

# DATASHEET

**Product Name**    **Metal Alloy Low Resistance Chip Resistor**

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**Part Name**    **ML Series**

**File No.**    **SMD-SP-056**

## **Uniroyal Electronics Global Co., Ltd.**

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Royal Technology (Thailand) Co., Ltd.

## 1. Scope

- 1.1 This specification for approve relates to the Metal Alloy Low Resistance Chip Resistor manufactured by UNI-ROYAL.
- 1.2 Low Resistance / Low TCR
- 1.3 Excellent long term stability
- 1.4 RoHS compliant and halogen free.
- 1.5 Lead free.
- 1.6 High precision current sensing and voltage division.

## 2. Part No. System

Part No. includes 14 codes shown as below:

2.1 1<sup>st</sup>~4<sup>th</sup> codes: Part name. E.g.: ML06、ML12、ML25、ML28、ML27

2.2 5<sup>th</sup>~6<sup>th</sup> codes: Power rating.

| Wattage     | 1  | 1.5 | 2  | 3  | 4  | 5  |
|-------------|----|-----|----|----|----|----|
| Normal Size | 1W | 1A  | 2W | 3W | 4W | 5W |

2.3 7<sup>th</sup> code: Tolerance. E.g.: D=±0.5%      F=±1%      G=±2%      J=±5%

2.4 8<sup>th</sup>~11<sup>th</sup> codes: Resistance Value.

2.4.1 If value belongs to standard value of  $\geq 5\%$  series, 8<sup>th</sup> code would be zero, 9<sup>th</sup>~10<sup>th</sup> codes are significant figures of the resistance and 11<sup>th</sup> code is the power of ten.

2.4.2 If value belongs to standard value of  $\leq 2\%$  series, 8<sup>th</sup>~10<sup>th</sup> codes are significant figures of the resistance, and 11<sup>th</sup> code is the power of ten.

2.4.3 11<sup>th</sup> codes listed as following:

0=10<sup>0</sup>    1=10<sup>1</sup>    2=10<sup>2</sup>    3=10<sup>3</sup>    4=10<sup>4</sup>    5=10<sup>5</sup>    6=10<sup>6</sup>    J=10<sup>-1</sup>    K=10<sup>-2</sup>    L=10<sup>-3</sup>    M=10<sup>-4</sup>  
 N=10<sup>-5</sup>    P=10<sup>-6</sup>

2.5 12<sup>th</sup>~14<sup>th</sup> codes.

2.5.1 12<sup>th</sup> code: Packaging Type. E.g.: C=Bulk      T=Tape/Reel

2.5.2 13<sup>th</sup> code: Standard Packing Quantity.

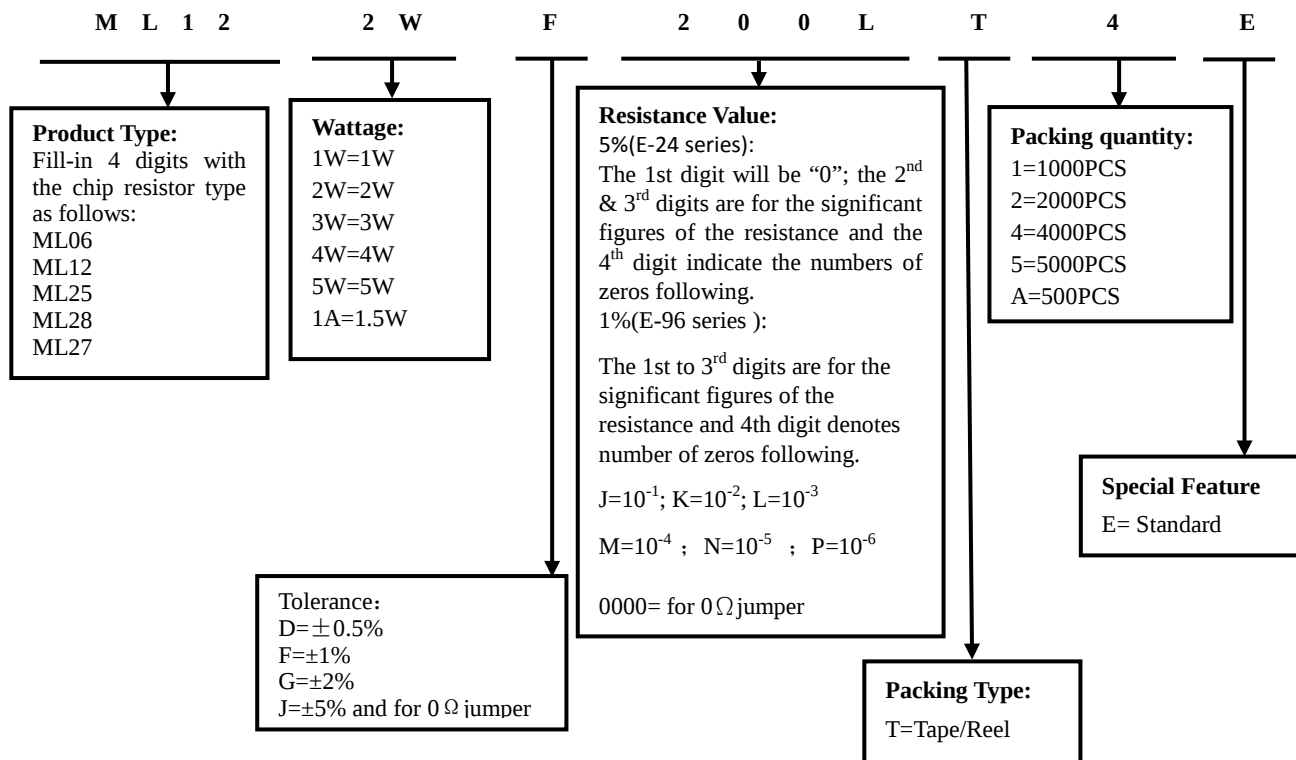
4=4000pcs    5=5000pcs    C=10000pcs    D=20000pcs    E=15000pcs  
 Chip Product:    BD=B/B-20000pcs      TC=T/R-10000pcs

2.5.3 14<sup>th</sup> code: Special features.

E = Standard

## 3. Ordering Procedure

(Example: ML12 2W ±1% 200mΩ T/R-4000)



## 4. Electrical Specifications

### 5.1 Standard Electrical Specifications

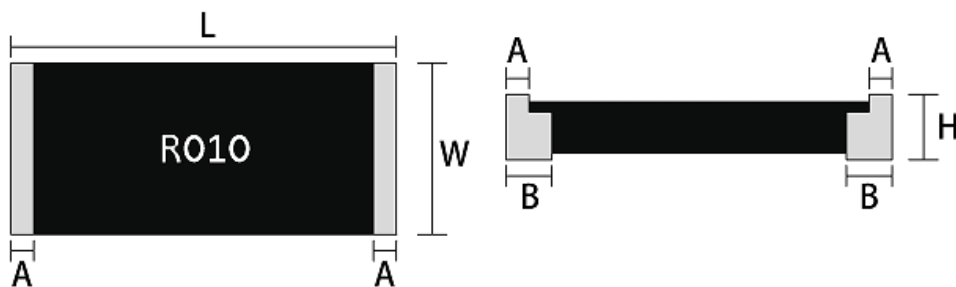
| Type | Rating Power | T.C.R.<br>(ppm/°C) | Max.<br>Rating<br>Current<br>(A) | Max.<br>Overload<br>Current<br>(A) | Resistance Range (mΩ) |                                  | Operating<br>Temperature<br>Range (°C) |
|------|--------------|--------------------|----------------------------------|------------------------------------|-----------------------|----------------------------------|----------------------------------------|
|      |              |                    |                                  |                                    | 0.5% (D)              | 1.0% (F)<br>2.0% (G)<br>5.0% (J) |                                        |
| ML06 | 1W           | $\leq \pm 50$      | 31.62                            | 70.71                              | 5~50                  | 1~50                             | -55°C~+170°C                           |
|      | 1.5W         | $\leq \pm 50$      | 38.72                            | 86.60                              | 5~10                  | 1~10                             |                                        |
| ML12 | 2W           | $\leq \pm 75$      | 63.24                            | 141.42                             | ---                   | 0.5~0.8                          |                                        |
|      |              | $\leq \pm 50$      | 44.72                            | 100.00                             | 3~450                 | 1~450                            |                                        |
|      | 3W           | $\leq \pm 75$      | 77.45                            | 173.20                             | ---                   | 0.5~0.8                          |                                        |
|      |              | $\leq \pm 50$      | 54.77                            | 122.47                             | 3~100                 | 1~100                            |                                        |
| ML25 | 4W           | $\leq \pm 100$     | 141.42                           | 282.84                             | ---                   | 0.2                              |                                        |
|      |              | $\leq \pm 50$      | 126.49                           | 252.98                             | ---                   | 0.25~3                           |                                        |
| ML28 | 4W           | $\leq \pm 50$      | 31.62                            | 63.24                              | 7~450                 | 4~450                            |                                        |
| ML27 | 3W           | $\leq \pm 75$      | 77.45                            | 173.20                             | ---                   | 0.5                              |                                        |
|      |              | $\leq \pm 50$      | 54.77                            | 122.47                             | 5~60                  | 1~60                             |                                        |
|      | 5W           | $\leq \pm 75$      | 100.00                           | 173.20                             | ---                   | 0.5                              |                                        |
|      |              | $\leq \pm 50$      | 70.71                            | 122.47                             | 5~500                 | 1~500                            |                                        |

Note : The resistance value not shown in the list can be provided by the factory

### 4.2 Jumper Specifications

| Type | Rating Power | Max.<br>Rating<br>Current | Resistance<br>(mΩ) | Operating<br>Temperature<br>Range (°C) |
|------|--------------|---------------------------|--------------------|----------------------------------------|
| ML06 | 1W           | 70.7A                     | $\leq 0.2$         | -55°C~+170°C                           |
| ML12 | 2W           | 100A                      |                    |                                        |
|      | 3W           | 122A                      |                    |                                        |

## 5. Dimension(Unit:mm)



| Type           | Power<br>Rating | Resistance Range | L         | W         | H         | A         | B         |
|----------------|-----------------|------------------|-----------|-----------|-----------|-----------|-----------|
| ML06<br>(1206) | 1W              | 1mΩ              | 3.20±0.25 | 1.65±0.25 | 0.82±0.25 | 0.50±0.30 | 0.50±0.30 |
|                |                 | 2mΩ              |           |           | 0.70±0.25 |           |           |
|                |                 | 3mΩ              |           |           | 0.60±0.25 |           |           |
|                |                 | 4~20mΩ           |           |           | 0.55±0.25 |           |           |
|                |                 | 21~50mΩ          |           |           | 0.47±0.25 |           |           |
|                | 1.5W            | 1mΩ              |           |           | 0.82±0.25 |           |           |
|                |                 | 2mΩ              |           |           | 0.70±0.25 |           |           |
|                |                 | 3mΩ              |           |           | 0.60±0.25 |           |           |
|                |                 | 4~10mΩ           |           |           | 0.55±0.25 |           |           |

|                |    |           |           |           |           |            |           |
|----------------|----|-----------|-----------|-----------|-----------|------------|-----------|
| ML12<br>(2512) | 2W | 0.5mΩ     | 6.35±0.25 | 3.05±0.25 | 0.82±0.25 | 1.98±0.25  | 2.00±0.25 |
|                |    | 0.75mΩ    |           |           | 0.70±0.25 | 1.15± 0.25 | 1.98±0.25 |
|                |    | 0.8mΩ     |           |           |           |            | 1.86±0.25 |
|                |    | 1mΩ       |           |           | 0.72±0.25 |            | 2.20±0.25 |
|                |    | 1.5mΩ     |           |           |           |            | 1.40±0.25 |
|                |    | 2~5mΩ     |           |           | 0.55±0.25 |            | 1.15±0.25 |
|                |    | 6mΩ       |           |           |           | 0.60±0.25  | 1.05±0.25 |
|                |    | 7~10mΩ    |           |           | 0.75±0.25 |            |           |
|                |    | 11~75mΩ   |           |           |           | 0.60±0.25  |           |
|                |    | 76~100mΩ  |           |           |           | 0.55±0.25  |           |
|                |    | 101~135mΩ |           |           | 0.47±0.25 |            |           |
|                |    | 136~200mΩ |           |           | 0.40±0.25 | 0.85±0.25  |           |
|                |    | 201~450mΩ |           |           |           |            |           |

|                |    |          |           |           |           |           |           |
|----------------|----|----------|-----------|-----------|-----------|-----------|-----------|
| ML12<br>(2512) | 3W | 0.5mΩ    | 6.35±0.25 | 3.05±0.25 | 0.82±0.25 | 1.98±0.25 | 2.00±0.25 |
|                |    | 0.75mΩ   |           |           | 0.70±0.25 | 1.15±0.25 | 1.98±0.25 |
|                |    | 0.8mΩ    |           |           |           |           | 1.86±0.25 |
|                |    | 1mΩ      |           |           | 0.72±0.25 |           | 2.20±0.25 |
|                |    | 1.5mΩ    |           |           |           |           | 1.40±0.25 |
|                |    | 2~5mΩ    |           |           | 0.55±0.25 |           | 1.15±0.25 |
|                |    | 6mΩ      |           |           | 0.60±0.25 | 0.75±0.25 | 1.10±0.25 |
|                |    | 7~10mΩ   |           |           |           | 1.15±0.25 |           |
|                |    | 11~75mΩ  |           |           | 0.55±0.25 | 0.75±0.25 |           |
|                |    | 76~100mΩ |           |           |           |           |           |

|                |    |           |           |           |           |           |           |
|----------------|----|-----------|-----------|-----------|-----------|-----------|-----------|
| ML25<br>(2725) | 4W | 0.2mΩ     | 6.90±0.25 | 6.35±0.25 | 1.10±0.25 | 1.20±0.25 | 2.15±0.25 |
|                |    | 0.25mΩ    |           |           | 0.95±0.25 |           | 2.29±0.25 |
|                |    | 0.3mΩ     |           |           |           |           | 1.97±0.25 |
|                |    | 0.35mΩ    |           |           |           |           | 1.71±0.25 |
|                |    | 0.4mΩ     |           |           |           |           | 1.44±0.25 |
|                |    | 0.5mΩ     |           |           |           |           | 2.08±0.25 |
|                |    | 0.6mΩ     | 0.85±0.25 |           | 1.78±0.25 |           |           |
|                |    | 0.8mΩ     |           |           | 1.30±0.25 |           |           |
|                |    | 1mΩ       | 6.80±0.25 |           | 0.65±0.25 | 1.15±0.25 | 1.80±0.25 |
|                |    | 1.5~1.6mΩ |           |           | 1.50±0.25 |           |           |
|                |    | 2~3mΩ     |           |           |           | 0.55±0.25 |           |

|                |    |         |           |           |           |           |           |
|----------------|----|---------|-----------|-----------|-----------|-----------|-----------|
| ML28<br>(2728) | 4W | 4~450mΩ | 6.60±0.25 | 6.70±0.25 | 0.58±0.25 | 0.40±0.25 | 1.05±0.25 |
|----------------|----|---------|-----------|-----------|-----------|-----------|-----------|

|                |    |          |            |           |           |           |           |
|----------------|----|----------|------------|-----------|-----------|-----------|-----------|
| ML27<br>(4527) | 3W | 0.5mΩ    | 11.30±0.50 | 6.60±0.50 | 0.77±0.25 | 0.90±0.25 | 3.00±0.25 |
|                |    | 1mΩ      |            |           | 0.65±0.25 |           |           |
|                |    | 1.5~20mΩ |            |           |           |           | 0.55±0.25 |
|                |    | 21~60mΩ  |            |           |           |           |           |
|                | 5W | 0.5mΩ    |            |           | 0.80±0.25 | 0.65±0.25 | 3.00±0.25 |
|                |    | 1mΩ      |            |           | 0.68±0.25 |           |           |
|                |    | 1.5~20mΩ |            |           |           |           | 0.58±0.25 |
|                |    | 21~500mΩ |            |           |           |           |           |

## Jumper Dimension

| Unit:mm        |              |                          |                |                |                |                |                |
|----------------|--------------|--------------------------|----------------|----------------|----------------|----------------|----------------|
| Type           | Power Rating | Resistance Range         | L              | W              | H              | A              | B              |
| ML06<br>(1206) | 1W           | $\leq 0.2\text{m}\Omega$ | $3.20\pm 0.25$ | $1.65\pm 0.25$ | $0.65\pm 0.25$ | $0.50\pm 0.30$ | $0.50\pm 0.30$ |
| ML12<br>(2512) | 2W<br>3W     | $\leq 0.2\text{m}\Omega$ | $6.35\pm 0.25$ | $3.05\pm 0.25$ | $0.65\pm 0.25$ | $1.15\pm 0.25$ | $1.10\pm 0.25$ |

## 6. Marking

6.1 Normally, All the products marking are 4 digits.

(1) For some products, “R” designates the decimal location in ohms

e.g.  $1\text{m}\Omega$  the product marking is R001.

$200\text{m}\Omega$  the product marking is R200.

(2) For some products, “m” designates the decimal location in milli-ohms

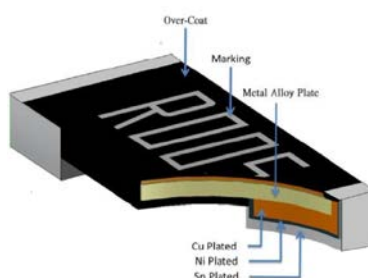
eg :  $0.25\text{m}\Omega$  the product marking is 0m25.

$0.5\text{m}\Omega$  the product marking is 0m50

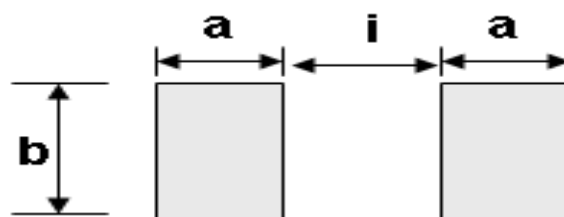
6.2  $0\Omega$  product marking is 0R

6.3 The criteria to distinguishing the mark on the surface of products are that characters can be identified.

## 7. Structure



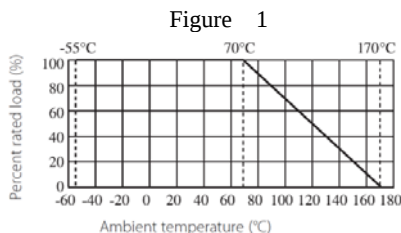
## 8. Recommend land pattern



| Unit: mm |                                             |      |      |      |
|----------|---------------------------------------------|------|------|------|
| Type     | Resistance Range                            | a    | b    | i    |
| ML06     | Jumper : $\leq 0.2\text{m}\Omega$           | 1.46 | 2.15 | 1.68 |
|          | $1\text{m}\Omega \sim 50\text{m}\Omega$     | 1.46 | 2.15 | 1.68 |
| ML12     | Jumper : $\leq 0.2\text{m}\Omega$           | 2.30 | 3.68 | 3.15 |
|          | $0.5\text{m}\Omega \sim 1\text{m}\Omega$    | 3.24 | 3.68 | 1.27 |
|          | $1.5\text{m}\Omega$                         | 3.20 | 3.68 | 1.35 |
|          | $2\text{m}\Omega \sim 5\text{m}\Omega$      | 2.60 | 3.68 | 2.55 |
|          | $6\text{m}\Omega \sim 200\text{m}\Omega$    | 2.30 | 3.68 | 3.15 |
|          | $201\text{m}\Omega \sim 450\text{m}\Omega$  | 2.05 | 3.68 | 3.65 |
| ML25     | $0.2\text{m}\Omega \sim 0.35\text{m}\Omega$ | 2.90 | 6.7  | 1.28 |
|          | $0.4\text{m}\Omega \sim 0.8\text{m}\Omega$  | 3.25 | 6.85 | 1.70 |
|          | $1\text{m}\Omega \sim 3\text{m}\Omega$      | 2.75 | 6.85 | 2.70 |
| ML28     | $4\text{m}\Omega \sim 450\text{m}\Omega$    | 2.05 | 7.20 | 3.90 |
| ML27     | $0.5\text{m}\Omega \sim 1.5\text{m}\Omega$  | 4.50 | 8.74 | 4.50 |
|          | $2.0\text{m}\Omega \sim 100\text{m}\Omega$  | 3.50 | 8.74 | 6.50 |
|          | $101\text{m}\Omega \sim 500\text{m}\Omega$  | 3.50 | 8.74 | 6.50 |

## 9. Derating Curve

Resistors shall have a power rating based on continuous load operation at an ambient temperature of 70 °C. For temperature in excess of 70 °C , The load shall be derate as shown in figure 1.



The following equation may be used to determine the DC (Direct Current) or AC (Alternating Current) (RMS, root mean square value) of normal rated power. However, if the result value exceeds the highest current of regulated standards, the highest normal rated power is to be used

$$I = \sqrt{P/R}$$

I = Rating current (A)

P= Rating Power (W)

R= Resistance( $\Omega$ )

## 10. Performance Specification

| Test Item                       | Test Methods<br>(GB/T 5729, JIS-C-5201, IEC 60115-1)                                                                                                                                                                                                                                                                       | Requirements                                                             |
|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|
| Temperature Coefficient         | At 25°C /+150 °C, 25°C is the reference temperature                                                                                                                                                                                                                                                                        | List by specification                                                    |
| Short-time overload             | 4.13 The number of rated power are as follows :<br>ML06: 5 times of rated power;<br>ML12-2W: 5 times of rated power;<br>ML12-3W: 5 times of rated power;*(Note)<br>ML25: 4 times of rated power;<br>ML28: 4 times of rated power;<br>ML27-3W: 5 times of rated power;<br>ML27-5W: 3 times of rated power;<br>for 5 seconds | ML27: $\Delta R \leq \pm 2.0\%$<br>The others: $\Delta R \leq \pm 0.5\%$ |
| Load Life                       | 4.25.1 Permanent Resistance change after 1000 hours operating at rated working current or Max .Working Current whichever less with duty cycle of 1.5hours “ON” , 0.5 hour “OFF” at 70 $\pm$ 2°C ambient.                                                                                                                   | ML27: $\Delta R \leq \pm 2.0\%$<br>The others: $R \leq \pm 1.0\%$        |
| High Temperature Exposure       | <b>MIL-STD-202 108A</b><br>Exposed to a temperature of 155 $\pm$ 2°C for 1000H.                                                                                                                                                                                                                                            | ML27: $\Delta R \leq \pm 2.0\%$<br>The others: $R \leq \pm 1.0\%$        |
| Biased Humidity                 | <b>MIL-STD-202 Method 103</b><br>1000 hours 85°C/85%RH. Note: Specified conditions:10% of operating power. Measurement at 24 $\pm$ 4 hours after test conclusion.                                                                                                                                                          | $\Delta R \leq \pm 0.5\%$                                                |
| Rapid change of temperature     | 4.19. 30 min at -55 °C and 30 min at 155°C; 100 cycles                                                                                                                                                                                                                                                                     | $\Delta R \leq \pm 0.5\%$                                                |
| Terminal bending                | 4.33. 2mm , 10Sec                                                                                                                                                                                                                                                                                                          | $\Delta R \leq \pm 0.5\%$                                                |
| Resistance to Solder Heat       | 4.18 Dip the resister into a temperature of 260 $\pm$ 5°C and hold it for a 10 $\pm$ 1 seconds.                                                                                                                                                                                                                            | $\Delta R \leq \pm 0.5\%$                                                |
| Solderability                   | 4.17 The area covered with a new, smooth, clean, shiny and continuous surface free from concentrated pinholes. Temperature of solder: 245 $\pm$ 3°C; Dwell time in solder: 2~3seconds.                                                                                                                                     | >95% Coverage                                                            |
| Dielectric Withstanding Voltage | 4.7 Applied 500 VAC for 1 minute , and Limit surge current 50 mA (max.)                                                                                                                                                                                                                                                    | No short or burned on the appearance                                     |
| Terminal Strength               | 4.16 5N , 10 seconds                                                                                                                                                                                                                                                                                                       | No broken                                                                |

**\*Note: This test is a destructive experiment. The top protective layer is prone to damage and peculiar smell during, in the 50mR~100mR resistance test. The resistance change rate can meets the specifications.**

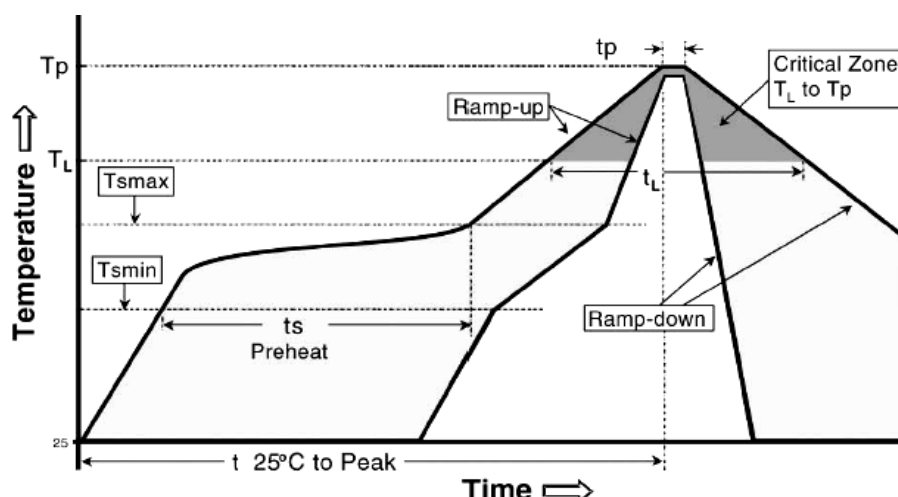
For Jumper

| Test Item                   | Test Methods<br>(GB/T 5729, JIS-C-5201, IEC 60115-1)                                                                                                                                                                | Requirements             |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Short Time Overload         | 4.13 Permanent resistance change after the application of a potential of 4 times power rate for 5 seconds                                                                                                           | $\leq 0.2\text{m}\Omega$ |
| Rapid change of temperature | 4.19 30 min at $-55^{\circ}\text{C}$ and 30 min at $155^{\circ}\text{C}$ ; 100 cycles                                                                                                                               | $\leq 0.2\text{m}\Omega$ |
| High Temperature Exposure   | <b>MIL-STD-202 108A</b><br>Exposed to a temperature of $155\pm 2^{\circ}\text{C}$ for 1000H.                                                                                                                        | $\leq 0.2\text{m}\Omega$ |
| Biased Humidity             | <b>MIL-STD-202 Method 103</b><br>1000 hours $85^{\circ}\text{C}/85\%\text{RH}$ . Note: Specified conditions:10% of operating power . Measurement at $24\pm 4$ hours after test conclusion.                          | $\leq 0.2\text{m}\Omega$ |
| Load Life                   | 4.25 Permanent Resistance change after 1000 hours operating at rated working current or Max .Working Current whichever less with duty cycle of 1.5hours “ON” , 0.5 hour “OFF” at $70\pm 2^{\circ}\text{C}$ ambient. | $\leq 0.2\text{m}\Omega$ |
| Solderability               | 4.17 The area covered with a new, smooth, clean, shiny and continuous surface free from concentrated pinholes. Temperature of solder : $245\pm 3^{\circ}\text{C}$ ; Dwell time in solder: 2~3 seconds.              | >95% coverage            |

## 11. Soldering Condition

(This is for recommendation, please customer perform adjustment according to actual application)

11.1 Recommend Reflow Soldering Profile: (solder : Sn96.5 / Ag3 / Cu0.5)

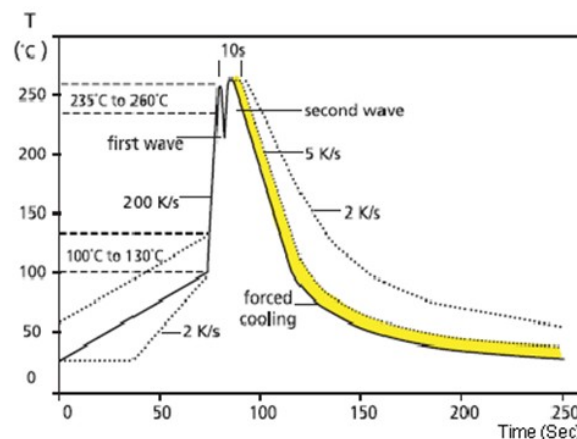


| Profile Feature                                                                                                                                 | Lead (Pb)-Free solder            |
|-------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| Preheat:<br>Temperature Min (T <sub>smin</sub> )<br>Temperature Max (T <sub>smax</sub> )<br>Time (T <sub>smin</sub> to T <sub>smax</sub> ) (ts) | 150°C<br>200°C<br>60 -120seconds |
| Average ramp-up rate:<br>(T <sub>smax</sub> to Tp)                                                                                              | 3°C/ second max.                 |
| Time maintained above :<br>Temperature (T <sub>L</sub> )<br>Time (t <sub>L</sub> )                                                              | 217°C<br>60-150 seconds          |
| Peak Temperature (Tp)                                                                                                                           | 260°C                            |
| Time within $+0^{\circ}\text{C}$ to $-5^{\circ}\text{C}$ of actual peak Temperature (tp) <sup>2</sup>                                           | 10 seconds                       |
| Ramp-down Rate                                                                                                                                  | 6°C/second max.                  |
| Time 25°C to Peak Temperature                                                                                                                   | 8minutes max.                    |

Allowed Re-flow times : 2 times

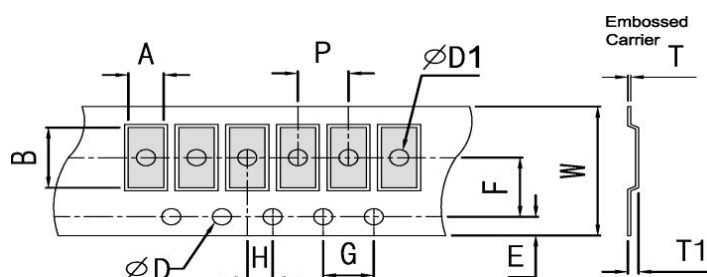
Remark : To avoid discoloration phenomena of chip on terminal electrodes, please use N<sub>2</sub> Re-flow furnace .

## 11.2 Recommend Wave Soldering Profile :



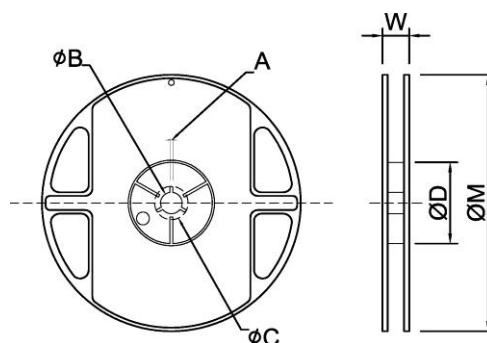
## 12. Packing of Surface Mount Resistors

### 12.1 Embossed Dimensions:(Unit: mm)



| Type | Resistance Range                                   | W               | P               | E               | F               | $\phi D$            | $\phi D1$       | G              | H              | A               | B               | T1              | T               |
|------|----------------------------------------------------|-----------------|-----------------|-----------------|-----------------|---------------------|-----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|
| ML06 | 1m $\Omega$                                        | 8.0 $\pm$ 0.30  | 4.0 $\pm$ 0.10  | 1.75 $\pm$ 0.10 | 3.5 $\pm$ 0.10  | 1.50 $^{+0.1}_{-0}$ | 1.0 $\pm$ 0.10  | 4.0 $\pm$ 0.10 | 2.0 $\pm$ 0.10 | 2.03 $\pm$ 0.10 | 3.55 $\pm$ 0.10 | 1.10 $\pm$ 0.10 | 0.20 $\pm$ 0.05 |
| ML06 | 2~50m $\Omega$                                     | 8.0 $\pm$ 0.30  | 4.0 $\pm$ 0.10  | 1.75 $\pm$ 0.10 | 3.5 $\pm$ 0.10  | 1.50 $^{+0.1}_{-0}$ | 1.0 $\pm$ 0.10  | 4.0 $\pm$ 0.10 | 2.0 $\pm$ 0.10 | 2.03 $\pm$ 0.10 | 3.55 $\pm$ 0.10 | 0.85 $\pm$ 0.10 | 0.20 $\pm$ 0.05 |
| ML12 | 0.5 m $\Omega$ /1 m $\Omega$                       | 12.0 $\pm$ 0.30 | 4.0 $\pm$ 0.10  | 1.75 $\pm$ 0.10 | 5.5 $\pm$ 0.10  | 1.50 $^{+0.1}_{-0}$ | 1.55 $\pm$ 0.10 | 4.0 $\pm$ 0.10 | 2.0 $\pm$ 0.10 | 3.50 $\pm$ 0.10 | 6.75 $\pm$ 0.10 | 1.10 $\pm$ 0.10 | 0.20 $\pm$ 0.05 |
| ML12 | 0.75m $\Omega$ /0.8m $\Omega$<br>1.5~450m $\Omega$ | 12.0 $\pm$ 0.30 | 4.0 $\pm$ 0.10  | 1.75 $\pm$ 0.10 | 5.5 $\pm$ 0.10  | 1.50 $^{+0.1}_{-0}$ | 1.55 $\pm$ 0.10 | 4.0 $\pm$ 0.10 | 2.0 $\pm$ 0.10 | 3.50 $\pm$ 0.10 | 6.75 $\pm$ 0.10 | 0.90 $\pm$ 0.10 | 0.20 $\pm$ 0.05 |
| ML25 | 0.2~0.8m $\Omega$                                  | 12.0 $\pm$ 0.30 | 8.0 $\pm$ 0.10  | 1.75 $\pm$ 0.10 | 5.5 $\pm$ 0.10  | 1.50 $^{+0.1}_{-0}$ | 1.55 $\pm$ 0.10 | 4.0 $\pm$ 0.10 | 2.0 $\pm$ 0.10 | 6.81 $\pm$ 0.10 | 7.16 $\pm$ 0.10 | 1.30 $\pm$ 0.10 | 0.25 $\pm$ 0.05 |
| ML25 | 1~3m $\Omega$                                      | 12.0 $\pm$ 0.30 | 8.0 $\pm$ 0.10  | 1.75 $\pm$ 0.10 | 5.5 $\pm$ 0.10  | 1.50 $^{+0.1}_{-0}$ | 1.55 $\pm$ 0.10 | 4.0 $\pm$ 0.10 | 2.0 $\pm$ 0.10 | 6.81 $\pm$ 0.10 | 7.16 $\pm$ 0.10 | 1.05 $\pm$ 0.10 | 0.25 $\pm$ 0.05 |
| ML28 | 4~450m $\Omega$                                    | 12.0 $\pm$ 0.30 | 8.0 $\pm$ 0.10  | 1.75 $\pm$ 0.10 | 5.5 $\pm$ 0.10  | 1.50 $^{+0.1}_{-0}$ | 1.55 $\pm$ 0.10 | 4.0 $\pm$ 0.10 | 2.0 $\pm$ 0.10 | 7.10 $\pm$ 0.10 | 7.05 $\pm$ 0.10 | 0.95 $\pm$ 0.10 | 0.20 $\pm$ 0.05 |
| ML27 | 0.5~500m $\Omega$                                  | 24.0 $\pm$ 0.30 | 12.0 $\pm$ 0.10 | 1.75 $\pm$ 0.10 | 11.5 $\pm$ 0.10 | 1.50 $^{+0.1}_{-0}$ | 1.50 $\pm$ 0.10 | 4.0 $\pm$ 0.10 | 2.0 $\pm$ 0.10 | 7.38 $\pm$ 0.10 | 12.0 $\pm$ 0.10 | 1.05 $\pm$ 0.10 | 0.30 $\pm$ 0.10 |

## 12.2 Dimension of Reel : (Unit: mm)



| Type                | Taping   | Qty/Reel             | A       | φ B      | φ C      | φ D      | W        | φ M     |
|---------------------|----------|----------------------|---------|----------|----------|----------|----------|---------|
| ML06                | Embossed | 5,000pcs             | 2.0±0.5 | 13.2±0.5 | 17.7±0.5 | 60.0±0.5 | 12.0±0.5 | 178±1.0 |
| ML06-1mΩ            | Embossed | 4,000pcs             | 2.0±0.5 | 13.2±0.5 | 17.7±0.5 | 60.0±0.5 | 12.0±0.5 | 178±1.0 |
| ML12                | Embossed | 4,000pcs             | 2.5±0.5 | 13.5±0.5 | 17.7±0.5 | 60.0±0.5 | 16.2±0.5 | 178±1.0 |
| ML25<br>0.2≤R≤0.8mΩ | Embossed | 1,000pcs             | 2.5±0.5 | 13.5±0.5 | 17.7±0.5 | 60.0±0.5 | 16.2±0.5 | 178±1.0 |
| ML25<br>R≥1mΩ       | Embossed | 2,000pcs             | 2.5±0.5 | 13.5±0.5 | 17.7±0.5 | 60.0±0.5 | 16.2±0.5 | 178±1.0 |
| ML28                | Embossed | 2,000pcs<br>1,000pcs | 2.5±0.5 | 13.5±0.5 | 17.7±0.5 | 60.0±0.5 | 16.2±0.5 | 178±1.0 |
| ML27                | Embossed | 1,000pcs<br>500pcs   | 2.0±0.5 | 13.2±0.5 | 17.7±0.5 | 60.0±0.5 | 24.4±2.0 | 178±1.0 |

## 13. Note

- 13.1 UNI-ROYAL recommend products store in warehouse with temperature between 15 to 35℃ under humidity between 25 to 75%RH.  
Even under UNI-ROYAL recommended storage condition, solderability of products over 1 year old. (Put condition for each product) may be degraded.
- 13.2 Store / transport cartons in the correct direction, which is indicated on a carton as a symbol.  
Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.
- 13.3 Product performance and soldered connections may deteriorate if the products are stored in the following places:
- Storage in high Electrostatic.
  - Storage in direct sunshine、rain and snow or condensation.
  - Where the products are exposed to sea winds or corrosive gases, including Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, NO<sub>2</sub>, Br, etc.

## 14. Record

| Version | Description                 | Page | Date         | Amended by  | Checked by |
|---------|-----------------------------|------|--------------|-------------|------------|
| 1       | First version               | 1~10 | Apr.26, 2021 | Haiyan Chen | Yuhua Xu   |
| 2       | Extend the resistance range | 3~4  | Mar.05, 2024 | Haiyan Chen | Yuhua Xu   |

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