## 1. Serviceability:

1.1 This acknowledgement applies to our lead-free, halogen-free series thick film chip resistors.

1.2 The Company's lead-free products mean that the RoHS-compliant end electrodes are free of lead, and the lead present in the resistive layer glass material is in compliance with the lead exclusion provisions of RoHS.

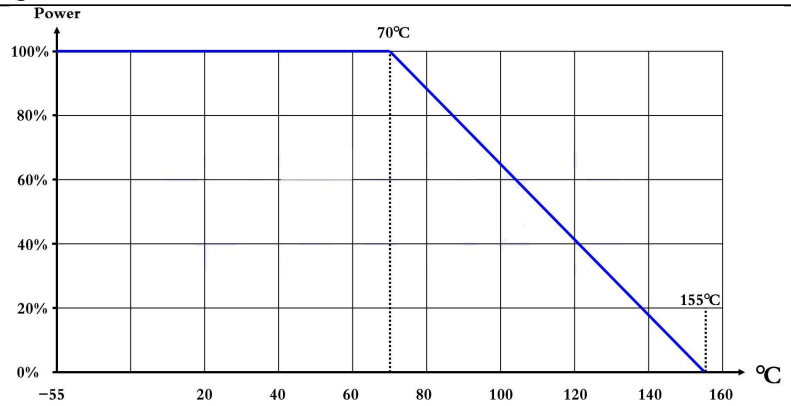
1.3 This product is suitable for automotive electronics applications. It meets the requirements of AEC-Q200, Table 7 Reliability.

## 2. Specification Table:

2.1.

| Sizes | Power | rated voltage | Max. overload voltage | T.C.R (ppm/℃) | Resistance range | | Working Temperature Range |
|---|---|---|---|---|---|---|---|
| | | | | | F(±1%) B(±0.1%) D(±0.5%) E-24、E-96 | J(±5%) E-24 | |
| 0402 | 1/8 W | 50V | 100V | ±200 | 10Ω≦R＜1MΩ | --- | -55℃ ~ +155℃ |
| | | | | ±400 | 1Ω≦R＜10Ω | 1Ω≦R＜10Ω | |
| | | | | ±200 | 1MΩ≦R≦22MΩ | 10Ω≦R≦22MΩ | |
| 0603 | 1/5 W | 75V | 150V | ±200 | 10Ω≦R＜1MΩ | --- | |
| | | | | ±400 | 1Ω≦R＜10Ω | 1Ω≦R＜10Ω | |
| | | | | ±200 | 1MΩ≦R≦22MΩ | 10Ω≦R≦22MΩ | |
| 0805 | 1/4 W | 150V | 300V | ±200 | 10Ω≦R＜1MΩ | --- | |
| | | | | ±400 | 1Ω≦R＜10Ω | 1Ω≦R＜10Ω | |
| | | | | ±200 | 1MΩ≦R≦22MΩ | 10Ω≦R≦22MΩ | |
| 1206 | 1/2 W | 200V | 400V | ±200 | 10Ω≦R＜1MΩ | --- | |
| | | | | ±400 | 1Ω≦R＜10Ω | 1Ω≦R＜10Ω | |
| | | | | ±200 | 1MΩ≦R≦22MΩ | 10Ω≦R≦22MΩ | |
| 1210 | 3/4 W | 200V | 400V | ±200 | 10Ω≦R＜1MΩ | --- | |
| | | | | ±400 | 1Ω≦R＜10Ω | 1Ω≦R＜10Ω | |
| | | | | ±200 | 1MΩ≦R≦22MΩ | 10Ω≦R≦22MΩ | |
| 2010 | 1 W | 200V | 400V | ±200 | 10Ω≦R＜1MΩ | --- | -55℃ ~ +155℃ |
| | | | | ±400 | 1Ω≦R＜10Ω | 1Ω≦R＜10Ω | |
| | | | | ±200 | 1MΩ≦R≦22MΩ | 10Ω≦R≦22MΩ | |
| 2512 | 2 W | 200V | 400V | ±200 | 10Ω≦R＜1MΩ | --- | |
| | | | | ±400 | 1Ω≦R＜10Ω | 1Ω≦R＜10Ω | |
| | | | | ±200 | 1MΩ≦R≦22MΩ | 10Ω≦R≦22MΩ | |

2.2. Power Decay Curve:

| Sizes | 0402/0603/0805/1206/1210/2010/2512 |
|---|---|
| Working Temperature Range | −55℃ ~ +155℃ |
| clarification | If the ambient temperature exceeds 70℃ to 155℃, the power can be modified according to the curve below. |
| Power attenuation graph |  |



2.3. Rated voltage or rated current:

Resistance Range: ≧1Ω

Rated voltage: DC or AC (commercial rms) voltage for rated power.

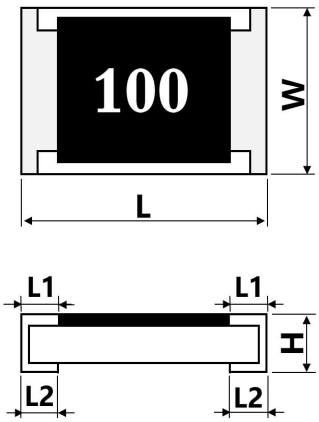
Can be obtained by the following formula, but if the value obtained exceeds the maximum voltage in the specification table, then the maximum rated voltage as its rated voltage.

$$E=\sqrt{P\times R}$$

E=Rated voltage (V)
P=Rated power (W)
R=Nominal resistance (Ω)

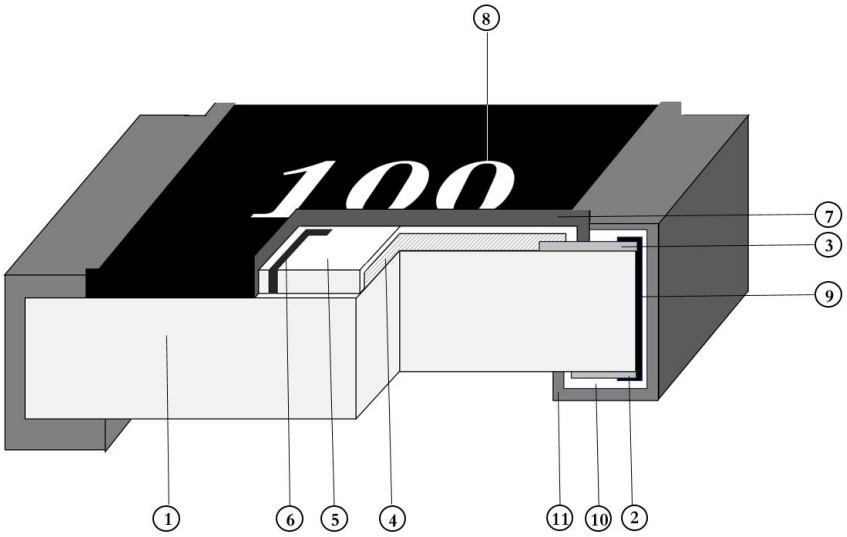
Rated current flow (I) can be obtained by the following formula:
rated current I = E (rated voltage) / R (nominal resistance)

## 3. Dimension Drawing




| Dimensions / Type | L | W | H | L1 | L2 |
|---|---|---|---|---|---|
| 0201 | 0.60±0.03 | 0.3±0.03 | 0.23±0.03 | 0.10±0.05 | 0.15±0.05 |
| 0402 | 1.00±0.10 | 0.50±0.05 | 0.30±0.05 | 0.20±0.10 | 0.25±0.10 |
| 0603 | 1.60±0.10 | 0.80±0.10 | 0.45±0.10 | 0.30±0.15 | 0.25±0.15 |
| 0805 | 2.00±0.10 | 1.25±0.10 | 0.50±0.10 | 0.35±0.20 | 0.35±0.20 |
| 1206 | 3.05±0.10 | 1.55±0.10 | 0.50±0.10 | 0.45±0.20 | 0.40±0.20 |
| 1210 | 3.05±0.10 | 2.60±0.15 | 0.55±0.10 | 0.45±0.20 | 0.50±0.20 |
| 2010 | 5.00±0.10 | 2.50±0.15 | 0.55±0.10 | 0.45±0.20 | 0.50±0.20 |
| 2512 | 6.35±0.10 | 3.10±0.15 | 0.55±0.10 | 0.60±0.20 | 0.50±0.20 |

## 4. Structure Plan




| | | | |
|---|---|---|---|
| 1 | Ceramic substrate | 7 | 2nd Protective coating |
| 2 | Bottom inner electrode | 8 | Marking |
| 3 | Top inner electrode | 9 | Terminal inner electrode |
| 4 | Resistive layer | 10 | Ni plating |
| 5 | 1st Protective coating | 11 | Sn plating |
| 6 | Laser Trimmed | - | - |

## 5. Character Code Representation

| Type \ Tolerance | J | F |
|---|---|---|
| 0402 | No Marking | No Marking |
| 0603 | 3-character code | Reference 6.3 |
| 0805/1206/1210/2010/2512 | 3-character code | 4-character code |

5.1. 0603/0805/1206/1210/2010/2512 ±5% tolerance:

●Resistance range≥10Ω:Three digits in the E-24 series, with the first two digits being significant and the third digit being a power exponent ($10^{\times}$).

<example> marks→100
100=10*100=10Ω

●Resistance range<10Ω:Three digits in the E-24 series, with the first and third digits being significant and the second digit being a power ($10^{-1}$)

<example> marks→4R7
4R7=47*10-1=4.7Ω

5.2. 0603/0805/1206/1210/2010/2512 F (±1%) B (±0.1%) D (±0.5%) tolerance:

●Resistance range≥100Ω:The E-24 series or E-96 series has 4 digits, with the first three digits being significant and the fourth digit being a power ($10^{\times}$).

<example> marks→1002
1002=100*10²=10000Ω

●Resistance range<100Ω:E-24 series or E-96 series have 4 digits, 3 digits are Significant figures, and R digit is a power exponent ($10^{\times}$).

<example> marks→10R2
10R2=102*10-1=10.2Ω

5.3. 0603 ±1% Tolerance:

●If the resistor is not in the E-96 series or E-24 series, it is marked with the E-24 series and there is a short bar under the marking letter.

<例> Marking→47B
47B=301*101=3010Ω

<例> Marking→471
471=47*101=470Ω

5.4. 0603/0805/1206/1210/2010/2512 : The 0Ω mark is represented by "0".

| ±1% & ±5% Tolerance |
|---|
| |

## Code Table

E-12 series

| | | | | | |
|---|---|---|---|---|---|
| 10 | 12 | 15 | 18 | 22 | 27 |
| 33 | 39 | 47 | 56 | 68 | 82 |

E-24 series

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 11 | 12 | 13 | 15 | 16 | 18 | 20 | 22 | 24 | 27 | 30 |
| 33 | 36 | 39 | 43 | 47 | 51 | 56 | 62 | 68 | 75 | 82 | 91 |

E-96 series

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 | 102 | 105 | 107 | 110 | 113 | 115 | 118 | 121 | 124 | 127 | 130 |
| 133 | 137 | 140 | 143 | 147 | 150 | 154 | 158 | 162 | 165 | 169 | 174 |
| 178 | 182 | 187 | 191 | 196 | 200 | 205 | 210 | 215 | 221 | 226 | 232 |
| 237 | 243 | 249 | 255 | 261 | 267 | 274 | 280 | 287 | 294 | 301 | 309 |
| 316 | 324 | 332 | 340 | 348 | 357 | 365 | 374 | 383 | 392 | 402 | 412 |
| 422 | 432 | 442 | 453 | 464 | 475 | 487 | 499 | 511 | 523 | 536 | 549 |
| 562 | 576 | 590 | 604 | 619 | 634 | 649 | 665 | 681 | 698 | 715 | 732 |
| 750 | 768 | 787 | 806 | 825 | 845 | 866 | 887 | 909 | 931 | 953 | 976 |

EIAJ Code Table

| code | Ω | code | Ω | code | Ω | code | Ω | code | Ω | code | Ω | code | Ω | code | Ω |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 100 | 13 | 133 | 25 | 178 | 37 | 237 | 49 | 316 | 61 | 422 | 73 | 562 | 85 | 750 |
| 02 | 102 | 14 | 137 | 26 | 182 | 38 | 243 | 50 | 324 | 62 | 432 | 74 | 576 | 86 | 768 |
| 03 | 105 | 15 | 140 | 27 | 187 | 39 | 249 | 51 | 332 | 63 | 442 | 75 | 590 | 87 | 787 |
| 04 | 107 | 16 | 143 | 28 | 191 | 40 | 255 | 52 | 340 | 64 | 453 | 76 | 604 | 88 | 806 |
| 05 | 110 | 17 | 147 | 29 | 196 | 41 | 261 | 53 | 348 | 65 | 464 | 77 | 619 | 89 | 825 |
| 06 | 113 | 18 | 150 | 30 | 200 | 42 | 267 | 54 | 357 | 66 | 475 | 78 | 634 | 90 | 845 |
| 07 | 115 | 19 | 154 | 31 | 205 | 43 | 274 | 55 | 365 | 67 | 487 | 79 | 649 | 91 | 866 |
| 08 | 118 | 20 | 158 | 32 | 210 | 44 | 280 | 56 | 374 | 68 | 499 | 80 | 665 | 92 | 887 |
| 09 | 121 | 21 | 162 | 33 | 215 | 45 | 287 | 57 | 383 | 69 | 511 | 81 | 681 | 93 | 909 |
| 10 | 124 | 22 | 165 | 34 | 221 | 46 | 294 | 58 | 392 | 70 | 523 | 82 | 698 | 94 | 931 |
| 11 | 127 | 23 | 169 | 35 | 226 | 47 | 301 | 59 | 402 | 71 | 536 | 83 | 715 | 95 | 953 |
| 12 | 130 | 24 | 174 | 36 | 232 | 48 | 309 | 60 | 412 | 72 | 549 | 84 | 732 | 96 | 976 |

$Y=10^{-2}$ $X=10^{-1}$ $A=10^{0}$ $B=10^{1}$ $C=10^{2}$ $D=10^{3}$ $E=10^{4}$ $F=10^{5}$

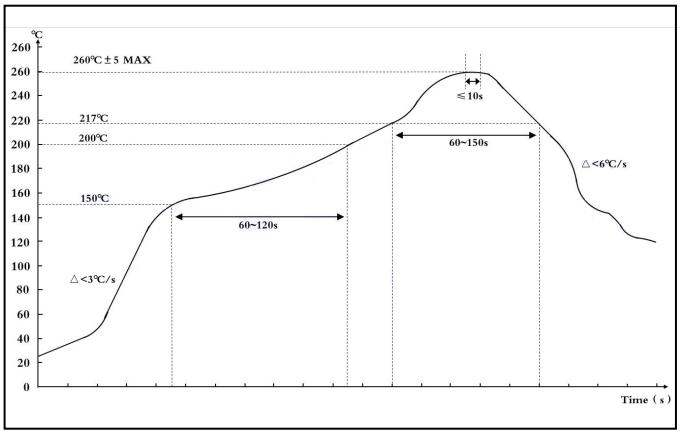
## 6. Reliability Test Items

| Item | Conditions | Specifications<br>Resistors |
|---|---|---|
| TCR | $TCR\ (ppm/^{\circ}C) = \frac{(R2-R1)}{R1\ (T2-T1)} \times 10^6$<br>R1:Measured resistance at room temperature(Ω)<br>R2:Measured resistance at -55°Cor+125°C.(Ω)<br>T1:room temperature(°C)<br>T2:Temperatures of -55°Cor+125°C(°C)。<br>According to JIS-C5201-14.8 | Reference 3. Specification Sheet |
| Short Time Overload | Apply 2.5 times the rated voltage(2.5 times the rated voltage or the maximum overload voltage,which ever is less) for 5 seconds,release the load for about 30 minutes,and then measure the resistance variance.(For rated voltage,refer to General Specification No.3.)<br>According to JIS-C5201-14.13 | F:△R≤±(1%R+0.05Ω)<br>J:△R≤±(2%R+0.05Ω)<br>No damage to appearance,no short circuits or burnouts. |
| Solderability | Immerse the resistor in the furnace at 235±5°C for 2 seconds,then remove it and place it under a microscope to observe the solder area<br>AccordingtoJIS-C5201-14.17 | Conductor tin eating area should be more than 95%.<br>Appearance without damage. |
| Resistant to Solder Heat | ◎Test Item I(SolderOvenTest):<br>Immerse in tin furnace at 260+5/-0°C for 10 seconds +1/-0, remove and leave for more than 60 minutes,then measure the resistance change rate.<br>◎Test Item II(SolderOvenTest):<br>Immerse in a tin furnace at 260+5/-0°C for 30+1/-0 seconds, remove and rinse.Place under a microscope to observe the area of the solder.<br>◎Test item III(solderingirontest):<br>Heating temperature:350±10°C<br>Heating time of soldering iron:3+1/-0sec.<br>Take the electric chromium iron to heat up both ends of the electrode,take it out and leave it for more than 60 hours,then measure the resistance change rate.<br>According to MIL-STD-202 Method 210 | Pilot project I:<br>(1).Resistance change rate<br>Resistance Range:≧1Ω<br>△R%=±(1.0%+0.05Ω)<br>(2).The electrodes have no abnormal appearance and no side guide detachment.<br>Pilot project II:<br>(1).The tin-eating area of the conductor shall be greater than 95%.<br>(2).The underlying material(e.g. White substrate)should not be visible at the edge of the electrode.<br>Pilot project III.<br>(1).Resistance change rate<br>Resistance Range:≧1Ω<br>△R%=±(1.0%+0.05Ω)<br>(2).No abnormalities in electrode appearance,no side guide detachment |
| Thermal Shock | The specimen is subjected to a high and low temperature chamber varying in temperature from -55°C to 125°C for 5 minutes for a total of 1000 cycles.The specimen is then removed,stabilised at room temperature for 24 hours ±4 hours or more,and its electrical resistance variance measured.<br>According to JESD22 Method JA-104 | △R%=±(2.0%+0.05Ω) |
| Substrate Bending Test | Solder the sample on the test PCB and place the PCB on the bend tester adding force to the centre of the PCB,the duration of the applied force should be 60(±5) seconds.Measure its resistance variance ratio in load.Bend Depth(D)<br>0402、0603、0805=5 mm<br>0201、1206、1210=3mm<br>2010、2512=2 mm<br>AccordingtoAEC-Q200-005 | △R%=±(1.0%+0.05Ω)<br>There is no damage to the appearance,no side guide detachment and no breakage occurs. |
| End Electrode Pull Test | Test item 1:Solder the resistor to the circuit board,apply a force of 5N to the back of the resistor for 10 sec,and check the appearance of the side conductor.<br>Test item 2:Solder the resistor to the circuit board,gradually apply force to the back of the resistor,and test the maximum peel strength ofthe end electrode.<br>According to AEC-Q200-006 | Item I:No damage in appearance,no side guide detachment and body breakage occur.<br>Item II:Tensile strength≧5N |
| Heat resistance test | The specimens are placed in a chamber at a temperature of 155±3°C for 1000 hours,then removed,stabilised at room temperature for 24 hours ± 4 hours or more,and their resistance variance measured.AccordingtoMIL-STD-202Method108 | F:△R≤±(1%R+0.05Ω)<br>J:△R≤±(2%R+0.05Ω) |

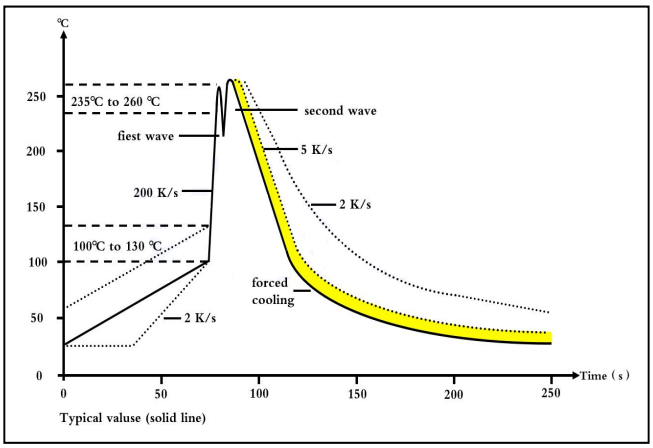
| | | |
|---|---|---|
| Humidity load | Temperature 85°C、Humidity 85%、10% Rated Power Current,Placement 1000 hours.<br>Based on MIL-STD-202 Method 103. | F:△R≤±(2%R+0.05Ω)<br>J:△R≤±(3%R+0.05Ω) |
| Electro static discharge | Human body mode,two discharges,1 each for positive and negative polarity.<br>According to AEC-Q200-002 | No damage to appearance<br>△R≤±(3.0%R+0.05Ω) |
| Load life | 125°C±2°C,1000 hours,voltage at 36% of rated power (current) value or component limit voltage(whichever is less),1.5 hours on / 0.5 hours off.<br>According to MIL-PRF-27 | F:△R≤±(2%R+0.05Ω)<br>J:△R≤±(3%R+0.05Ω) |

## 7.Recommended Soldering Conditions

### 7.1 Recommended reflow soldering curve




### 7.2 Recommended wave soldering curve




### 7.3 Recommended solder past type 96.5Sn/3.0Ag/0.5Cu

## 8. Plating Thickness

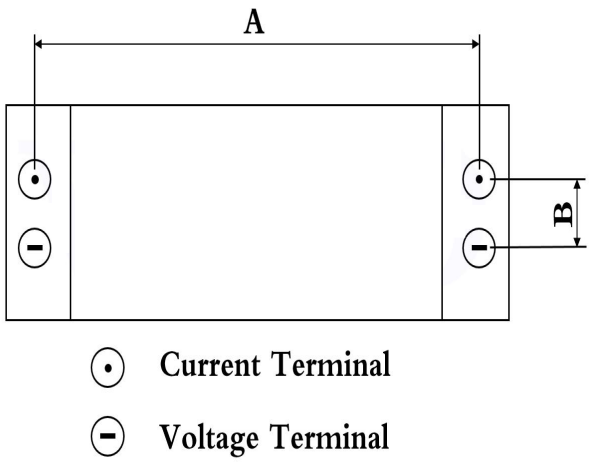
9.1 Nickel Layer Thickness: ≧2μm

9.2 Pure Tin: ≧3μm

9.3 Electroplated Pure Tin as Misty Tin

## 9. Resistance Test Package Standard Measurement Location

Back side Electrode Measurement




Unit : mm

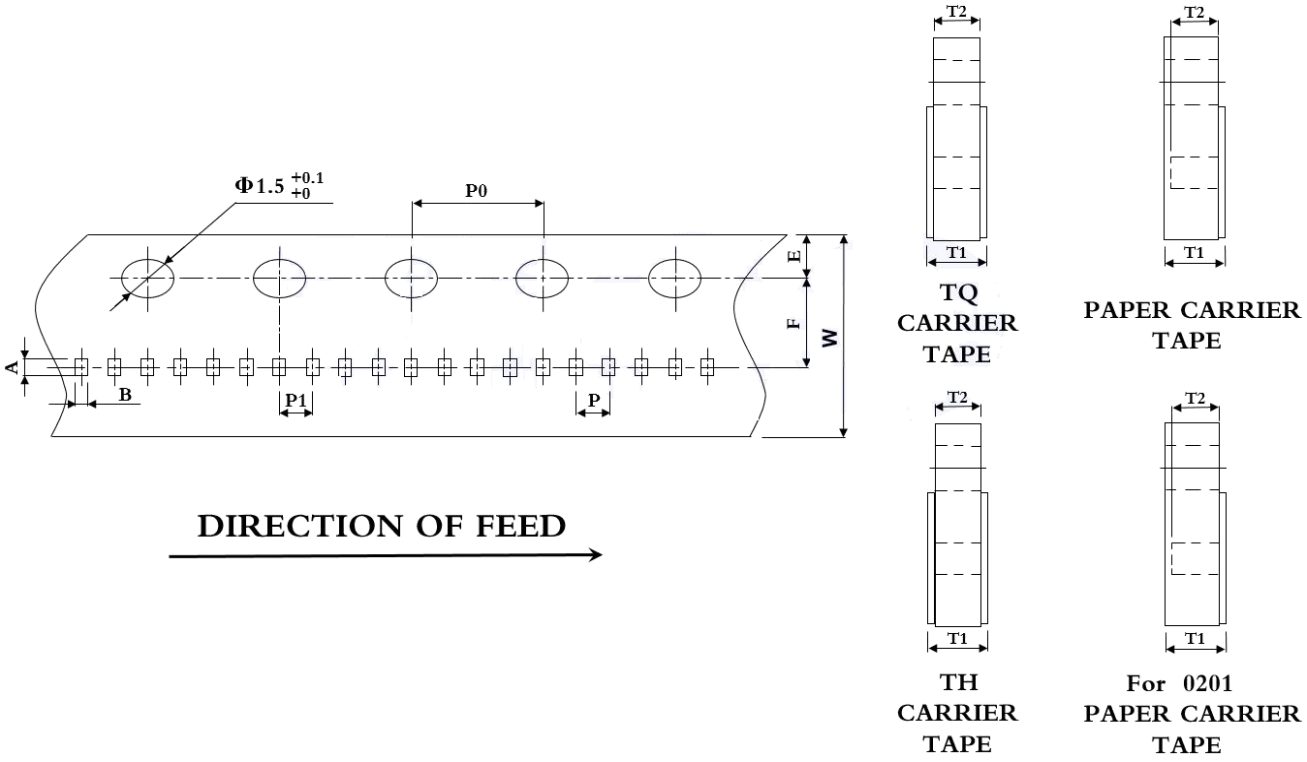
| TYPE \ DIM | A | B |
|---|---|---|
| 0402 | 0.80±0.05 | 0.24±0.05 |
| 0603 | 1.35±0.05 | 0.35±0.05 |
| 0805 | 1.80±0.05 | 0.35±0.05 |
| 1206 | 2.90±0.05 | 0.35±0.05 |
| 1210 | 2.90±0.05 | 0.35±0.05 |
| 2010 | 4.50±0.05 | 1.15±0.05 |
| 2512 | 5.9±0.05 | 1.60±0.05 |

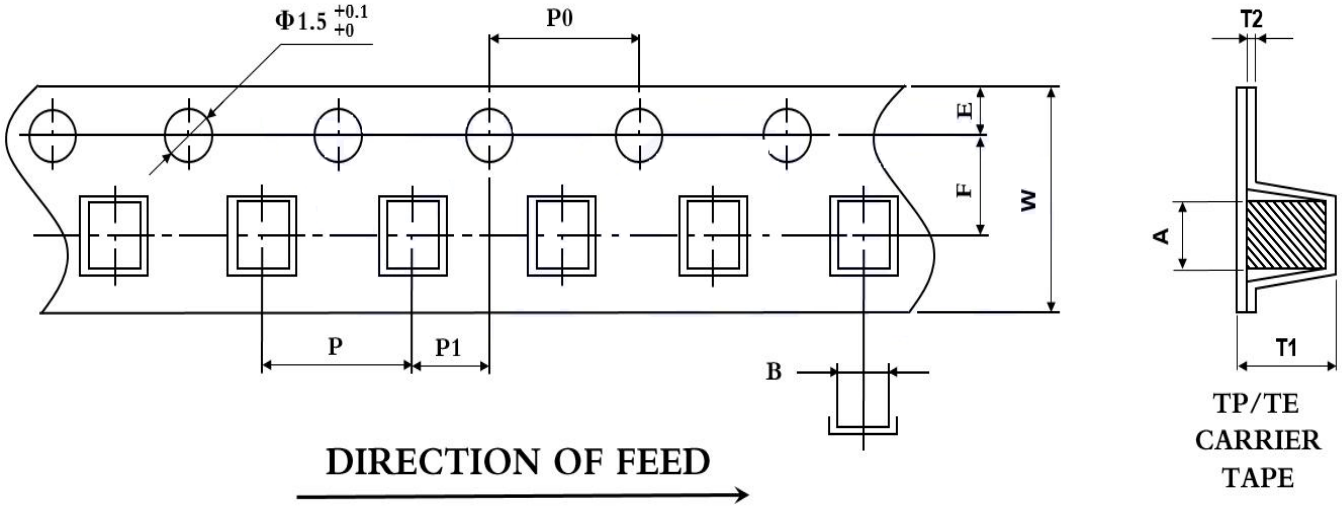
## 10. Storage Period

It can be stored for two years under the conditions of -5~40℃ and 20~75% of storage environment.

## 11. Packaging Specification

1. Scope of Application: This acknowledgement applies to lead-free and halogen-free thick film chip resistors produced by our company.
2. Carrier Tape Size:

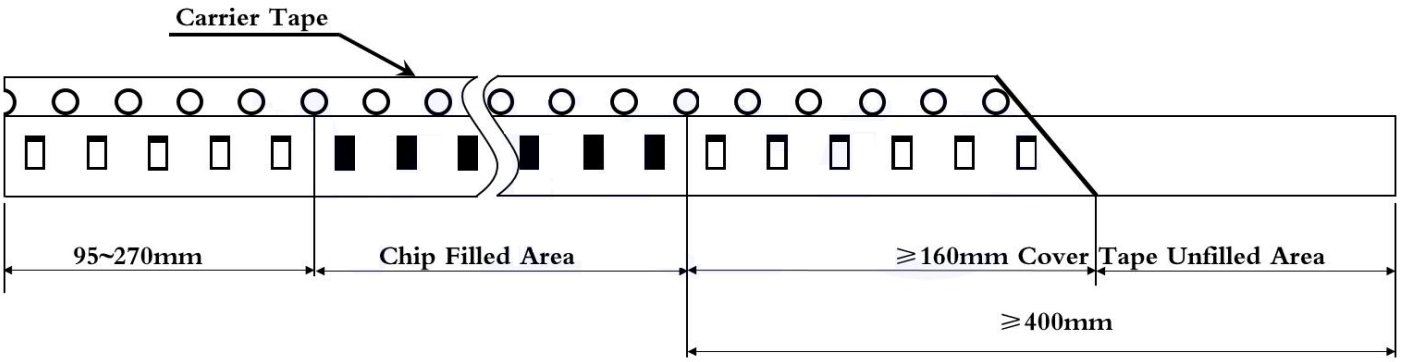


3. Single Resistor

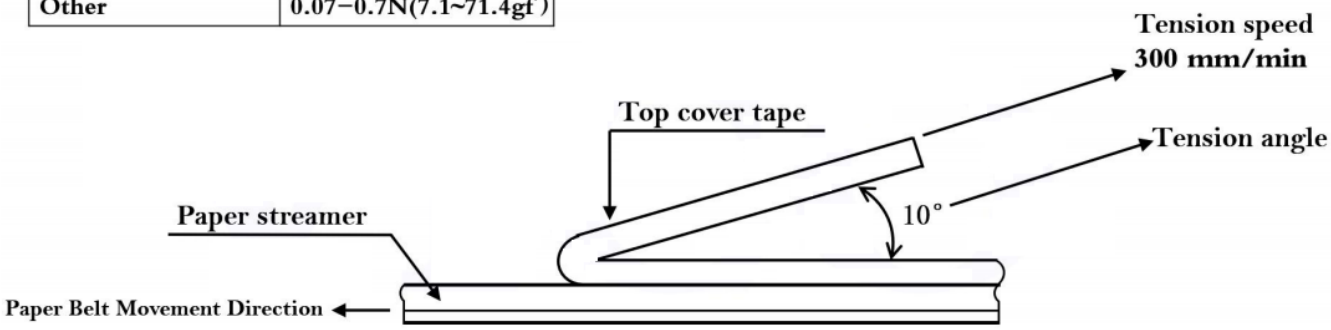
| Packaging | Single Size | Dimensions (mm) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | W | E | F | T1 | T2 | P | P0 | 10xP0 | P1 |
| TH Carrier Tape | 0402 | 1.15±0.05 | 0.65±0.05 | 8.00±0.20 | 1.75±0.10 | 3.50±0.05 | 0.40+0.2/-0 | 0.40±0.05 | 2.00±0.10 | 4.00±0.05 | 40.00±0.20 | 2.00±0.05 |
| | 0603 | 1.80±0.10 | 1.00±0.10 | 8.00±0.20 | 1.75±0.10 | 3.50±0.05 | 0.60+0.2/-0 | 0.60±0.10 | 2.00±0.10 | 4.00±0.05 | 40.00±0.20 | 2.00±0.05 |
| TP Carrier Tape | 0603 | 1.80±0.10 | 1.00±0.10 | 8.00±0.20 | 1.75±0.10 | 3.50±0.05 | 0.60+0.2/-0 | 0.60±0.10 | 4.00±0.10 | 4.00±0.05 | 40.00±0.20 | 2.00±0.05 |
| | 0805 | 2.30±0.10 | 1.55±0.10 | 8.00±0.20 | 1.75±0.10 | 3.50±0.05 | 0.75+0.2/-0 | 0.75±0.10 | 4.00±0.10 | 4.00±0.05 | 40.00±0.20 | 2.00±0.05 |
| | 1206 | 3.50±0.20 | 1.90±0.20 | 8.00±0.20 | 1.75±0.10 | 3.50±0.05 | 0.75+0.2/-0 | 0.75±0.10 | 4.00±0.10 | 4.00±0.05 | 40.00±0.20 | 2.00±0.05 |
| | 1210 | 3.50±0.20 | 2.80±0.20 | 8.00±0.20 | 1.75±0.10 | 3.50±0.05 | 0.75+0.2/-0 | 0.75±0.10 | 4.00±0.10 | 4.00±0.05 | 40.00±0.20 | 2.00±0.05 |
| TE | 2010 | 5.50±0.20 | 2.80±0.20 | 12.00±0.20 | 1.75±0.10 | 5.50±0.05 | 1.10±0.15 | 0.23±0.15 | 4.00±0.10 | 4.00±0.05 | 40.00±0.20 | 2.00±0.05 |
| | 2512 | 6.70±0.20 | 3.40±0.20 | 12.00±0.20 | 1.75±0.10 | 5.50±0.05 | 1.10±0.15 | 0.23±0.15 | 4.00±0.10 | 4.00±0.05 | 40.00±0.20 | 2.00±0.05 |

4. Front and Rear Guide Belt Dimensions:




5. Upper tape peeling force:

| Type(Size) | Specifications |
|---|---|
| 01005、0201、0402 | 0.07~0.5N(7.1~51gf) |
| Other | 0.07~0.7N(7.1~71.4gf) |



6. Packaging type:

Unit: pcs/reel

| SIZE | 7 “reel for 8 mm tape | 7 “reel for 12 mm tape | 13 “reel for 8mm tape |
|---|---|---|---|
| 0402 | 10000 | | 50000 |
| 0603 | 5000 | | 20000/25000 |
| 0805 | 5000 | | 20000/25000 |
| 1206 | 5000 | | 20000/25000 |
| 1210 | 5000 | | 20000 |
| 2010 | | 4000 | |
| 2512 | | 4000 | |

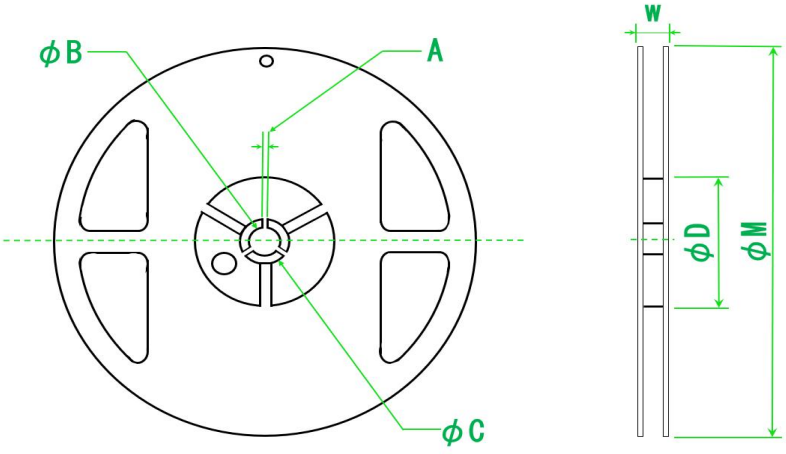
6.1 Typical Packaging Types:

TH,TP Material: paper or PE tape.

TE Material: embossed tape.

6.2 Other types of packaging are available upon request.

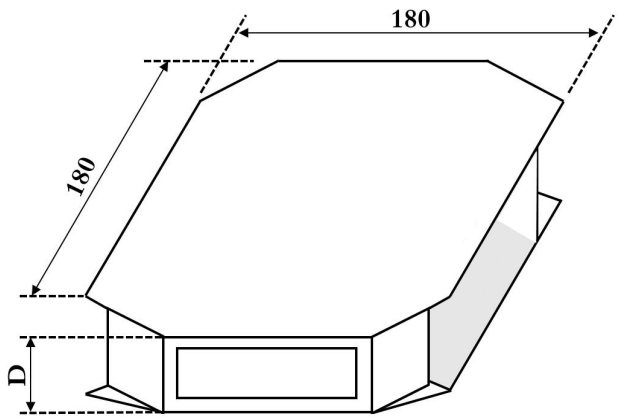
7. Plastic disc size:




| Reel Type /Tape | Wa | M | A | B | C | D |
|---|---|---|---|---|---|---|
| 7"reel for 8 mm tape | 9.0±0.5 | 178±0.5 | 2.0±0.5 | 13.5±0.5 | 21.0±0.5 | 60.0±1.0 |
| 7"reel for 12 mm tape | 13.8±0.5 | 178±0.5 | | | | 80.0±1.0 |
| 13"reel for 8 mm tape | 10.0±0.5 | 330±0.5 | | | | 100.0±1.0 |

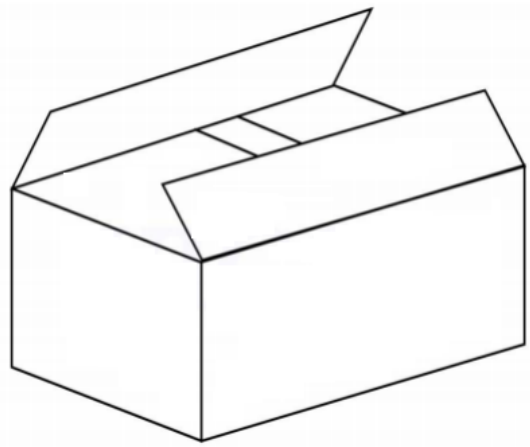
8.1 Inner box size:

| Number of scrolls | D (mm) |
|---|---|
| 1 | 12 |
| 2 | 24 |
| 3 | 36 |
| 4 | 48 |
| 5 | 60 |
| 6 | 72 |
| 7 | 84 |
| 8 | 96 |
| 9 | 108 |
| 10 | 120 |




8.2 Outer box size:

| Number of boxes | lengths (mm) | breadth (mm) | heights (mm) |
|---|---|---|---|
| 2 | 272 | 205 | 210 |
| 6 | 375 | 368 | 195 |
| 8 | 544 | 380 | 210 |



Outer box size: 37x36.8x19.5cm Material new material: KEB
Packing Quantity: 0402 600K; 0603~1210 300K; 2010~2512 168K;

## 12. Precautionary Note

Chip resistors are widely used as standard products, so the application of this product may be affected in some specific environments.

1. If you intend to use our products in equipment requiring extremely high reliability (e.g., medical equipment, aircraft/spacecraft, nuclear power controllers, automotive electronics, etc.), the failure of which may result in the loss of human life, bodily injury, or serious damage to property, please consult with an ChipNobo sales representative in advance.

Unless prior written consent is given by ChipNobo

the above specific applications are not permitted to be used in any manner whatsoever. ChipNobo shall not be liable for any loss or expense incurred by you or any third party as a result of the use of this equipment.

2. ChipNobo designs and manufactures its products under a strict quality control system; however,

electronic products may fail or malfunction in some unusual applications.

Users are requested to implement safety measures in accordance with their responsibilities,

including but not limited tophysical injury, damage to any property.

The following are examples of safety measures:

[A] Installation of protective circuits or other protective devices to enhance system safety

[B] Installation of redundant circuits to reduce the effects of single or multiple circuit failures

3. The products are not designed to be used in special environments or conditions, so performance may be affected when used in the following special environments:

[A]Products are intended for use in any type of liquid, including water, oil, chemicals and organic solvents.

[B] the product is outdoors or where the product is exposed to direct sunlight or dust.

[C]the product is exposed to sea breezes or corrosive gases, including : Cl2、H2S、NH3、SO2、NO2.

[D] products exposed to static electricity or electromagnetic waves.

[E]The product is close to heat generating parts, plastic cords, or other flammable items.

[F]Products sealed or coated with resin or other coating materials our products

[G]Products are soldered with non-clean flux, or products are cleaned with water or water-soluble cleaning agents.

[H]Products are used in places where dew condensation occurs.

4. Our products are not designed to protect against radiation.

5. Avoid power ratings that exceed the normal operation of the product, especially for transient loads (applying a large amount of load for a short period of time, e.g. pulsed applications). There may be a negative impact on product performance.

6. Be careful when using hard objects in contact with the product, which may cause product damage due to external factors.

**NOTICE**

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