

**Key Features**

AEC-Q200 Qualified

Thin film technology

Excellent overall stability

Sn termination on Ni barrier layer

Tight tolerance down to  $\pm 0.1\%$ Extremely low TCR down to  $\pm 10 \text{ PPM}/^\circ\text{C}$ 

SMD enabled structure

Lead-free and RoHS compliant

**Applications**

Automotive (Non-safety parts)

Industrial

Telecommunication

Medical Equipment

Measurement/Testing Equipment

**Type SMA-A series**

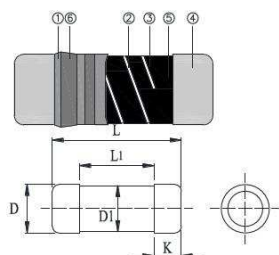
The SMA-A series is a metal film precision MELF resistor with an SMD enabled structure tight tolerance and low TCR. A sister to our SMA series the SMA-A series is AEC-Q200 qualified

It comes in three sizes and six power ratings to 1W, is lead free and RoHS compliant.

**Technical Specifications**

|                                                                                         |             |            |                |            |                |            |
|-----------------------------------------------------------------------------------------|-------------|------------|----------------|------------|----------------|------------|
| Description                                                                             | SMA-A0102   |            | SMA-A0204      |            | SMA-A0207      |            |
| Resistance range                                                                        | 1Ω-1MΩ; 0Ω  |            | 0.1Ω-3.4MΩ; 0Ω |            | 0.1Ω-3.4MΩ; 0Ω |            |
| Resistance tolerance                                                                    | See below   |            |                |            |                |            |
| Temperature coefficient                                                                 | See below   |            |                |            |                |            |
| Operation mode                                                                          | Standard    | High Power | Standard       | High Power | Standard       | High Power |
| Power rating P <sub>70</sub>                                                            | 0.2W        | 0.3W       | 0.25W          | 0.4W       | 0.5W           | 1W         |
| Operating voltage U <sub>max</sub>                                                      | 200V        | 200V       | 200V           | 200V       | 300V           | 350V       |
| Operating temperature range                                                             | -55°C~155°C |            |                |            |                |            |
| Max. resistance change at P <sub>70</sub> for resistance range, ΔR/R max., after 1000 h | ≤0.5%       |            | ≤0.5%          |            | ≤0.5%          |            |

## Construction and Dimensions

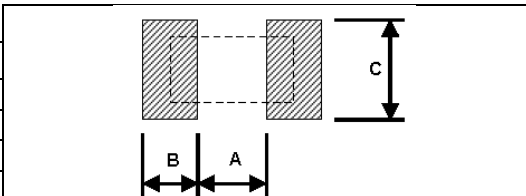


|                      |                  |
|----------------------|------------------|
| ① Insulation Coating | ④ Electrode Cap  |
| ② Trimming Line      | ⑤ Resistor Layer |
| ③ Ceramic Rod        | ⑥ Marking        |

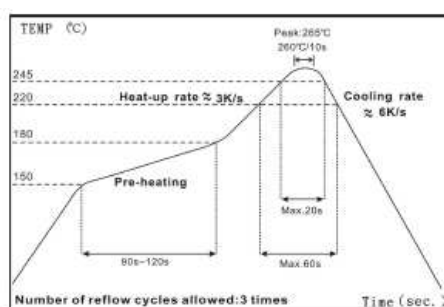
| Type      | L (mm)    | L <sub>1</sub> min. (mm) | ΦD (mm)   | ΦD <sub>1</sub> (mm) | K (mm)    | Weight 1,000EA (g) |
|-----------|-----------|--------------------------|-----------|----------------------|-----------|--------------------|
| SMA-A0102 | 2.20±0.10 | 1.1                      | 1.10±0.10 | D +0/-0.15           | 0.45±0.05 | 7.7                |
| SMA-A0204 | 3.50±0.2  | 1.7                      | 1.40±0.15 | D +0/-0.2            | 0.8±0.1   | 18.7               |
| SMA-A0207 | 5.90±0.2  | 2.9                      | 2.20±0.20 | D +0/-0.2            | 1.3±0.1   | 80.9               |

## Recommended Land Pattern

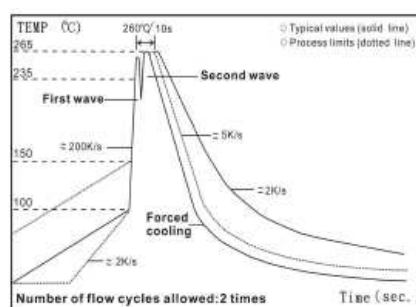
| Type      | A (mm) | B (mm) | C (mm) |
|-----------|--------|--------|--------|
| SMA-A0102 | 1.0    | 0.8    | 1.5    |
| SMA-A0204 | 1.6    | 1.2    | 1.6    |
| SMA-A0207 | 3.0    | 1.7    | 2.4    |



## Soldering Condition



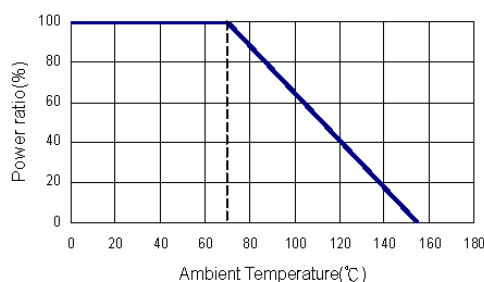
IR Reflow Soldering



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

## Derating Curve



### Standard Electrical Specifications

| Size | Power Rating at 70°C | Max. Operating Voltage | Max. Overload Voltage | Resistance Range |           |             |             |     | TCR (PPM/°C) |     |
|------|----------------------|------------------------|-----------------------|------------------|-----------|-------------|-------------|-----|--------------|-----|
|      |                      |                        |                       | ±0.1%            | ±0.25%    | ±0.5%       | ±1%         | ±5% |              |     |
| 0102 | 0.2W                 | 200V                   | 400V                  | 100Ω-56KΩ        |           |             |             |     | -            | ±15 |
|      |                      |                        |                       |                  | 100Ω-82KΩ | 49.9Ω-200KΩ | 49.9Ω-390KΩ | -   | ±25          |     |
|      |                      |                        |                       | -                |           | 1Ω-1MΩ      |             |     | ±50          |     |
|      |                      |                        |                       | -                |           |             | 1Ω-1MΩ      |     | ±100         |     |
|      | Jumper: 2A           |                        |                       | 0Ω(<15mΩ)        |           |             |             |     |              | -   |
| 0204 | 0.25W                | 200V                   | 400V                  | 49.9Ω-20KΩ       |           |             |             |     | ±10          |     |
|      |                      |                        |                       | 10Ω-300KΩ        |           |             |             |     | ±15          |     |
|      |                      |                        |                       | 10Ω-1MΩ          |           | 10Ω-3.4MΩ   | 4.02Ω-3.4MΩ |     | ±25          |     |
|      |                      |                        |                       | 10Ω-1MΩ          | 1Ω-1MΩ    | 1Ω-3.4MΩ    | 0.2Ω-3.4MΩ  |     | ±50          |     |
|      |                      |                        |                       | -                |           |             | 0.1Ω-1MΩ    |     | ±100         |     |
|      | Jumper: 2A           |                        |                       | 0Ω(<15mΩ)        |           |             |             |     |              | -   |
| 0207 | 0.5W                 | 300V                   | 600V                  | 49.9Ω-20KΩ       |           |             |             |     | ±10          |     |
|      |                      |                        |                       | 10Ω-300KΩ        |           |             |             |     | ±15          |     |
|      |                      |                        |                       | 10Ω-1MΩ          |           | 10Ω-3.4MΩ   | 4.02Ω-3.4MΩ |     | ±25          |     |
|      |                      |                        |                       | 10Ω-1MΩ          | 1Ω-1MΩ    | 1Ω-3.4MΩ    | 0.2Ω-3.4MΩ  |     | ±50          |     |
|      |                      |                        |                       | -                |           |             | 0.1Ω-1MΩ    |     | ±100         |     |
|      | Jumper: 4A           |                        |                       | 0Ω(<15mΩ)        |           |             |             |     |              | -   |

### High Power Rating Electrical Specifications

| Size | Power Rating at 70°C | Max. Operating Voltage | Max. Overload Voltage | Resistance Range |           |             |             |     | TCR (PPM/°C) |     |
|------|----------------------|------------------------|-----------------------|------------------|-----------|-------------|-------------|-----|--------------|-----|
|      |                      |                        |                       | ±0.1%            | ±0.25%    | ±0.5%       | ±1%         | ±5% |              |     |
| 0102 | 0.3W                 | 200V                   | 400V                  | 100Ω-56KΩ        |           |             |             |     | -            | ±15 |
|      |                      |                        |                       | -                | 100Ω-82KΩ | 49.9Ω-200KΩ | 49.9Ω-390KΩ |     | ±25          |     |
|      |                      |                        |                       | -                |           | 1Ω-1MΩ      |             |     | ±50          |     |
|      |                      |                        |                       | -                |           |             | 1Ω-1MΩ      |     | ±100         |     |
| 0204 | 0.4W                 | 200V                   | 400V                  | 10Ω-300KΩ        |           |             |             |     | ±15          |     |
|      |                      |                        |                       | 10Ω-1MΩ          |           | 10Ω-3.4MΩ   | 1Ω-3.4MΩ    |     | ±25          |     |
|      |                      |                        |                       | 10Ω-1MΩ          | 1Ω - 1MΩ  | 1Ω – 3.4MΩ  | 0.2Ω-3.4MΩ  |     | ±50          |     |
|      |                      |                        |                       | -                |           |             | 0.1Ω-1MΩ    |     | ±100         |     |
| 0207 | 1W                   | 350V                   | 700V                  | 10Ω-300KΩ        |           |             |             |     | ±15          |     |
|      |                      |                        |                       | 10Ω-1MΩ          |           | 10Ω-3.4MΩ   | 1Ω-3.4MΩ    |     | ±25          |     |
|      |                      |                        |                       | 10Ω-1MΩ          | 1Ω - 1MΩ  | 1Ω – 3.4MΩ  | 0.2Ω-3.4MΩ  |     | ±50          |     |
|      |                      |                        |                       | -                |           |             | 0.1Ω-1MΩ    |     | ±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.

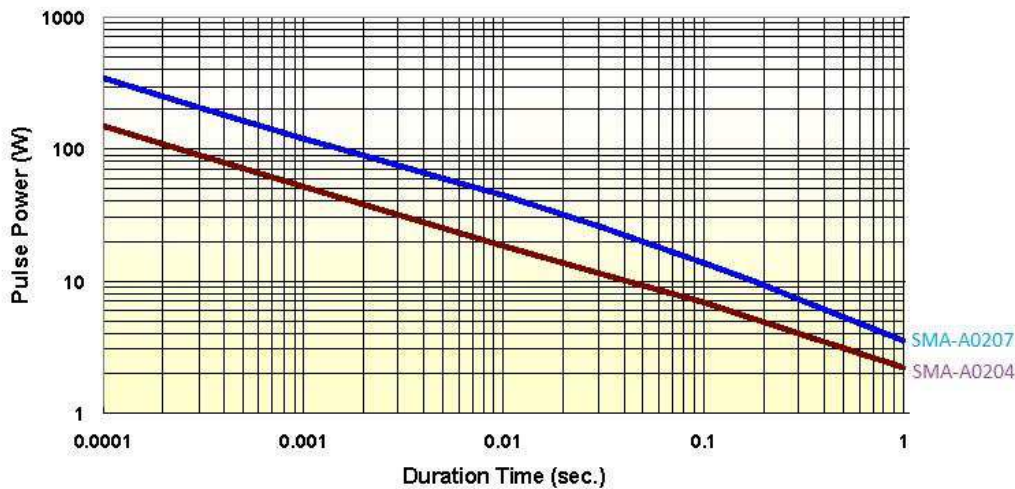
RCWV(Rated Continuous Working Voltage)= $\sqrt{P \cdot R}$  or Max. Operating Voltage whichever is lower.

Operating temperature range -55°C~155°C

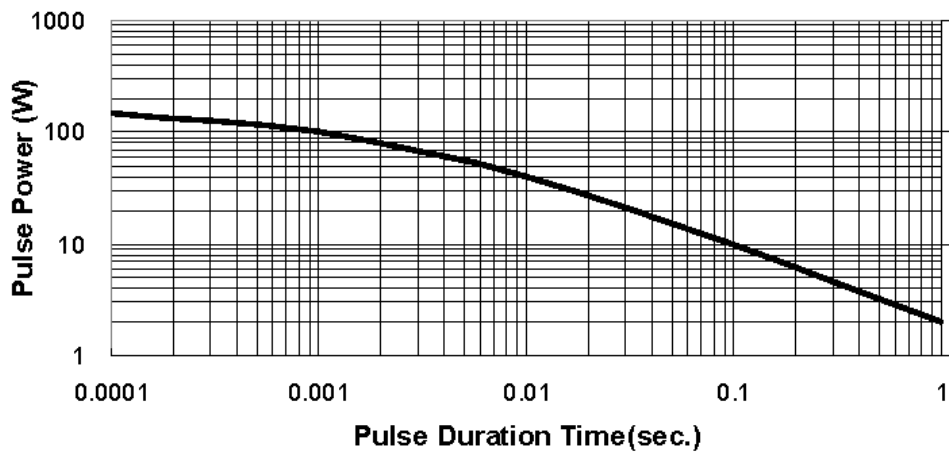
**Pulse withstanding capacity**

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

**SMA-A Series Single Pulse(100 Ohm)**



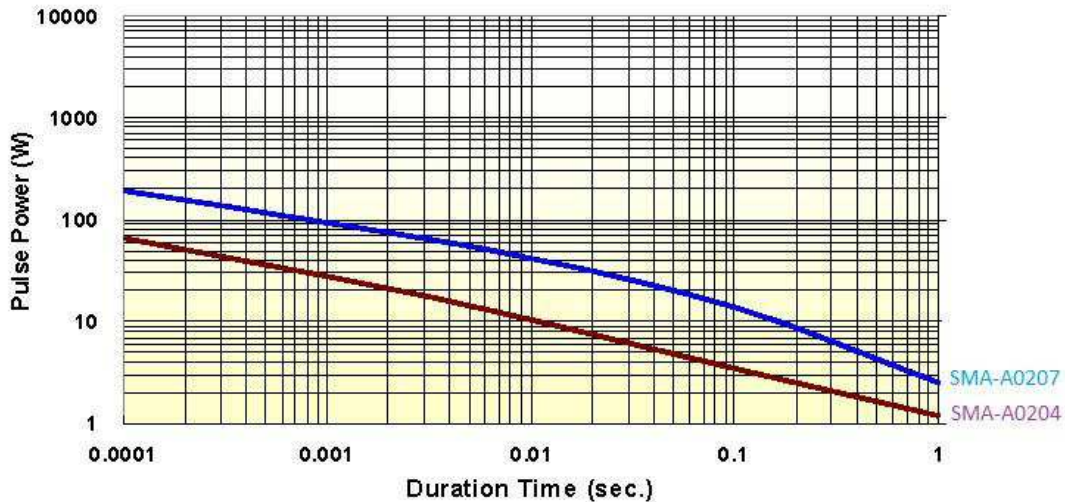
**SMA-A0102 Series Single Pulse**



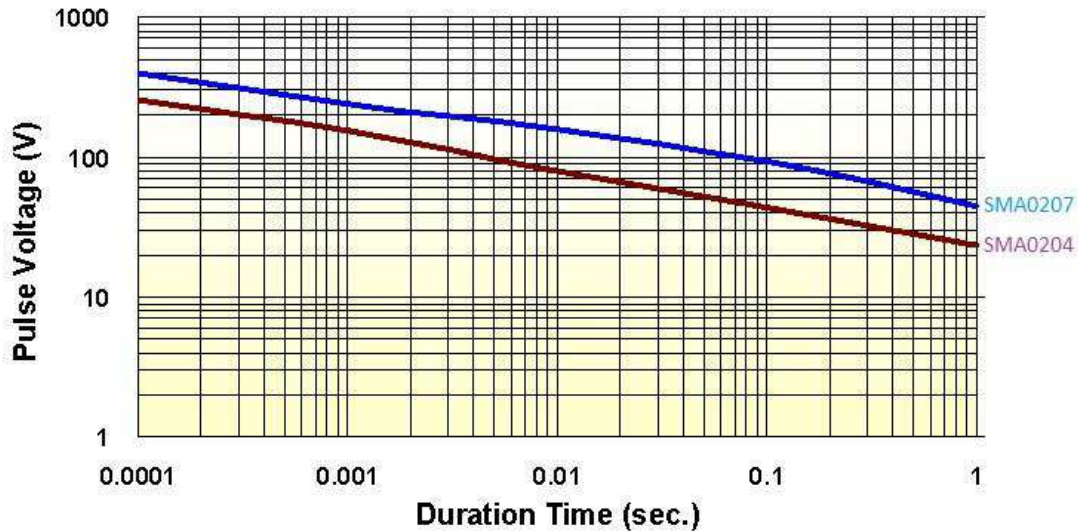
**Continuous Pulse**

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

**SMA-A series Continuous Pulse (100 Ohm)**

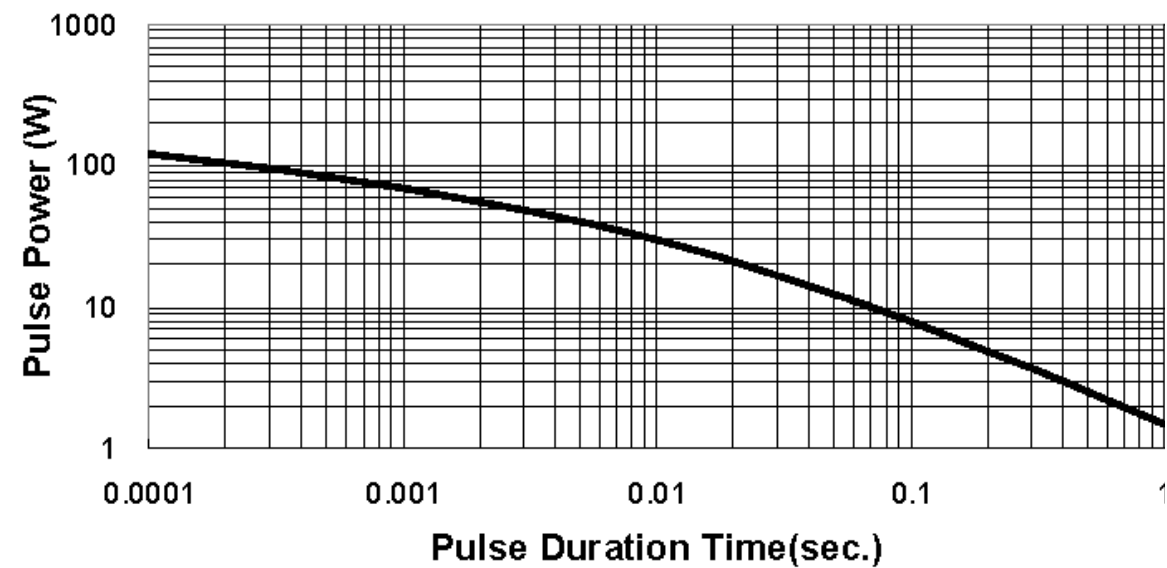


**SMA-A series Pulse Voltage (100 Ohm)**

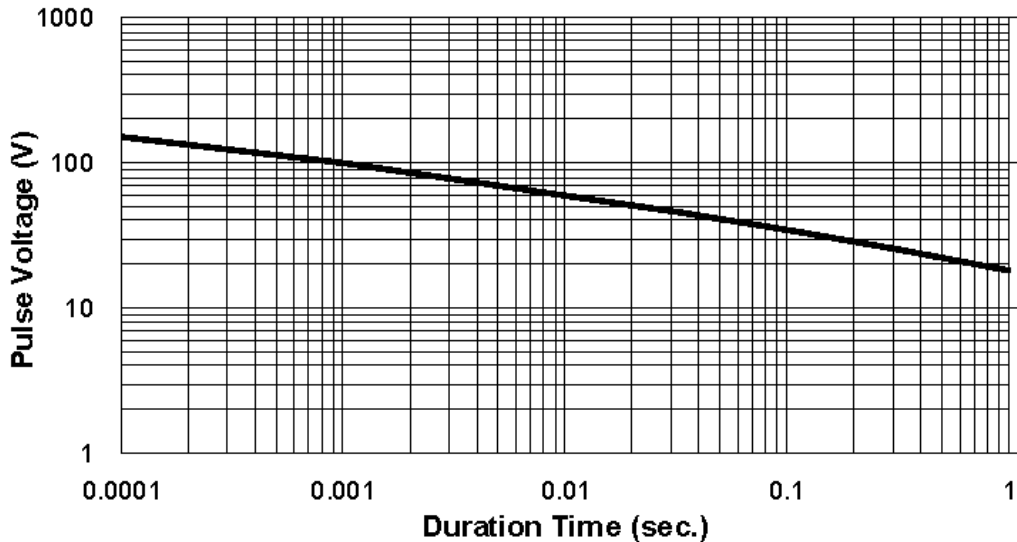




SMA-A0102 Continuous Pulse



SMA-A0102 Pulse Voltage (100 Ohm)



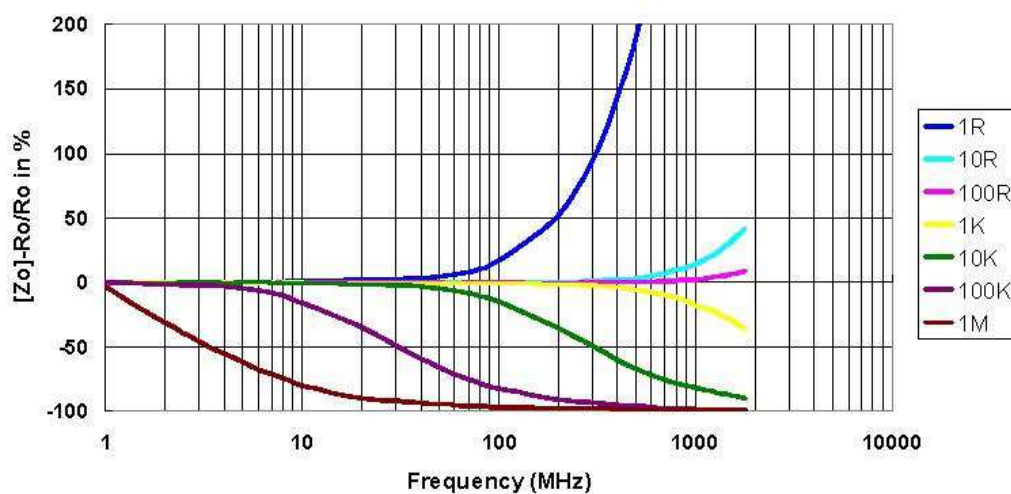
## Frequency behaviour

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 behaviour of the component on the printed-circuit board.

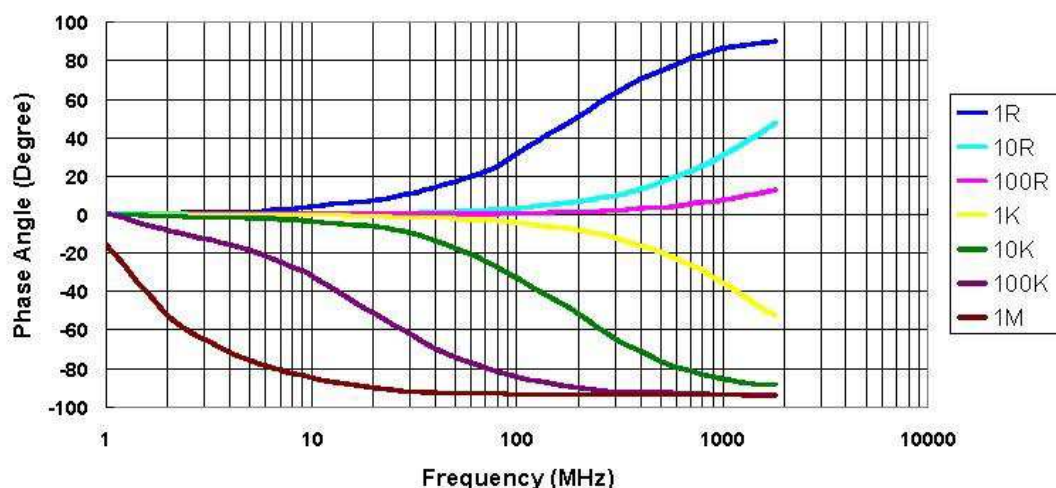
### Frequency Vs. Impedance

#### SMA-A0204



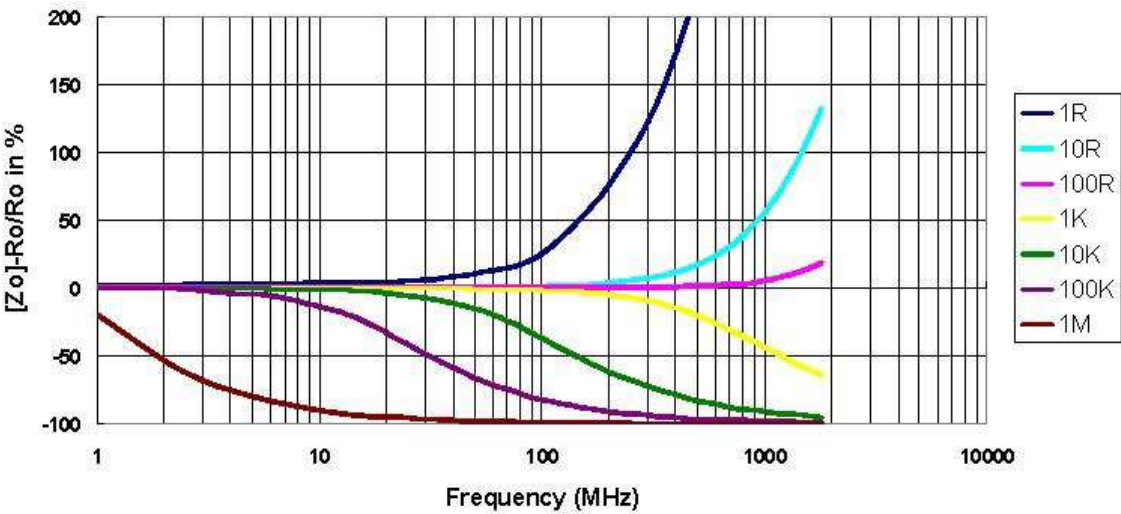
### Frequency Vs Phase Angle

#### SMA-A0204



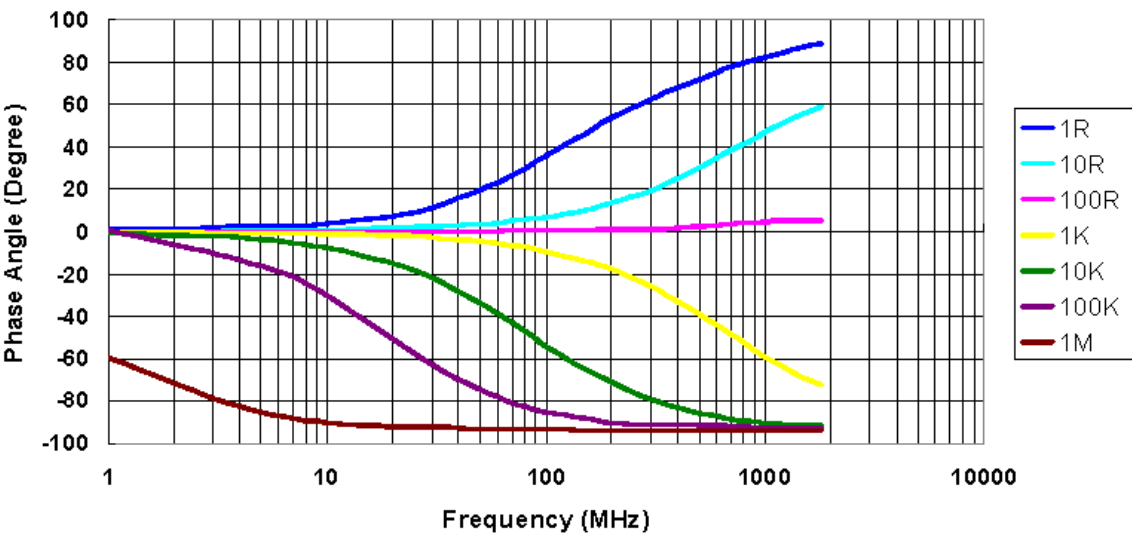
Frequency Vs Impedance

SMA-A0207



Frequency Vs Phase Angle

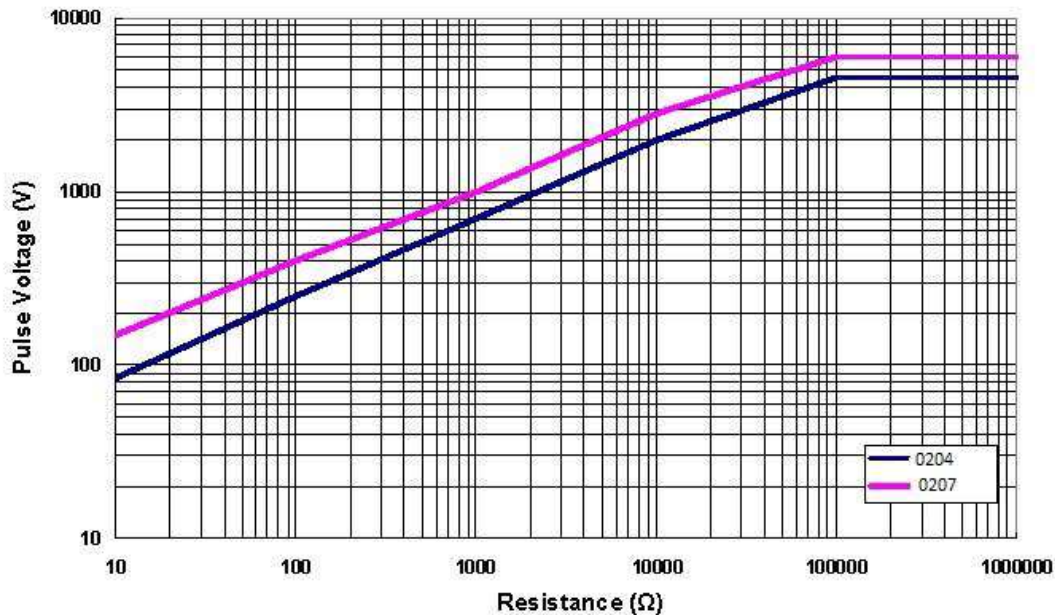
SMA-A0207



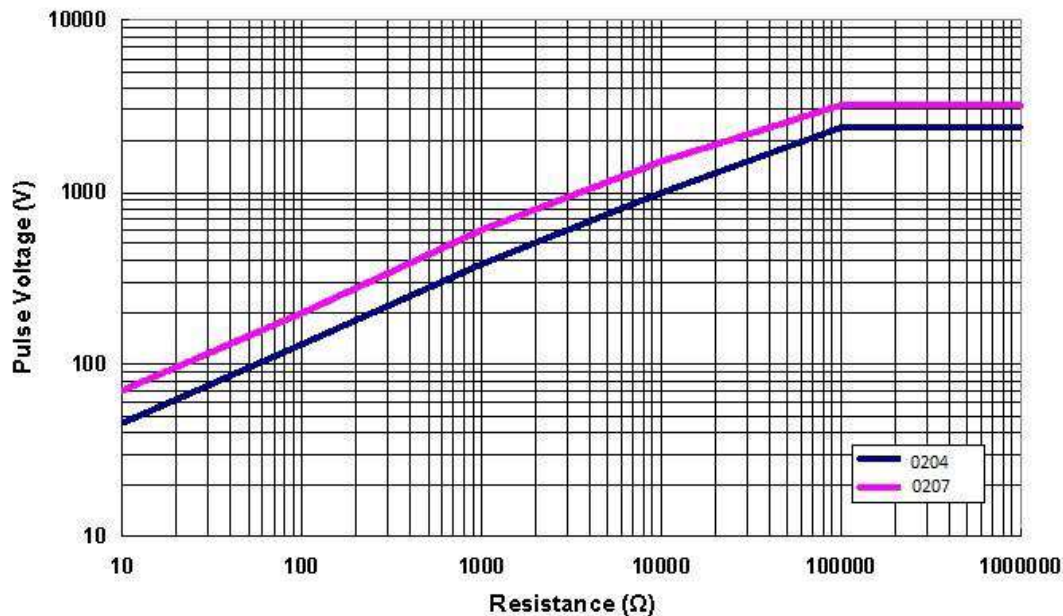
Lightning Surge

Resistors are tested in accordance with IEC 60115-1 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.

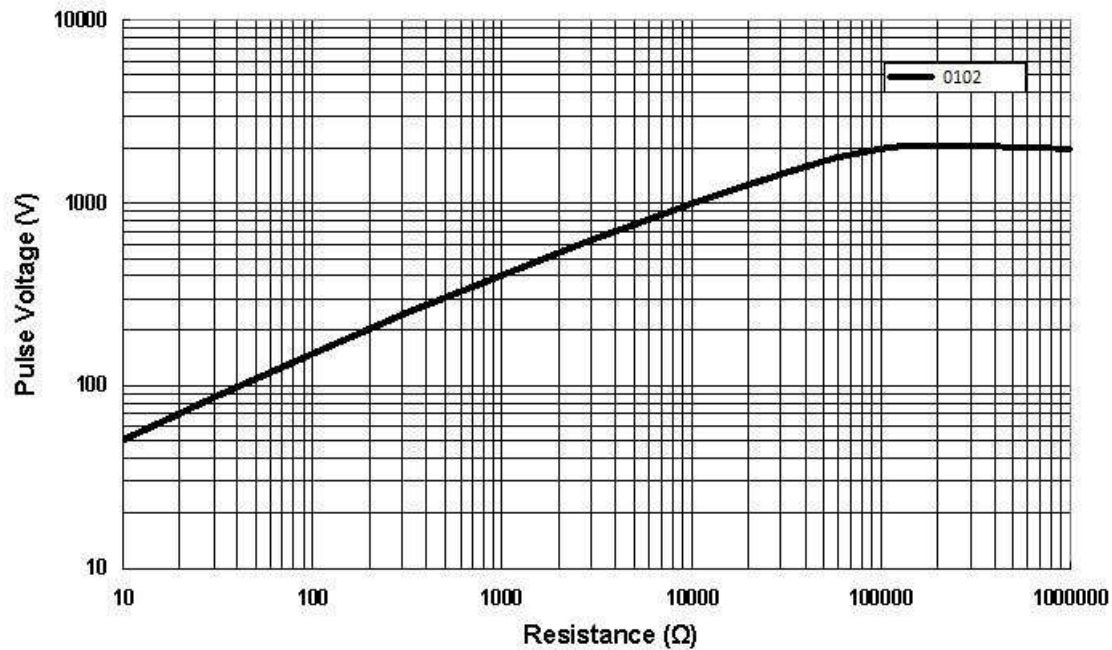
1.2/50µs Lightning Surge



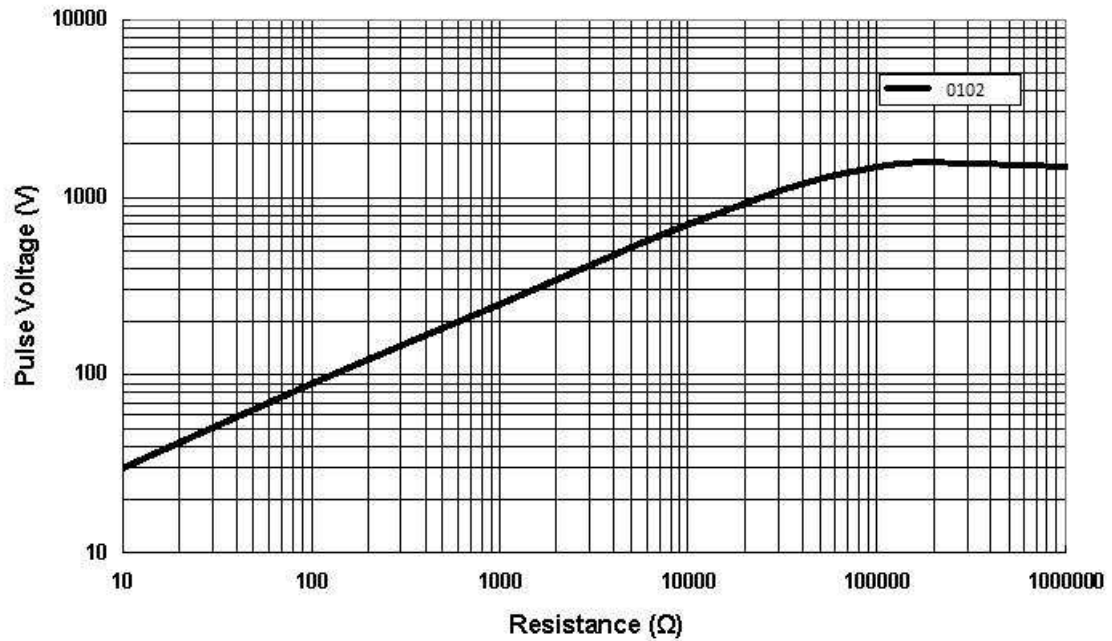
10/700µs Lightning Surge



SMA-A0102 1.2/50µs Lightning Surge



SMA-A0102 10/700µs Lightning Surge

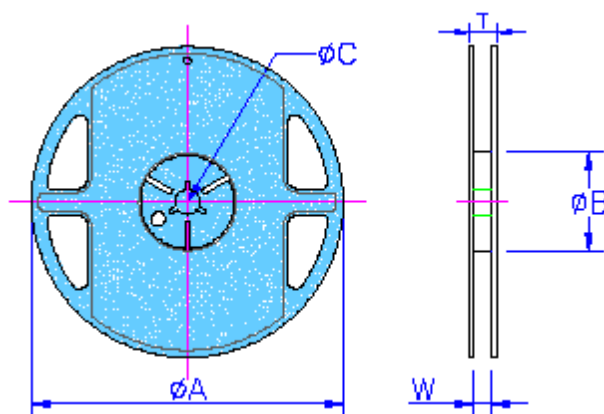


## Environmental Characteristics

| Item                                           | Requirement                                                                                                     | Test Method                                                                                                                                 |
|------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| Temperature Coefficient of Resistance (T.C.R.) | As Spec                                                                                                         | <b>JIS-C-5201-1 4.8</b><br><b>IEC-60115-1 4.8</b><br>-55°C~+125°C, 25°C is the reference temperature                                        |
| Short Time Overload                            | 10Ω-270KΩ: $\pm(0.1\%+0.05\Omega)$<br><10Ω & >270KΩ: $\pm(0.15\%+0.05\Omega)$<br>0102: $\pm(0.15\%+0.05\Omega)$ | <b>JIS-C-5201-1 4.13</b><br><b>IEC-60115-1 4.13</b><br>RCWV*2.5 or Max. Overload Voltage whichever is lower for 5 seconds                   |
| Insulation Resistance                          | ≥10G                                                                                                            | <b>JIS-C-5201-1 4.6</b><br><b>IEC-60115-1 4.6</b><br>Max. Overload Voltage for 1 minute                                                     |
| Endurance                                      | 10Ω-270KΩ: $\pm(0.25\%+0.05\Omega)$<br><10Ω & >270KΩ: $\pm(0.5\%+0.05\Omega)$<br>0102: $\pm(0.5\%+0.05\Omega)$  | <b>MIL-STD-202 Method 108</b><br>Condition D Steady State<br>TA=125°C at derated power.<br>Measurement at 24±4 hours after test conclusion. |
| Biased Humidity                                | 10Ω-270KΩ: $\pm(0.5\%+0.05\Omega)$<br><10Ω & >270KΩ: $\pm(1\%+0.05\Omega)$<br>0102: $\pm(2\%+0.05\Omega)$       | <b>MIL-STD-202 Method 103</b><br>1000 hrs 85°C/85%RH 10% of operating power.                                                                |
| High Temperature Exposure                      | 10Ω-270KΩ: $\pm(0.25\%+0.05\Omega)$<br><10Ω & >270KΩ: $\pm(1\%+0.05\Omega)$<br>0102: $\pm(1\%+0.05\Omega)$      | <b>MIL-STD-202 Method 108</b><br>at +155°C for 1000 hrs                                                                                     |
| Board Flex                                     | 10Ω-270KΩ: $\pm(0.1\%+0.05\Omega)$<br><10Ω & >270KΩ: $\pm(0.5\%+0.05\Omega)$<br>0102: $\pm(0.5\%+0.05\Omega)$   | <b>AEC-Q200-005</b><br>Bending once for 60 seconds with 2mm                                                                                 |
| Solderability                                  | 95% min. coverage                                                                                               | <b>JIS-C-5201-1 4.17</b><br><b>IEC-60115-1 4.17</b><br><b>J-STD-002</b><br>245±5°C for 3 seconds                                            |
| Resistance to Soldering Heat                   | 10Ω-270KΩ: $\pm(0.1\%+0.05\Omega)$<br><10Ω & >270KΩ: $\pm(0.25\%+0.05\Omega)$<br>0102: $\pm(0.25\%+0.05\Omega)$ | <b>MIL-STD-202 Method 210</b><br>260±5°C for 10 seconds                                                                                     |
| Voltage Proof                                  | No breakdown or flashover                                                                                       | <b>JIS-C-5201-1 4.7</b><br><b>IEC-60115-1 4.7</b><br>1.42 times Max. Operating Voltage for 1 minute                                         |
| Leaching                                       | Individual leaching area ≤5%<br>Total leaching area ≤10%                                                        | <b>JIS-C-5201-1 4.18</b><br><b>IEC-60068-2-58 8.2.1</b><br>260±5°C for 30 seconds                                                           |
| Temperature Cycling                            | 10Ω-270KΩ: $\pm(0.25\%+0.05\Omega)$<br><10Ω & >270KΩ: $\pm(0.5\%+0.05\Omega)$<br>0102: $\pm(1\%+0.05\Omega)$    | <b>JESD22 Method JA-104</b><br>-55°C to +125°C, 1000 cycles                                                                                 |
| Mechanical Shock                               | $\pm(0.25\%+0.05\Omega)$                                                                                        | <b>MIL-STD-202 Method 213</b><br>Wave Form: Tolerance for half sine shock pulse.<br>Peak value is 100g's. Normal duration (D) is 6.         |

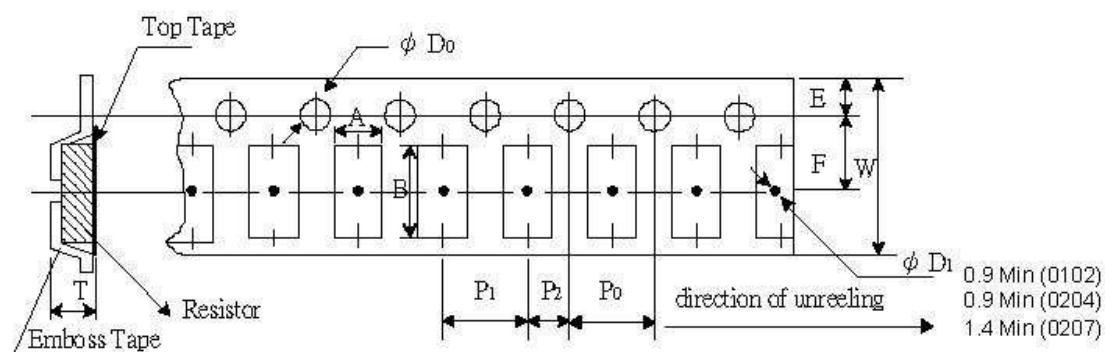
**Environmental Characteristics (continued)**

| Item                                                                                                 | Requirement                                                        | Test Method                                                                                                        |
|------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| Vibration                                                                                            | $\pm(0.5\%+0.05\Omega)$                                            | <b>MIL-STD-202 Method 204</b><br>5 g's for 20 min., 12 cycles each of 3 orientations, 10-2000 Hz                   |
| ESD                                                                                                  | $\pm(0.5\%+0.05\Omega)$                                            | <b>AEC-Q200-002</b><br>Human body, 2KV                                                                             |
| Resistance to Solvents                                                                               | No visible damage on appearance and marking                        | <b>MIL-STD-202 Method 215</b><br>Add Aqueous wash chemical - OKEM Clean or equivalent. Do not use banned solvents. |
| Terminal Strength                                                                                    | No broken                                                          | <b>AEC-Q200-006</b><br>Force of 1.8kg for 60 seconds.                                                              |
| Flammability                                                                                         | No ignition of the tissue paper or scorching of the pinewood board | <b>UL-94</b><br>V-0 or V-1 are acceptable. Electrical test not required.                                           |
| RCWV(Rated Continuous Working Voltage)= $V(P \cdot R)$ or Max. Operating Voltage whichever is lower. |                                                                    |                                                                                                                    |
| Storage Temperature: 15~28°C; Humidity < 80%RH                                                       |                                                                    |                                                                                                                    |

**Packaging****Packaging Quantity and Reel Specification**

| Size | Reel Diameter | ΦA (mm)   | ΦB (mm)  | ΦC (mm)  | W (mm)   | T (mm)   | Emboss Plastic Tape (EA) |
|------|---------------|-----------|----------|----------|----------|----------|--------------------------|
| 0102 | 7"            | 178.5±1.5 | 60.0±1.0 | 13.0±0.2 | 9.0±0.5  | 12.5±0.5 | 3,000                    |
| 0204 | 7"            | 178.5±1.5 | 60.0±1.0 | 13.0±0.2 | 9.0±0.5  | 12.5±0.5 | 3,000                    |
| 0207 | 7"            | 178.5±1.5 | 60.0±1.0 | 13.0±0.2 | 13.0±0.5 | 15.5±0.5 | 2,000                    |

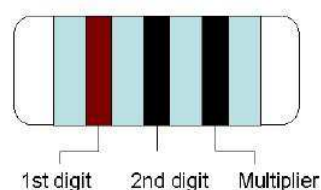
## Embossed Plastic Tape Specification



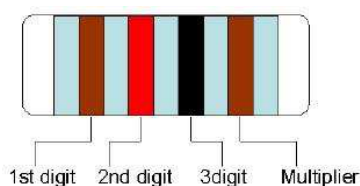
| Size | A<br>(mm)<br>±0.10 | B<br>(mm)<br>±0.10 | W<br>(mm)<br>±0.10 | E<br>(mm)<br>±0.10 | F<br>(mm)<br>±0.05 | P0<br>(mm)<br>±0.10 | P1<br>(mm)<br>±0.10 | P2<br>(mm)<br>±0.05 | ΦD0<br>(mm)<br>±0.10 | T<br>(mm)<br>±0.10 |
|------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------------|---------------------|---------------------|----------------------|--------------------|
| 0102 | 1.30               | 2.40               | 8.0                | 1.75               | 3.50               | 4.00                | 4.00                | 2.00                | 1.50                 | 1.50               |
| 0204 | 1.55               | 3.65               | 8.0                | 1.75               | 3.50               | 4.00                | 4.00                | 2.00                | 1.50                 | 1.80               |
| 0207 | 2.40               | 6.15               | 12.0               | 1.75               | 5.50               | 4.00                | 4.00                | 2.00                | 1.50                 | 2.70               |

## Marking

## E-24



## E-96



| 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     | $10^9$     |

## How To Order

| SMA-A                                           | 0204                 | B                                                     | T                    | N                                                                                  | X                                                                   | 100R                                                                                             |
|-------------------------------------------------|----------------------|-------------------------------------------------------|----------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| Common Part                                     | Size                 | Tolerance                                             | Packaging            | TCR                                                                                | Power Rating                                                        | Resistance Codes                                                                                 |
| SMA-A<br>MELF Resistor<br>AEC-Q200<br>compliant | 0102<br>0204<br>0207 | B - 0.1%<br>C - 0.25%<br>D - 0.5%<br>F - 1%<br>J - 5% | T - Tape<br>and Reel | B - ±10PPM/°C<br>N - ±15PPM/°C<br>C - ±25PPM/°C<br>D - ±50PPM/°C<br>E - ±100PPM/°C | T - 1W<br>U - 0.5W<br>X - 0.4W<br>L - 0.3W<br>V - 0.25W<br>P - 0.2W | 10R - 10Ω<br>100R - 100Ω<br>1K0 - 1,000Ω<br>10K - 10,000Ω<br>100K - 100,000Ω<br>1M0 - 1,000,000Ω |