

## *Data Sheet*

Customer: \_\_\_\_\_

Product: Metal Film MELF Resistor. Precision MM/MML Series \_\_\_\_\_

Size : 0102/0204/0207 \_\_\_\_\_

Issued Date: 17-Jan.-2018 \_\_\_\_\_

Edition: Ver. 2 \_\_\_\_\_

### Record of change

Date	Ver.	Description	Page
17-Jul.-2017	1		
17-Jan.-2018	2	Revise ohmic range, add surge curve	2, 6~10

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Prepared by	Checked by	Approved by	Accepted by (customer)
17-Jul.-2017	17-Jul.-2015	17-Jul.-2015	
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# METAL FILM RESISTOR

## MELF & MINI-MELF MM, MML TYPE

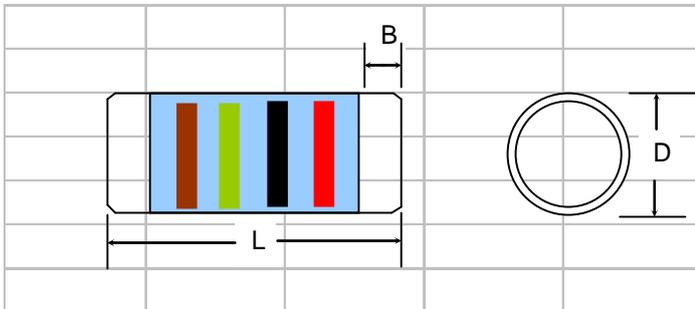
### ■ Features

- SMD enabled structure.
- Conformal Multi-layer Coating Against Humidity
- Tight tolerance down to  $\pm 0.1\%$
- Extremely low TCR down to  $\pm 10 \text{ PPM}/^\circ\text{C}$

### ■ Applications

- Telecommunication
- Medical Equipment
- Measurement/Testing Equipment

### ■ Construction and Dimension



Body Color : Light Blue

Marking: Color code (3 or 4 bands)

Type	Body Length (L)	Body Diameter (D)	Soldering spot (B)
MM102	2.20±0.10mm	1.10±0.10mm	0.45±0.05
MML102	2.20±0.10mm	1.10±0.10mm	0.45±0.05
MM204	3.50±0.20mm	1.40±0.15mm	0.80±0.10
MML204	3.50±0.20mm	1.40±0.15mm	0.80±0.10
MM207	5.90±0.20mm	2.20±0.20mm	1.30±0.10
MML207	5.90±0.20mm	2.20±0.20mm	1.30±0.10

■ General Specification

Type	Power Rating (at 70°C)	Max. Working Voltage	Max. Overload Voltage	Resistance Range					TCR ppm/°C		
				±0.1%	±0.25%	±0.5%	±1%	±5%			
MM102	0.125W	150V	300V	100Ω~56KΩ					-	±10	
				100Ω~82KΩ		49.9Ω~200KΩ	49.9Ω~390KΩ			-	±15
				-		40Ω~1MΩ					±25
				-			40Ω~1MΩ				±50
MML102	0.2W	200V	400V	100Ω~56KΩ						±15	
				100Ω~82KΩ		49.9Ω~200KΩ	49.9Ω~390KΩ			±25	
				-		40Ω~1MΩ					±50
				-			40Ω~1MΩ				±100
MM204	0.25W	200V	400V	10Ω~20KΩ						±10	
				10Ω~300KΩ						±15	
				10Ω~1MΩ			4.02Ω~4.7MΩ				±25
				10Ω~1MΩ	1Ω~1MΩ		0.2Ω~10MΩ				±50
				-			0.1Ω~10MΩ				±100
MML204	0.4W	200V	400V	10Ω~100KΩ						±15	
				10Ω~1MΩ			4.02Ω~1MΩ				±25
				10Ω~1MΩ	1Ω~1MΩ		0.2Ω~1MΩ				±50
				-			0.1Ω~1MΩ				±100
MM207	0.5W	300V	600V	10Ω~20KΩ						±10	
				10Ω~300KΩ						±15	
				10Ω~1MΩ			4.02Ω~4.7MΩ				±25
				10Ω~1MΩ	1Ω~1MΩ		0.2Ω~10MΩ				±50
				-			0.1Ω~10MΩ				±100
MML207	1W	350V	700V	10Ω~100KΩ						±15	
				10Ω~1MΩ			4.02Ω~1MΩ				±25
				10Ω~1MΩ	1Ω~1MΩ		0.2Ω~10MΩ				±50
				-			0.1Ω~10MΩ				±100

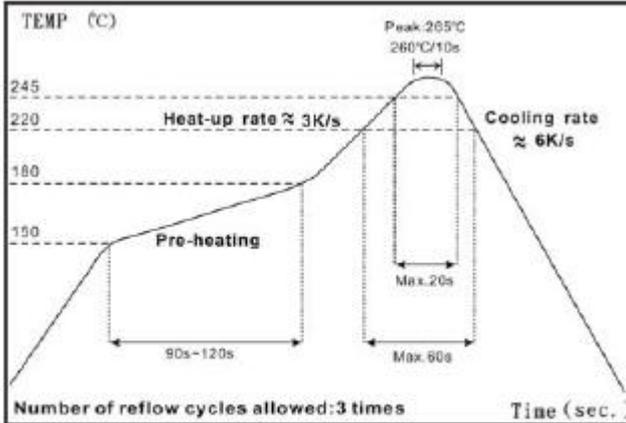
\* For zero-ohm jumper, resistance value is under 15 mΩ.

\* Please consult factory for values out of above range, or the range of tolerance ±0.1%, ±0.25% and ±0.5%

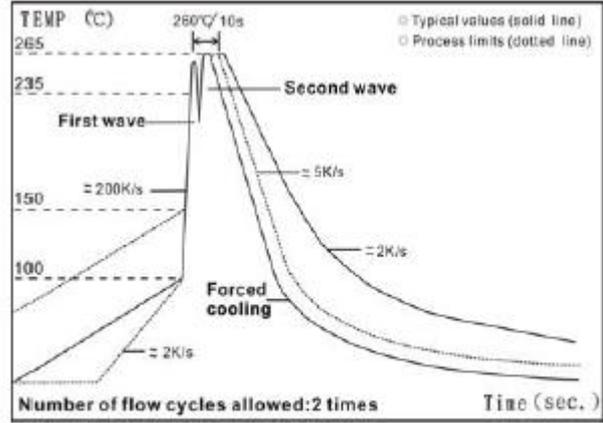
\* Operating Voltage=  $\sqrt{(P * R)}$  or Max. operating voltage listed above, whichever is lower.

\* Overload Voltage=  $2.5 * \sqrt{(P * R)}$  or Max. overload voltage listed above, whichever is lower.

## ■ Soldering Condition



IR Reflow Soldering



Wave Soldering (Flow Soldering)

- (1) Time of IR reflow soldering at maximum temperature point 260° C : 10s
- (2) Time of wave soldering at maximum temperature point 260° C : 10s
- (3) Time of soldering iron at maximum temperature point 410° C : 5s

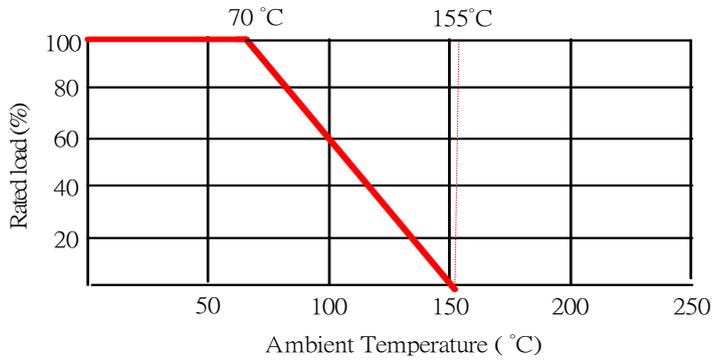
## ■ Environmental Characteristics

Item	Requirement	Test Method
Temperature Coefficient of Resistance (T.C.R.)	As Spec	-55°C~+125°C, 25°C is the reference temperature
Short Time Overload	0204/0207: ±(0.15%+0.05Ω)	RCWV*2.5 or Max. Overload voltage whichever is lower
	0102: ±(0.5%+0.05Ω)	
Insulation Resistance	≥10G	Max. Overload voltage for 1 minute
Endurance	0204/0207: ±(0.5%+0.05Ω)	70±2°C, RCWV for 1000 hrs with 1.5 hrs "ON"
	0102: ±(1.5%+0.05Ω)	and 0.5 hrs "OFF"
Damp Heat with Load	0204/0207: ±(1.0%+0.05Ω)	40±2°C, 90~95% R.H., RCWV for 1000 hrs with
	0102: ±(1.5%+0.05Ω)	1.5 hrs "ON" and 0.5 hrs "OFF"
Thermal Shock	0204/0207: ±(0.5%+0.05Ω)	-55°C/+155°C, No. of cycles required – 300, Maximum
	0102: ±(1.5%+0.05Ω)	Transfer time – 20 sec, Dwell time – 15 min. Air-Air
Bending Strength	±(0.5%+0.05Ω)	Bending once for 5 seconds with 2mm
Solderability	95% min. coverage	245±5°C for 3 seconds
Resistance to Soldering Heat	±(0.5%+0.05Ω)	260±5°C for 10 seconds
Voltage Proof	No breakdown or flashover	1.42 times Max. Operating Voltage for 1 minute
Leaching	Individual leaching area ≤ 5%	260±5°C for 30 seconds
	Total leaching area ≤ 10%	
Rapid Change of Temperature	±(0.5%+0.05Ω)	-55°C to +155°C, 5 cycles

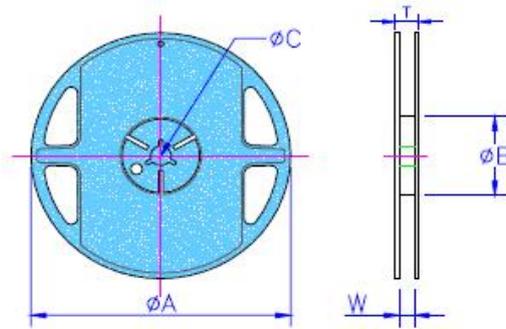
RCWV(Rated continuous working voltage)= $\sqrt{P * R}$  or Max. Operating voltage whichever is lower.

Storage Temperature: 25±3°C; Humidity < 80%RH

## Derating Curve



## Packaging



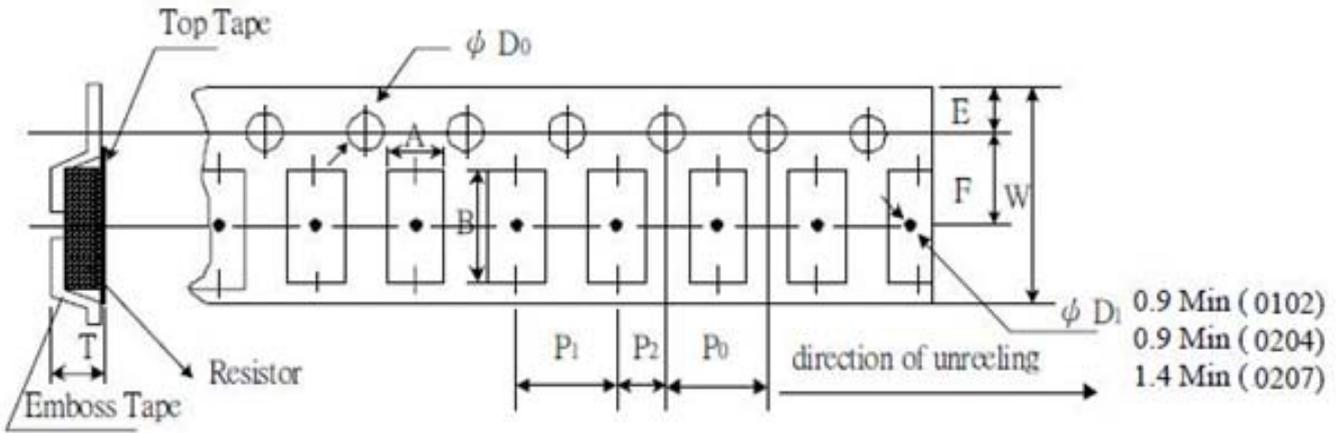
## Packaging Quantity & Reel Specifications

Type	Reel Diameter	ΦA	ΦB	ΦC	W	T	Emboss
	Diameter	(mm)	(mm)	(mm)	(mm)	(mm)	Plastic Tape (EA)
MM/MML102	7 inch	178.5±1.5	60.0+1.0	13.0±0.2	9.0±0.5	12.5±0.5	3,000
MM/MML204	7 inch	178.5±1.5	60.0+1.0	13.0±0.2	9.0±0.5	12.5±0.5	3,000
MM/MML207	7 inch	178.5±1.5	60.0+1.0	13.0±0.2	13.0±0.5	15.5±0.5	2,000

## Part Numbering

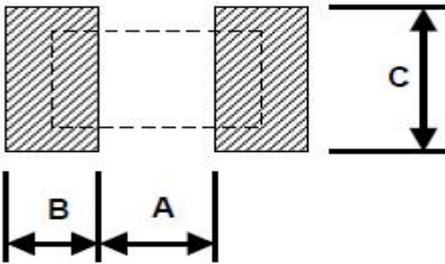
<u>MM204</u>	<u>F</u>	<u>E</u>	<u>- 100KR</u>
Type	Tolerance	PPM	Ohmic value
MM102	J = ±5%	B = ±10	10R = 10Ω
MM204	F = ±1%	C = ±15	120R = 120Ω
MML204	D = ±0.5%	D = ±25	1K2R = 1.2KΩ
MM207	C = ±0.25%	E = ±50	1MR = 1MΩ
MML207	B = ±0.1%	F = ±100	

■ **Emboss Plastic Tape Specifications**



Type	A	B	W	E	F	P0	P1	P2	$\Phi D_0$	T
	(mm)	(mm)								
MM/MML102	1.50±0.10	2.30±0.10	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	1.70±0.10
MM/MML204	1.55±0.10	3.65±0.10	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/MML207	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

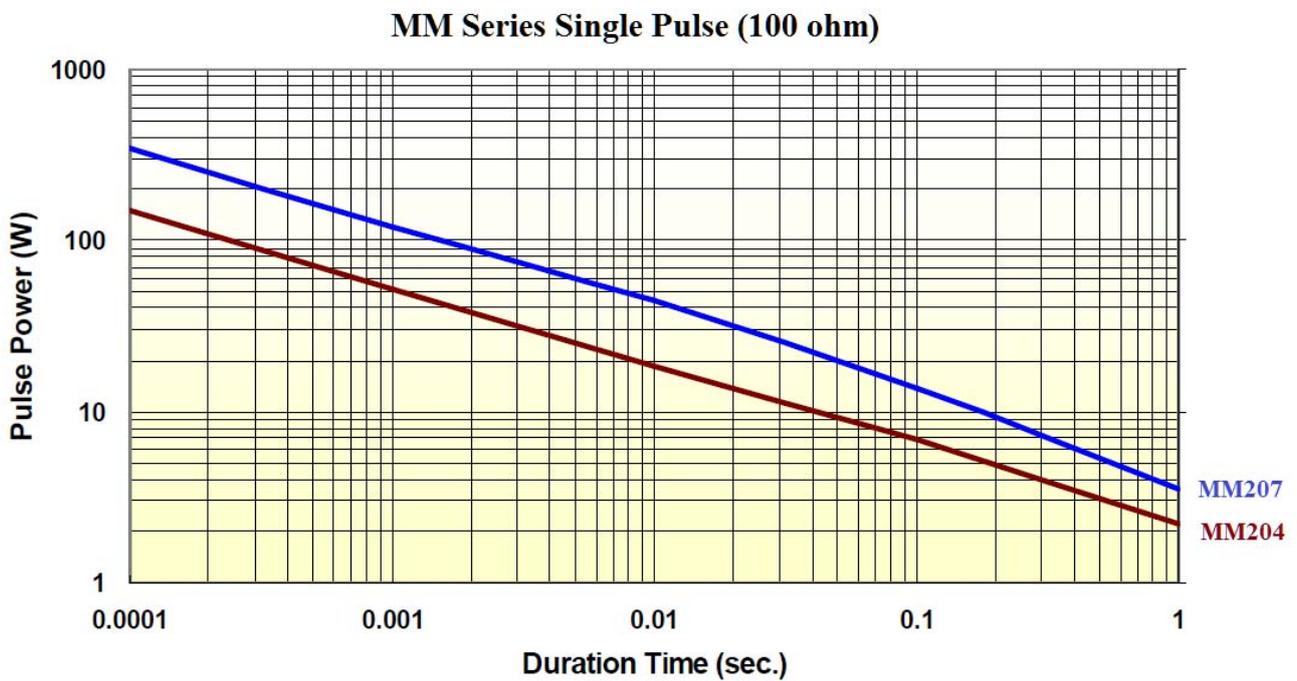
■ **Recommend Land Pattern**



Type	A	B	C
	(mm)	(mm)	(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

### ■ Pulse withstanding capacity

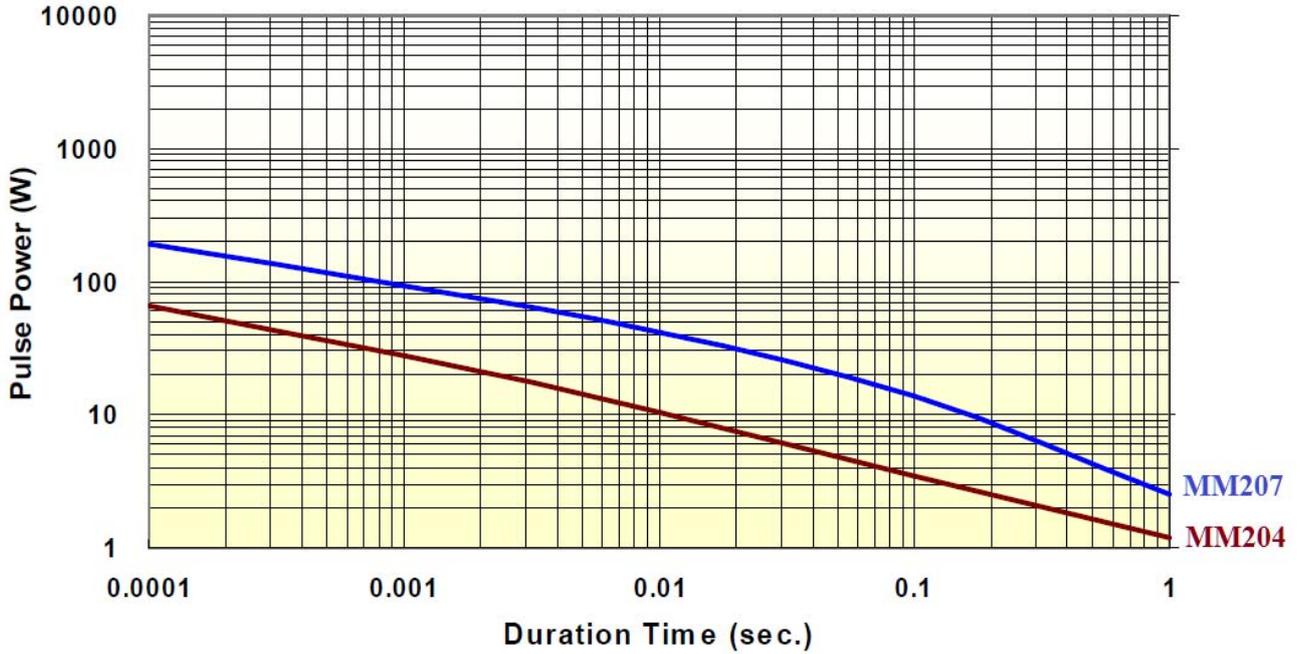
The single impulse graph is the result of 50 impulses of rectangular shape applied at one-minute intervals. The limit of acceptance was a shift in resistance of less than 1% from the initial value. The power applied was subject to the restrictions of the maximum permissible impulse voltage graph shown.



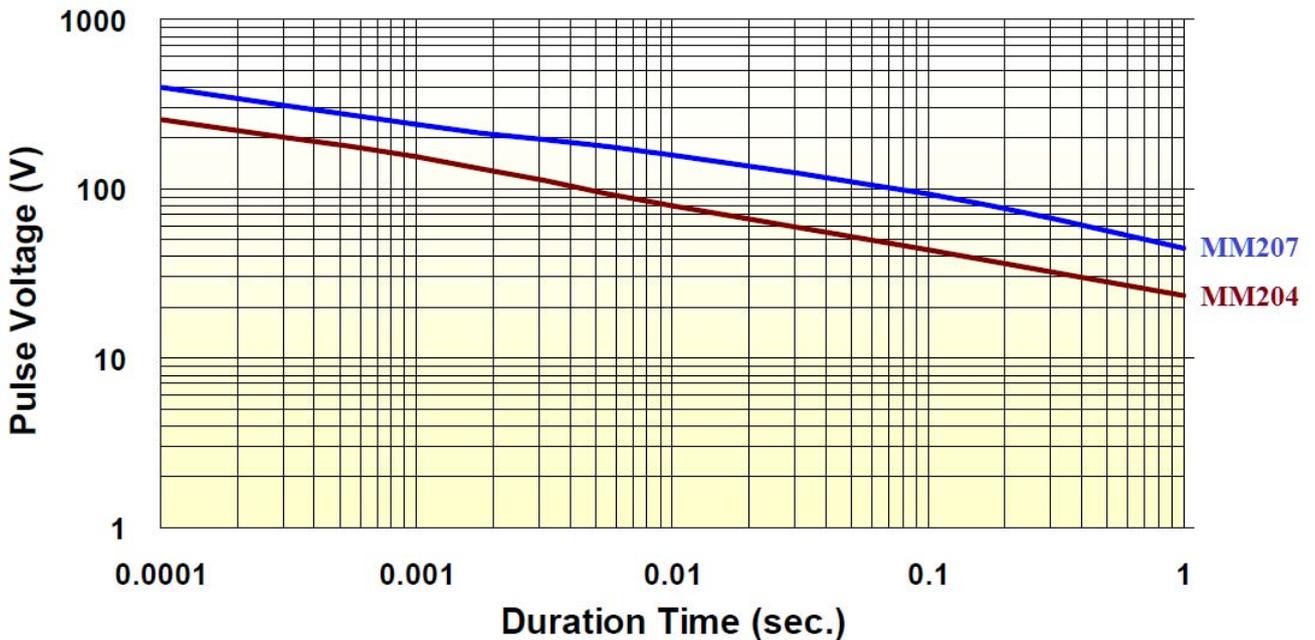
■ **Continuous Pulse**

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.

**MM Series Continuous Pulse (100 ohm)**



**MM Series Pulse Voltage (100 ohm)**

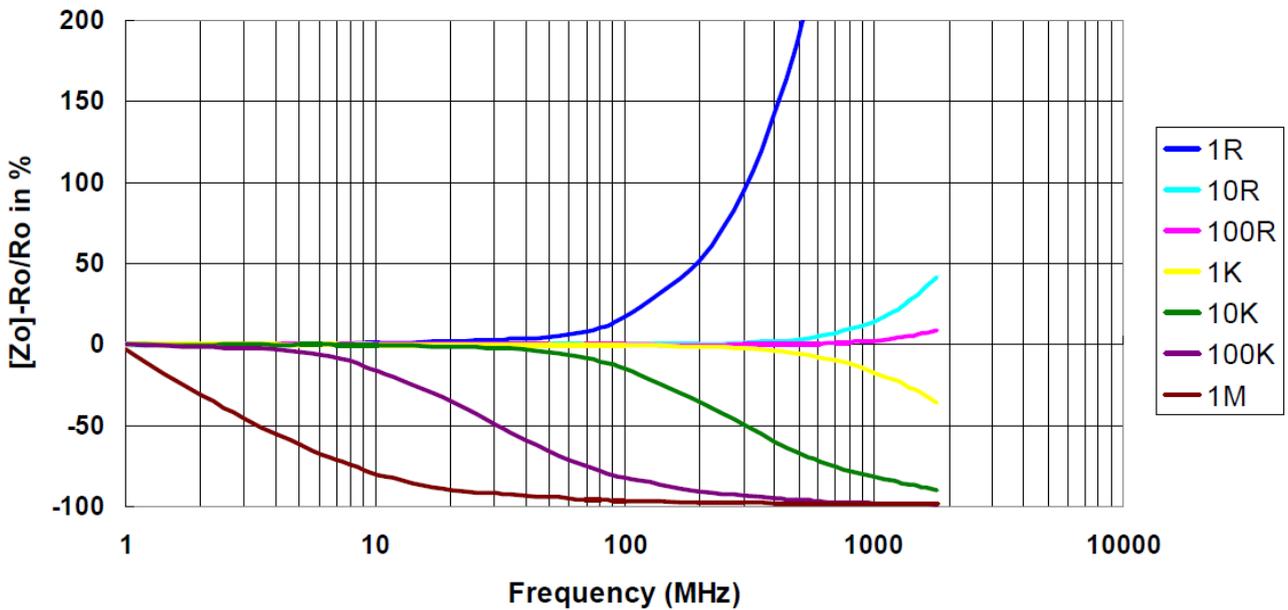


## Frequency behavior

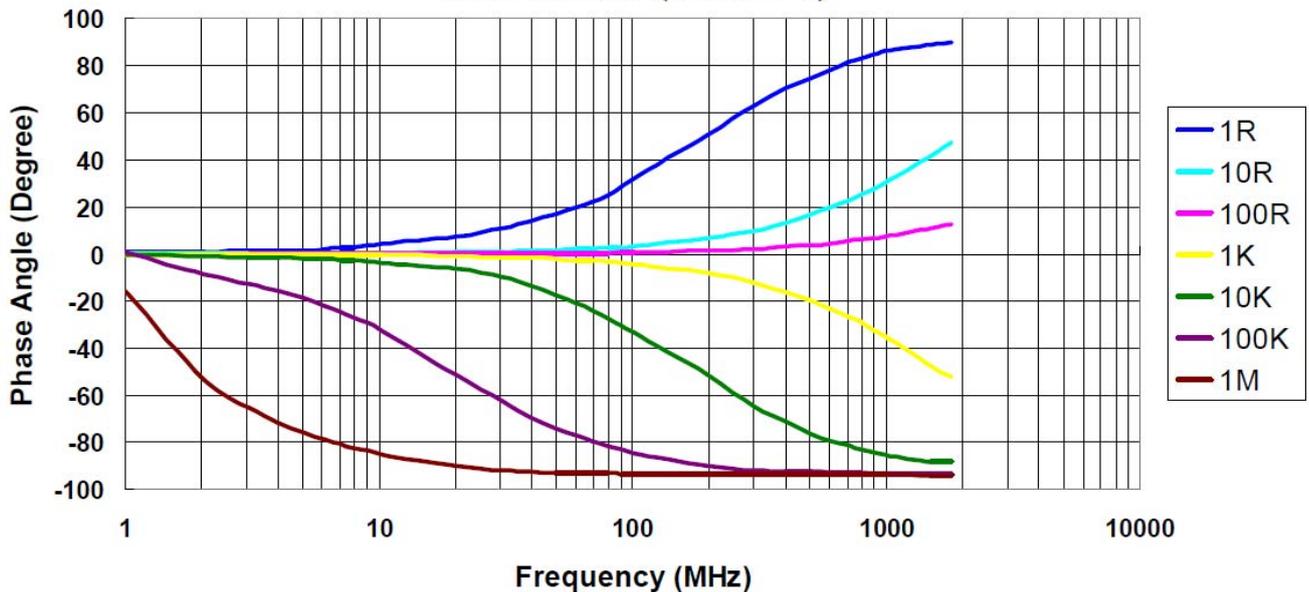
Resistors are designed to function according to ohmic laws. This is basically true of resistors for frequencies up to 100kHz. At higher frequencies, there is an additional contribution to the impedance by an ideal resistor switched in series with a coil and both switched parallel to a capacitor. The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

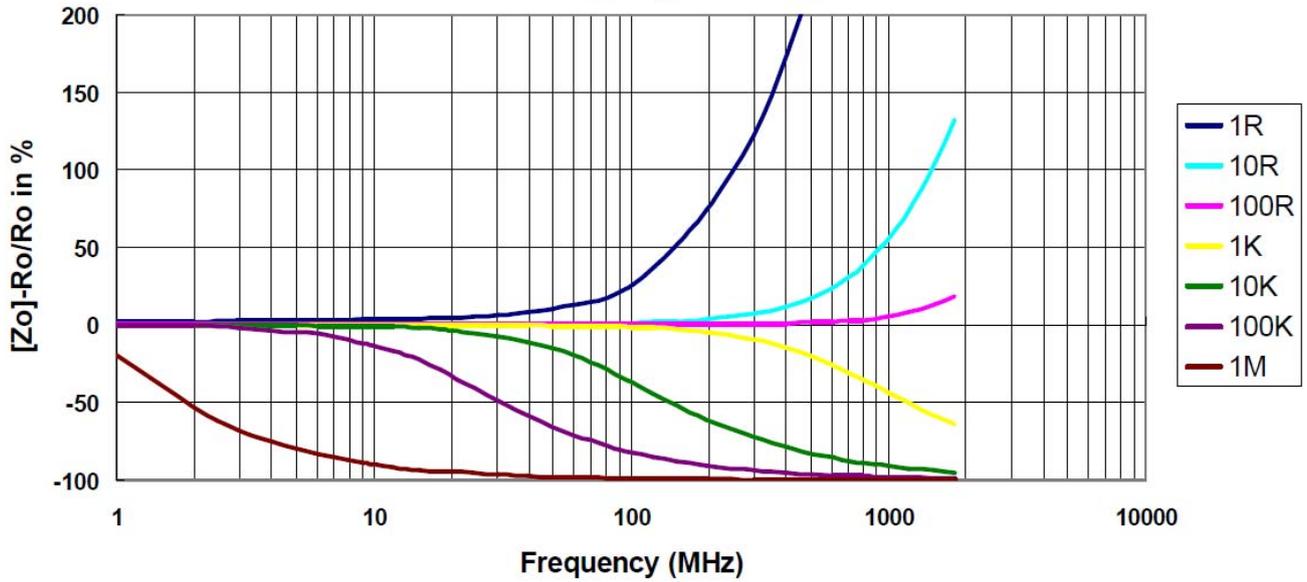
### Frequency vs. Impedance MM Series ( MM204 )



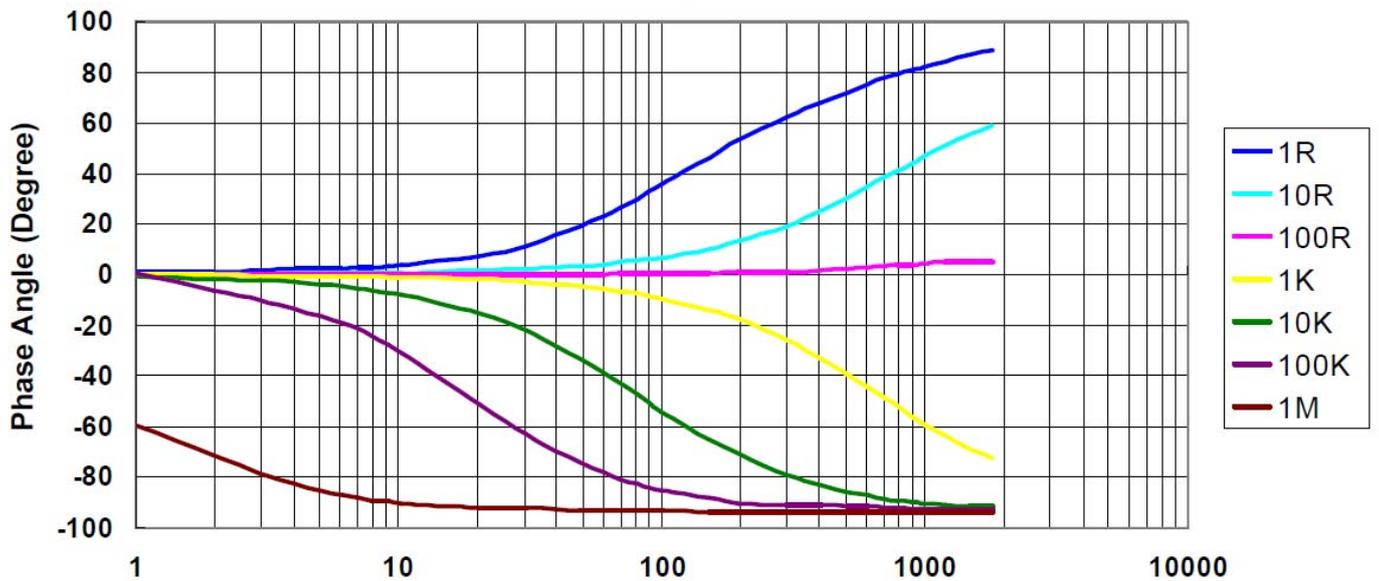
### Frequency vs Phase Angle MM Series (MM204)



### Frequency vs Impedance MM Series (MM207)



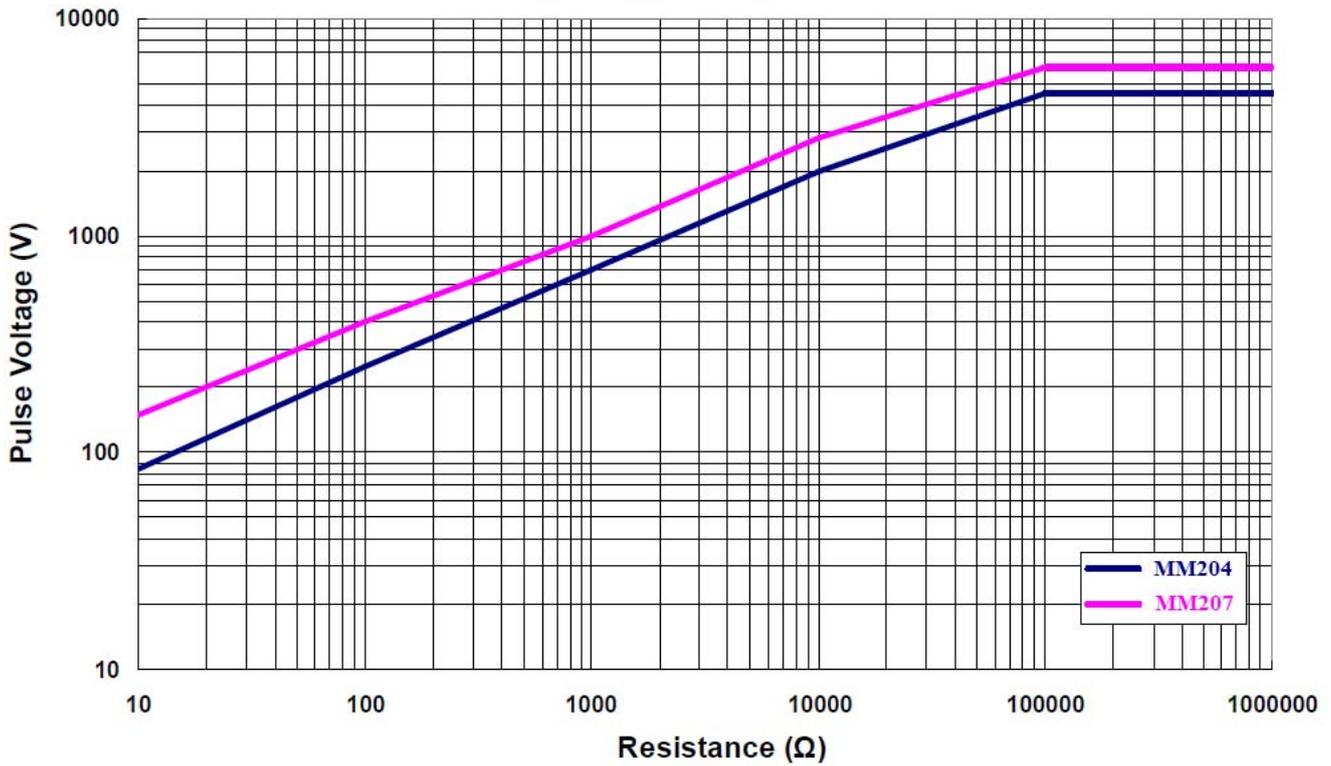
### Frequency vs Phase Angle MM Series (MM207)



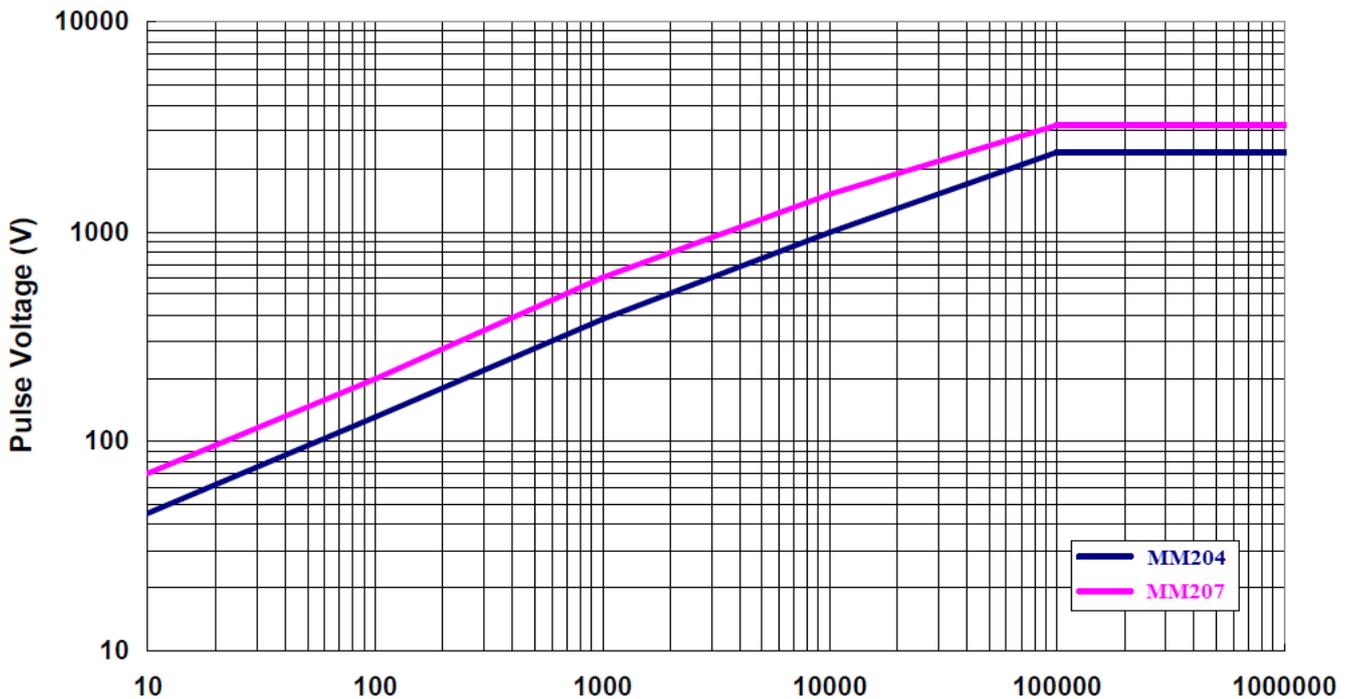
■ **Lightning Surge**

Resistors are tested in accordance with IEC 60 115-1 using both 1.2/50us and 10/700us pulse shapes. The limit of acceptance is a shift in resistance of less than 0.5% from the initial value.

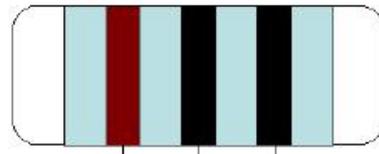
**1.2/50µs Lightning Surge**



**10/700µs Lightning Surge**

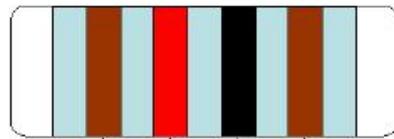


■ **Marking & Resistance Tolerance**



1st digit      2nd digit      Multiplier

±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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1st digit      2nd digit      3rd digit      Multiplier

±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 <sup>-2</sup>
Gold	-	10 <sup>-1</sup>
Black	0	10 <sup>0</sup>
Brown	1	10 <sup>1</sup>
Red	2	10 <sup>2</sup>
Orange	3	10 <sup>3</sup>
Yellow	4	10 <sup>4</sup>
Green	5	10 <sup>5</sup>
Blue	6	10 <sup>6</sup>
Violet	7	10 <sup>7</sup>
Grey	8	10 <sup>8</sup>
White	9	10 <sup>9</sup>