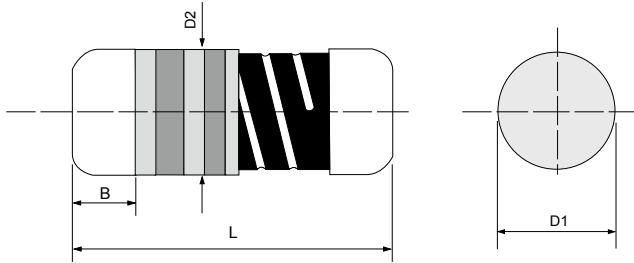


MM(V) – Metal Film MELF Resistor, Vehicle Grade

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

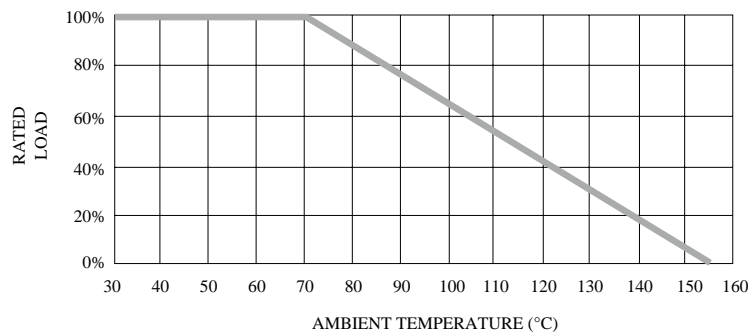
DIMENSIONS

| 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

Quality • Reliability
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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 <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 | |

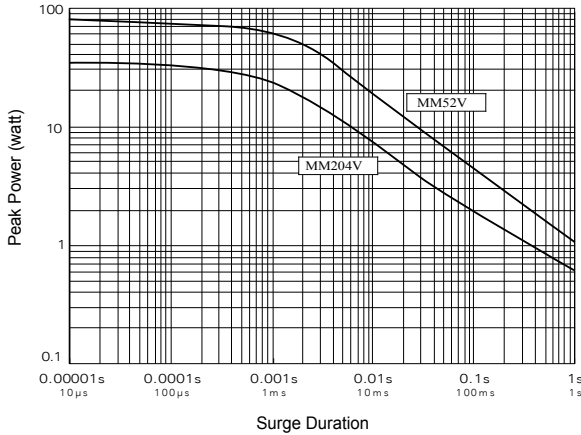
* Not applicable to all resistance values. Please check with us regarding the PPM of specific resistance value(s).

PERFORMANCE SPECIFICATIONS

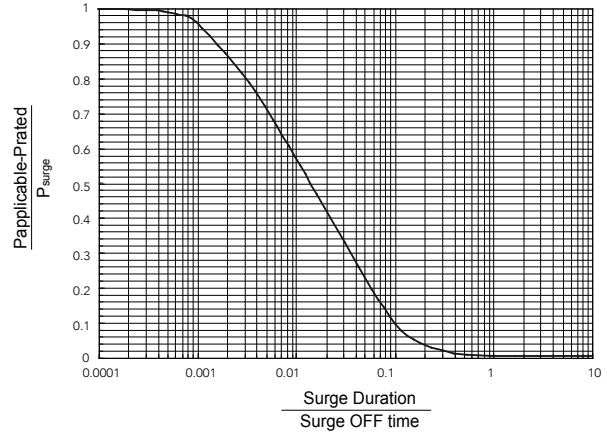
| Characteristics | Test Conditions | Limits | |
|-------------------------------------|---|---|--------|
| High Temperature Exposure (Storage) | AEC-Q200 REV D. Stress NO.3 (refer to MIL-STD-202 Method 108) 1,000 hours at 125°C without load | 0.47Ω to <332KΩ | ±0.5% |
| | | 332KΩ to 1MΩ | ±0.75% |
| | | >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



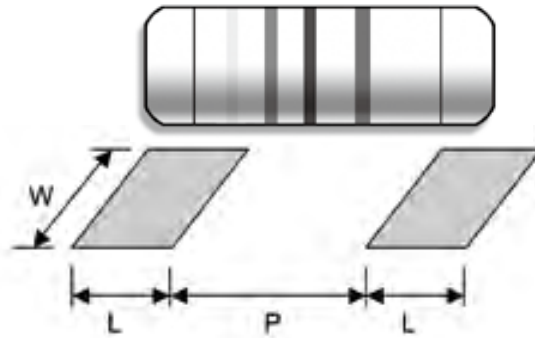
■ SURGE POWER DERATING CURVE



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

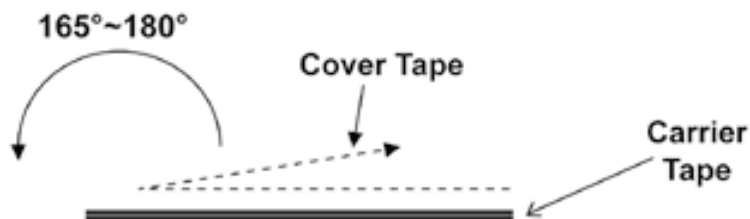


| Type | Soldering Mode | Pad Length (L, mm, Min.) | Pad Spacing (P, mm) | Pad Width (W, mm, Min.) |
|--------|----------------|--------------------------|---------------------|-------------------------|
| MM204V | Reflow | 1.3 | 1.6 ± 0.1 | 1.6 |
| | Wave | 1.5 | 1.5 ± 0.1 | 1.8 |
| MM52V | Reflow |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



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