

Data Sheet

Customer: _____

Product: Metal Film Precision MELF Resistor - MM / MML Series _____

Size : 102/204/207 _____

Issued Date: 01-Jul.-2025 _____

Edition: Ver. 4 _____

Record of change

Date	Ver.	Description	Page
17-Jul.-2017	1		
17-Jan.-2018	2	Revise ohmic range, add surge curve	2,6~10
25-Aug.-2023	3	Revise ohmic range & derating curve	2,6~10
01-Jul.-2025	4	All	2~14

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01-Jul.-2025	01-Jul.-2025	01-Jul.-2025	
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Metal Film Precision MELF Resistor

MM/MML Series



Features

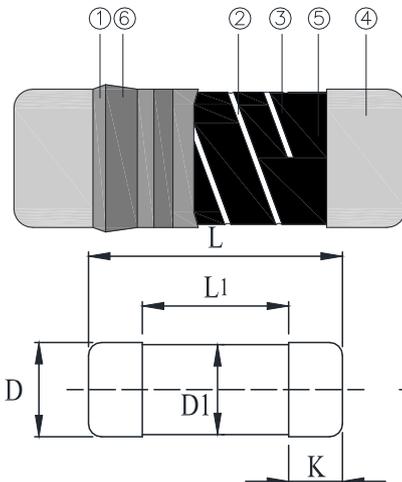
- Thin film technology
- Excellent overall stability
- Sn termination on Ni barrier layer
- Tight tolerance down to $\pm 0.1\%$
- Extremely low TCR down to ± 5 PPM/ $^{\circ}\text{C}$
- High power rating up to 1 Watts
- SMD enabled structure
- Lead-free and RoHS compliant

Applications

- Industrial
- Telecommunication
- Medical Equipment
- Measurement/Testing Equipment

TECHNICAL SPECIFICATIONS							
DESCRIPTION	MM102/MML102			MM204/MML204		MM207/MML207	
Resistance range	1 Ω -1M Ω ; 0 Ω			0.1 Ω -10M Ω ; 0 Ω		0.1 Ω -10M Ω ; 0 Ω	
Resistance tolerance	$\pm 5\%$; $\pm 1\%$; $\pm 0.5\%$; $\pm 0.25\%$; $\pm 0.1\%$						
Temperature coefficient	± 100 ppm/ $^{\circ}\text{C}$; ± 50 ppm/ $^{\circ}\text{C}$; ± 25 ppm/ $^{\circ}\text{C}$; ± 15 ppm/ $^{\circ}\text{C}$			± 100 ppm/ $^{\circ}\text{C}$; ± 50 ppm/ $^{\circ}\text{C}$; ± 25 ppm/ $^{\circ}\text{C}$; ± 15 ppm/ $^{\circ}\text{C}$; ± 10 ppm/ $^{\circ}\text{C}$; ± 5 ppm/ $^{\circ}\text{C}$			
Operation mode	Standard	High power		Standard	High power	Standard	High power
Power rating P ₇₀	1/8W	1/5W	0.3W	1/4W	2/5W	1/2W	1W
Operating voltage U _{max.}	150V	200V	200V	200V	200V	300V	350V
Operating temperature range	-55 $^{\circ}\text{C}$ ~ 155 $^{\circ}\text{C}$						
Max. resistance change at P70 for resistance range, $\Delta R/R$ max., after 1000 h	$\leq 0.5\%$			$\leq 0.5\%$		$\leq 0.5\%$	

Construction & Dimension



① Insulation Coating	④ Electrode Cap
② Trimming Line	⑤ Resistor Layer
③ Ceramic Rod	⑥ Marking

Type	L (mm)	L _{1 min.} (mm)	ΦD (mm)	ΦD_1 (mm)	K (mm)	Weight 1,000EA (g)
MM102	2.20 \pm 0.10	1.1	1.10 \pm 0.10	D +0/-0.15	0.45 \pm 0.05	7.7
MML102	2.20 \pm 0.10	1.1	1.10 \pm 0.10	D +0/-0.15	0.45 \pm 0.05	7.7
MM204	3.50 \pm 0.20	1.7	1.40 \pm 0.15	D +0/-0.20	0.80 \pm 0.10	18.7
MML204	3.50 \pm 0.20	1.7	1.40 \pm 0.15	D +0/-0.20	0.80 \pm 0.10	18.7
MM207	5.90 \pm 0.20	2.9	2.20 \pm 0.20	D +0/-0.20	1.30 \pm 0.10	80.9
MML207	5.90 \pm 0.20	2.9	2.20 \pm 0.20	D +0/-0.20	1.30 \pm 0.10	80.9

Metal Film Precision MELF Resistor

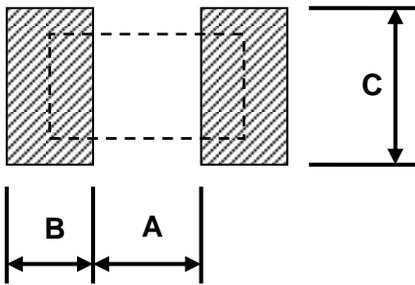
MM/MML Series

Part Numbering

<u>MM204</u>	<u>F</u>	<u>E</u>	-	<u>100KR</u>
Type	Tolerance	TCR(ppm/°C)		Ohmic value
MM102	B= ±0.1%	A= ±5		10R=10Ω
MML204	C= ±0.25%	B= ±10		120R=120Ω
MM204	D= ±0.5%	C= ±15		1K2R=1.2KΩ
MML204	F= ±1%	D= ±25		1MR=1MΩ
MM207	J= ±5%	E= ±50		
MML207		F= ±100		

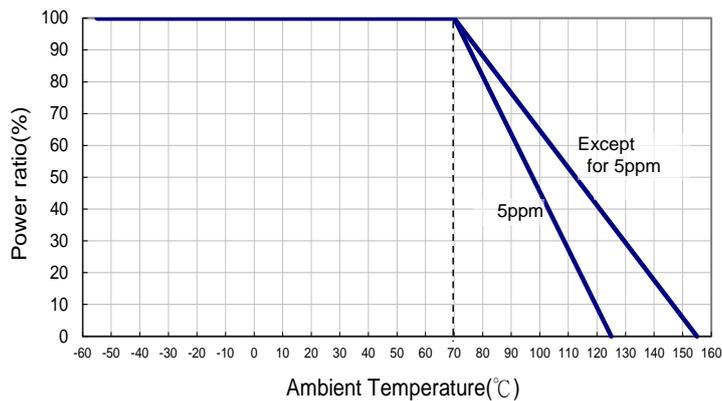
※Packaging Code “S” & “M” only for 102 & 204 size products, not include 207 size product.

Recommend Land Pattern



Type	A (mm)	B (mm)	C (mm)
MM/MML102	1.0	0.8	1.5
MM/MML204	1.6	1.2	1.6
MM/MML207	3.0	1.7	2.4

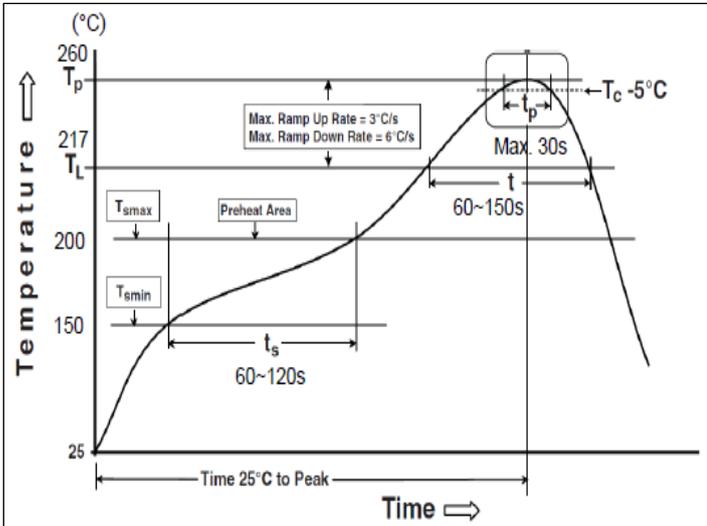
Derating Curve



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Soldering Condition (Ref. IPC/JEDEC J-STD-020 & J-STD-002)



Reflow Profiles	
Profile Feature	Pb-Free Assembly
Preheat	
Min. Temperature (T _{sm})	150 °C
Max Temperature (T _{smax})	200 °C
Preheating time (t _s) from (T _{sm} to T _{smax})	60-120 seconds
Ramp-up rate (T _L to T _p)	3 °C/second max.
Liquidous temperature (T _L)	217 °C
Time (t _L) maintained above T _L	60-150 seconds
Min. Peak temperature (T _p min)	235°C
Max. Peak temperature (T _p max)	260°C
Time (t _p) within 5 °C of the specified classification temperature (T _c)	30 seconds max.
Ramp-down rate (T _p to T _L)	6 °C/second max.
Time 25 °C to peak temperature	8 minutes max.

Standard Electrical Specifications

Item Type	Power Rating at 70 °C	Operating Temp. Range	Max. Operating Voltage	Max. Overload Voltage	Resistance Range					TCR (PPM/°C)		
					±0.1% (E24,E96)	±0.25% (E24,E96)	±0.5% (E24,E96)	±1% (E24,E96)	±5% (E24)			
MM102	1/8W	-55 ~ +155°C	150V	300V	100Ω-56KΩ					-	±15	
					100Ω-82KΩ		49.9Ω-200KΩ	49.9Ω-390KΩ	-		±25	
					-		1Ω-1MΩ			-		±50
					-		1Ω-1MΩ			-		±100
MM204	1/4W	-55 ~ +125°C	200V	400V	10Ω-332KΩ		-			±5		
					10Ω-20KΩ			-		±10		
		-55 ~ +155°C	200V	400V	10Ω-300KΩ			-		±15		
					10Ω-1MΩ	10Ω-3.4MΩ	1Ω-3.4MΩ		±25			
					10Ω-1MΩ	1Ω-3.4MΩ	0.2Ω-10MΩ		±50			
					-		0.1Ω-10MΩ		±100			
MM207	1/2W	-55 ~ +125°C	300V	600V	10Ω-332KΩ		-			±5		
					10Ω-20KΩ			-		±10		
		-55 ~ +155°C	300V	600V	10Ω-300KΩ			-		±15		
					10Ω-1MΩ	10Ω-3.4MΩ	1Ω-3.4MΩ		±25			
					10Ω-1MΩ	1Ω-3.4MΩ	0.2Ω-10MΩ		±50			
					-		0.1Ω-10MΩ		±100			

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High Power Rating Electrical Specifications

Item Type	Power Rating at 70 °C	Operating Temp. Range	Max. Operating Voltage	Max. Overload Voltage	Resistance Range					TCR (PPM/°C)	
					±0.1% (E24,E96)	±0.25% (E24,E96)	±0.5% (E24,E96)	±1% (E24,E96)	±5% (E24)		
MML102	1/5W	-55 ~ +155°C	200V	400V	100Ω-56KΩ					-	±15
					100Ω-82KΩ	49.9Ω-200KΩ	49.9Ω-390KΩ	-	±25		
	-				1Ω-1MΩ			-	±50		
	-				1Ω-1MΩ			-	±100		
MML204	2/5W	-55 ~ +125°C	200V	400V	10Ω-332KΩ	-			±5		
		-55 ~ +155°C	200V	400V	10Ω-20KΩ					-	±10
					10Ω-300KΩ					-	±15
					10Ω-1MΩ	10Ω-3.4MΩ	1Ω-3.4MΩ	±25			
					10Ω-1MΩ	1Ω-3.4MΩ	0.2Ω-10MΩ	±50			
					-	0.1Ω-10MΩ			±100		
MML207	1W	-55 ~ +125°C	350V	700V	10Ω-332KΩ	-			±5		
		-55 ~ +155°C	350V	700V	10Ω-20KΩ					-	±10
					10Ω-300KΩ					-	±15
					10Ω-1MΩ	10Ω-3.4MΩ	1Ω-3.4MΩ	±25			
					10Ω-1MΩ	1Ω-3.4MΩ	0.2Ω-10MΩ	±50			
					-	0.1Ω-10MΩ			±100		

Operating Voltage= $\sqrt{P \cdot R}$ or Max. Operating Voltage listed above, whichever is lower.

Overload Voltage= $2.5 \cdot \sqrt{P \cdot R}$ or Max. Overload Voltage listed above, whichever is lower.

RCWV(Rated Continuous Working Voltage)= $\sqrt{P \cdot R}$ or Max. Operating Voltage whichever is lower.

■ Viking is capable of manufacturing the optional spec based on customer's requirement.

Jumper Specifications

Item Type	Power Rating	Operating Temp. Range	Resistance	Rated Current	
MM/MML102	1/8W	-55 ~ +155°C	0Ω(<15mΩ)	2A	
	1/5W				
	0.3W				
MM/MML204	1/4W	-55 ~ +155°C		0Ω(<15mΩ)	3A
	2/5W				
MM/MML207	1/2W	-55 ~ +155°C			0Ω(<15mΩ)
	1W				

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Environmental Characteristics

Item	Requirement		Test Method
	5% and Below	Jumper	
Temperature Coefficient of Resistance (T.C.R.)	As Spec		JIS-C-5201-1 4.8 IEC-60115-1 4.8 At 25°C/-55°C and 25°C/+125°C, 25°C is the reference temperature 5ppm: At 25°C/-10°C and 25°C/+85°C, 25°C is the reference temperature
Short Time Overload	10Ω-270KΩ: ±(0.1%+0.01Ω) <10Ω & >270KΩ: ±(0.15%+0.01Ω) 0102: ±(0.15%+0.01Ω) 5ppm: ±(0.05%+0.01Ω)	<15mΩ	JIS-C-5201-1 4.13 IEC-60115-1 4.13 RCWV*2.5 or Max. Overload Voltage whichever is lower for 5 seconds
Insulation Resistance	≥10G		JIS-C-5201-1 4.6 IEC-60115-1 4.6 Max. Overload Voltage for 1 minute
Operational Life	10Ω-270KΩ: ±(0.25%+0.01Ω) <10Ω & >270KΩ: ±(0.5%+0.01Ω) 0102: ±(0.5%+0.01Ω)	<15mΩ	MIL-STD-202 Method 108 Condition D Steady State TA=125°C at derated power. Measurement at 24±4 hours after test conclusion. 5ppm: 70±2°C, RCWV for 1000 hrs with 1.5 hrs "ON" and 0.5 hr "OFF"
Biased Humidity	<10Ω: ±(1%+0.01Ω) 10Ω-270KΩ: ±(0.5%+0.01Ω) >270KΩ-3.4MΩ: ±(1%+0.01Ω) >3.4MΩ: ±(2%+0.01Ω) 0102: ±(2%+0.01Ω)	<15mΩ	MIL-STD-202 Method 103 1000 hrs 85°C/85%RH 10% of operating power. (≤ 100 V)
High Temperature Exposure	10Ω-270KΩ: ±(0.25%+0.01Ω) <10Ω & >270KΩ: ±(1%+0.01Ω) 0102: ±(1%+0.01Ω)	<15mΩ	MIL-STD-202 Method 108 at +125°C/+155°C for 1000 hrs
Board Flex	10Ω-270KΩ: ±(0.1%+0.01Ω) <10Ω & >270KΩ: ±(0.5%+0.01Ω) 0102: ±(0.5%+0.01Ω)	<15mΩ	AEC-Q200-005 Bending once for 60 seconds with 2mm
Solderability	95% min. coverage		JIS-C-5201-1 4.17 IEC-60115-1 4.17 J-STD-002 245±5°C for 3 seconds
Resistance to Soldering Heat	10Ω-270KΩ: ±(0.1%+0.01Ω) <10Ω & >270KΩ: ±(0.25%+0.01Ω) 0102: ±(0.25%+0.01Ω) 5ppm: ±(0.05%+0.01Ω)	<15mΩ	MIL-STD-202 Method 210 260±5°C for 10 seconds
Voltage Proof	No breakdown or flashover		JIS-C-5201-1 4.7 IEC-60115-1 4.7 1.42 times Max. Operating Voltage for 1 minute
Leaching	Individual leaching area ≤ 5% Total leaching area ≤ 10%		JIS-C-5201-1 4.18 IEC-60068-2-58 8.2.1 260±5°C for 30 seconds
Temperature Cycling	10Ω-270KΩ: ±(0.25%+0.01Ω) <10Ω & >270KΩ: ±(0.5%+0.01Ω) 0102: ±(1%+0.01Ω)	<15mΩ	JESD22 Method JA-104 -55°C to +125°C, 1000 cycles
Mechanical Shock	±(0.25%+0.01Ω)	<15mΩ	MIL-STD-202 Method 213 Wave Form: Tolerance for half sine shock pulse. Peak value is 100g's. Normal duration (D) is 6.
Vibration	±(0.5%+0.01Ω)	<15mΩ	MIL-STD-202 Method 204 5 g's for 20 min., 12 cycles each of 3 orientations, 10-2000 Hz
ESD	±(0.5%+0.01Ω)	<15mΩ	AEC-Q200-002 Human body, 0102/0204:2KV; 0207:4KV
Resistance to Solvents	No visible damage on appearance and marking.		MIL-STD-202 Method 215 Add Aqueous wash chemical - OKEM Clean or equivalent. Do not use banned solvents.

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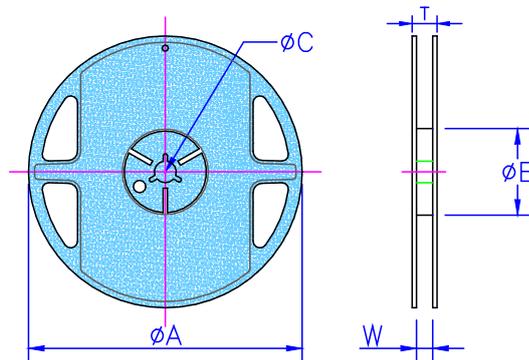
Item	Requirement		Test Method
	5% and Below	Jumper	
Terminal Strength	No broken		AEC-Q200-006 Force of 1.8kg for 60 seconds.
Flammability	No ignition of the tissue paper or scorching or the pinewood board		UL-94 V-0 or V-1 are acceptable. Electrical test not required.

RCWV(Rated Continuous Working Voltage)= $\sqrt{P \cdot R}$ or Max. Operating Voltage whichever is lower.

■Storage Temperature: 15~28°C; Humidity < 80%RH

■Shelf Life: 2 years from production date.

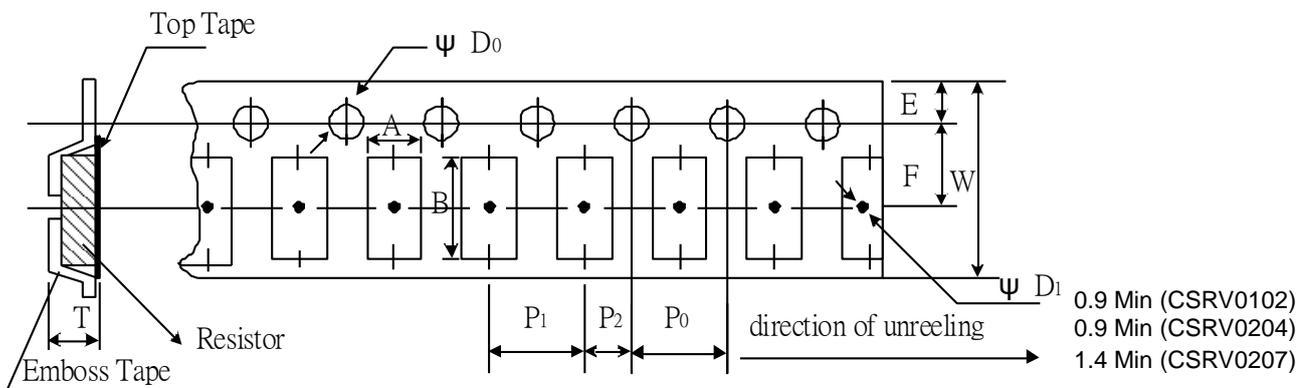
■Packaging



Packaging Quantity & Reel Specifications

Type	Reel Diameter	ΦA (mm)	ΦB (mm)	ΦC (mm)	W (mm)	T (mm)	Emboss Plastic Tape (EA)
MM/MML0102	7 inch	178.5±1.5	60.0+1.0	13.0±0.2	9.0±0.5	12.5±0.5	3,000
	13 inch	330±1.0	100±0.5	13.0±0.2	9.5±0.5	13.5±0.5	10,000
MM/MML0204	7 inch	178.5±1.5	60.0+1.0	13.0±0.2	9.0±0.5	12.5±0.5	3,000
	13 inch	330±1.0	100±0.5	13.0±0.2	9.5±0.5	13.5±0.5	10,000
MM/MML0207	7 inch	178.5±1.5	60.0+1.0	13.0±0.5	13.0±0.5	15.5±0.5	2,000
	13 inch	330±1.0	99±0.5	13.5±0.5	13.4±1	17.8±1	6,000

Emboss Plastic Tape Specifications



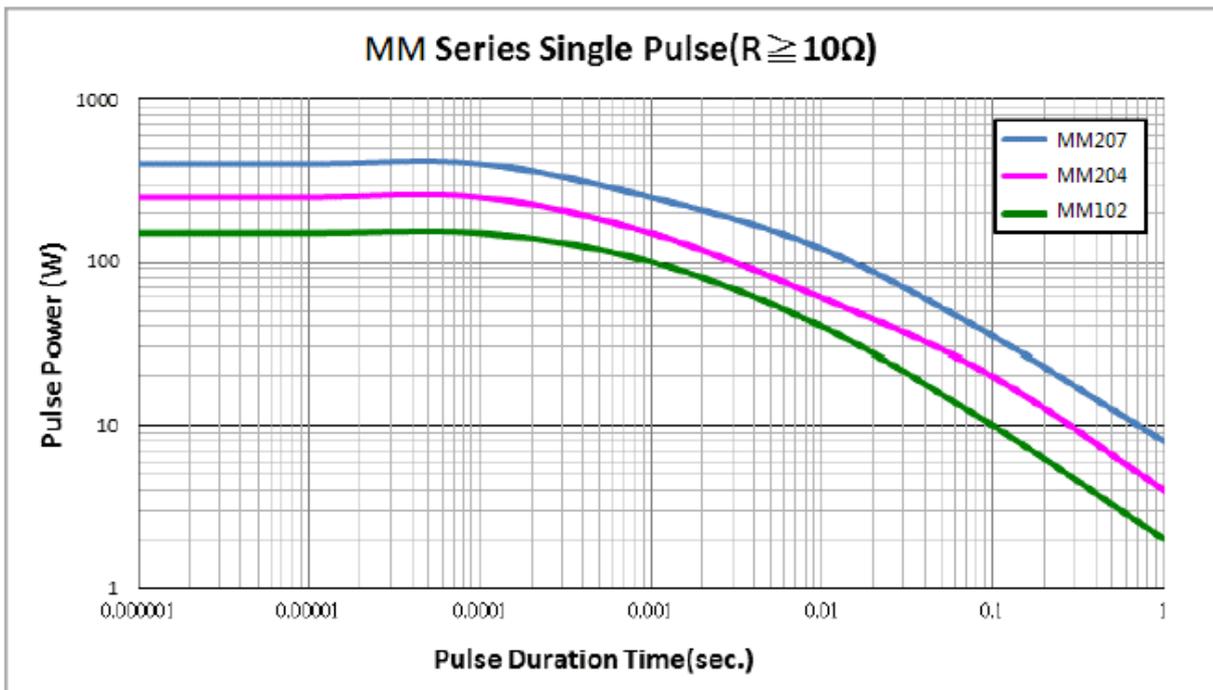
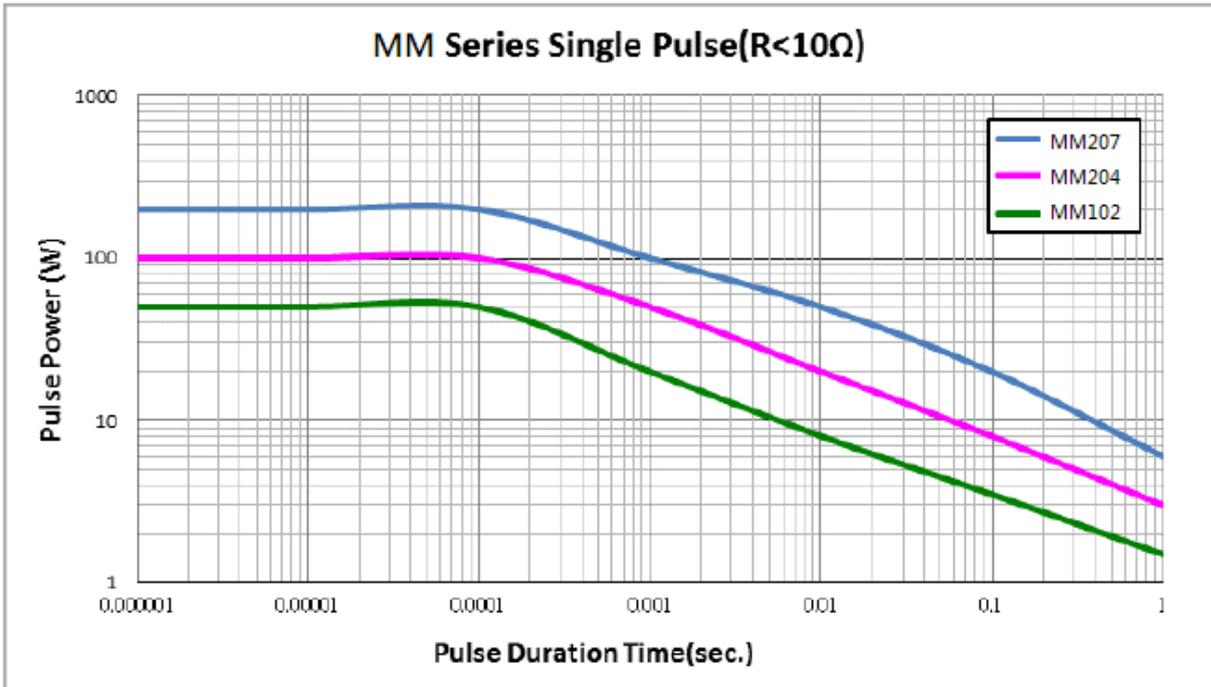
Type	A (mm)	B (mm)	W (mm)	E (mm)	F (mm)	P ₀ (mm)	P ₁ (mm)	P ₂ (mm)	ΦD ₀ (mm)	T (mm)
MM/MML0102	1.30±0.20	2.40±0.20	8.0±0.10	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.50+0.10	1.50±0.10
MM/MML0204	1.55±0.20	3.65±0.20	8.0±0.10	1.75±0.10	3.50±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.50+0.10	1.80±0.10
MM/MML0207	2.40±0.10	6.15±0.10	12.0±0.10	1.75±0.10	5.50±0.05	4.00±0.10	4.00±0.10	2.00±0.05	1.50+0.10	2.70±0.10

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■ Pulse withstanding capacity

The single impulse graph is the result of the impulse of rectangular shape applied. The limit of acceptance was a shift in resistance of less than 1% from the initial value. The power applied was subject to the restrictions of the maximum permissible impulse voltage graph shown.

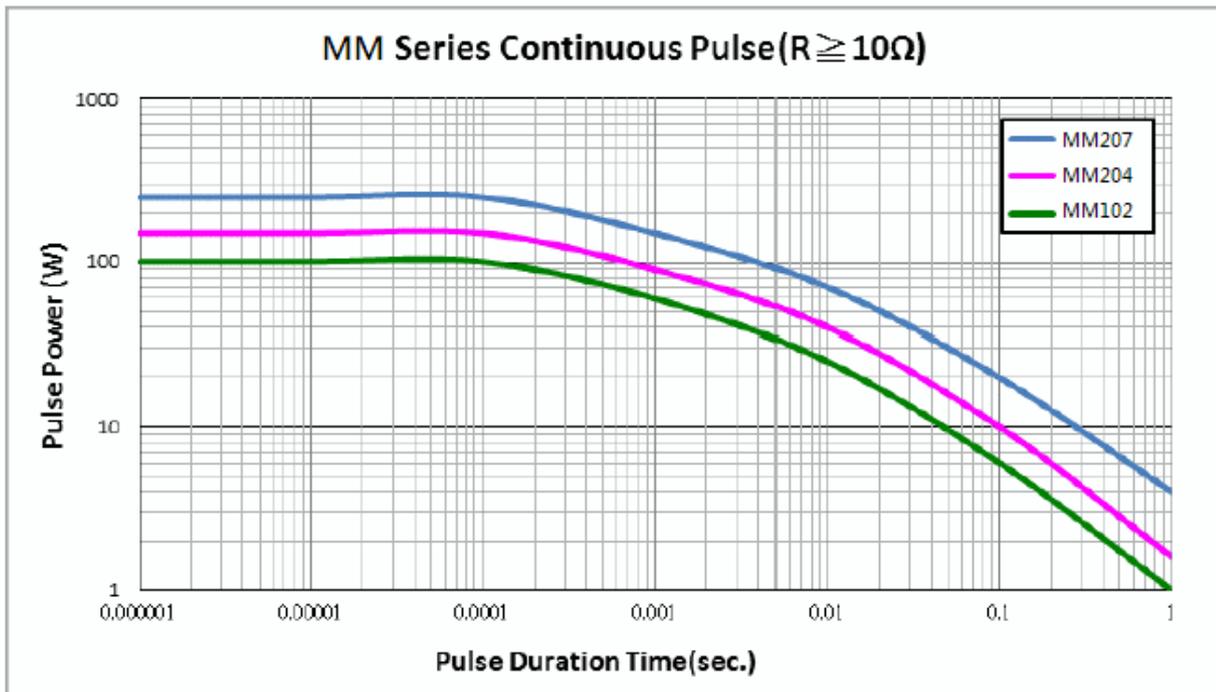
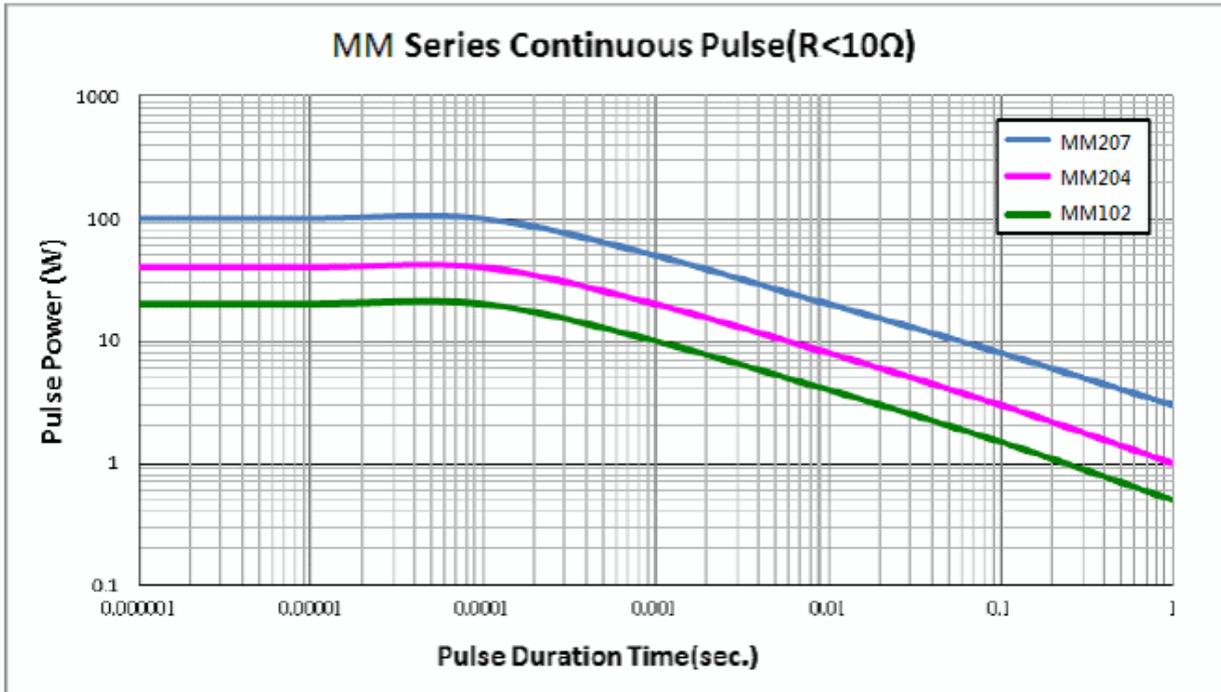


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Continuous Pulse

The continuous load graph was obtained by applying repetitive rectangular pulses where the pulse period was adjusted so that the average power dissipated in the resistor was equal to its rated power at 70°C. Again the limit of acceptance was a shift in resistance of less than 1% from the initial value.



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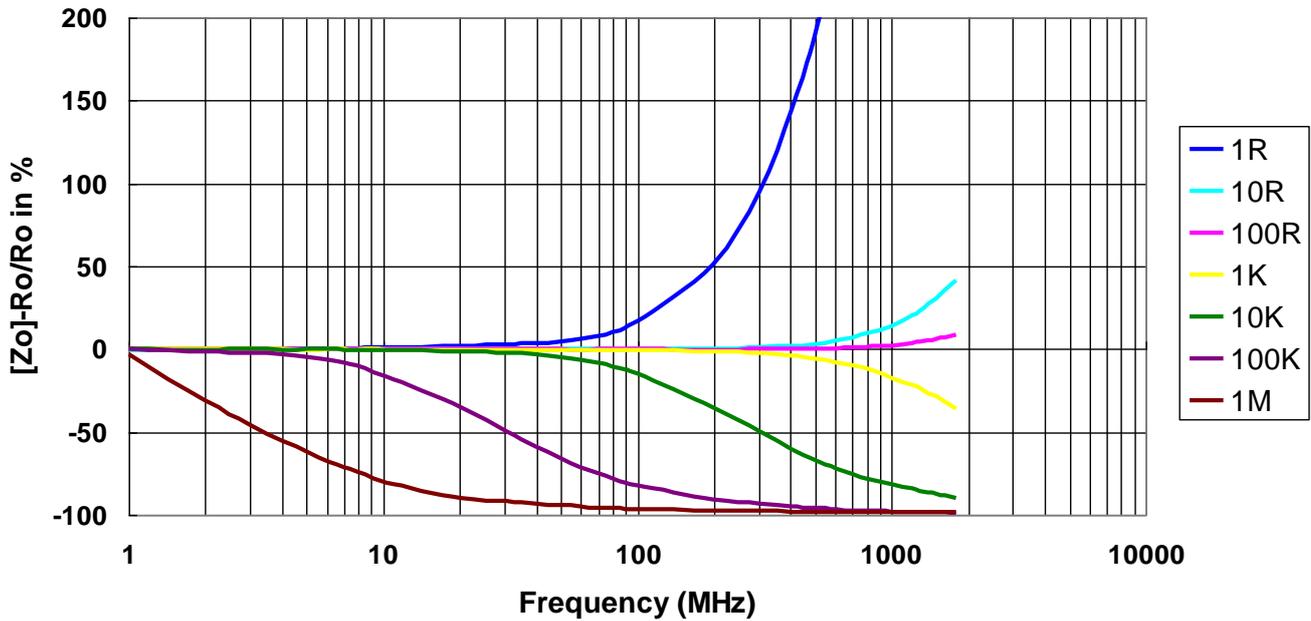
MM/MML Series

Frequency behavior

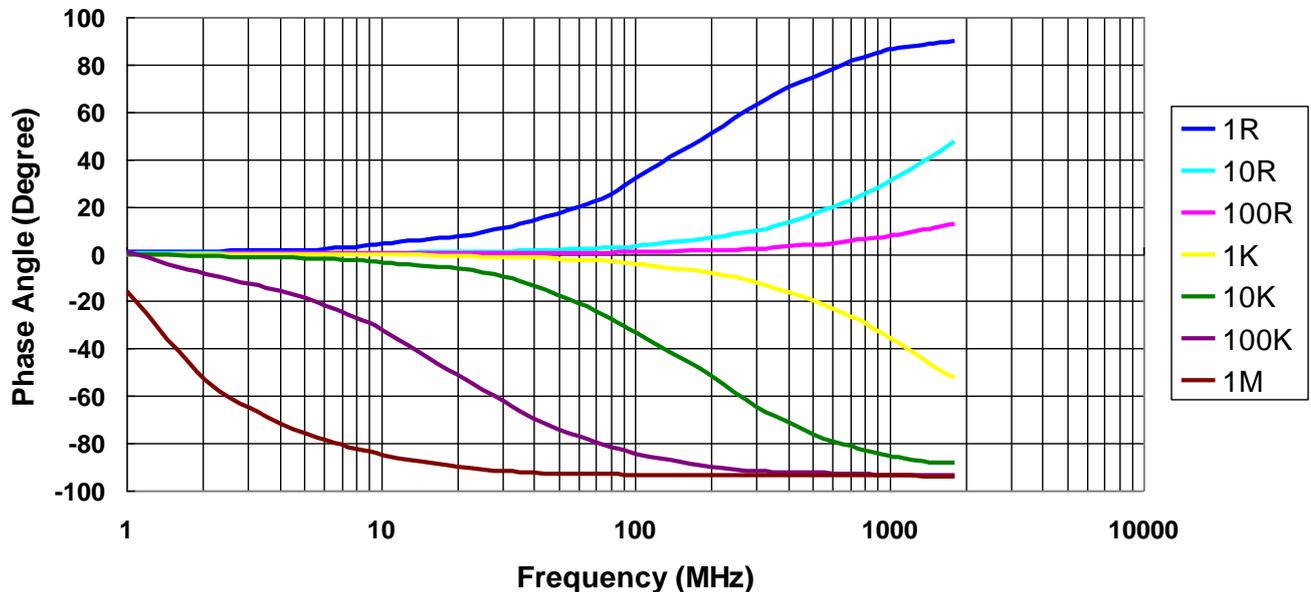
Resistors are designed to function according to ohmic laws. This is basically true of resistors for frequencies up to 100kHz. At higher frequencies, there is an additional contribution to the impedance by an ideal resistor switched in series with a coil and both switched parallel to a capacitor. The values of the capacitance and inductance are mainly determined by the dimensions of the terminations and the conductive path length.

The environment surrounding components has a large influence on the behavior of the component on the printed-circuit board.

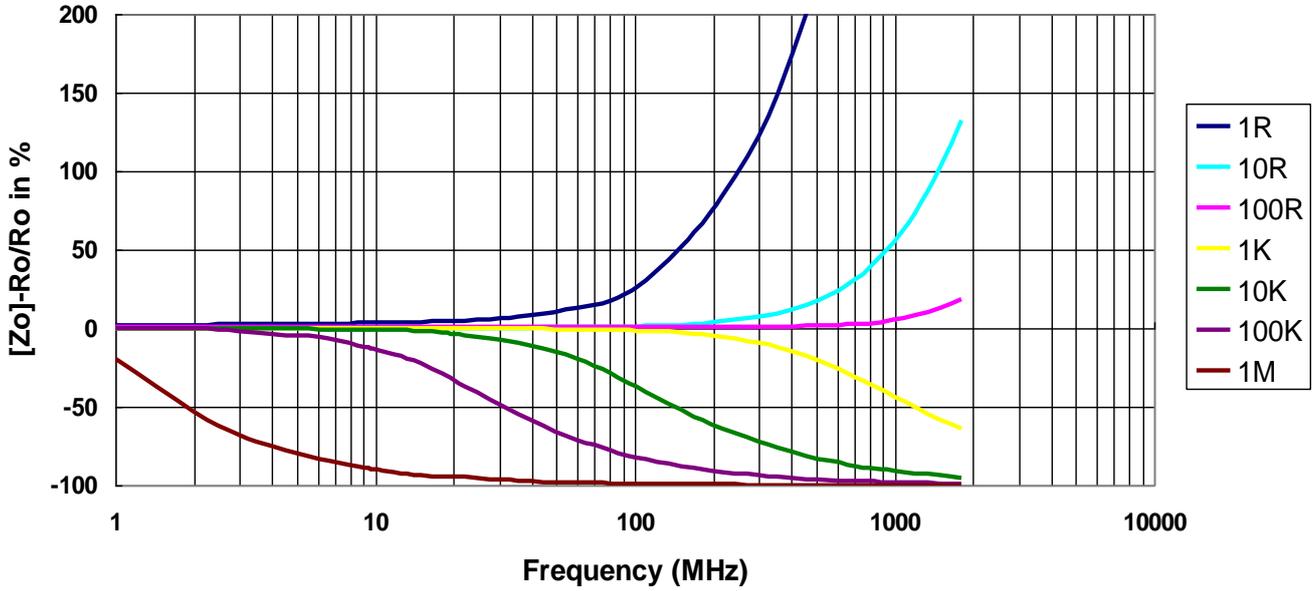
Frequency vs. Impedance MM Series (MM204)



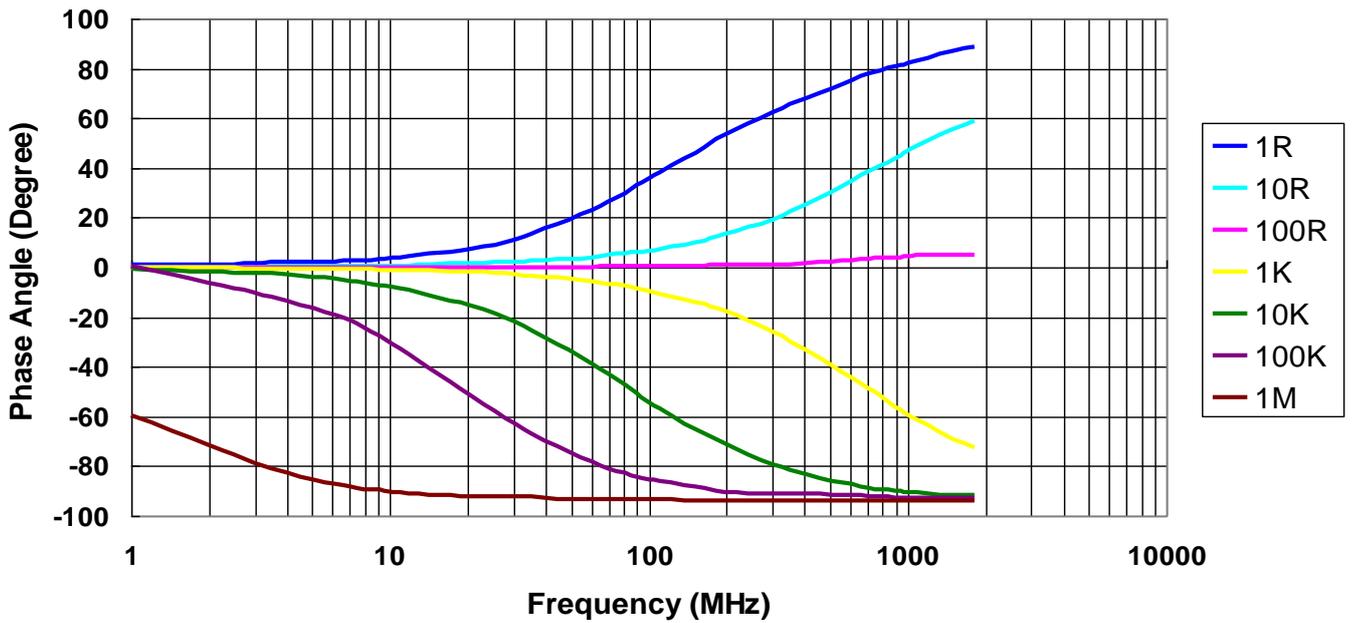
Frequency vs. Phase Angle MM Series (MM204)



Frequency vs. Impedance
MM Series (MM207)



Frequency vs. Phase Angle
MM Series (MM207)



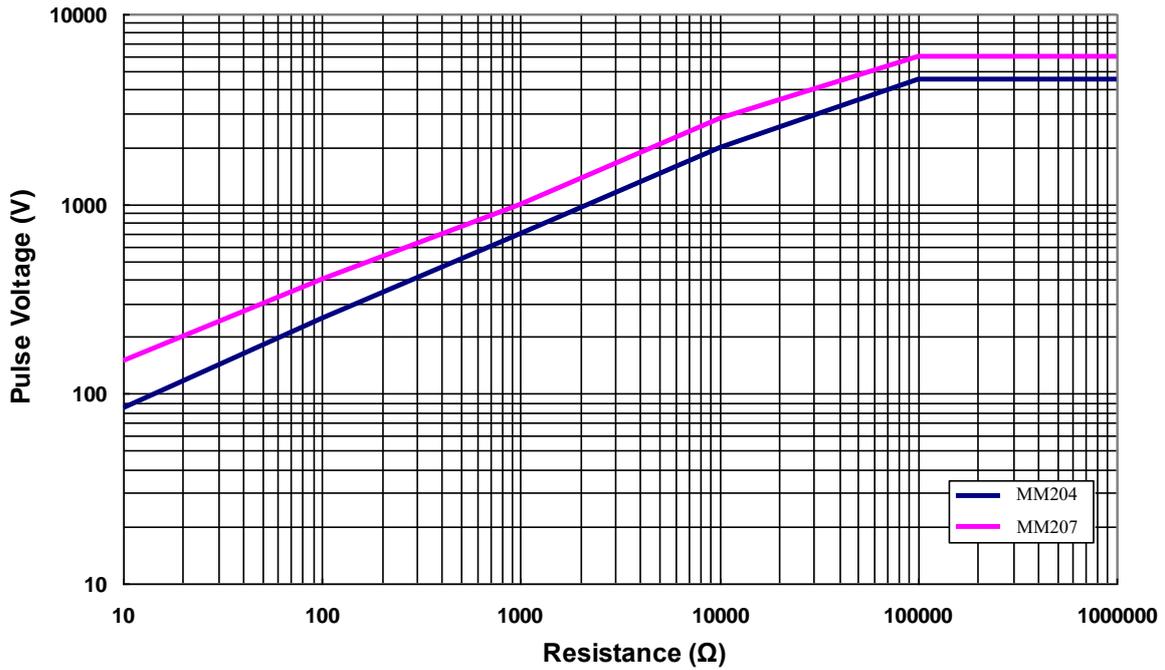
Metal Film Precision MELF Resistor

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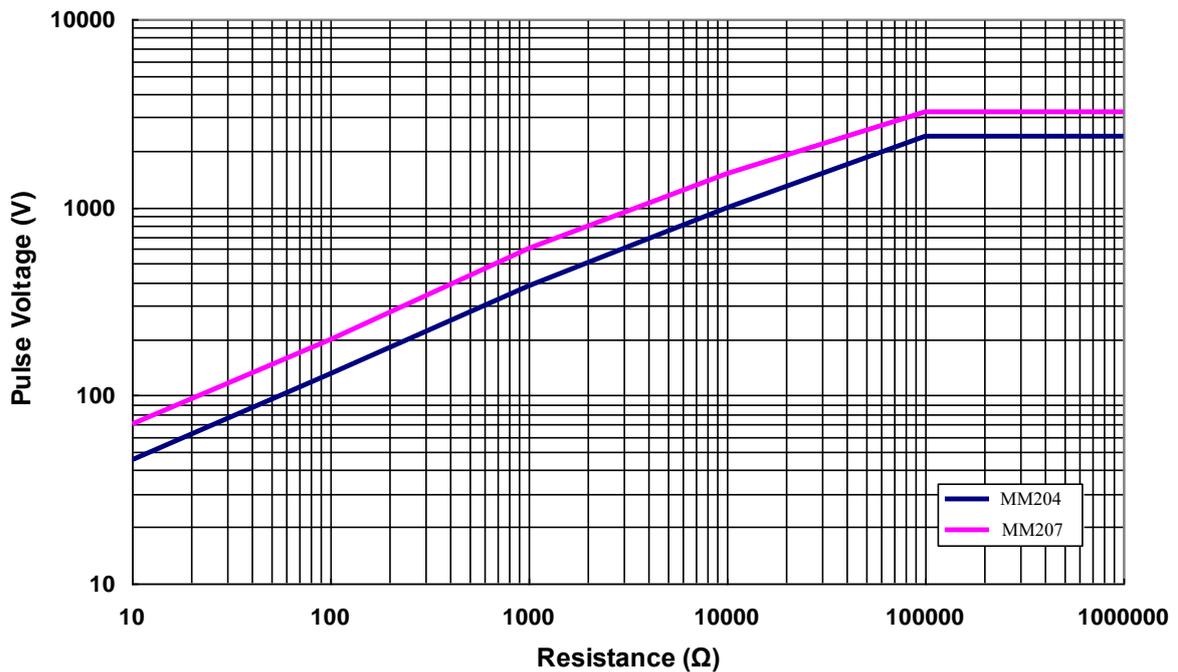
Lightning Surge

Resistors are tested in accordance with IEC 60115-1 using both 1.2/50 μ s and 10/700 μ s pulse shapes. The limit of acceptance is a shift in resistance of less than 0.5% from the initial value.

1.2/50 μ s Lightning Surge



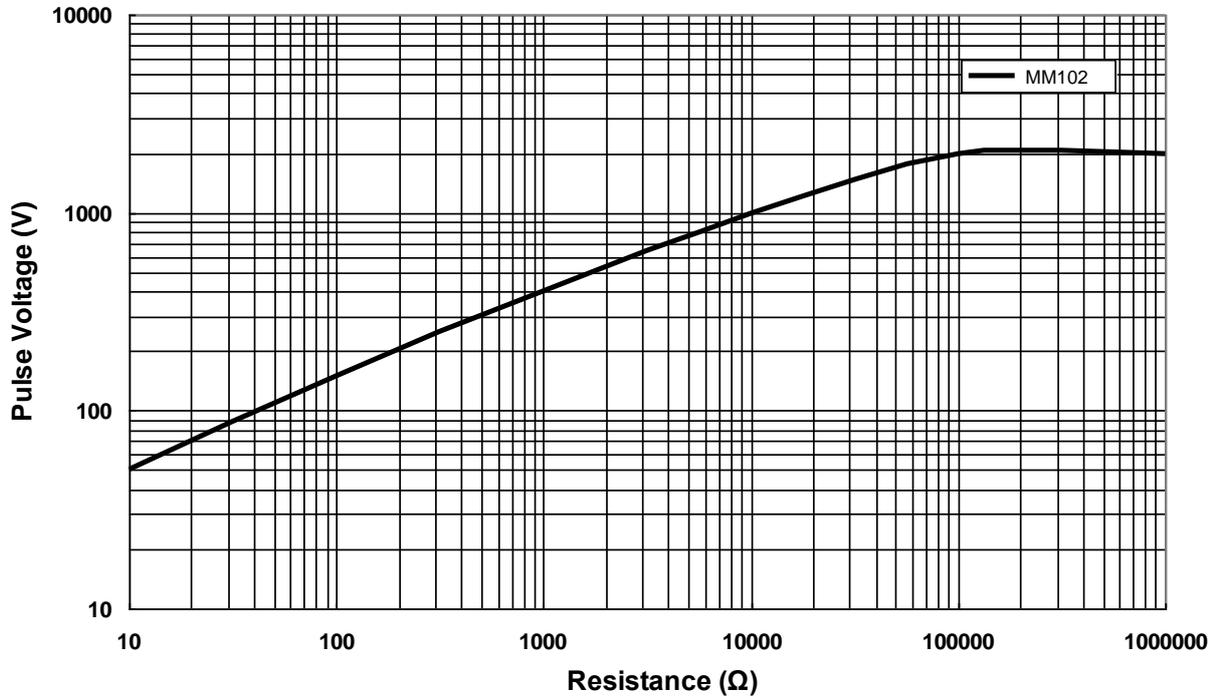
10/700 μ s Lightning Surge



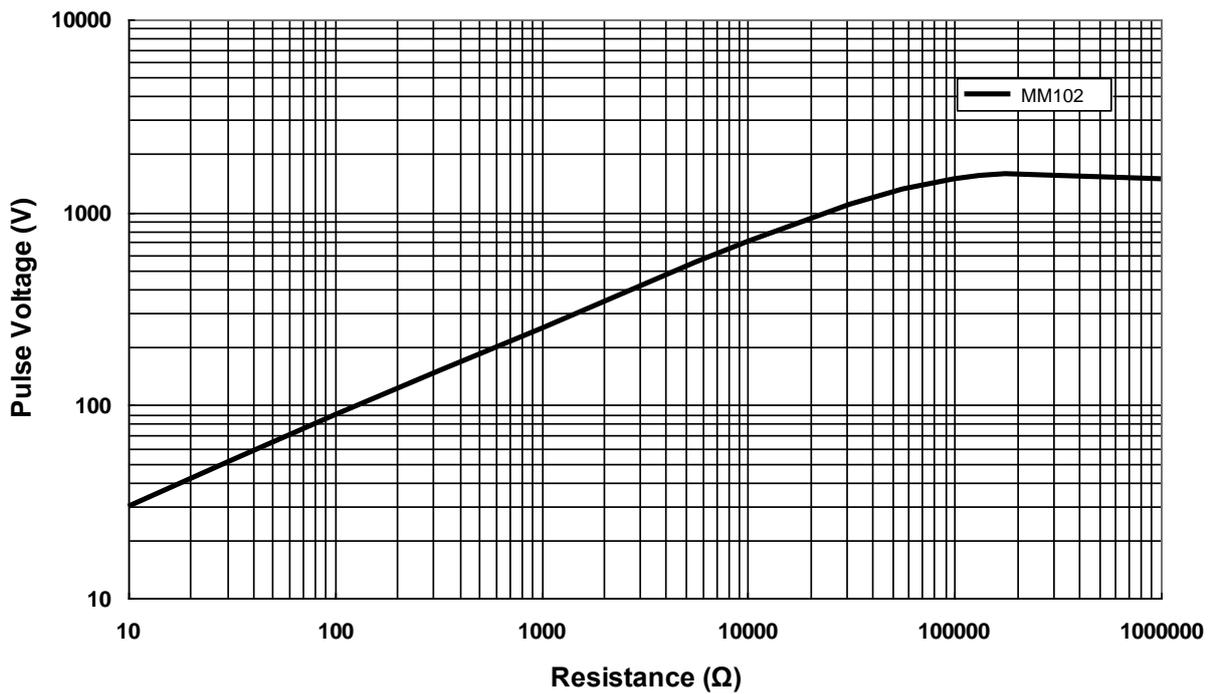
Metal Film Precision MELF Resistor

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1.2/50 μ s Lightning Surge



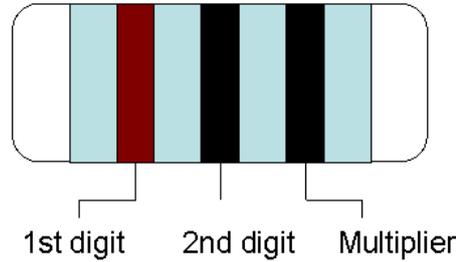
10/700 μ s Lightning Surge



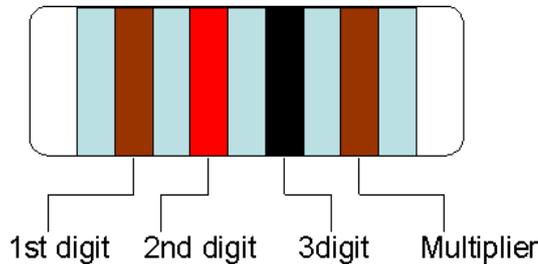
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■ Marking & Resistance Tolerance



±5%	E-24	1.0	1.1	1.2	1.3	1.5	1.6	1.8	2.0	2.2	2.4	2.7	3.0	3.3	3.6	3.9	4.3	4.7	5.1	5.6	6.2	6.8	7.5	8.2	9.1
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±1%	E-96	1.00	1.02	1.05	1.07	1.10	1.13	1.15	1.18	1.21	1.24	1.27	1.30	1.33	1.37	1.40	1.43	1.47	1.50	1.54	1.58	1.62	1.65	1.69	1.74
		1.78	1.82	1.87	1.91	1.96	2.00	2.05	2.10	2.15	2.21	2.26	2.32	2.37	2.43	2.49	2.55	2.61	2.67	2.74	2.80	2.87	2.94	3.01	3.09
		3.16	3.24	3.32	3.40	3.48	3.57	3.65	3.74	3.83	3.92	4.02	4.12	4.22	4.32	4.42	4.53	4.64	4.75	4.87	4.99	5.11	5.23	5.36	5.49
		5.62	5.76	5.90	6.04	6.19	6.34	6.49	6.65	6.81	6.98	7.15	7.32	7.50	7.68	7.87	8.06	8.25	8.45	8.66	8.87	9.09	9.31	9.53	9.76
±0.5%	E-192	10.0	10.1	10.2	10.4	10.5	10.6	10.7	10.9	11.0	11.1	11.3	11.4	11.5	11.7	11.8	12.0	12.1	12.3	12.4	12.6	12.7	12.9	13.0	13.2
		13.3	13.5	13.7	13.8	14.0	14.2	14.3	14.5	14.7	14.9	15.0	15.2	15.4	15.6	15.8	16.0	16.2	16.4	16.5	16.7	16.9	17.2	17.4	17.6
		17.8	18.0	18.2	18.4	18.7	18.9	19.1	19.3	19.6	19.8	20.0	20.3	20.5	20.8	21.0	21.3	21.5	21.8	22.1	22.3	22.6	22.9	23.2	23.4
		23.7	24.0	24.3	24.6	24.9	25.2	25.5	25.8	26.1	26.4	26.7	27.1	27.4	27.7	28.0	28.4	28.7	29.1	29.4	29.8	30.1	30.5	30.9	31.2
		31.6	32.0	32.4	32.8	33.2	33.6	34.0	34.4	34.8	35.2	35.7	36.1	36.5	37.0	37.4	37.9	38.3	38.8	39.2	39.7	40.2	40.7	41.2	41.7
		42.2	42.7	43.2	43.7	44.2	44.8	45.3	45.9	46.4	47.0	47.5	48.1	48.7	49.3	49.9	50.5	51.1	51.7	52.3	53.0	53.6	54.2	54.9	55.6
		56.2	56.9	57.6	58.3	59.0	59.7	60.4	61.2	61.9	62.6	63.4	64.2	64.9	65.7	66.5	67.3	68.1	69.0	69.8	70.6	71.5	72.3	73.2	74.1
		75.0	75.9	76.8	77.7	78.7	79.6	80.6	81.6	82.5	83.5	84.5	85.6	86.6	87.6	88.7	89.8	90.9	92.0	93.1	94.2	95.3	96.5	97.6	98.8

Color	Digit	Multiplier
Silver	-	10 ⁻²
Gold	-	10 ⁻¹
Black	0	10 ⁰
Brown	1	10 ¹
Red	2	10 ²
Orange	3	10 ³
Yellow	4	10 ⁴
Green	5	10 ⁵
Blue	6	10 ⁶
Violet	7	10 ⁷
Grey	8	10 ⁸
White	9	10 ⁹

※ Resistance more than two significant figures(<1R) or more than three significant figures(>1R) will not provide color code.