMP-UP (WETTING)	2~4°C / SEC
RAMP-DOWN (COOLING)	-1~-3°C / SEC

WAVE SOLDERING



RECOMMENDATIONS

PRE-HEATING	OVER 120 SEC
RAMP-UP (WETTING)	150°C / SEC
RAMP-DOWN (COOLING)	-1~-3°C / SEC
TIME IN WAVE	5 SEC

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■ PART NUMBER CONSTRUCTION FOR M, MM, MM(P), MMP, MP, PMA, SFP AND SM SERIES:

Example: MM204F162R TKR TR3K0

MM204	F	162R	TKR	TR3K0
MM204	1%	162Ω	50ppm	Tape Reel 3,000 pieces per reel
Type	Tolerance*	Resistance	TCR	Packaging**
Type name seen in the datasheet	B (0.1%) C (0.25%) D (0.5%) F (1%) G (2%) J (5%)	4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code Insert the corresponding code for the temperature coefficient available for the specific product. Please see the TCR letter code table below in section (4)*.	5-character code TB = Tape Box TR = Tape Reel BK = Bulk*** 500 = 500 1K0 = 1,000 2K0 = 2,000 2K5 = 2,500 3K0 = 3,000 5K0 = 5,000 6K0 = 6,000 10K = 10,000

* May not be applicable to all product types or to all resistance values. Please check with us before placing order.

** Actual packaging varies by types. Please refer to the individual datasheet or check with us.

*** Quantities for bulk packaging vary by types. Please check with us.

■ PART NUMBER CONSTRUCTION FOR ALL OTHER SERIES:

Example: EFP101J1K00TKZTR2K0

EFP101	J	1K00	TKZ	TR2K0
EFP101	5%	1kΩ	Typical product temperature coefficient	Tape Reel 2,000 pieces per reel
Type	Tolerance*	Resistance	TCR	Packaging**
Type name seen in the datasheet	D (0.5%) F (1%) G (2%) J (5%) K (10%) M (20%)	4-character code containing - 3 significant digits 1 letter multiplier <u>OHM MULTIPLIER</u> R = 1 K = 10 ³ M = 10 ⁶ G = 10 ⁹	3-character code TKZ = Default Product Temperature Coefficient. Information of typical product temperature coefficient can be found in the technical summary of individual product datasheets. For availabilities of non-default temperature coefficient, please check with us. For reference on code letters, please see the TCR letter code table below in section (4)*.	5-character code TB = Tape Box TR = Tape Reel BK = Bulk*** 100 = 100 150 = 150 400 = 400 500 = 500 1K0 = 1,000 2K0 = 2,000 2K5 = 2,500 3K0 = 3,000 5K0 = 5,000 6K0 = 6,000 10K = 10,000

* May not be applicable to all product types or to all resistance values. Please check with us before placing order.

** Actual packaging varies by types. Please refer to the individual datasheets or check with us.

*** Quantities for bulk packaging vary by types. Please check with us.

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■ EXAMPLES OF RESISTANCE VALUE CODE MARKING

4-character code containing 3 significant digits and 1 letter multiplier

Resistance	Value	Code	Resistance	Value	Code
0.1	Ω	R100	10	KΩ	10K0
0.365	Ω	R365	36.5	KΩ	36K5
0.68	Ω	R680	68	KΩ	68K0
0.909	Ω	R909	90.9	KΩ	90K9
0	Ω	R000	--	--	--
1	Ω	1R00	100	KΩ	100K
3.65	Ω	3R65	365	KΩ	365K
6.8	Ω	6R80	680	KΩ	680K
9.09	Ω	9R09	909	KΩ	909K
10	Ω	10R0	1	MΩ	1M00
36.5	Ω	36R5	3.65	MΩ	3M65
68	Ω	68R0	6.8	MΩ	6M80
90.9	Ω	90R9	9.09	MΩ	9M09
100	Ω	100R	10	MΩ	10M0
365	Ω	365R	36.5	MΩ	36M5
680	Ω	680R	68	MΩ	68M0
909	Ω	909R	90.9	MΩ	90M9
1	KΩ	1K00	100	MΩ	100M
3.65	KΩ	3K65	365	MΩ	365M
6.8	KΩ	6K80	680	MΩ	680M
9.09	KΩ	9K09	909	MΩ	909M
			1	GΩ	1G00

■ LETTER CODE FOR TEMPERATURE COEFFICIENT OF RESISTANCE (TCR)

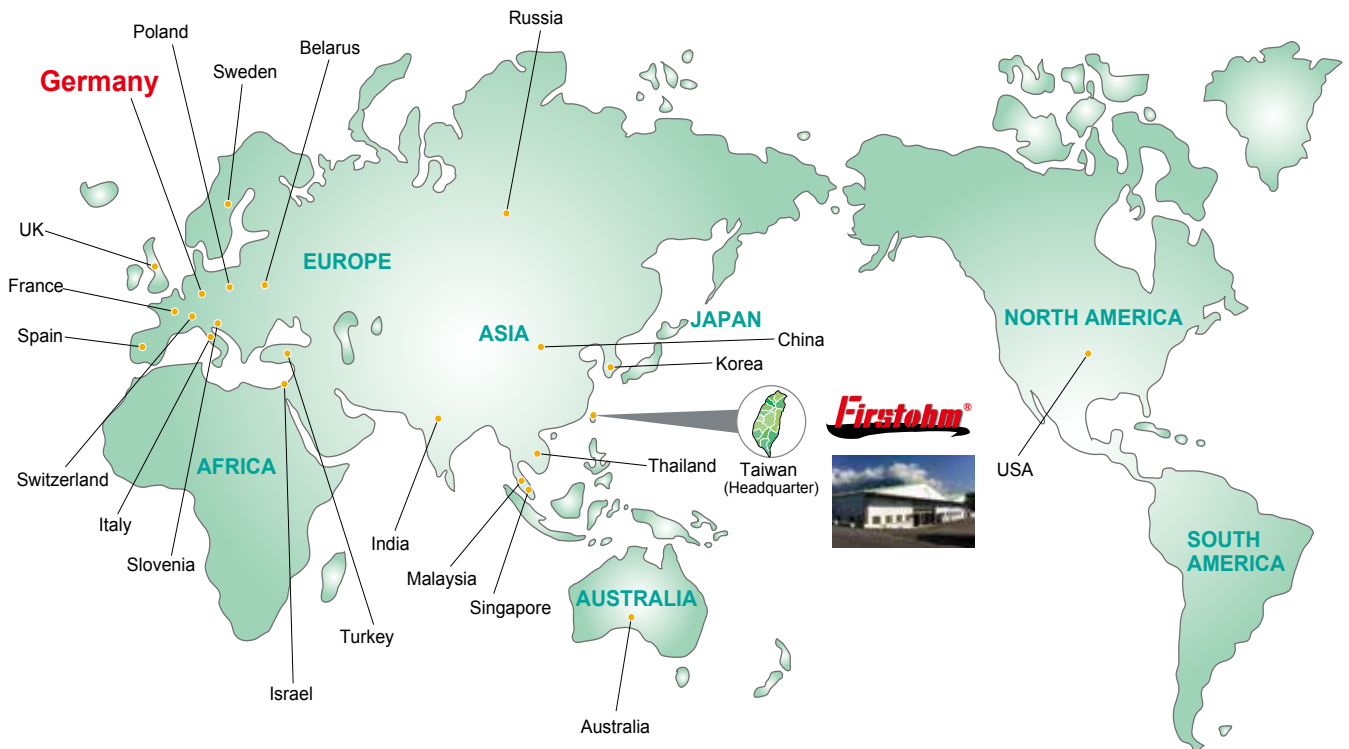
TCR 10 ⁻⁶ /K		Code Letter
*	TK	Z
±2500	TK	Y
±1500	TK	X
±1000	TK	W
±900	TK	9
±800	TK	8
±700	TK	7
±600	TK	6
±500	TK	V
±400	TK	4
±300	TK	3
±250	TK	U
±200	TK	2
±150	TK	T
±100	TK	S
±50	TK	R
±25	TK	Q
±15	TK	P
±10	TK	N
±5	TK	M

* Refer to the technical summary in the individual datasheets for product temperature coefficient.

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