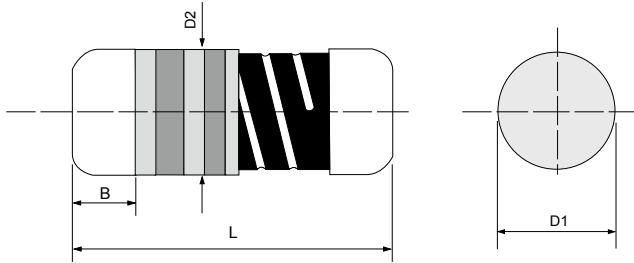


# MM(V) – Metal Film MELF Resistor, Vehicle Grade

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

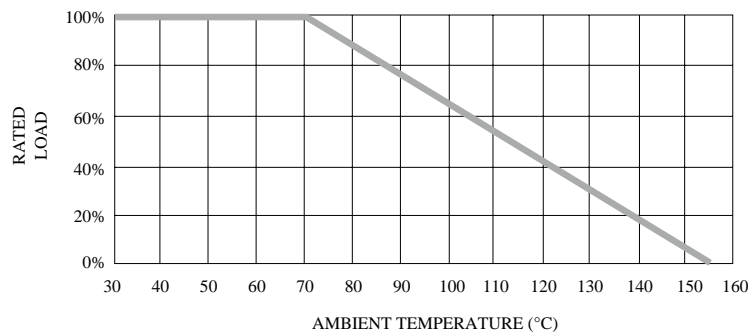
## DIMENSIONS

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 <b>4-character code</b> containing - 3 significant digits 1 letter multiplier  <u>OHM MULTIPLIER</u> R = 1 K = 10 <sup>3</sup> M = 10 <sup>6</sup> G = 10 <sup>9</sup>	50ppm <b>3-character code</b>  TKQ = ±25ppm TKR = ±50ppm TKS = ±100ppm	<b>5-character code</b> 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 <sup>4</sup>	
Tin Whisker (JESD201 Temperature Cycling & High Temp. /Humidity Storage), μm	<5	

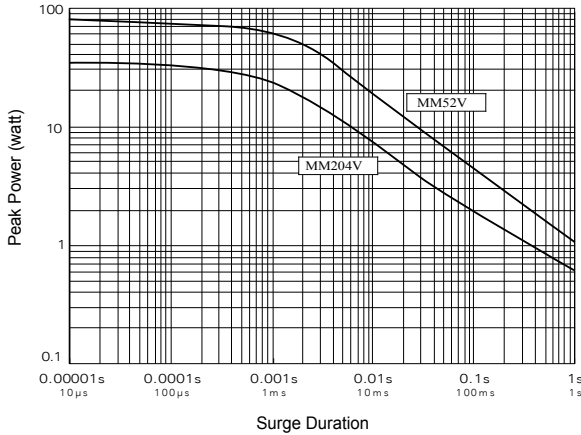
\* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

## ■ PERFORMANCE SPECIFICATIONS

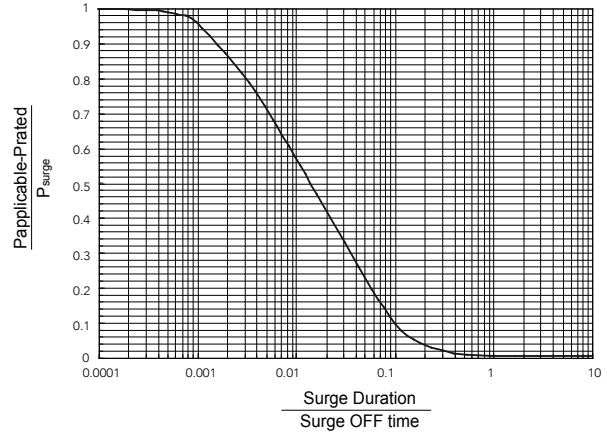
Characteristics	Test Conditions	Limits	
High Temperature Exposure (Storage)	<b>AEC-Q200 REV D. Stress NO.3 (refer to MIL-STD-202 Method 108)</b> 1,000 hours at 125°C without load	0.47Ω to <332KΩ	±0.5%
		332KΩ to 1MΩ	±0.75%
		>1MΩ	±1%
Temperature Cycling	<b>AEC-Q200 REV D. Stress NO.4 (refer to IEC 60115-1 4.19/ JESD22 Method JA-104)</b> -55°C 30minutes, +125°C 30minutes, 1,000 cycles <b>Proprietary test specification FRC-AECQ-180702</b> -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	<b>AEC-Q200 REV D. Stress NO.7 (refer to IEC 60115-1 4.37/ MIL-STD-202 Method 103)</b> 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	<b>IEC 60115-1 4.25.1</b> Rated load (not over max. working voltage) 1,000 hours with 1.5 hours ON, 0.5 hours OFF, at 70°C <b>AEC-Q200 REV D. Stress NO.8 (refer to MIL-STD-202 Method 108)</b> 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	<b>AEC-Q200 REV D. Stress NO.12 (refer to MIL-STD-202 Method 215)</b> Add Aqueous wash chemical-OKEM Clean or equivalent. Do not use banned solvents.	No visible damage on appearance and marking	
Mechanical Shock	<b>AEC-Q200 REV D. Stress NO.13 (refer to MIL-STD-202 Method 213 Condition C)</b> 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	<b>AEC-Q200 REV D. Stress NO.14 (refer to MIL-STD-202 Method 204)</b> 5 g's for 20 min., 12 cycles each of 3 orientations, Test from 10 - 2,000 Hz.	± 0.5%	
Resistance to Soldering Heat	<b>AEC-Q200 REV D. Stress NO.15 (refer to IEC 60115-1 4.18.2/ MIL-STD-202 Method 210)</b> Dip the resistor into a solder bath measured (260±5)°C and hold it for a 10±1 seconds	±0.5%	
ESD	<b>AEC-Q200 REV D. Stress NO.17 (refer to AEC-Q200-002/ ISO/DIS 10605) (150pF/ 2000Ohm discharge network)</b> Human body model, 1 positive & 1 negative discharges with 2KV source	±0.5%	
Solderability	<b>AEC-Q200 REV D. Stress NO.18 (refer to J-STD-002 or IEC 60115-1 4.17)</b> Solder area covered after (235±3)°C/(2±0.2) seconds with flux applied	95% min. coverage	
Flammability	<b>AEC-Q200 REV D. Stress NO.20 (refer to UL-94)</b> V-0 or V-1 are acceptable. Electrical test not required.	NO flaming	
Board Flex	<b>AEC-Q200 REV D. Stress NO.21 (refer to AEC-Q200-005)</b> 60 sec minimum holding time.	±0.5%	
Terminal Strength	<b>AEC-Q200 REV D. Stress NO.22 (refer to AEC-Q200-006)</b> Force of 1.8kg for 60 seconds	±0.5%	
Short Time Overload	<b>IEC 60115-1 4.13</b> 5 seconds 2.5x rated voltage(not over max. overload voltage)	0.47Ω to 332KΩ	±0.25%
		>332KΩ	± 0.5%
Climatic test	<b>IEC 60115-1 4.23</b> 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	<b>IEC 60115-1 4.24</b> 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	<b>IEC 60115-1 4.27</b> 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	<b>IEC 60115-1 4.39</b> 3.9x rated voltage (not over max. overload voltage) with 0.1s ON, 2.5s OFF for 1,000 cycles	±1%	
Anti-sulfuration test	<b>EIA-977(conditions B)</b> 750 hours at (105±2)°C without load	±1%	±1%
		±2%	±2%
		±5%	±5%

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## ■ SINGLE SURGE PERFORMANCE



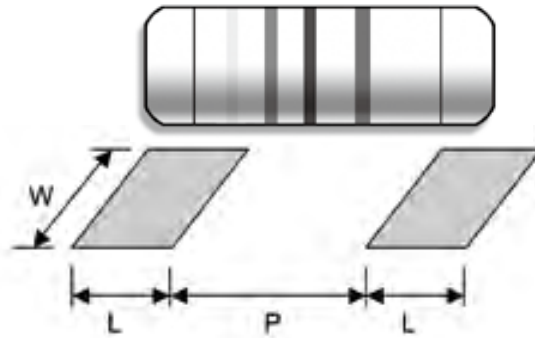
## ■ SURGE POWER DERATING CURVE



### 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

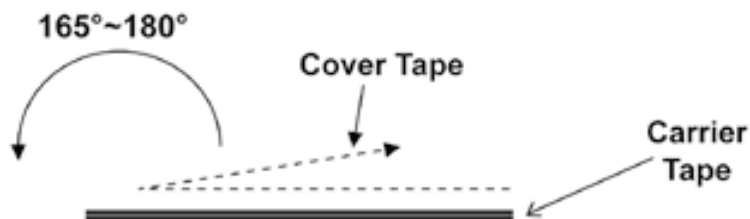


Type	Soldering Mode	Pad Length (L, mm, Min.)	Pad Spacing (P, mm)	Pad Width (W, mm, Min.)
MM204V	Reflow	1.3	1.6 ± 0.1	1.6
	Wave	1.5	1.5 ± 0.1	1.8
MM52V	Reflow	2.0	3.0 ± 0.1	3.0
	Wave	2.5	3.0 ± 0.1	3.0

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

## ■ COVER TAPE PEELING SPECIFICATION

Recommended peeling force: 50gf±5gf



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