



富捷科技

Product Datasheet

产品规格说明书

FRG Series High Ohmic Thick Film Chip Resistor

高阻值厚膜片式电阻器

安徽省富捷电子科技有限公司

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高阻值厚膜片式电阻器

High Ohmic Thick Film Chip Resistor FRC Series



特点 (Features)

- 最高阻值 100MΩ - Maximum resistance:100MΩ
- 电性能稳定, 可靠度高 - Stable electrical capability and high Reliability
- 符合 RoHS 指令要求 - Compliant with RoHS directive
- 符合无卤素要求 - Halogen free requirement

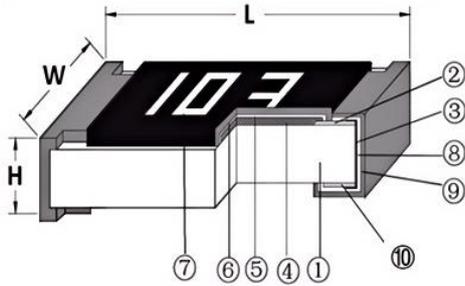
应用 (Application)

- 开关电源、电压调节器、电源转换器、充电器、汽车引擎控制器、便携式设备等。
- Switching Power Supply Voltage Regulation Module(VRM) DC-DC Converter Charger Automotive Engine Control Portable Devices etc.

产品料号 (Parts Number Explanation) 示例: FRG1206J476 TS

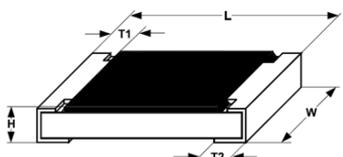
| F 公司 | RG 产品别 | 1206 尺寸 | J 公差 | 476 字码 | T 包装别 | S 端电极 | 特殊码 |
|----------------------------------|-----------------------|---------|-----------|----------------|----------------|-------------|--------------|
| FOJAN | RC: Normal | 0603 | F:±1% | ±5%:E24 | T: 7 inch reel | S: Sn | Blank: |
| | RL: Low ohmic | 0805 | J:±5% | 3-digits+blank | Q:10 inch reel | C: Cu | none |
| | RP: High Power | 1206 | | 102=1KΩ | R:13 inch reel | A: Au | |
| | RH: High Precision | 1210 | | 1R0=1Ω | B:Bulk | | |
| | RV: High Voltage | 1218 | | ±1%&Below: | | | |
| | RG: High Ohmic | 1812 | | E24+E96: | | | |
| | RS: Anti-Surge | 2010 | | 4-digits | | | |
| | RQ: Auto-motive | 2512 | | 1001=1KΩ | | | |
| | RR: Anti-Sulfur | | | 1R00=1Ω | | | |
| | RA: Array | | | | | | |
| Others series refer to Catalogue | | | | | | | |
| Company | Product Type | Size | Tolerance | Resistance | Packaging | Termination | Special Case |

电阻结构 (Construction)



| NO. | 结构 Construction | 主要材料 Major material |
|-----|-----------------------------|------------------------|
| 1 | 陶瓷基板 Ceramic substrate | 氧化铝 Al_2O_3 |
| 2 | 银电极 Conductive layer(Top) | 银 Ag |
| 3 | 侧电极 Side conductive layer | 镍铬合金 NiCr |
| 4 | 阻体层 Resistive layer | 氧化钌 RuO_2 |
| 5 | 内保护层 Inner protective layer | 玻璃 Glass |
| 6 | 外保护层 Outer Protective layer | 环氧树脂 Epoxy |
| 7 | 文字 Marking | 环氧树脂 Epoxy |
| 8 | 镍电极 Ni plating layer | 镍 Ni |
| 9 | 镍电极 Ni plating layer | 镍 Ni |
| 10 | 银电极 Conductive layer(Back) | 银 Ag |

尺寸 (Dimension):

| 尺寸 Dimension | |  | | | | |
|--------------|------|---|-----------------|-----------------|-----------------|-----------------|
| 型别 (Type) | | L | W | H | T1 | T2 |
| 英制 | 公制 | | | | | |
| 0603 | 1608 | 1.60 ± 0.10 | 0.80 ± 0.10 | 0.45 ± 0.10 | 0.25 ± 0.15 | 0.25 ± 0.15 |
| 0805 | 2012 | 2.00 ± 0.10 | 1.25 ± 0.10 | 0.50 ± 0.10 | 0.35 ± 0.20 | 0.40 ± 0.20 |
| 1206 | 3216 | 3.10 ± 0.10 | 1.60 ± 0.10 | 0.55 ± 0.10 | 0.45 ± 0.20 | 0.45 ± 0.20 |
| 1210 | 3225 | 3.10 ± 0.10 | 2.50 ± 0.15 | 0.55 ± 0.10 | 0.45 ± 0.15 | 0.50 ± 0.20 |
| 1218 | 3245 | 3.10 ± 0.10 | 4.60 ± 0.10 | 0.55 ± 0.10 | 0.45 ± 0.20 | 0.40 ± 0.20 |
| 1812 | 4532 | 4.50 ± 0.20 | 3.10 ± 0.20 | 0.55 ± 0.10 | 0.55 ± 0.20 | 0.70 ± 0.20 |
| 2010 | 5025 | 5.00 ± 0.10 | 2.50 ± 0.15 | 0.55 ± 0.10 | 0.45 ± 0.15 | 0.50 ± 0.20 |
| 2512 | 6432 | 6.35 ± 0.10 | 3.10 ± 0.15 | 0.55 ± 0.10 | 0.60 ± 0.20 | 0.90 ± 0.20 |

单位 (unit) : mm

温度系数 (Temperature Coefficient)

| 型别 Type | 阻值范围 Resistance Range | 产品精度和温漂系数 (ppm/°C) Resistance Tolerance and TCR (ppm/°C) | | |
|--|---------------------------------|--|------|------|
| | | ±1% | ±2% | ±5% |
| 0603/0805 1206/1210 1812/2010/2512 | $10M\Omega \leq R < 100M\Omega$ | ±200 | ±200 | ±200 |

■ 电气特性 (Electrical characteristics)

| 型别 Type | 70°C 下额定功率 Rated Power at 70°C | 最大工作电压 Max Working Voltage | 最大过负荷电压 Max Overload Voltage | 绝缘耐压 Dielectric Withstanding Voltage |
|------------|-----------------------------------|-------------------------------|---------------------------------|---|
| 0603 | 1/10W | 75V | 150V | 300V |
| 0805 | 1/8W | 150V | 300V | 500V |
| 1206 | 1/4W | 200V | 400V | 500V |
| 1210 | 1/2W | 200V | 400V | 500V |
| 1812 | 3/4W | 200V | 500V | 500V |
| 2010 | 3/4W | 200V | 400V | 500V |
| 2512 | 1W | 200V | 400V | 500V |

备注 (Remark) : 额定电压计算公式 (The rated voltage is calculated by the following formula) :

$$E = \sqrt{RP}$$

E: 额定电压 (Rated Voltage) (V)

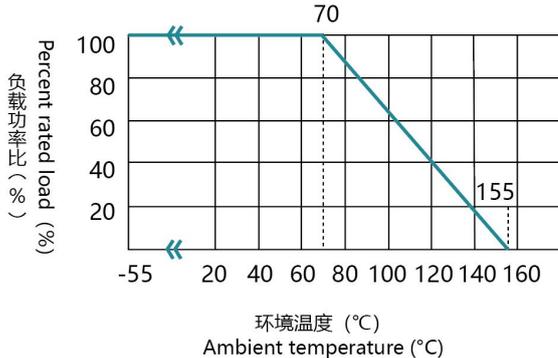
P: 额定功率 (Rated Power) (W)

R: 电阻阻值 (Resistance) (ohm)

如果计算出的电压超过此型别的最大工作电压, 则此型别的最大工作电压为此电阻的额定电压。

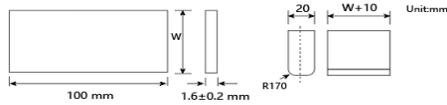
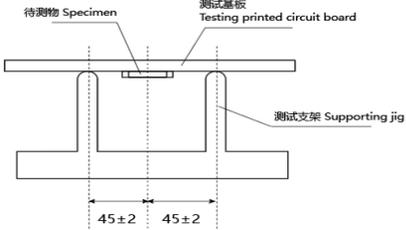
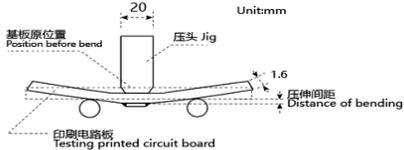
In case the value calculated by the formula exceed the maximum working voltage as above table 8, the maximum working voltage shall be regarded as rated voltage.

■ 功率衰减曲线 (Derating Curve)

| 使用温度范围 Temperature usage range | -55°C ~ +155°C |
|------------------------------------|--|
| 说明 Describe | <p>周围温度若超过 70°C 至 155°C 之间, 功率可照下图曲线予以修订</p> <p>If the ambient temperature exceeds 70°C to 155°C, the power can be revised according to the curve in the following figure</p> |
| 功率衰减曲线图 Power Attenuation Curve |  <p>The graph shows the power attenuation curve. The y-axis is 'Percent rated load (%)' ranging from 0 to 100. The x-axis is 'Ambient temperature (°C)' ranging from -55 to 160. The curve is constant at 100% load until 70°C, then decreases linearly to 0% load at 155°C. Dashed vertical lines indicate the 70°C and 155°C points on the x-axis.</p> |

■ 性能 (Performance)

| 内容 Item | 测试方法 Test Methods | 测试条件 Test Conditions | 规格 Specification |
|---|----------------------|---|---|
| 温度系数 Temperature Coefficient | JIS C 5201 4.8 | $TCR = (R - R_0) / (t - t_0) R_0 \times 10^6$ (ppm) R0: 电阻在室温下的阻值(resistance at room temperature) R: 电阻在 125°C或-55°C下的阻值(resistance at 125°C or -55°C) t0: 室温(room temperature) t: 测试温度 (test temperature 125°C or -55°C) | As SEPC |
| 短时间过负荷 Short-time overload | JIS C 5201 4.13 | 加载 2.5 倍的额定电压, 时间 5 秒后测量试验前后的阻值变化率。 Applied 2.5 times of rated voltage for 5 second. Measure the variation of resistance. | 0.5%/1%: $\pm(1.0\% + 0.05\Omega)$ 5%: $\pm(2.0\% + 0.05\Omega)$ |
| 焊锡性 Solderability | JIS C 5201 4.17 | 沾助焊剂后浸入锡炉, 锡炉温度 $245 \pm 5^\circ\text{C}$, 时间 3 ± 0.5 秒。 Dip the terminal in a flux and then dip into a soldering bath at $245 \pm 5^\circ\text{C}$ for $3 \pm 0.5\text{sec}$. | > 95%面积上锡 (> 95% coverage) |
| 抗焊锡热 Resist to soldering heat | JIS C 5201 4.18 | 沾助焊剂后浸入锡炉, 锡炉温度 $260 \pm 5^\circ\text{C}$, 时间 10 ± 0.5 秒, 测量试验前后的阻值变化率。 Dip the terminal in a flux and then dip into a soldering bath at $260 \pm 5^\circ\text{C}$ for $10 \pm 0.5\text{sec}$. Measure the variation of resistance. | $\pm(1.00\% + 0.05\Omega)$ |
| 绝缘电阻 Insulation resistance | JIS C 5201 4.6 | 电阻本体上加载绝缘耐压 60 ± 5 秒后, 测量绝缘阻抗。 Applied the dielectric withstanding voltage on the center of body for $60 \pm 5\text{seconds}$. Then measure insulation resistance. | > 10G Ω |
| 绝缘耐压 Dielectric withstanding voltage | JIS C 5201 4.7 | 电阻本体上加载绝缘耐压 60 ± 5 秒。 Applied the dielectric withstanding voltage on the center of body for $60 \pm 5\text{seconds}$. | 无击穿、飞弧及可见机械性损伤 No evidence of flash over, mechanical damage arcing or insulation breakdown |
| 温度快速变化 Rapid temperature changes | JIS C 5201 4.19 | 电阻放入温度循环机中, T1 温度: $-55 \pm 3^\circ\text{C}$; T2 温度: $155 \pm 3^\circ\text{C}/125 \pm 3^\circ\text{C}$, 放置 30 分钟, 共 300 个循环。量测试验前后阻值变化率。 Put specimen in a chamber which temperature can be T1: $-55 \pm 3^\circ\text{C}$; T2: $155 \pm 3^\circ\text{C}/125 \pm 3^\circ\text{C}$, 30min, repeated 300 cycles. Measure the variation of resistance. | 0.5%/1%: $\pm(1.0\% + 0.05\Omega)$ 5%: $\pm(2.0\% + 0.05\Omega)$ |
| 负荷寿命 Load life | JIS C 5201 4.25.1 | 电阻放入恒温箱中, 温度 $70 \pm 2^\circ\text{C}$, ON TIME:1.5H, OFF TIME:0.5H, 通电额定电压 $1000^{+24}/_{-0}$ 小时, 量测试验前后阻值变化率。 Put the specimen in a chamber at $70 \pm 2^\circ\text{C}$ temperature, ON TIME:1.5H, OFF TIME:0.5H, and applied rated voltage for $1000^{+24}/_{-0}\text{H}$. Measure the variation of resistance. | 0.5%、1%: $\pm(1.0\% + 0.05\Omega)$ 5%: $\pm(2.0\% + 0.05\Omega)$ |

| 内容 Item | 测试方法 Test Methods | 测试条件 Test Conditions | 规格 Specification |
|--------------------------------|---------------------------|--|---|
| 温湿循环 Moisture resistance | MIL-STD-202 METHOD 106 | 25°C~65°C,90~100%RH, 2.5 小时; 65°C 90~100%RH, 3 小时; 65°C~25°C,80~100%RH,2.5 小时,10 个循环,试验结束 24±4 小时后进行测试. 25°C~65°C,90~100%RH, 2.5H; 65°C 90~100%RH, 3H; 65°C~25°C 80~100%RH, 2.5H, 10 cycles, Measurement at 24±4 hours after test conclusion. | 0.5%/1%:±(1.0%+0.05Ω) 5%: ±(2.0%+0.05Ω) |
| 端子弯曲 Terminal bending | JIS C 5201 4.33 | <p>电阻焊接在测试板上进行弯折,弯折保持时间 20±1 秒, 1206(含) 以下的尺寸弯曲 5+0.2/0 mm; 1206 以上的尺寸弯曲 2+0.2/0 mm; 量测试验前后阻值变化率</p> <p>Specimen shall be mounted on test board, then bend the board and maintained for 20±1s. the distance of bending is 5+0.2/0 mm for resistors which size no larger than 1206 or 2+0.2/0 mm which size larger than 1206. Measure the variation of resistance.</p> <p>测试板 (test board) 压头 (jig)</p>    | ±(1.00% +0.05Ω) |
| 耐湿特性 Humidity | JIS C 5201 4.24 | <p>电阻放入恒温恒湿箱, 温度 40±2°C, 湿度 90~95 %RH;通电额定电压 1.5 小时, 断电 0.5 小时; 重复通断电至试验时间 1000⁺⁴⁸/₀ 小时. 量测试验前后阻值变化率.</p> <p>Put the specimen in a chamber at 40±2°C temperature and 90~95% relative humidity, then applied rated voltage for1.5H "ON" and 0.5H "OFF" repeatedly till total test time is 1000⁺⁴⁸/₀ H. Measure the variation of resistance.</p> | 0.5%、1%: ±(1.0%+0.05Ω) 5%: ±(2.0%+0.05Ω) |

■ 本体标识 (Marking on the Resistor's Body)

| | | |
|--|--|--|
| <p>1.公差±5%的产品，以三字码标示，前两位表示阻值的有效数字，最后一位表示 10 的乘幂 ±5% tolerance product: the marking is 3 digits, the first 2 digits are significant figures of resistance value and the 3rd one denotes the power number of 10, (10X)</p> <p>2.±0.5%, ±1%, ±2%的产品，以四字码标示，前三位表示阻值的有效数字，最后一位表示 10 的乘幂 ±0.5%, ±1%, ±2% tolerance product: the marking is 4 digits, the first 3 digits are significant figures of resistance value and the 4th one denotes the power number of 10, (10X)</p> <p>3.0603 ±1% E96 系列的标准阻值，因电阻本体太小，采用三位代码标示。 Standard E96 series values of 0603 ±1%: due to the small size of the resistor's body, use 3digits code to indicate the resistance value.</p> |  | 472=47×10 ² =4.7KΩ |
| |  | 10Ω以下标示: 5R6=5.6Ω Below 10Ω: 5R6=5.6Ω |
| |  | 4992=499×10 ² =49.9KΩ |
| |  | 100Ω以下标示 6R81=6.81Ω Below 100Ω: 6R81=6.81Ω |

■ 0603±1% E96 系列电阻值代码 Standard E96 Series Resistance Value Code for 0603 ±1% Marking

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

■ 0603±1%标记的倍增码 Multiplier Code for 0603 ±1% Marking

| 代码 Code | Y | X | A | B | C | D | E | F | G |
|---------------|------------------|------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 指数 Multiplier | 10 ⁻² | 10 ⁻¹ | 10 ⁰ | 10 ¹ | 10 ² | 10 ³ | 10 ⁴ | 10 ⁵ | 10 ⁶ |

阻值标示如下(So the resistance value are marked as the following examples)



$$10D = 124 \times 10^3 = 124K\Omega$$



$$38Y = 243 \times 10^{-2} = 2.43\Omega$$

0603 $\pm 1\%$ 的产品，在标准 E24 系列中，但不属于 E96 系列，标示与 5% 的字码相同，但是在中间字码下加一条线 (Standard E24 and not belong to E96 series values of 0603 $\pm 1\%$, the marking is the same as 5% tolerance but marking as underline)



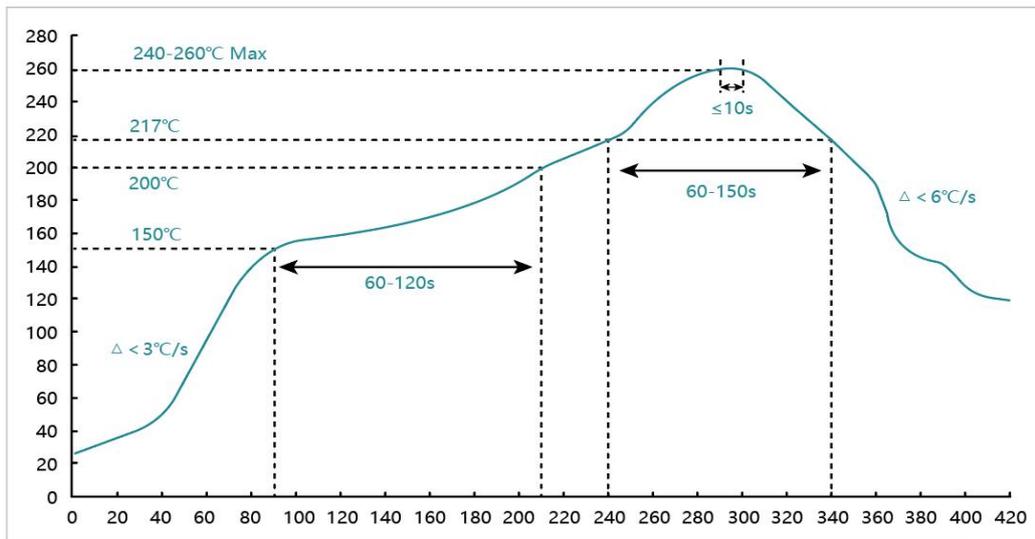
$$33\underline{1} = 33 \times 10^1 = 330\Omega$$



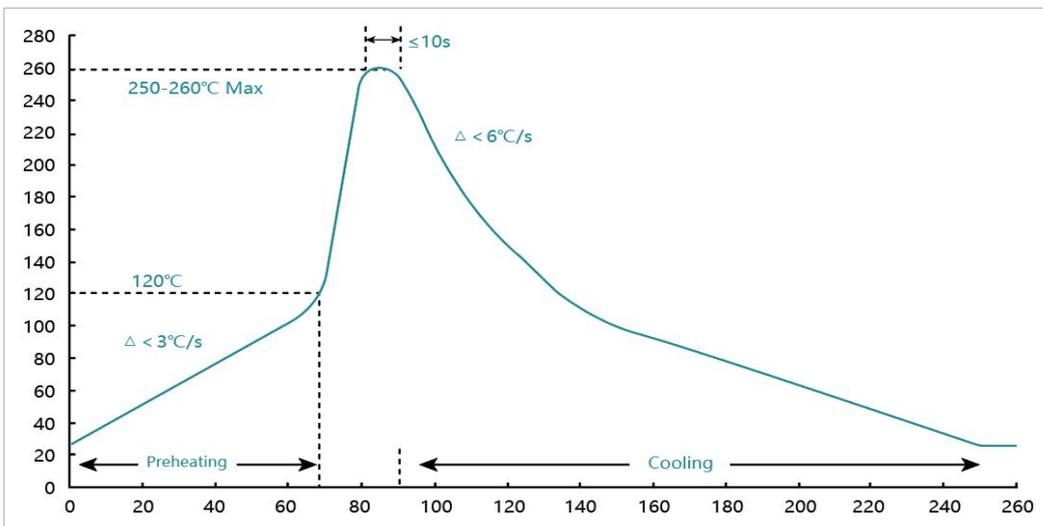
$$56\underline{0} = 56 \times 10^0 = 56\Omega$$

■ 焊接 (soldering)

- 建议回流焊曲线 (Recommend reflow soldering profile)



- 建议波峰焊曲线 (Recommend wave soldering profile)

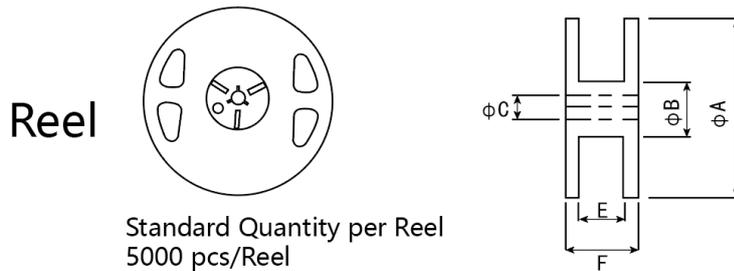


- 手工焊温度 (hand soldering temperature)

烙铁温度 $350\pm 10^{\circ}\text{C}$ 3 秒之内, 避免烙铁接触电阻本体

The iron temperature is $350\pm 10^{\circ}\text{C}$, hand soldering time less than 3S. Avoid solder iron tip direct touch the components body

■ 包装规格 (Tapping Specification)

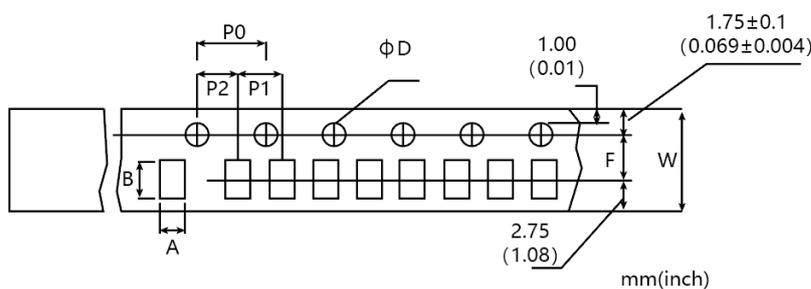


-卷盘尺寸 (Reel dimension)

| Type | Size | Unit | A | B | C | F | W | |
|---------------------|------|----------|----|--------------|----------------|---------------|---------------|---------------|
| 0603/0805/1206/1210 | 7" | 5K/Reel | mm | 178 ± 2.0 | 60.0 ± 1.0 | 13.5 ± 0.5 | 11.4 ± 0.1 | 9.00 ± 0.3 |
| 0603/0805/1206 | 10" | 10K/Reel | mm | 254 ± 2.0 | 100.0 ± 1.0 | 13.5 ± 0.5 | 11.4 ± 0.1 | 9.00 ± 0.3 |
| 0603/0805/1206 | 13" | 20K/Reel | mm | 330 ± 2.0 | 100.0 ± 1.0 | 13.5 ± 0.5 | 11.4 ± 0.1 | 9.00 ± 0.3 |
| 1218/1812/2010/2512 | 7" | 4K/Reel | mm | 178 ± 2.0 | 60.0 ± 1.0 | 13.5 ± 0.5 | 15.4 ± 1.0 | 13.0 ± 0.3 |

-包装尺寸 (packing dimension)

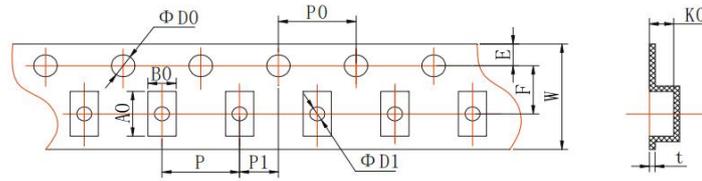
纸带编带 Paper Taping



Unit: mm

| Dim | A | B | D | F | P0 | P1 | P2 | W | T |
|------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| 0603 | 1.10 ± 0.10 | 1.90 ± 0.10 | 1.50 ± 0.10 | 3.50 ± 0.05 | 4.00 ± 0.10 | 4.00 ± 0.10 | 2.00 ± 0.05 | 8.00 ± 0.20 | 0.60 ± 0.03 |
| 0805 | 1.65 ± 0.20 | 2.40 ± 0.20 | 1.50 ± 0.10 | 3.50 ± 0.05 | 4.00 ± 0.10 | 4.00 ± 0.10 | 2.00 ± 0.05 | 8.00 ± 0.20 | 0.75 ± 0.05 |
| 1206 | 1.90 ± 0.20 | 3.50 ± 0.20 | 1.50 ± 0.10 | 3.50 ± 0.05 | 4.00 ± 0.10 | 4.00 ± 0.10 | 2.00 ± 0.05 | 8.00 ± 0.20 | 0.75 ± 0.05 |
| 1210 | 2.80 ± 0.20 | 3.50 ± 0.20 | 1.50 ± 0.10 | 3.50 ± 0.05 | 4.00 ± 0.10 | 4.00 ± 0.10 | 2.00 ± 0.05 | 8.00 ± 0.20 | 0.75 ± 0.05 |

塑料带编带 Embossed Taping



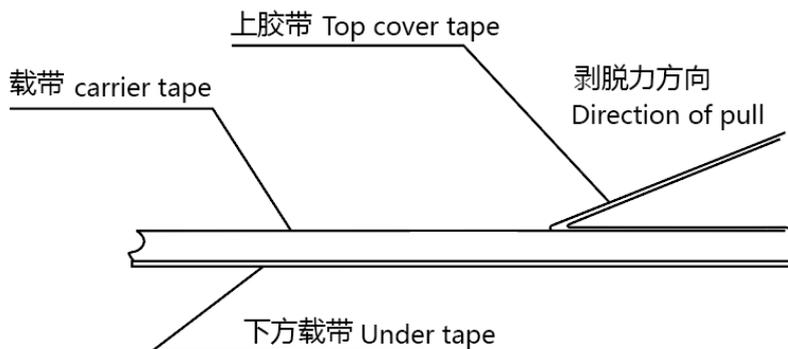
Unit: mm

| Dim | B0 | A0 | D0 | F | P0 | P | P1 | W | K0 |
|------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 1218 | 2.80±0.20 | 4.60±0.20 | 1.50±0.10 | 5.50±0.05 | 4.00±0.10 | 4.00±0.10 | 2.00±0.05 | 12.0±0.10 | 0.75±0.10 |
| 1812 | 3.52±0.10 | 5.10±0.10 | 1.50±0.10 | 5.50±0.05 | 4.00±0.10 | 4.00±0.10 | 2.00±0.05 | 12.0±0.10 | 0.78±0.10 |
| 2010 | 2.75±0.10 | 5.40±0.10 | 1.50±0.10 | 5.50±0.05 | 4.00±0.10 | 4.00±0.10 | 2.00±0.05 | 12.0±0.10 | 0.75±0.10 |
| 2512 | 3.35±0.10 | 6.70±0.10 | 1.50±0.10 | 5.50±0.05 | 4.00±0.10 | 4.00±0.10 | 2.00±0.05 | 12.0±0.10 | 0.75±0.10 |

上胶带剥离力测试 (Peel force of top cover tape)

上胶带以 200mm/分钟的速度，沿 165~180 度角的方向进行剥离，如下图所示。纸带的剥离力范围为 10g~70g；载带的剥离力范围 30~100g。

The top cover tape is pulled at a speed of 200 mm/min with the angle between the tape during peel and the direction of unreeling maintained at 165 to 180 degree as following picture. The peel force of paper carrier tape shall be 0.1N to 0.7N(10 to 70 g), the peel force of plastic carrier tape shall be 0.3N to 1N (30 to 100 g)



■ 厚膜电阻器使用说明 (Chip Resistor Instructions for use)

本产品以下特殊环境下应用，性能可能会受到影响：

(Application of the products in a special environment can deteriorate product performance) :

1. 高温；
High temperature
2. 有海风或腐蚀性气体，包括氯气，硫化氢，氨气，二氧化硫，二氧化氮等；
Near the sea ,or corrosive gas, such as Cl_2, H_2S, NH_3, SO_2 and NO_2 etc;
3. 各种类型的液体，包括水，油，化学品，有机溶剂的使用；
Unverified liquids, such as water,oil,chenical or organic solvent;
4. 在用树脂或其他涂层材料密封产品的情况下使用；
Unverified resin or paint to cover products;
5. 焊接后使用不洁焊剂或使用水或水溶性清洁剂清洗产品
Products should be washed with soluble cheaner even if non cleaning flux.

- 储存 / 搬运条件 (Storage / Carry conditions)

1. 储存温度 $25\pm 5^{\circ}C$ Temperature: $25\pm 5^{\circ}C$
2. 湿度 30~70%RH Humidity: 30~70%RH
3. 储存期限：先进先出，2年 Storage life: 2years FIFO
4. 存放和搬运时，请保持盒子的正确方向。严禁跌落在箱体上，否则可能损坏产品电极或本体
Please hold box correct orientation when storing and carrying.It is strictly prohibited to fall on the box.
otherwise the product electrode or body may be damaged.

