



富捷科技

Product Datasheet

产品规格说明书

FQL Series Low-ohmic Automotive Thick Film Chip Resistor

低阻车规厚膜片式电阻器

安徽省富捷电子科技有限公司

ANHUI FOJAN ELECTRONICS TECHNOLOGY CO., LTD

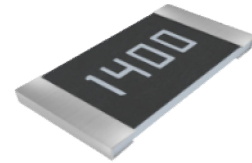
安徽省马鞍山市郑蒲港新区金蒲电子产业园

JINPU ELECTRONIC INDUSTRIAL PARK, ZHENGPU PORT NEW
DISTRICT, MAANSHAN CITY, ANHUI PROVINCE

zoey@fosan.net.cn www.fosan.vip

低阻车规厚膜片式电阻器

General Low-ohmic Automotive Thick Film Chip Resistor



特点 (Features)

- 低阻值 -Low-ohmic
- 电性能稳定, 可靠度高 - Stable electrical capability and high Reliability
- 符合 RoHS 指令和无卤素要求 - Compliant with RoHS directive and Halogen free requirement
- 具有优越的抗硫化性能 - With excellent Anti-sulfured performance
- 符合 汽车标准相关条款 -Compliant with AEC-Q200 standard

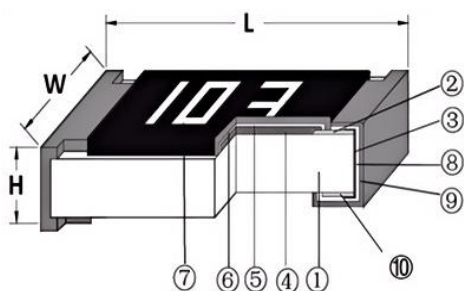
应用 (Application)

- 广泛用于汽车开关电源、音响设备的过电流保护、电压调节器、电源转换器、充电器、灯驱动电源等。
- Widely used in Automotive Switching Power Supply, Over Current Protection in Audio Application, Voltage Regulation, Module(VRM), DC-DC Converter, Charger, LED Lamp Devices, , etc

产品料号 (Parts Number Explanation) 示例: FQL1206FR100TS

F 公司	QL 产品别	1206 尺寸	F 公差	R100 字码	T 包装别	S 端电极	特殊码
FOJAN	QL: General	0402	F:±1%	0603:3-digits	T: 7 inch reel	S: Sn	Blank:
	Low-ohmic	0603	J:±5%	R10=100mR	Q:10 inch reel	C: Cu	none
	Others series refer to Catalogue	0805		R50=500mR	R:13 inch reel	A: Au	
		1206		02Z=102mR	B:Bulk		
		1210		0805-2512:			
		1218		4-digits			
		1812		R100=100mR			
		2010		R500=500mR			
2512							
Company	Product Type	Size	Tolerance	Resistance	Packaging	Termination	Special Case

■ 电阻结构 (Construction)

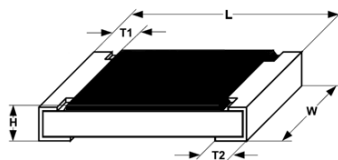


NO.	结构 Construction	主要材料 Major material
1	陶瓷基板 Ceramic substrate	三氧化二铝 Al_2O_3
2	银电极 Conductive layer (Top)	银 Ag
3	侧电极 Side conductive layer	镍铬合金 NiCr
4	阻体层 Resistive layer	氧化钌 RuO_2
5	内保护层 Inner protective layer	玻璃 Glass
6	外保护层 Outer Protective layer	环氧树脂 Epoxy
7	文字 Marking	环氧树脂 Epoxy
8	镍电极 Ni plating layer	镍 Ni
9	镍电极 Ni plating layer	镍 Ni
10	银电极 Conductive layer (Back)	银 Ag

■ 尺寸 (Dimension):

型别 (Type)		L	W	H	T1	T2
英制	公制					
0402	1005	1.00 ± 0.05	0.50 ± 0.05	0.35 ± 0.05	0.20 ± 0.10	0.25 ± 0.10
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

尺寸 Dimension



单位 (unit) : mm

■ 电气特性 (Electrical characteristics)

型别 Type	70°C 下额定功率 Rated Power at 70°C	最大工作电流 Max Working Current	最大过负荷电流 Max Overload Current	绝缘耐压 Dielectric Withstanding Voltage
0402	1/16W	0.79A	1.97A	300V
0603	1/10W	2.23A	5.59A	300V
0805	1/8W	2.50A	6.25A	500V
1206	1/4W	3.53A	8.83A	500V
1210	1/2W	5.00A	12.50A	500V
1812	3/4W	6.12A	15.30A	500V
2010	3/4W	6.12A	15.30A	500V
2512	1W	7.07A	17.67A	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)

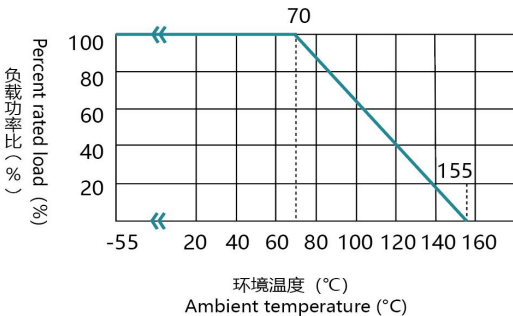
P: 额定功率 (Rated Power) (W)

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	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 If the ambient temperature exceeds 70°C to 155°C, the power can be revised according to the curve in the following figure
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% for temperatures up to 70°C. At 70°C, the power begins to decrease linearly, reaching 0% at 155°C. Dotted lines indicate the points (70, 100) and (155, 0) on the curve.</p>

■ 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%
0402	$0.1\Omega \leq R < 0.5\Omega$	±800	±800	±800
	$0.5\Omega \leq R < 0.91\Omega$	±400	±400	±400
0603/0805 1206/1210 1812/2010/2512	$0.05\Omega \leq R < 0.1\Omega$	±1200	±1200	±1200
	$0.1\Omega \leq R < 0.5\Omega$	±800	±800	±800
	$0.5\Omega \leq R < 0.91\Omega$	±400	±400	±400

■ 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	$TCR = (R - R_0) / (t - t_0) R_0 \times 10^6 (\text{ppm})$ 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%:±(1.0%+0.05Ω) 5%:±(2.0%+0.05Ω)
高温储存 High Temperature Exposure	AEC-Q200 TEST 3 MIL-STD-202 METHOD 108	125°C下放置 1000h, 不加载功率, 试验结束 24±4 小时后进行测试。 1000 hrs. @ T=155 . Unpowered.Measurement at 24±4 hours °C after test conclusion	±(1.00%+0.05Ω)
温度循环 Temperature Cycling	AEC-Q200 TEST 4 JESD22 METHOD JA-104	-55 ~ +155, °C °C 循环 1000 次, 在每一个极限温度持续时间不超过 30 分钟, 且温度转换时间不超过 1 分钟, 试验结束 24±4 小时后进行测试。 1000 Cycles (-55 to +155) Measurement at 24±4 hours °C °C after test conclusion. 30min maximum dwell time at each temperature extreme. 1min. maximum transition time.	±(2.00% +0.05Ω)
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)

内容 Item	测试方法 Test Methods	测试条件 Test Conditions	规格 Specification
耐湿特性 Humidity	MIL-STD-202 METHOD 103 AEC-Q200 TEST 7	电阻放入恒温恒湿箱，加载 10%额定功率，85°C /85%RH，持续通电 1000 ⁺²⁴ / ₋₀ H，试验结束 24±4 小时后进行测试 Put the specimen in a chamber Load 10% of operating power,1000 hours 85°C/85%RH. Measurement at 24±4 hours after test conclusion.	0.5%、1%:±(1.0%+0.05Ω) 5%:±(2.0%+0.05Ω)
负荷寿命 Load life	MIL-STD-202 METHOD 108 AEC-Q200 TEST 8	电阻放入恒温箱中，温度 125±2°C，加载 45%额定功率 ON TIME:1.5H，OFF TIME:0.5H，通电 1000 ⁺²⁴ / ₋₀ H，试验结束 24±4 小时后进行测试 Put the specimen in a chamber at 125±2°C temperature, Load 45% rated power ON TIME:1.5H, OFF TIME:0.5H, and applied for 1000 ⁺²⁴ / ₋₀ H.Measurement at 24±4 hours after test conclusion.	0.5%/1%:±(1.0%+0.05Ω) 5%:±(2.0%+0.05Ω)
焊锡性 Solderability	AEC-Q200 TEST 18 J-STD-002	用于引脚型和表面贴装型元件，不需要电气测试。放大倍数 50 倍。测试条件：表面贴装型： a) 方法 B，干热@155°C,4 小时，@235°C,3±0.5 秒 b) 方法 B，蒸煮 8 小时，@235°C,3±0.5 秒 For pin and surface-mount components, no electrical testing required. Magnification 50 times.Test conditions: Surface mount type: a) Method B: dry heat @155°C,4 hours, @235°C,3±0.5 seconds b) Method B: cook for 8 hours at @235°C,3±0.5 seconds	> 95%面积上锡 (>95% coverage)
抗焊锡热 Resist to soldering heat	AEC-Q200 TEST 15 MIL-STD-202 METHOD 210	沾助焊剂后浸入锡炉，锡炉温度 260±5°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±5°C for 10±0.5sec. Measure the variation of resistance.	±(1.00% +0.05Ω)
绝缘电阻 Insulation resistance	JIS C 5201 4.6 IEC60115-1-4.6	电阻本体上加载绝缘耐压 60±5 秒，测量绝缘阻抗。 Applied the dielectric withstanding voltage on the center of body for 60±5seconds. Then measure insulation resistance.	> 10GΩ
绝缘耐压 Dielectric withstanding voltage	JIS C 5201 4.7 IEC60115-1-4.7	电阻本体上加载绝缘耐压 60±5 秒。 Applied the dielectric withstanding voltage on the center of body for60±5seconds.	无击穿、飞弧可见机械性损伤 No evidence of flash over, mechanical damage arcing or insulation breakdown
端子强度 Terminal Strength	AEC-Q200 TEST 11 MIL-STD 202 METHOD 211	04020.5kgf; 0603:1.0kgf; 其他规格: 2.0kgf 施加推力，维持 60±1 秒 0402:0.5kgf, 0603:1.0kgf; Other:2.0kgf ;60±1 seconds;	无破损 No Broken

内容 Item	测试方法 Test Methods	测试条件 Test Conditions	规格 Specification
ESD 试验 ESD test	AEC-Q200 TEST 17 AEC-Q200-002	加载规定静电电压 2 次/间隔 1 秒, 0402 规格: 0.5KV, 0603 规格: 1KV, 其他规格 2KV. 0402: 0.5KV, 0603: 1.0KV, Other:2KV, 2times/1s	$\pm(3.0\%+0.05\Omega)$
端子弯曲 Terminal bending	AEC-Q200 TEST 21 AEC-Q200-005	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; 量测试前后阻值变化率 Specimen shall be mounted on test board, then bend the board and maintained for 20 ± 1 s. 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.	$\pm(1.00\% +0.05\Omega)$
耐溶剂性 Resistance to Solvents	AEC-Q200 TEST 12 MIL-STD 202 METHOD 215	注意: 添加水性洗涤化学品-OKEM Clean 或等效物。请勿使用违 禁溶剂 Note: Add Aqueous wash chemical - OKEM Clean or equivalent. Do not use banned solvents.	标识无脱落、损伤 No Marking fall off and broken
抗硫化实验 Sulfuration test	ASTM-B-809-95	方法一: 温度 105°C , 湿热蒸硫粉试验 (加饱和硝酸钾) 1000hrs Method 1: steam sulfur powder test (with saturated potassium nitrate) at 105°C with humidity and heat (1000hrs)	$\pm(3.0\% +0.05\Omega)$ Max

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

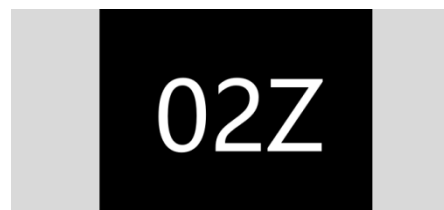
1.0402 因本体太小, 本体上无字码标识

For 0402 size, no marking on the body due to the small size of the resistor

2.0603 规格 (1%&5%) (0603Type) : 3 字码 (3-digits)



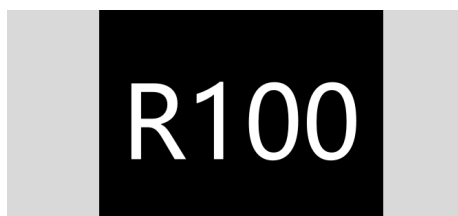
R10=100mΩ



02Z=102mΩ

3.0805/1206/1210/2010/2512/1812 规格 (1%&5%) : 4 字码

0805/1206/1210/2010/2512/1812type(1%&5%):4-digits



R100=100mΩ

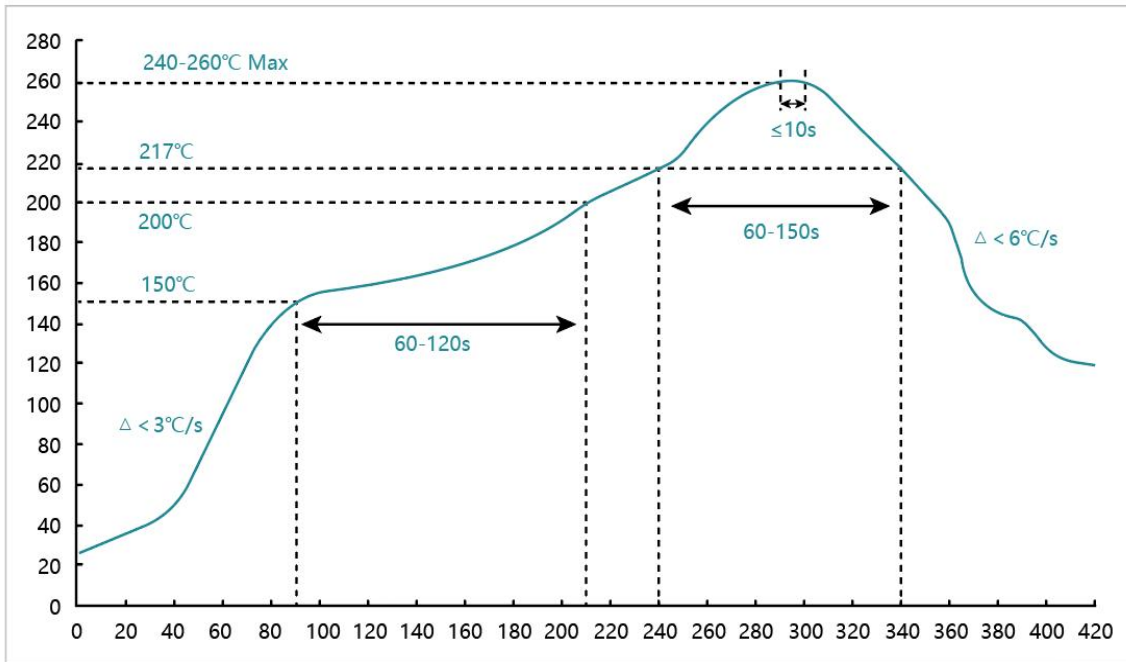
R102=102mΩ

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

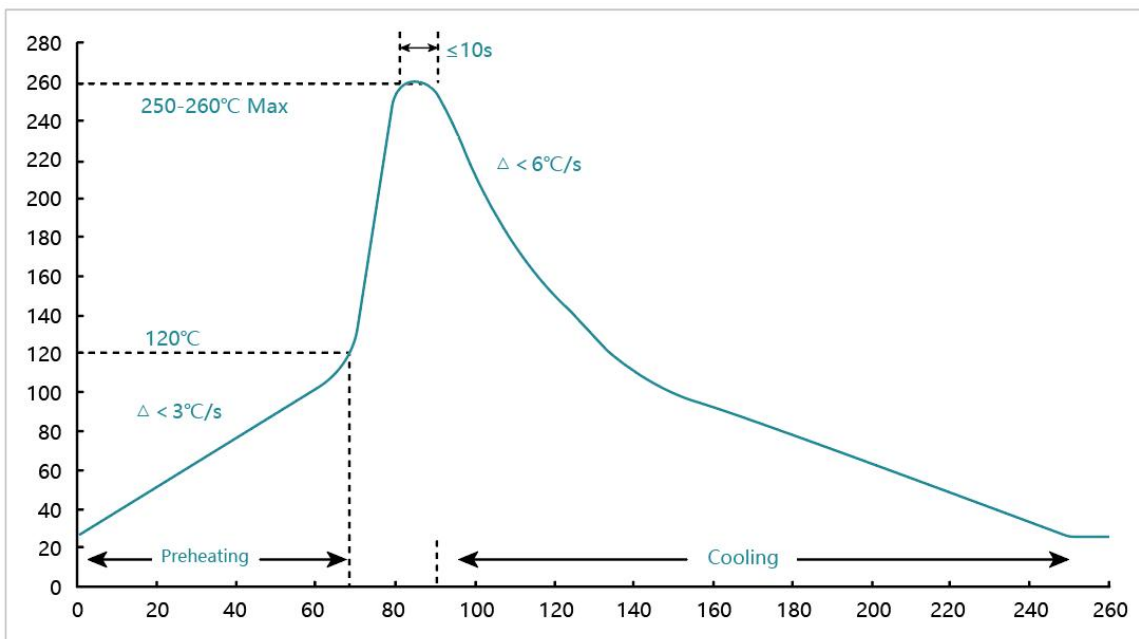
代码 Code	阻值 Value	代码 Code	阻值 Value	代码 Code	阻值 Value	代码 Code	阻值 Value	代码 Code	阻值 Value	代码 Code	阻值 Value
102 mR	02Z	158 mR	20 Z	232 mR	36 Z	332 mR	51 Z	475 mR	66 Z	681 mR	81 Z
105 mR	03 Z	162 mR	21 Z	237 mR	37 Z	340 mR	52 Z	487 mR	67 Z	698 mR	82 Z
107 mR	04 Z	165 mR	22 Z	243 mR	38 Z	348 mR	53 Z	499 mR	68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

▪ **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)



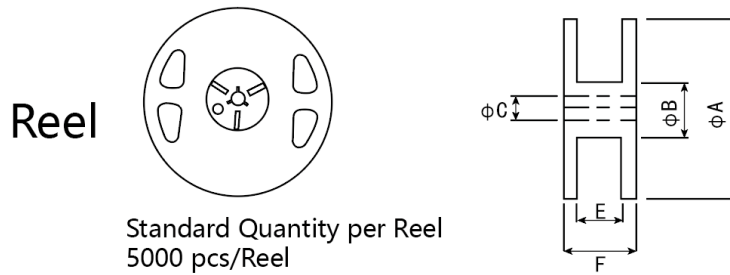
- 手工焊温度 (hand soldering temperature)

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)

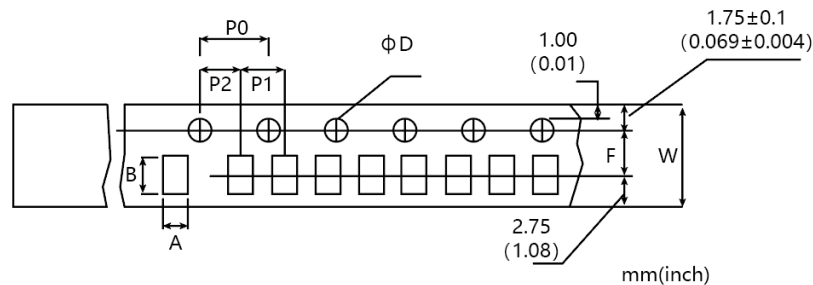
- 卷盘尺寸 (Reel dimension)



Type	Size	Unit	A	B	C	F	W
0402	7"	10K/Reel	178±2.0	60.0±1.0	13.5±0.5	11.4±0.1	9.00±0.3
0402	13"	40K/50K Reel	330±2.0	100.0±1.0	13.5±0.5	11.4±0.1	9.00±0.3
0603/0805/1206/1210	7"	5K/Reel	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	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	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	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)

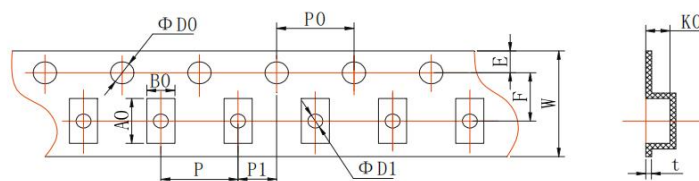
纸带编带 Paper Taping



Unit: mm

Dim	A	B	D	F	P0	P1	P2	W	T
0402	0.65±0.10	1.15±0.10	1.50±0.10	3.50±0.05	4.00±0.10	2.00±0.10	2.00±0.05	8.00±0.20	0.42±0.03
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



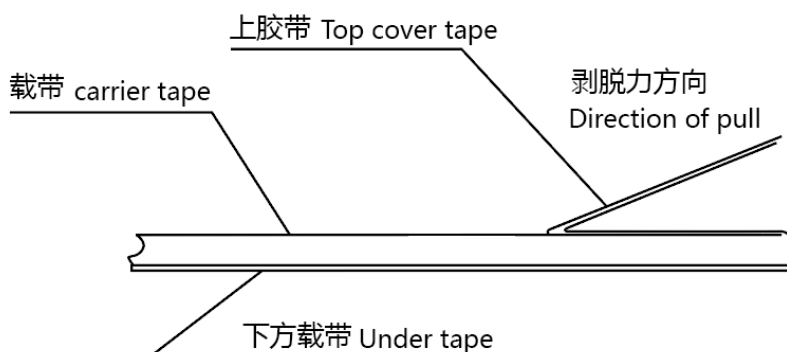
Unit: mm

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):

