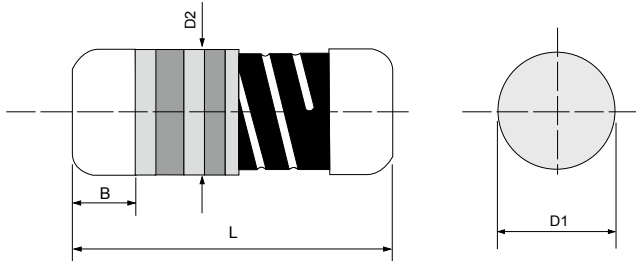


MM(V) – Metal Film MELF Resistor, Vehicle Grade

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
- Products meet RoHS requirements and do not contain substances of very high concern identified by European Chemicals Agency

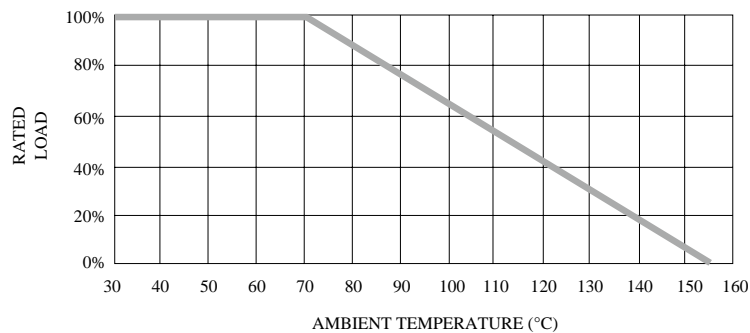
DIMENSIONS

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-24/ E-96
						±2%, ±5%	E-24
MM52V	1/2W	300V	500V	0.47Ω	10MΩ	±1%	E-24/ E-96
						±2%, ±5%	E-24

POWER DERATING CURVE



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

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■ 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 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) MM204V 3K0 = 3,000 6K0 = 6,000** 10K = 10,000** MM52V 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	

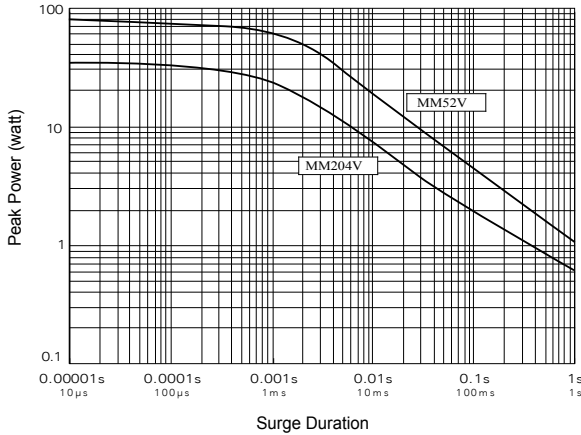
* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

■ PERFORMANCE SPECIFICATIONS

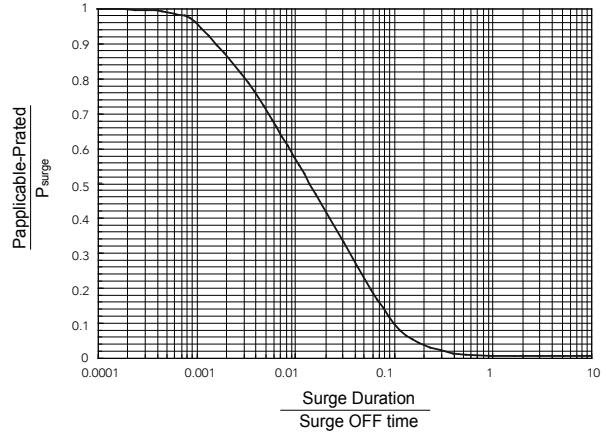
Characteristics	Test Conditions	Limits	
High Temperature Exposure (Storage)	AEC-Q200 REV D. Stress NO.3 (refer to MIL-STD-202 Method 108) 1,000 hours at 125°C without load	0.47Ω to <332KΩ	±0.5%
		332KΩ to 1MΩ	±0.75%
		>1MΩ	±1%
Temperature Cycling	AEC-Q200 REV D. Stress NO.4 (refer to IEC 60115-1 4.19/ JESD22 Method JA-104) -55°C 30minutes, +125°C 30minutes, 1,000 cycles 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)	0.47Ω to 332KΩ	±1%
		>332KΩ	±2.5%
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 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)	0.47Ω to 332KΩ	±0.75%
		>332KΩ	±1%
		0.47Ω to <1Ω	±2%
		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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■ SINGLE SURGE PERFORMANCE



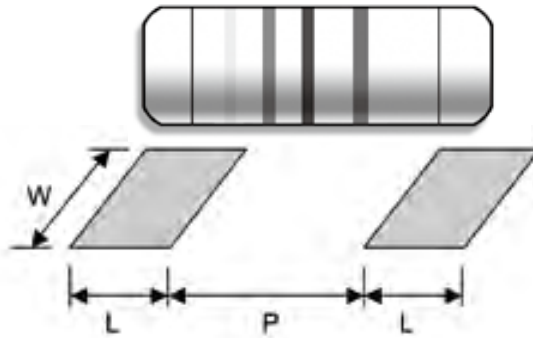
■ SURGE POWER DERATING CURVE



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

