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[www.pdc.com.tw](http://www.pdc.com.tw)

SPECIFICATION FOR APPROVAL

DATE :

CUSTOMER :

PART NAME :

Thick Film Anti-Surge Chip Resistor

CUSTOMER'S DWG. NO. :

CUSTOMER'S PART NO. :

PDC PART NO. :

**FNF SERIES APPROVED**

DESCRIPTION. :

| RESULT               | ACTION | CUSTOMER'S<br>SIGNATURE | NOTE |
|----------------------|--------|-------------------------|------|
|                      | " V "  |                         |      |
| FULL APPROVED        |        |                         |      |
| CONDITIONAL APPROVED |        |                         |      |
| REJECTED             |        |                         |      |

| OUR ACTION  | SIGNATURE   |
|-------------|-------------|
| PREPARED By | Jenny Tseng |
| CHECKED By  | Tony Chou   |
| APPROVED By | Byron Tsai  |

CUSTOMER SIGNATURE FOR  
ACCEPTANCE

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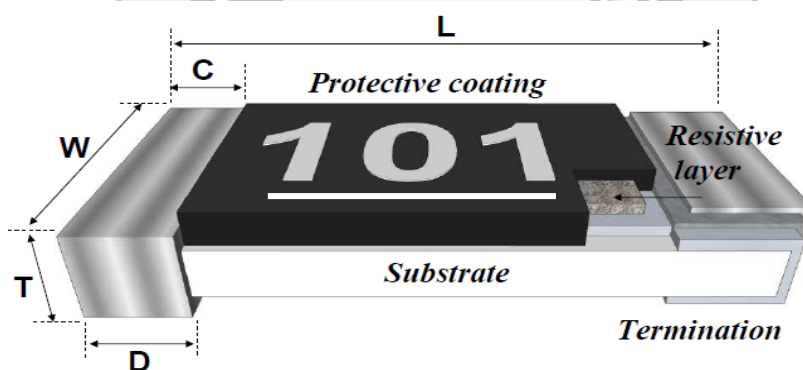
## 1. Features

- High reliability and compact size.
- Suitable for withstanding surge voltage.
- Suitable for lead free soldering.
- RoHS compliant & Halogen Free.
- Meet AEC-Q200

## 2. Applications

- Power supply.
- Automotive industry.
- Digital meter, Consumer electronics, M/B.
- LED Lighting.
- Industry control board.

## 3. Dimension and Construction



Unit : mm

| Type  | L         | W         | C         | D         | T         |
|-------|-----------|-----------|-----------|-----------|-----------|
| FNF03 | 1.60±0.10 | 0.80±0.10 | 0.30±0.20 | 0.30±0.20 | 0.45±0.10 |
| FNF05 | 2.00±0.10 | 1.25±0.10 | 0.40±0.20 | 0.40±0.20 | 0.50±0.10 |
| FNF06 | 3.10±0.10 | 1.60±0.10 | 0.50±0.25 | 0.50±0.25 | 0.55±0.10 |
| FNF12 | 3.10±0.10 | 2.60±0.10 | 0.50±0.25 | 0.50±0.25 | 0.55±0.10 |
| FNF20 | 5.00±0.20 | 2.50±0.20 | 0.60±0.25 | 0.60±0.25 | 0.60±0.10 |
| FNF25 | 6.40±0.20 | 3.20±0.20 | 0.60±0.25 | 0.90±0.25 | 0.60±0.15 |

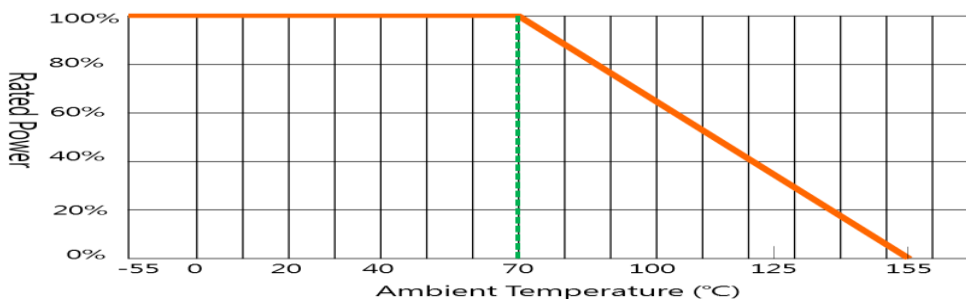


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## 4. Power Derating Curve

Operating Temperature Range: -55 to +155 deg.C



## 5. Rating

### Standard

| Type  | Size | Power Rating at 70°C | Max. RCWV | Max. Overload Voltage | Resistance Tolerance                    | Temperature Coefficient (ppm/°C) | Resistance Range |      | Standard Resistance Values |
|-------|------|----------------------|-----------|-----------------------|-----------------------------------------|----------------------------------|------------------|------|----------------------------|
|       |      |                      |           |                       |                                         |                                  | Min.             | Max. |                            |
| FNF03 | 0603 | 1/10W                | 50V       | 100V                  | ±5%(J)<br>±10%(K)<br>±15%(L)<br>±20%(M) | ±100                             | 1Ω               | 1MΩ  | E24                        |
| FNF05 | 0805 | 1/8W                 | 150V      | 300V                  |                                         |                                  |                  |      |                            |
| FNF06 | 1206 | 1/4W                 | 200V      | 400V                  |                                         |                                  |                  |      |                            |
| FNF12 | 1210 | 1/3W                 | 200V      | 400V                  |                                         |                                  |                  |      |                            |
| FNF20 | 2010 | 3/4W                 | 200V      | 400V                  |                                         |                                  |                  |      |                            |
| FNF25 | 2512 | 1W                   | 200V      | 400V                  |                                         |                                  |                  |      |                            |

### Power Enhance

| Type  | Size | Power Rating at 70°C | Max. RCWV | Max. Overload Voltage | Resistance Tolerance | Temperature Coefficient (ppm/°C) | Resistance Range |      | Standard Resistance Values |
|-------|------|----------------------|-----------|-----------------------|----------------------|----------------------------------|------------------|------|----------------------------|
|       |      |                      |           |                       |                      |                                  | Min.             | Max. |                            |
| FNF05 | 0805 | 1/4W                 | 150V      | 300V                  | ±5%(J)               | ±100                             | 1Ω               | 1MΩ  | E24                        |
| FNF06 | 1206 | 1/3W                 | 200V      | 400V                  | ±10%(K)              |                                  |                  |      |                            |
|       |      |                      |           |                       | ±15%(L)              |                                  |                  |      |                            |
|       |      |                      |           |                       | ±20%(M)              |                                  |                  |      |                            |

Application Note :  $RCWV = \sqrt{P \times R}$  or Max. RCWV listed above, whichever is lower.

RCWV : Working Voltage (V) , P : Rated Power (W) , R : Resistance Value (Ω)

Solder-pad and trace size influences should be evaluated, and board surface temperature should keep not exceed 105°C when full rated power applied.



# FNF-M series. (AEC-Q200) Anti-Surge Thick-film Lead Free Chip Resistors

## 6.Part Number

| Type       | Size                                                                                                                                                     | Tolerance                                                                                       | Packing                                                                                                                                                                                                                                                                       | Watt                                                                    | R Code (GM)                       | Special Code                                                                       |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|-----------------------------------|------------------------------------------------------------------------------------|
| <b>FNF</b> | <b><u>03</u></b> :0603<br><b><u>05</u></b> :0805<br><b><u>06</u></b> :1206<br><b><u>12</u></b> :1210<br><b><u>20</u></b> :2010<br><b><u>25</u></b> :2512 | <b><u>J</u></b> :±5%<br><b><u>K</u></b> :±10%<br><b><u>L</u></b> :±15%<br><b><u>M</u></b> :±20% | <b>Paper Tape :</b><br><b>0603.0805</b><br><b>1206.1210</b><br><b><u>I</u></b> : 5Kpcs<br><b><u>V</u></b> : 10Kpcs<br><b><u>W</u></b> : 20Kpcs<br><b>Plastic Tape :</b><br><b>2010.2512</b><br><b><u>P</u></b> : 4Kpcs<br><b><u>X</u></b> : 8Kpcs<br><b><u>Y</u></b> : 16Kpcs | <b><u>±</u></b> :<br>Standard<br><br><b><u>P</u></b> :<br>Power Enhance | <b><u>XXX</u></b><br><br>3 digits | <b><u>" Null "</u></b> :<br>Standard<br><br><b><u>-M</u></b> :<br>Meet<br>AEC-Q200 |

Example :

### FNF25JP-104-M

→2512 size, tolerance 5%, plastic tape, 1W, 1 MΩ, Aec-Q200.

### FNF06KT-104

→1206 size, tolerance 10%, paper tape, 1/4W, 100 KΩ, standard.

## 7.Marking/Soldering/Surge

Resistance value identify :

E24 ±5% : 3 Digits marking with underline to identify the resistance value

0603/0805/1206/1210/2010/2512



$$301 \rightarrow 30 \times 10^1 = 300\Omega$$

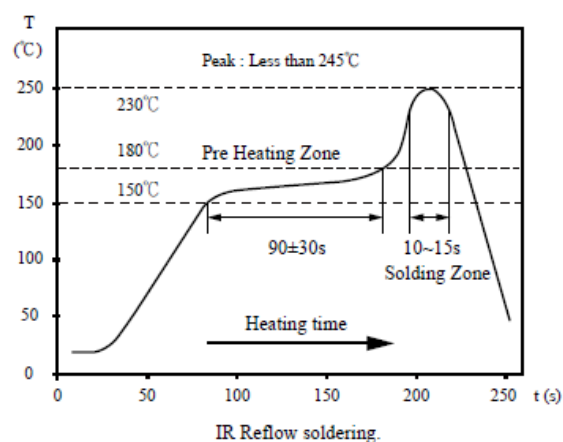
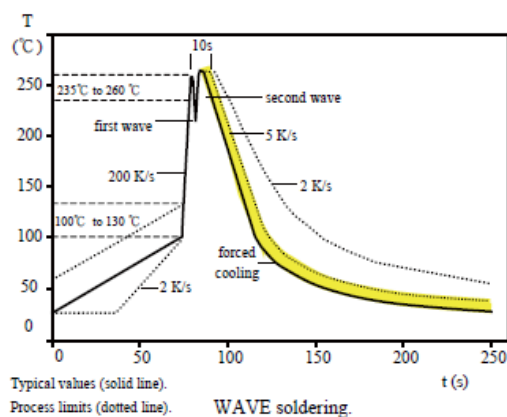


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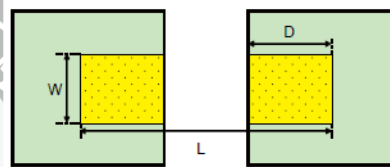
# FNF-M series. (AEC-Q200) Anti-Surge Thick-film Lead Free Chip Resistors

## Soldering Reference :



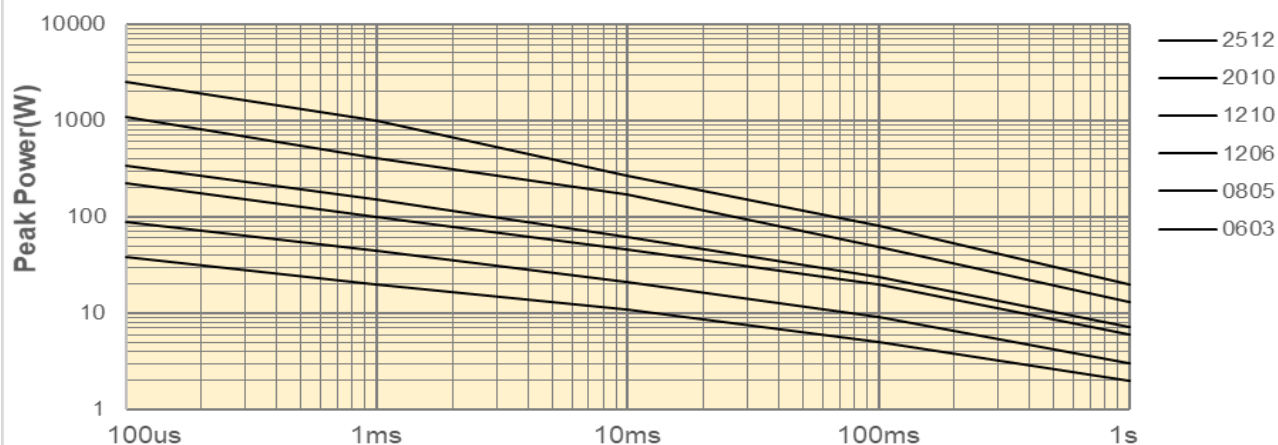
## Recommend Solder Pad Dimensions :

| Type  | W    | D    | L    |
|-------|------|------|------|
| FNF03 | 0.90 | 1.00 | 3.00 |
| FNF05 | 1.30 | 1.15 | 3.50 |
| FNF06 | 1.80 | 1.30 | 4.70 |
| FNF12 | 3.00 | 1.30 | 4.70 |
| FNF20 | 3.00 | 1.50 | 6.80 |
| FNF25 | 3.70 | 1.60 | 7.60 |



Unit:mm

## FNF Single Pulse(Surge) Performance



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## 8. Reliability Performance

### 8.1 AEC-Q200 Grade

| Test Item                                  | Specification                                                 | Test Method<br>(AEC-Q200. IEC 60115)                                                                                                     |
|--------------------------------------------|---------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| <b>DC Resistance</b>                       | J : $\pm 5\%$ K : $\pm 10\%$<br>L : $\pm 15\%$ M : $\pm 20\%$ | <b>AEC-Q200 TABLE 7.1</b><br><b>IEC 60115-1 / JIS C 5201-1 , Clause 4.5</b> Measure the resistance Value.                                |
| <b>High Temperature Exposure (Storage)</b> | $\Delta R \leq \pm(3\%+0.1\Omega)$                            | <b>AEC-Q200 TABLE 7.3</b><br>1000 hrs. @ T=125°C. Unpowered.<br>Measurement at 24 $\pm$ 2 hours after test conclusion.                   |
| <b>Temperature Cycling</b>                 | $\Delta R \leq \pm(1\%+0.1\Omega)$<br>No mechanical damage.   | <b>AEC-Q200 TABLE 7.4</b><br>1000 Cycles (-55°C to +125°C). Measurement at 24 $\pm$ 2 hours after test conclusion.                       |
| <b>Moisture Resistance</b>                 | $\Delta R \leq \pm(1\%+0.1\Omega)$                            | <b>AEC-Q200 TABLE 7.6</b><br>Test 65°C/80~100%RH/10Cycles.<br>Measurement at 24 $\pm$ 2 hours after test conclusion.<br>(t=24hrs/cycle). |
| <b>Biased Humidity</b>                     | $\Delta R \leq \pm(5\%+0.1\Omega)$                            | <b>AEC-Q200 TABLE 7.7</b><br>1000 hours 85°C/85%RH.<br>10% of operating power.<br>Measurement at 24 $\pm$ 2 hours after test conclusion. |
| <b>Operational Life</b>                    | $\Delta R \leq \pm(5\%+0.1\Omega)$                            | <b>AEC-Q200 TABLE 7.8</b><br>Test 1000hr @ TA=125°C at specified rated power.<br>Measurement at 24 $\pm$ 2 hours after test conclusion.  |
| <b>External Visual</b>                     | No visual damage and refer PDC marking code.                  | <b>AEC-Q200 TABLE 7.9</b><br>Inspect device construction, marking and workmanship.                                                       |
| <b>Physical Dimension</b>                  | Within the spec.                                              | <b>AEC-Q200 TABLE 7.10</b><br>Verify physical dimensions to the applicable device detail specification.                                  |
| <b>Mechanical Shock</b>                    | Within product specification tolerance and no visible damage. | <b>AEC-Q200 TABLE 7.13</b><br>Test Peak value:100g's,Wave:Hail-sine,<br>Duration:6ms,Velocity:12.3ft/sec.                                |



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# FNF-M series. (AEC-Q200) Anti-Surge Thick-film Lead Free Chip Resistors

| Test Item                        | Specification                                                 | Test Method<br>(AEC-Q200. IEC 60115)                                                                                                 |
|----------------------------------|---------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| <b>Vibration</b>                 | No mechanical damage.                                         | <b>AEC-Q200 TABLE 7.14</b><br>5 g's for 20 min., 12 cycles each of 3 orientations.<br>Test from 10-2000 Hz.                          |
| <b>Resistance to Solder Heat</b> | $\Delta R \leq \pm(1\% + 0.1\Omega)$<br>No mechanical damage. | <b>AEC-Q200 TABLE 7.15</b><br>Solder dipping @ 270°C±5°C for 10sec.±1sec.                                                            |
| <b>Thermal Shock</b>             | $\Delta R \leq \pm(1\% + 0.1\Omega)$<br>No mechanical damage. | <b>AEC-Q200 TABLE 7.16</b><br>-55 to 155°C/ dwell time 15min/ Max transfer time 20sec/ 300cycles.                                    |
| <b>ESD</b>                       | $\Delta R \leq \pm(3\% + 0.1\Omega)$                          | <b>AEC-Q200-002</b><br>Test contact min. 1KV.                                                                                        |
| <b>Solder Ability</b>            | Over 95% of termination must be covered with solder.          | <b>AEC-Q200 TABLE 7.18</b><br>a) Baking 155°C 4H, dipping 235°C 5s<br>b) Steam 1H, dipping 215°C 5s<br>c) Steam 1H, dipping 260°C 7s |
| <b>Flammability</b>              | Refer UL-94.                                                  | <b>AEC-Q200 TABLE 7.20</b><br>UL-94 V-0 or V-1 are acceptable                                                                        |
| <b>Board Flex</b>                | $\Delta R \leq \pm(1\% + 0.1\Omega)$<br>No mechanical damage. | <b>AEC-Q200 TABLE 7.21</b><br>Bending 2mm 2512.2010.1210.1206,<br>3mm 0805.0603.                                                     |
| <b>Terminal Strength</b>         | No mechanical damage                                          | <b>AEC-Q200 TABLE 7.22</b><br>Force 1 Kg for 60 seconds.                                                                             |



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# FNF-M series. (AEC-Q200) Anti-Surge Thick-film Lead Free Chip Resistors

## 8.2 Standard Grade

| Test Item                                          | Specification                                                  | Test Method                                                                                                                                                                                                                                            |
|----------------------------------------------------|----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>DC Resistance</b>                               | J : $\pm 5\%$ K : $\pm 10\%$<br>L : $\pm 15\%$ M : $\pm 20\%$  | IEC 60115-1 / JIS C 5201-1 , Clause 4.5<br>Measure the resistance Value.                                                                                                                                                                               |
| <b>Resistance to Solder Heat</b>                   | $\Delta R \leq \pm(1\% + 0.1\Omega)$<br>No mechanical damage.  | IEC 60115-1, Clause 4.18<br>Solder dipping @ $260^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for 10sec. $\pm 1$ sec.                                                                                                                                       |
| <b>Solder Ability</b>                              | Over 95% of termination must be covered with solder.           | IEC 60115-1, Clause 4.17<br>After immersing flux, dip in the $245 \pm 2^{\circ}\text{C}$ molten solder bath for $3 \pm 0.5$ sec.                                                                                                                       |
| <b>Board Flex</b>                                  | $\Delta R \leq \pm(1\% + 0.1\Omega)$<br>No mechanical damage.  | IEC 60115-1, Clause 4.33<br>Resistance change after bended on the 90mm PCB. Bending 2mm                                                                                                                                                                |
| <b>Short Time Overload</b>                         | $\Delta R \leq \pm(2\% + 0.1\Omega)$                           | IEC 60115-1, Clause 4.13<br>$2.5 \times$ Rated voltage for 5 seconds                                                                                                                                                                                   |
| <b>Temperature Cycle</b>                           | $\Delta R \leq \pm(1\% + 0.05\Omega)$<br>No mechanical damage. | IEC 60115-1, Clause 4.19<br>Repeat 5 cycles as follow.<br>$-55^{\circ}\text{C}(30\text{min}) \rightarrow 25^{\circ}\text{C}(2 \sim 3\text{min}) \rightarrow 155^{\circ}\text{C}(30\text{min})$<br>$\rightarrow 25^{\circ}\text{C}(2 \sim 3\text{min})$ |
| <b>Load Life Humidity</b>                          | $\Delta R \leq \pm(3\% + 0.1\Omega)$                           | IEC 60115-1, Clause 4.24<br>$40 \pm 2^{\circ}\text{C}$ with relative humidity 90% ~ 95%, rated voltage for 1.5 hours ON 30 minutes OFF.<br>Cycle repeated 1000 hours.                                                                                  |
| <b>Temperature Coefficient of Resistance (TCR)</b> | Within the spec.                                               | IEC 60115-1, Clause 4.8<br>$T_1 \quad T_2$<br>Test temperature : $25^{\circ}\text{C} \sim +155^{\circ}\text{C}$<br>$\text{TCR}(\text{ppm}/^{\circ}\text{C}) = (R_2 - R_1) / R_1 \times 1 / (T_2 - T_1) \times 10^6$                                    |
| <b>Load Life</b>                                   | $\Delta R \leq \pm(3\% + 0.1\Omega)$                           | IEC 60115-1, Clause 4.25<br>Rated voltage for 1.5 hours for followed by a pause 0.5 hour at $70 \pm 2^{\circ}\text{C}$ .<br>Cycle repeated 1000 hours.                                                                                                 |
| <b>Insulation Resistance</b>                       | Between termination and coating must over 1000M $\Omega$       | IEC 60115-1, Clause 4.6<br>Test voltage : $100 \pm 15\text{V}$                                                                                                                                                                                         |



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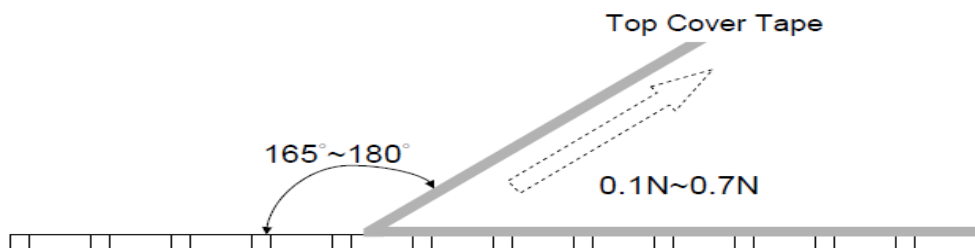


## 9. PACKAGING

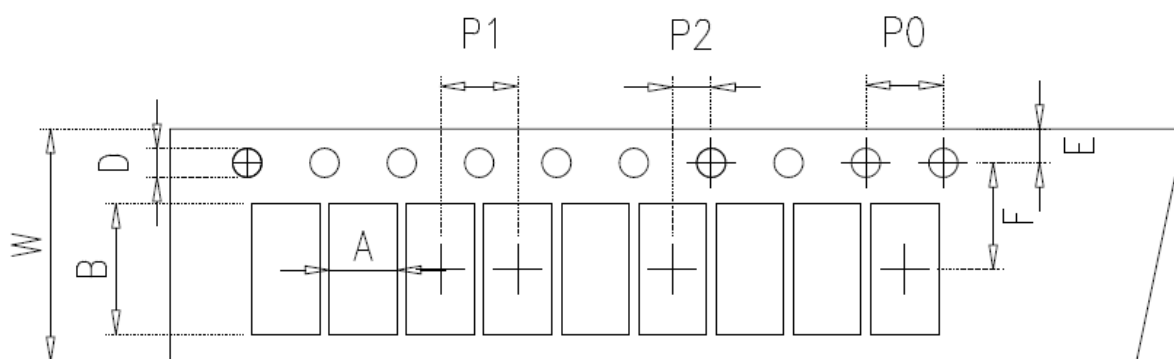
### 9.1 Peel Strength of Top Cover Tape

The peel speed shall be about 300 mm/min

The peel force of top cover tape shall between 0.1 to 0.7N



### 9.2 Tape Packaging Dimensions



unit:mm

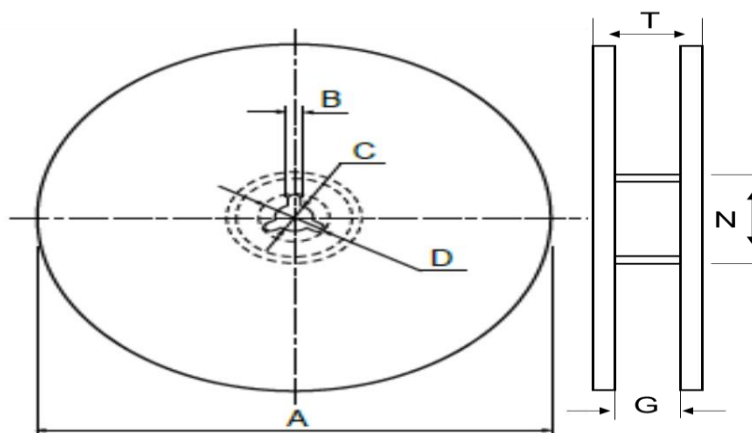
| Size | A         | B         | W          | F         | E         | P1        | P2        | P0        | D            |
|------|-----------|-----------|------------|-----------|-----------|-----------|-----------|-----------|--------------|
| 0603 | 1.10±0.20 | 1.90±0.20 | 8.00±0.30  | 3.50±0.05 | 1.75±0.10 | 4.00±0.10 | 2.00±0.05 | 4.00±0.10 | 1.50+0.10/-0 |
| 0805 | 1.65±0.20 | 2.40±0.20 | 8.00±0.30  | 3.50±0.05 | 1.75±0.10 | 4.00±0.10 | 2.00±0.05 | 4.00±0.10 | 1.50+0.10/-0 |
| 1206 | 2.00±0.20 | 3.60±0.20 | 8.00±0.30  | 3.50±0.05 | 1.75±0.10 | 4.00±0.10 | 2.00±0.05 | 4.00±0.10 | 1.50+0.10/-0 |
| 1210 | 3.00±0.20 | 3.60±0.20 | 8.00±0.30  | 3.50±0.05 | 1.75±0.10 | 4.00±0.10 | 2.00±0.05 | 4.00±0.10 | 1.50+0.10/-0 |
| 2010 | 2.80±0.20 | 5.50±0.20 | 12.00±0.30 | 5.50±0.05 | 1.75±0.10 | 4.00±0.10 | 2.00±0.05 | 4.00±0.10 | 1.50+0.10/-0 |
| 2512 | 3.50±0.20 | 6.70±0.20 | 12.00±0.30 | 5.50±0.05 | 1.75±0.10 | 4.00±0.10 | 2.00±0.05 | 4.00±0.10 | 1.50+0.10/-0 |



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### 9.3 Reel Dimensions



| unit:mm |                |           |           |          |          |         |          |          |
|---------|----------------|-----------|-----------|----------|----------|---------|----------|----------|
| Size    | Packaging Q'ty | A         | N         | C        | D        | B       | G        | T        |
| 0603    | 5kpcs/Reel     | 178.0±2.0 | 60.0±0.5  | 13.0±0.5 | 20(Min.) | 2.0±0.5 | 10.0±1.5 | 14.9max. |
| 0805    | 10kpcs/Reel    | 254.0±2.0 | 100.0±1.0 | 13.5±0.5 | 20(Min.) | 2.0±0.5 | 10.0±1.5 | 14.9max. |
| 1206    | 20kpcs/Reel    | 330.0±2.0 | 100.0±1.0 | 13.5±0.5 | 20(Min.) | 2.0±0.5 | 10.0±1.5 | 14.9max. |
| 2010    | 4kpcs/Reel     | 178.0±2.0 | 60.0±0.5  | 13.0±0.5 | 20(Min.) | 2.0±0.5 | 13.8±1.5 | 16.7max. |
| 2512    | 8kpcs/Reel     | 254.0±2.0 | 100.0±0.5 | 13.5±0.5 | 20(Min.) | 2.0±0.5 | 13.8±1.5 | 20.0max. |
|         | 16kpcs/Reel    | 330.0±2.0 | 100.0±1.0 | 13.5±0.5 | 20(Min.) | 2.0±0.5 | 13.8±1.5 | 20.0max. |

### 10. Storage & Handling

... Products are recommended to be used up within one year as ensured shelf life.

Check solder ability in case shelf life extension is needed.

... To store products with following condition:

Temperature: 5 to 40°C ; Humidity: 20 to 70% relative humidity.

#### Precaution for use :

The AEC-Q200 series resistors is mainly used on general automotive equipment without safety considerations.

Please contact our company in advanced if you intend to use resistor for designing the equipment which may damage itself and the safety of third party. If necessary, please consider to add the protect circuit in devising process and obtaining fully safety evaluation. The contents of the acknowledgment is only used for our parent company, marketing subsidiaries and official marketing agents who purchase our products. Not applicable for the other nonofficial channels.

