

# FrelTec GmbH

Mathildenstr. 10A  
82319 Starnberg  
Germany

## Ultra Low Ohm - Metal Strip Chip Resistor SMD

## SMD

## SPECIFICATION

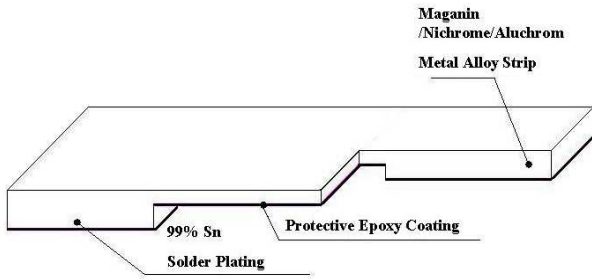
Part  
Number

047	06*	R010*	J*	T05*	O	D	G**
Type	Size	Value	Tolerance	Packing	TCR	Power Rating	Marking
047 : SMD Ultra Low Ohm Metal Strip Chip Resistor	06 : 1206	The last digit is the multiplier	J : $\pm 5\%$	E02: Tape and Reel for 2k pc (7"reel)	E : $\pm 50\text{ppm}/^\circ\text{C}$	K: 1,5W	No marking: Black Coating
	20 : 2010	which denotes the number of zero following	H : $\pm 3\%$		O : $\pm 75\text{ppm}/^\circ\text{C}$	L: 2W	G: Green Coating
	25 : 2512		F : $\pm 1\%$		F : $\pm 100\text{ppm}/^\circ\text{C}$	N: 2,5W	
		Example:			X : $\pm 150\text{ppm}/^\circ\text{C}$	M: 3W	
		97R6=					
		R100 = 0,1Ohm					
		R050 = 0,05Ohm					
		R001: 0,001Ohm					
		0M50 = 0,0005Oh m			** 1206 and 2010 no marking, no coating		
		1M50: 0,0015Oh m			* not all combination is possible		

All products according to RoHS (2011/65/EU)

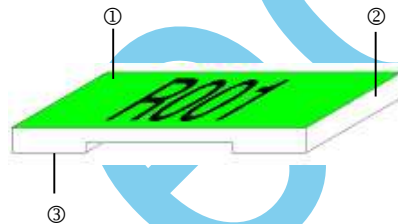
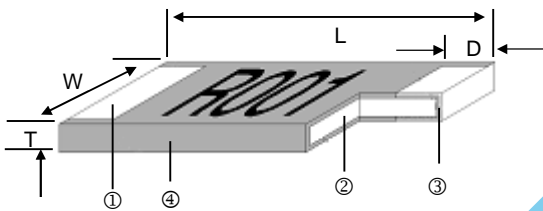
### SMD

Construction  
1206 and 2010



Type	Material
0M50 to R003	Manganese, Copper
3M50 to R010	Aluminum, Iron, Copper

### 2512



Black – Wave or IR reflow soldering

Green – IR reflow soldering only

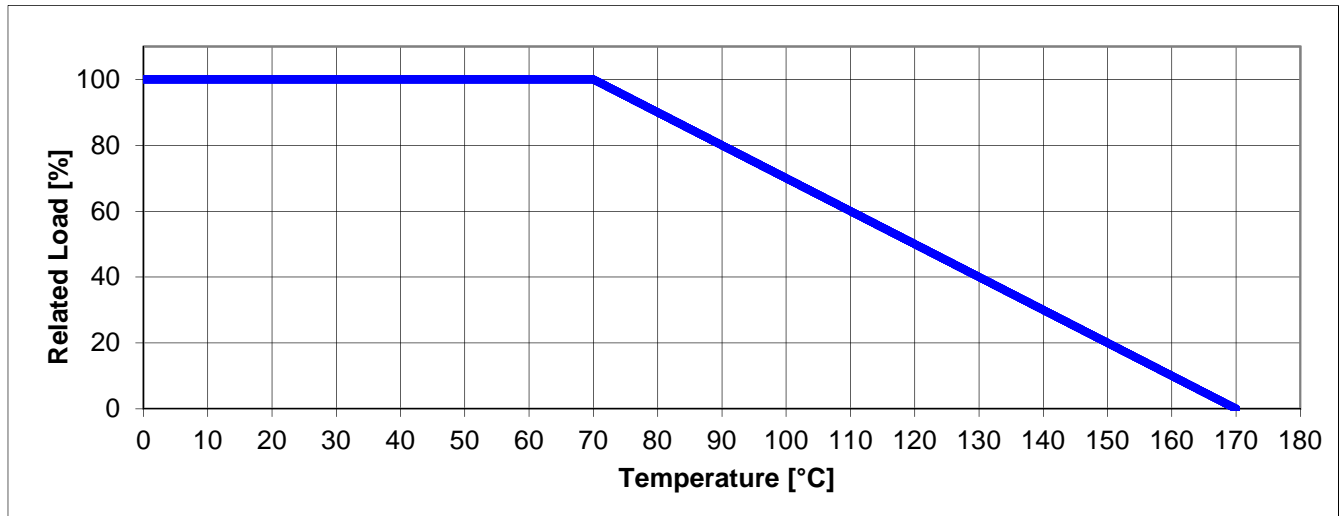
①	Solder Plating (Sn)
②	Alloy Plate
③	Barrier Layer (Ni)
④	Overcoat

①	Overcoat
②	Alloy Plate
③	Solder Plating

## SMD

## Power Derating Curve

For resistors operated in ambient temperatures above 70 °C , power rating shall be derated in accordance with figure below, Operating Temperature Range : -55°C 170°C

**Voltage Rating:**

Rated Voltage: The resistor shall have a DC continuous working voltage or a rms AC continuous working voltage at commercial-line frequency and wave form corresponding to the power rating, as determined from the following:

E= Rated voltage [V]

P= Power rating [W]

R= Nominal resistance [ $\Omega$ ]

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

**047 Series****Standard Electrical Specifications**

	Power Rating at 70°C	Operating Temp. Range	Resistance Range (mΩ)			TCR (PPM/°C)
			F(±1%)	H(±3%)	F(±5%)	
04706 1206	1W	-55°C ~ +170°C	0,5			±200
	1W		0,75 - 10			±50
04725 2512	1W		0,5, 0,75, 1, 1,5, 2			±50
	1W		6, 6,5, 7			±75
	1W		4, 5, 10			±100
	1W		2,5, 3			±150
04725 2512 (green coating)	1W		11, 12, 13, 14, 15			±50

**Special High Power Rating Electrical Specifications**

	Power Rating at 70°C	Operating Temp. Range	Resistance Range (mΩ)			TCR (PPM/°C)
			F(±1%)	H(±3%)	F(±5%)	
04720 2010	1.5W	-55°C ~ +170°C	0,5			±100
	1.5W		0,75 - 10			±50
04725 2512	2W		0,5, 0,75, 1, 1,5, 2			±50
	2W		6, 6,5, 7			±75
	2W		4, 5, 10			±100
	2W		2,5, 3			±150
04725 2512 (green coating)	2W		6,5, 7, 8, 9, 10			±50
	2.5W		4, 4,5, 5, 6			±50
	3W	1, 1,5, 2, 2,5, 3, 3,5			±50	
	3W	0,5, 0,75			±100	

**Resistance code examples**Resistance (3Marking)

Resistance	0,5mΩ	0,75mΩ
Codes	M50	M75

Resistance (4Marking)

Resistance	1mΩ	1,5mΩ	2mΩ	7mΩ	10
Codes	R001	1M50	R002	R007	R010

SMD  
Dimensions

Part No.	Coating	Resistance (mΩ)	L	W	T	D
04706 1206	no	0,5	3,20±0,25	1,60±0,10	0,60±0,20	1,35±0,25
		0,75	3,20±0,25	1,60±0,10	0,60±0,20	1,23±0,25
		1,0, 3,5, 4,0, 5,0, 6,0	3,20±0,25	1,60±0,10	0,60±0,20	1,10±0,25
		2,0 3,0 10	3,20±0,25	1,60±0,10	0,60±0,20	0,60±0,25
		1,2 1,5, 7,0, 8,0, 9,0	3,20±0,25	1,60±0,10	0,60±0,20	0,90±0,25
04720 2010	no	0,5	5,08±0,25	2,54±0,15	0,60±0,20	2,17±0,25
		0,75	5,08±0,25	2,54±0,15	0,60±0,20	2,04±0,25
		1,0	5,08±0,25	2,54±0,15	0,60±0,20	1,84±0,25
		2,0, 6,0, 7,0, 8,0	5,08±0,25	2,54±0,15	0,60±0,20	1,54±0,25
		3,0	5,08±0,25	2,54±0,15	0,60±0,20	1,04±0,25
		4,0, 5,0	5,08±0,25	2,54±0,15	0,60±0,20	1,84±0,25
		9,0, 10	5,08±0,25	2,54±0,15	0,60±0,20	1,29±0,25
04725 2512	green coating	0,50	6,35±0,25	3,00±0,20	0,60±0,20	2,68±0,25
		0,75	6,35±0,25	3,00±0,20	0,60±0,20	2,48±0,25
		1,0, 6,0	6,35±0,25	3,00±0,20	0,60±0,20	1,93±0,25
		1,5, 6,5, 7,0	6,35±0,25	3,00±0,20	0,60±0,20	1,43±0,25
		2,0, 2,5, 3,0, 3,5	6,35±0,25	3,00±0,20	0,60±0,20	1,18±0,25
		4,0, 4,5	6,35±0,25	3,00±0,20	0,60±0,20	2,18±0,25
		5,0, 6,0	6,35±0,25	3,00±0,20	0,60±0,20	1,93±0,25
		8,0 - 10	6,35±0,25	3,00±0,20	0,60±0,20	1,18±0,25
	no	11 - 15	6,35±0,25	3,00±0,20	0,60±0,20	1,18±0,25
		0,50	6,35±0,254	3,18±0,254	1,25±0,20	1,30±0,38
		0,75	6,35±0,254	3,18±0,254	0,75±0,20	1,30±0,38
		1,00	6,35±0,254	3,18±0,254	0,65±0,20	1,30±0,38
		1,50	6,35±0,254	3,18±0,254	0,45±0,20	1,30±0,38
		2,00	6,35±0,254	3,18±0,254	0,35±0,20	1,30±0,38
		2,50	6,35±0,254	3,18±0,254	0,65±0,20	1,30±0,38
		3,00	6,35±0,254	3,18±0,254	0,55±0,20	1,30±0,38
		4,00	6,35±0,254	3,18±0,254	0,45±0,20	1,30±0,38
		5,00	6,35±0,254	3,18±0,254	0,35±0,20	1,30±0,38
		6,00	6,35±0,254	3,18±0,254	0,32±0,20	1,30±0,38
		6,50	6,35±0,254	3,18±0,254	0,30±0,20	1,30±0,38
7,00	6,35±0,254	3,18±0,254	0,27±0,20	1,30±0,38		
10,00	6,35±0,254	3,18±0,254	0,25±0,20	1,30±0,38		

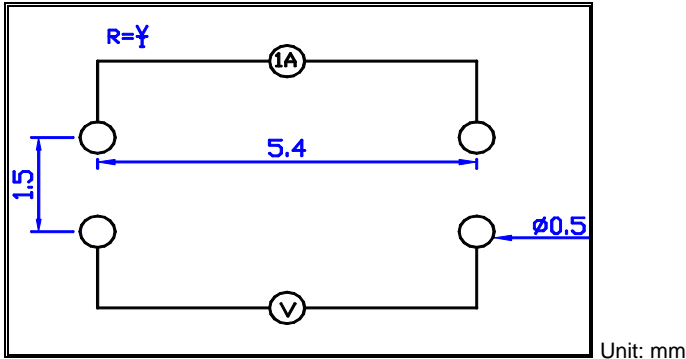
Unit: mm

### SMD

#### Measurements

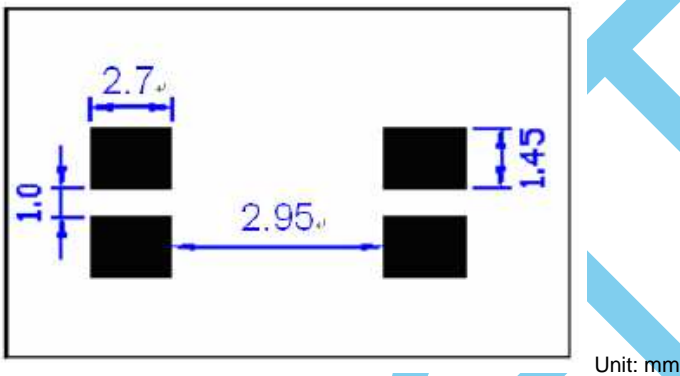
##### 1. 2512 4-wire precision measurement (Black Coating)

Equipment: ADEX AX-1152D DC Low Ohm Meter  
 Excitation Current: 3A (0,5mΩ~1,5 mΩ)  
 1A (2mΩ~7mΩ)



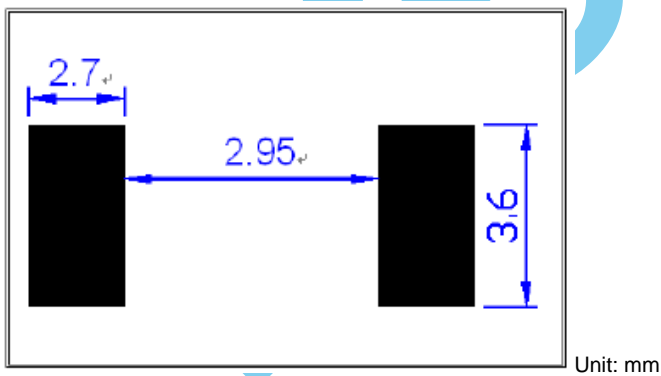
##### 2. 2512 4-wire pad layout (recommended for precision current sensing)

Note: No circuits between pads to avoid short circuit



##### 3. 2512 2-wire pad layout

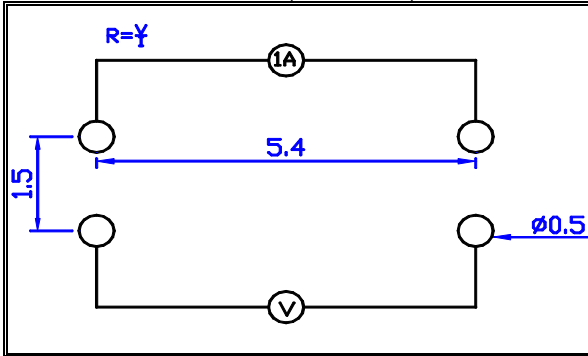
Note: No circuits between pads to avoid short circuit



### SMD

#### 4. 2512 4-wire precision measurement (Green Coating)

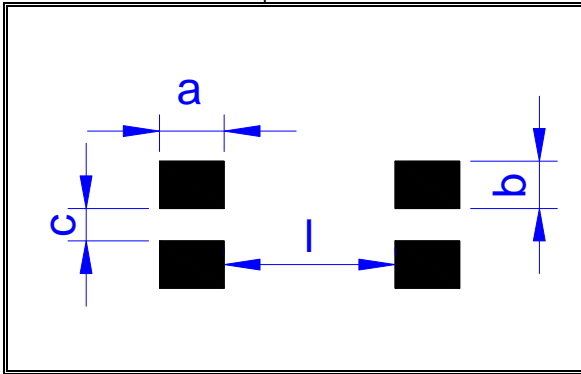
Equipment: ADEX AX-1152D DC Low Ohm Meter  
 Excitation Current: 3A (0,5mΩ~1,5 mΩ)  
 1A (2mΩ~15mΩ)



Unit: mm

#### 5. 2512 4-wire pad layout (recommended for precision current sensing)

Note: No circuits between pads to avoid short circuit



	a m/m	b m/m	c m/m	I m/m
0,50mΩ	3,13	1,2	1,0	0,52
0,75mΩ	2,93	1,2	1,0	0,94
1mΩ	2,38	1,2	1,0	2,04
1,5mΩ	1,88	1,2	1,0	3,04
2 to 3,5mΩ	1,63	1,2	1,0	3,54
4 to 4,5mΩ	2,63	1,2	1,0	1,54
5 to 6mΩ	2,38	1,2	1,0	2,04
6,5 to 7mΩ	1,88	1,2	1,0	3,04
8 to 15mΩ	1,63	1,2	1,0	3,54

Unit: mm

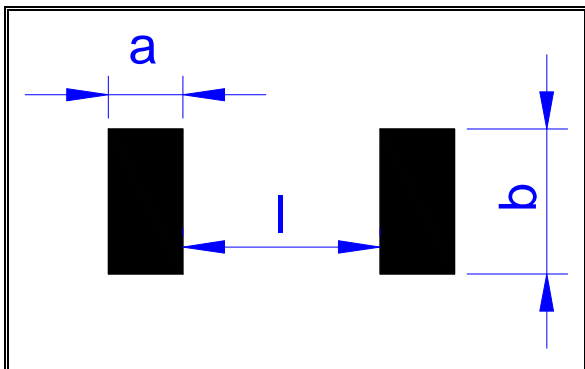


### SMD

#### 6. 2512 2-wire pad layout

Note: No circuits between pads to avoid short circuit

Unit: mm



	a m/m	b m/m	l m/m
0,50mΩ	3,13	3,4	0,52
0,75mΩ	2,93	3,4	0,94
1mΩ	2,38	3,4	2,04
1,5mΩ	1,88	3,4	3,04
2 to 3,5mΩ	1,63	3,4	3,54
4 to 4,5mΩ	2,63	3,4	1,54
5 to 6mΩ	2,38	3,4	2,04
6,5 to 7mΩ	1,88	3,4	3,04
8 to 15mΩ	1,63	3,4	3,54

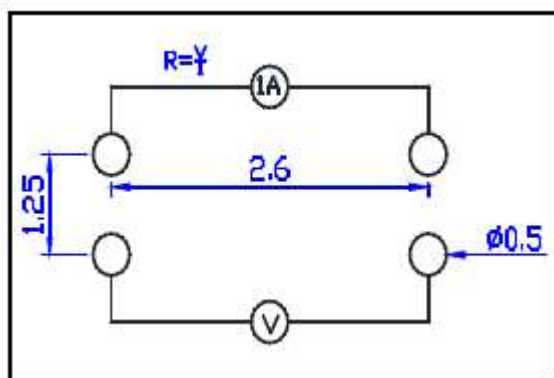
Unit: mm

#### 7. 1206 4-wire precision measurement

Equipment: ADEX AX-1152D DC Low Ohm Meter

Excitation Current: 3A (0,5mΩ~1,5mΩ)

1A (2mΩ~10mΩ)

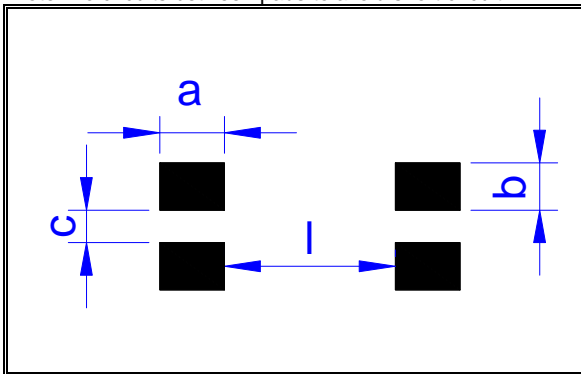


Unit: mm

## SMD

## 8. 1206 4-wire pad layout (recommended for precision current sensing)

Note: No circuits between pads to avoid short circuit



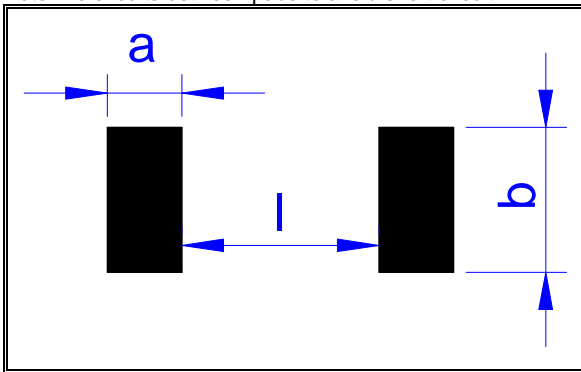
	a m/m	b m/m	c m/m	l m/m
<b>0,50mΩ</b>	1,80	0,7	0,5	0,55
<b>0,75mΩ</b>	1,68	0,7	0,5	0,55
<b>1mΩ</b>	1,55	0,7	0,5	0,55
<b>1,2mΩ</b>	1,35	0,7	0,5	0,95
<b>1,5mΩ</b>	1,35	0,7	0,5	1,55
<b>2 to 3mΩ</b>	1,05	0,7	0,5	1,55
<b>3,5 to 6mΩ</b>	1,55	0,7	0,5	0,55
<b>7 to 9mΩ</b>	1,35	0,7	0,5	0,95
<b>10mΩ</b>	1,05	0,7	0,5	1,55

Unit: mm

### SMD

#### 9. 1206 2-wire pad layout

Note: No circuits between pads to avoid short circuit

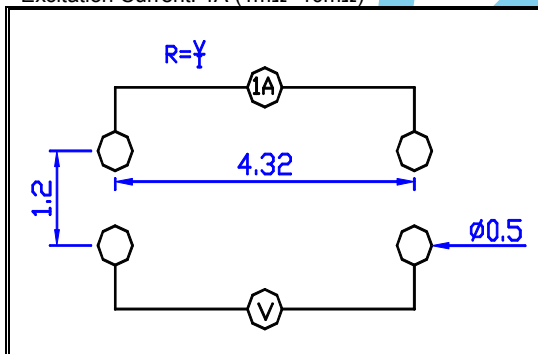


	a m/m	b m/m	l m/m
0,50mΩ	1,80	1,90	0,55
0,75mΩ	1,68	1,90	0,55
1mΩ	1,55	1,89	0,55
1,2mΩ	1,35	1,90	0,95
1,5mΩ	1,35	1,89	1,55
2 to 3mΩ	1,05	1,89	1,55
3,5 to 6mΩ	1,55	1,89	0,55
7 to 9mΩ	1,35	1,89	0,95
10mΩ	1,05	1,89	1,55

Unit: mm

#### 10. 2010 4-wire precision measurement

Equipment: ADEX AX-1152D DC Low Ohm Meter  
Excitation Current: 1A (1mΩ~10mΩ)

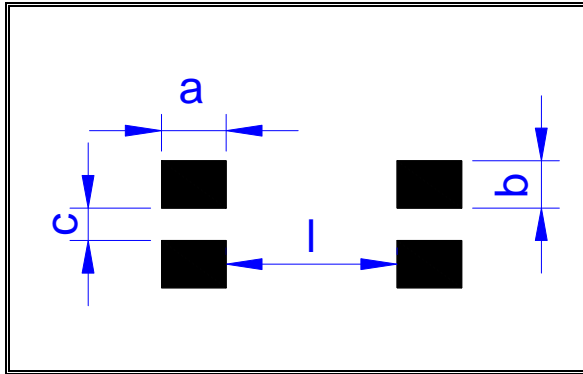


Unit: mm

### SMD

#### 11. 2010 4-wire pad layout (recommended for precision current sensing)

Note: No circuits between pads to avoid short circuit

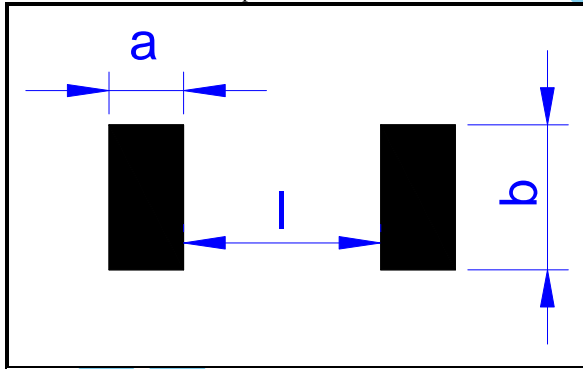


	a m/m	b m/m	c m/m	l m/m
0,50mΩ	2,61	1,045	0,8	0,60
0,75mΩ	2,49	1,045	0,8	0,80
1mΩ	2,29	1,045	0,8	0,95
2mΩ	1,99	1,045	0,8	1,55
3mΩ	1,49	1,045	0,8	2,55
4 to 5mΩ	2,29	1,045	0,8	0,95
6 to 8mΩ	1,99	1,045	0,8	1,55
9 to 10mΩ	1,74	1,045	0,8	2,05

Unit: mm

#### 12. 2010 2-wire pad layout

Note: No circuits between pads to avoid short circuit



Unit: mm

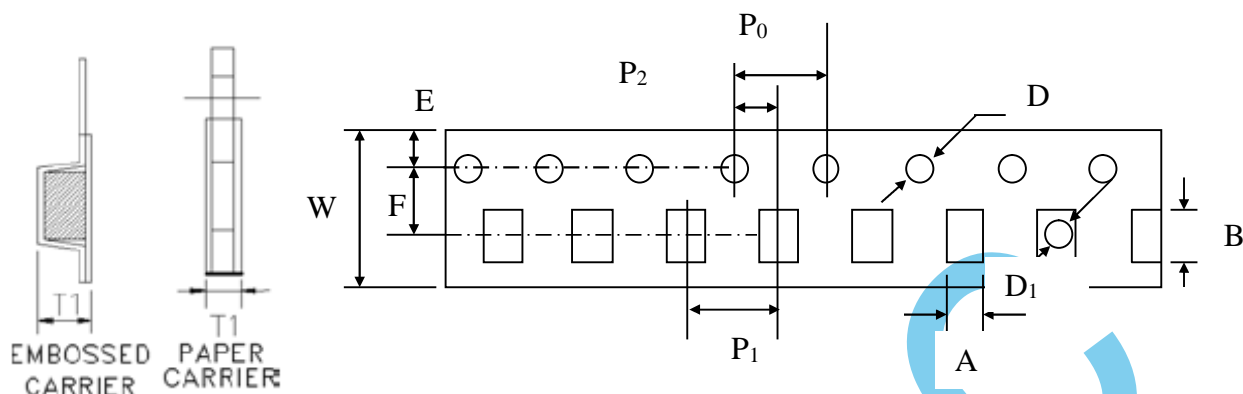
	a m/m	b m/m	l m/m
0,50mΩ	2,61	2,89	0,60
0,75mΩ	2,49	2,89	0,80
1mΩ	2,29	2,89	0,95
2mΩ	1,99	2,89	1,55
3mΩ	1,49	2,89	2,55
4 to 5mΩ	2,29	2,89	0,95
6 to 8mΩ	1,99	2,89	1,55
9 to 10mΩ	1,74	2,89	2,05

Unit: mm

### SMD

### SPECIFICATION

### Tape And Reel Package



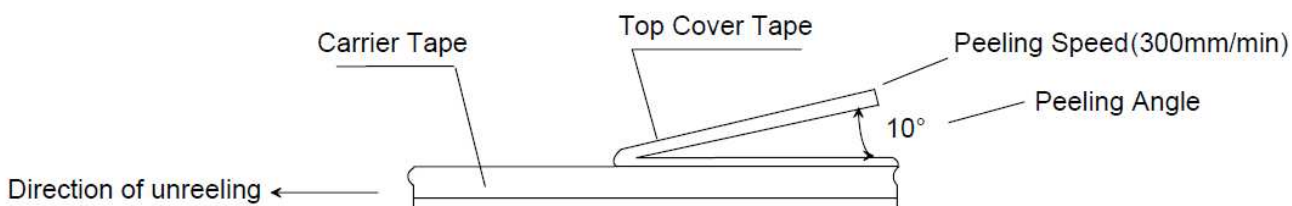
Type	Resistance [mΩ]	A	B	W	E	F	P <sub>0</sub>	P <sub>1</sub>	P <sub>2</sub>	ΦD	ΦD <sub>1</sub>	T1
1206	0,5 to 10	1,90±0,1	3,60±0,1	8,0±0,2	1,75±0,1	3,5±0,05	4,0±0,1	4,00±0,1	2,0±0,05	1,55±0,05	1,0min.	0,87±0,1
2010	0,5 to 10	2,85±0,1	5,55±0,1	12,0±0,2	1,75±0,1	5,5±0,05	4,0±0,1	4,00±0,1	2,0±0,05	1,55±0,05	1,4min.	0,85±0,1
2512	0,50 to 0,75	3,40±0,1	6,75±0,1	12,0±0,1	1,75±0,1	5,5±0,05	4,0±0,1	4,00±0,1	2,0±0,05	1,55±0,05	1,4min.	1,45±0,2
	1 to 10											0,81±0,1
2512 (green coating)	0,5 to 15	3,40±0,1	6,75±0,1	12,0±0,1	1,75±0,1	5,5±0,05	4,0±0,1	4,00±0,1	2,0±0,05	1,55±0,05	1,4min.	0,85±0,1

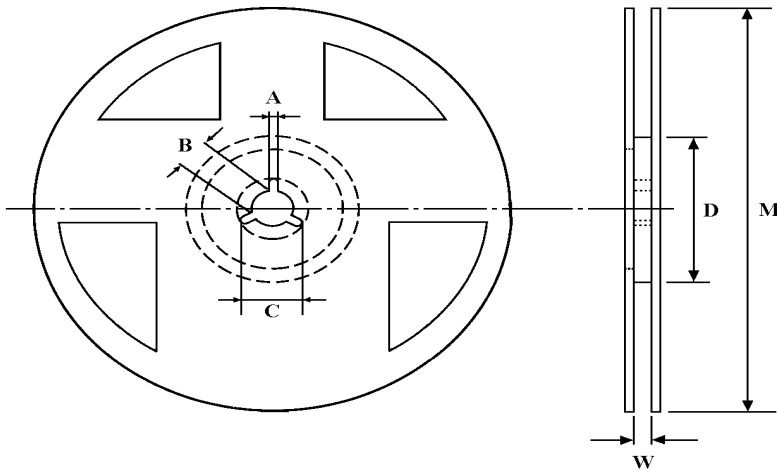
1. The cumulative tolerance of 10 sprockets hole pitch is  $\pm 0,2$ mm.
2. Carrier camber shall be not more than 1mm per 100mm through a length of 250mm.
3. A & B measured 0,3mm from the bottom of the packet
4. T measured at a point on the inside bottom of the packet to the top surface of the carrier.
5. Pocket position relative to sprocket hole is measured as the true position of the pocket and not the pocket hole.

### Cover Tape Peel off Strength

Specifications:

- 1206 – peel force of top cover tape shall be between 20 to 90g  
The peel speed shall be about 300mm/min $\pm 5\%$
- for 2010 , 2512 – peel force of top cover tape shall be between 20 to 110g  
The peel speed shall be about 300mm/min $\pm 5\%$



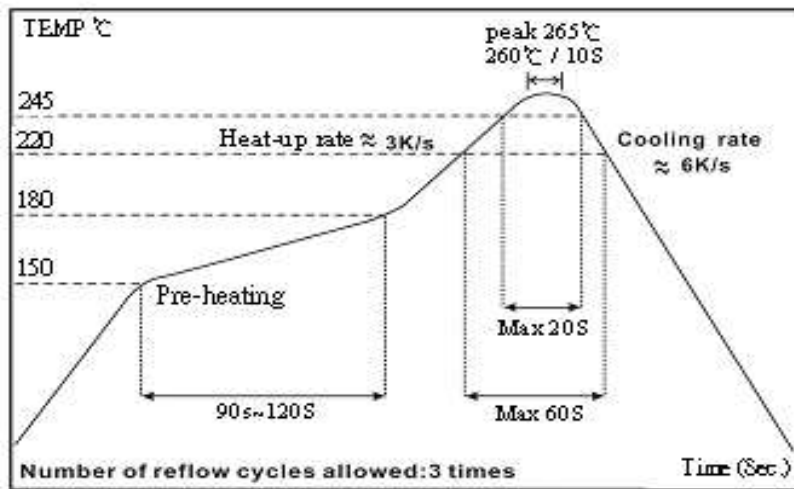


Type	Packaging	M	A	B	C	D	W	T
047 06 ... T05	Embossed	178.5±1.5	2+0,51 -0	13.0±0.5	18,45+0,20 -0	60+1 -0	9,0±0,5	11,5±0,5
047 20 ... E04	Embossed	178.5±1.5	2+0,51 -0	13.0±0.5	18,45+0,20 -0	60+1 -0	13,0±0,5	15,5±0,5
047 25 ... E04	Embossed	178.5±1.5	2+0,51 -0	13.0±0.5	18,45+0,20 -0	60+1 -0	13,0±0,5	15,5±0,5

### Stock period

The performance of these products, including the solderability, is guaranteed for 12 month, provided that they remain packed as they were when delivered and stored at a temperature of 25°C ± 3°C and a relative humidity less than 80%RH

## Lead Free Reflow Soldering Profile



Green coating "Reflow Air Convection" is available  
Green coating can't be working with wave soldering bath

SMD  
Strip

Item	Requirement		Test Method
	Black coating	Green coating	
Temperature Coefficient of Resistance (T.C.R.)	As Spec.		MIL-STD-202F Method 304 +25/-55/+25/+125/+25°C
Short Time Overload	±0,5%	±1%	JIS-C-5201-1 5.5 5*rated power for 5 seconds
Endurance	±1%	±1%	MIL-STD-202F Method 108A 70±2°C, Max. working voltage for 1000 hrs with 1,5 hrs "ON" and 0,5 hrs "OFF"
Dry Heat	±1%	±1%	JIS-C-5201-1 7.2 at +170°C for 1000 hrs"
Solderability	95% min. coverage		MIL-STD-202F Method 208H 245±5°C for 3 seconds
Resistance to Soldering Heat	±0,5%	±1%	MIL-STD-202F Method 210E 260±5°C for 10 seconds
Thermal Shock	±0,5%	±1%	MIL-STD-202F Method 107G -55°C ~ 150°C, 100 cycles



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