

# DATASHEET

**Product Name**   **Low T.C.R Thick Film Chip Resistors**

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**Part Name**   **LT Series**

**File No.**   **SMD-SP-008**

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

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## 1. Scope

- 1.1 This datasheet is the characteristics of Low T.C.R Thick Film Chip Resistors manufactured by UNI-ROYAL.
- 1.2 Low T.C.R  $\pm 50\text{PPM}/^{\circ}\text{C}$
- 1.3 Suitable for reflow& wave soldering
- 1.4 Application precision medical equipment, Auto industrial control system ,Communication equipment ,IPAD, Portable computer ,LED lamps, intelligent home appliances.
- 1.5 AEC-Q200 qualified.
- 1.6 Compliant with RoHS directive.
- 1.7 Halogen free requirement.

## 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.: LT02、LT03、LT05、LT06

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

E.g.: W=Normal Size “1~G” = “1~16”

| Wattage     | 1/4 | 1/8 | 1/10 | 1/16 |
|-------------|-----|-----|------|------|
| Normal Size | W4  | W8  | WA   | WG   |

If power rating is equal or lower than 1 watt, 5<sup>th</sup> code would be “W” and 6<sup>th</sup> code would be a number or letter.

E.g.: WA=1/10W W4=1/4W

2.3 7<sup>th</sup> code: Tolerance. E.g.: C= $\pm 0.25\%$  D= $\pm 0.5\%$  F= $\pm 1\%$

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

2.4.1 If value belongs to standard value of E-24 series, the 8<sup>th</sup> code is zero, 9<sup>th</sup>~10<sup>th</sup> codes are the significant figures of resistance value, and the 11<sup>th</sup> code is the power of ten.

2.4.2 If value belongs to standard value of E-96 series, the 8<sup>th</sup>~10<sup>th</sup> codes are the significant figures of resistance value, and the 11<sup>th</sup> code is the power of ten.

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

0= $10^0$  1= $10^1$  2= $10^2$  3= $10^3$  4= $10^4$  5= $10^5$  6= $10^6$  J= $10^{-1}$  K= $10^{-2}$  L= $10^{-3}$  M= $10^{-4}$

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

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

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

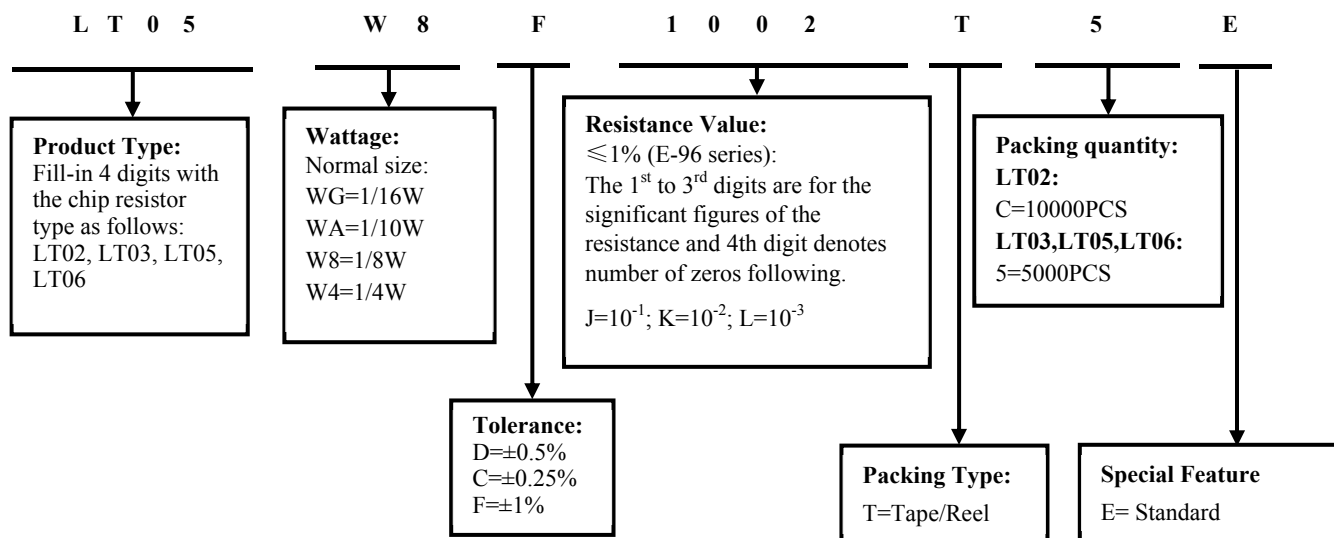
5=5,000pcs

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

E = Standard.

## 3. Ordering Procedure

(Example: LT05 1/8W  $\pm 1\%$  10K $\Omega$  T/R-5000)



## 4. Marking

4.1 For LT02 size. Due to the very small size of the resistor's body, there is no marking on the body.

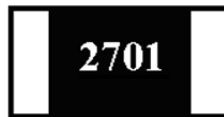


4.1  $\pm 1\%$  tolerance products (E-96 series):

4 codes.

1<sup>st</sup>~3<sup>rd</sup> codes are the significant figures of resistance value, and the rest code is the power of ten.

Letter "R" in mark means decimal point.



2701  $\rightarrow$  2.7K $\Omega$

4.2 Standard E-96 series values of LT03  $\leq \pm 1\%$  : due to the small size of the resistor's body, 3 digits marking will be used to indicate the accurate resistance value by using the following multiplier & resistance code.

Multiplier Code (for LT03  $\leq \pm 1\%$  marking)

| Code       | A      | B      | C      | D      | E      | F      | G      | H      | X         | Y         | Z         |
|------------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|-----------|-----------|
| Multiplier | $10^0$ | $10^1$ | $10^2$ | $10^3$ | $10^4$ | $10^5$ | $10^6$ | $10^7$ | $10^{-1}$ | $10^{-2}$ | $10^{-3}$ |

Standard E-96 series Resistance Value code (for LT03  $\leq \pm 1\%$  marking)

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

So the resistance value are marked as the following examples



1.96K $\Omega$ =196 $\times 10^1\Omega$ =29B



12.4 $\Omega$ =124 $\times 10^{-1}\Omega$ =10X

4.3 Standard E-24 and not belong to E-96 series values ( $\leq \pm 1\%$ ) of LT03 size: the marking is the same as 5% tolerance but marking as underline.



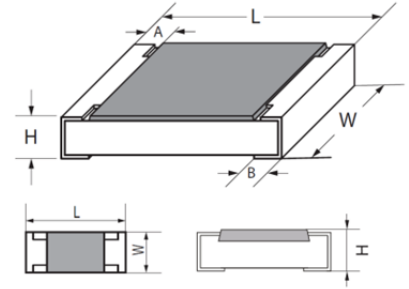
333=33K $\Omega$



680=68 $\Omega$

## 5. Dimension

| Type       | Dimension(mm) |                 |           |           |           |
|------------|---------------|-----------------|-----------|-----------|-----------|
|            | L             | W               | H         | A         | B         |
| LT02(0402) | 1.00±0.10     | 0.50±0.05       | 0.35±0.05 | 0.20±0.10 | 0.25±0.10 |
| LT03(0603) | 1.60±0.10     | 0.80±0.10       | 0.45±0.10 | 0.30±0.20 | 0.30±0.20 |
| LT05(0805) | 2.00±0.15     | 1.25±0.15/-0.10 | 0.55±0.10 | 0.40±0.20 | 0.40±0.20 |
| LT06(1206) | 3.10±0.15     | 1.55±0.15/-0.10 | 0.55±0.10 | 0.45±0.20 | 0.45±0.20 |



## 6. Resistance Range

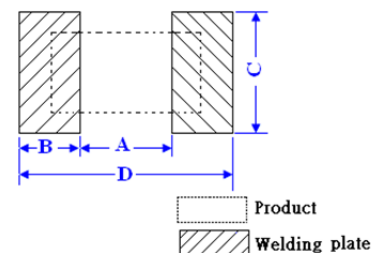
| Type | Power Rating | Resistance Range |          |          |
|------|--------------|------------------|----------|----------|
|      |              | 0.25%            | 0.5%     | 1.0%     |
| LT02 | 1/16W        | 100Ω-1MΩ         | 100Ω-1MΩ | 100Ω-1MΩ |
| LT03 | 1/10W        | 1Ω-1MΩ           | 1Ω-1MΩ   | 1Ω-1MΩ   |
| LT05 | 1/8W         | 1Ω-1MΩ           | 1Ω-1MΩ   | 1Ω-1MΩ   |
| LT06 | 1/4W         | 1Ω-1MΩ           | 1Ω-1MΩ   | 1Ω-1MΩ   |

## 7. Ratings:

| Type | Max. Working Voltage | Max. Overload Voltage | Dielectric withstanding Voltage | Operating Temperature |
|------|----------------------|-----------------------|---------------------------------|-----------------------|
| LT02 | 50V                  | 100V                  | 100V                            | -55~+155℃             |
| LT03 | 75V                  | 150V                  | 300V                            | -55℃~155℃             |
| LT05 | 150V                 | 300V                  | 500V                            | -55℃~155℃             |
| LT06 | 200V                 | 400V                  | 500V                            | -55℃~155℃             |

## 8. Soldering pad size recommended

| Type | Dimension(mm) |           |          |          |
|------|---------------|-----------|----------|----------|
|      | A             | B         | C        | D        |
| LT02 | 0.50±0.05     | 0.45±0.05 | 0.5±0.05 | 1.4±0.05 |
| LT03 | 0.8±0.05      | 0.65±0.05 | 0.8±0.05 | 2.1±0.05 |
| LT05 | 1.0±0.1       | 1.0±0.1   | 1.3±0.1  | 3.0±0.1  |
| LT06 | 2.0±0.1       | 1.2±0.1   | 1.6±0.1  | 4.4±0.1  |



## 9. Derating Curve:

Power rating will change based on continuous load at ambient temperature from -55 to 155℃. It is constant between -55 to 70℃, and derate to zero when temperature rise from 70 to 155℃.

Voltage rating:

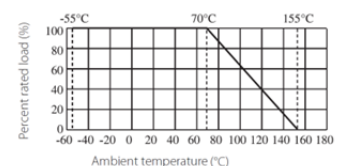
Resistors shall have a rated direct-current (DC) continuous working voltage or an approximate sine-wave root-mean-square (RMS) alternating-current (AC) continuous working voltage at commercial-line frequency and waveform corresponding to the power rating, as determined from the following formula:

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

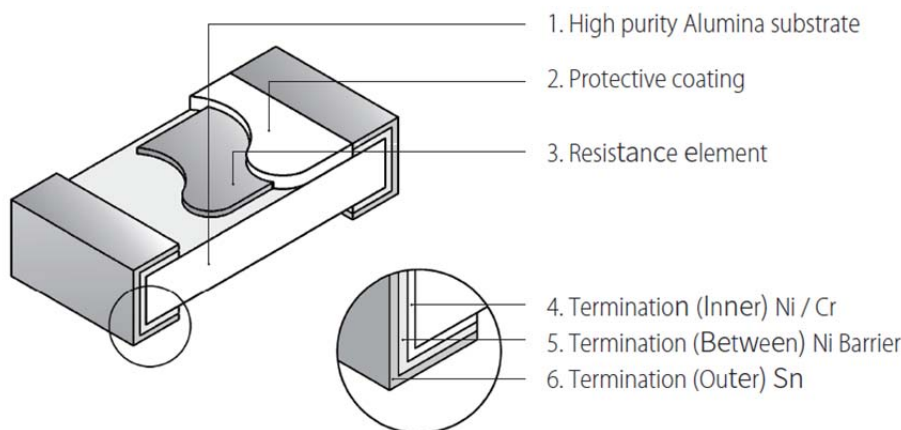
Remark: RCWV: Rating Continuous Working Voltage (Volt.) P: power rating (Watt) R: nominal resistance (Ω)

In no case shall the rated DC or RMS AC continuous working voltage be greater than the applicable maximum value.

The overload voltage is 2.5 times RCWV or Max. Overload voltage whichever is lower.



## 10. Structure



## 11. Performance Specification

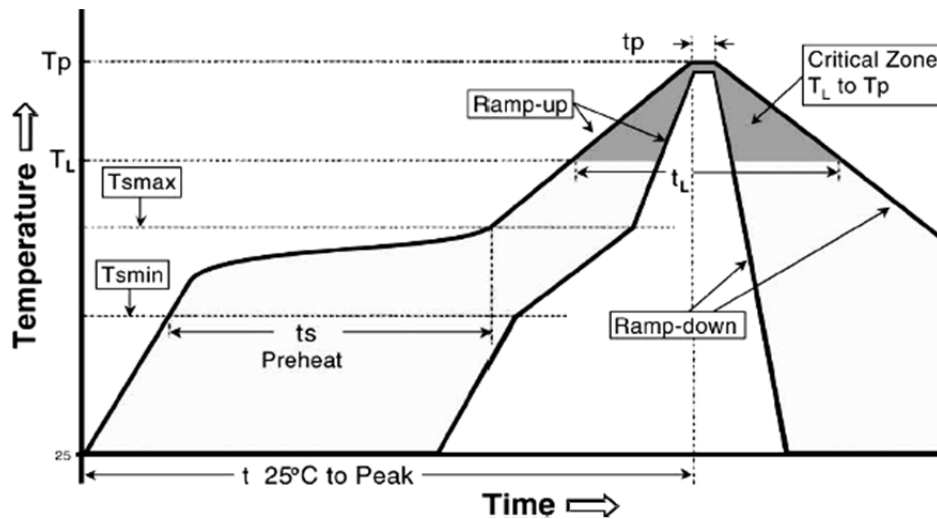
| Characteristic                      | Limits  | Ref. Standards   | Test Methods   |
|-------------------------------------|---|--|--|
| Operational life                    | $\pm(1.0\%+0.05\Omega)$   | MIL-STD-202  | 125°C, at 36% of operating power, 1000H(1.5 hours "ON", 0.5 hour "OFF"). Measurement at 24±4hours after test conclusion.   |
| Electrical Characterization (T.C.R) | LT02: $\pm 50\text{ppm}/^\circ\text{C}$<br>LT03: $1\Omega \leq R \leq 10\Omega$ : $\pm 100\text{ppm}/^\circ\text{C}$<br>$10\Omega < R \leq 1\text{M}\Omega$ : $\pm 50\text{ppm}/^\circ\text{C}$<br>LT05: $1\Omega \leq R \leq 10\Omega$ : $\pm 100\text{ppm}/^\circ\text{C}$<br>$10\Omega < R \leq 1\text{M}\Omega$ : $\pm 50\text{ppm}/^\circ\text{C}$<br>LT06: $1\Omega \leq R \leq 10\Omega$ : $\pm 100\text{ppm}/^\circ\text{C}$<br>$10\Omega < R \leq 1\text{M}\Omega$ : $\pm 50\text{ppm}/^\circ\text{C}$ | GB/T 5729 4.8<br>JIS-C-5201 4.8<br>IEC 60115-1 6.2       | Natural resistance changes per temp. Degree centigrade<br>$\frac{R_2 - R_1}{R_1(t_2 - t_1)} \times 10^6 \text{ (PPM}/^\circ\text{C})$ R <sub>1</sub> : Resistance Value at room temperature (t <sub>1</sub> ) ;<br>R <sub>2</sub> : Resistance at test temperature (t <sub>2</sub> )<br>t <sub>1</sub> : +25°C or specified room temperature<br>t <sub>2</sub> : Test temperature (-55°C or 125°C) |
| Short-time overload                 | $\pm(1.0\%+0.05\Omega)$   | GB/T 5729 4.13<br>JIS-C-5201 4.13<br>IEC 60115-1 8.1.4.2 | Permanent resistance change after the application of a potential of 2.5 times RCWV or Max. Overload Voltage whichever less for 5 seconds..   |
| External Visual                     | Marking Complete , no mechanical damage   | MIL-STD-883 Method 2009                                  | Electrical test not required. Inspect device construction, marking and workmanship   |
| Physical Dimension                  | Reference 5 Dimension Standards   | JESD22 MH Method JB-100                                  | Verify physical dimensions to the applicable device detail specification.<br>Note: User(s) and Suppliers spec. Electrical test not required.   |
| Resistance to Solvent               | Marking Complete , no mechanical damage   | MIL-STD-202 Method 215                                   | Note: Add Aqueous wash chemical – OKEM Clean or equivalent. Do not use banned solvents.  |
| Terminal Strength                   | Not broken  | AEC-Q200-0069  | LT02:5N; others:17.7N, 60±1 seconds.   |
| High Temperature Exposure (Storage) | $\pm(1.0\%+0.05\Omega)$   | MIL-STD-202 Method 108                                   | 1000hrs. @T=155°C.Unpowered. Measurement at 24±4 hours after test conclusion.  |
| Temperature Cycling                 | $\pm(1.0\%+0.05\Omega)$   | JESD22 Method JA-104                                     | 1000 Cycles (-55°C to +155°C). Measurement at 24±4 hours after test conclusion.  |
| Biased Humidity                     | $\pm(1.0\%+0.05\Omega)$   | MIL-STD-202 Method 103                                   | 1000 hours 85°C,85%RH.<br>Note: Specified conditions: 10% of operating power. Measurement at 24±4 hours after test conclusion.   |

|                              |  |                           |  |
|------------------------------|--|---------------------------|--|
| Mechanical Shock             | $\pm(1.0\%+0.05\Omega)$  | MIL-STD-202<br>Method 213 | Half sine wave, acceleration 100g's, each three times in X, Y and Z directions, pulse width 6ms.   |
| Vibration                    | $\pm(1.0\%+0.05\Omega)$  | MIL-STD-202<br>Method 204 | 5g's for 20 min., 12cycle each of 3 orientations.<br>Note: Use 8''*5''PCB. 031'' thick 7 secure points on one long side and 2 secure points at corners of opposite sides. Parts mounted within 2' from any secure point. Test from 10-2000Hz.        |
| ESD                          | $\pm(3.0\%+0.05\Omega)$  | AEC-Q200-002              | With the electrometer in direct contact with the discharge tip, verify the voltage setting at levels of $\pm 500V, \pm 1KV, \pm 2KV, \pm 4KV, \pm 8KV$ , The electrometer reading shall be within $\pm 10\%$ for voltages from 500V to $\leq 800V$ . |
| Solderability                | Coverage must be over 95%.   | J-STD-002                 | For both leaded & SMD. Electrical test not required. Magnification 50X. Conditions:<br>a) Method B 4hrs at 155°C dry heat, the dip in bath with $245\pm 3^\circ C, 5\pm 0.5s$ .<br>b) Method D: at $260\pm 3^\circ C, 30\pm 0.5s$ .                  |
| Flammability                 | No ignition of the tissue paper or scorching or the pinewood board | UL-94                     | V-0 or V-1 are acceptable. Electrical test not required.   |
| Board Flex                   | $\pm(1.0\%+0.05\Omega)$  | AEC-Q200-005              | Bending 2mm(min) for 60+5sec   |
| Flame Retardance             | No flame   | AEC-Q200-001              | Only requested, when voltage/power will increase the surface temp to 350°C. Apply voltage from 9V to 32V. No flame; No explosion.  |
| Resistance to Soldering Heat | $\pm(1.0\%+0.05\Omega)$  | MIL-STD-202<br>Method 210 | Condition B No pre-heat of samples.<br>Dipping the resistor into a solder bath having a temperature of $260^\circ C \pm 5^\circ C$ and hold it for $10 \pm 1$ seconds  |

## 12. Soldering Condition

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

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

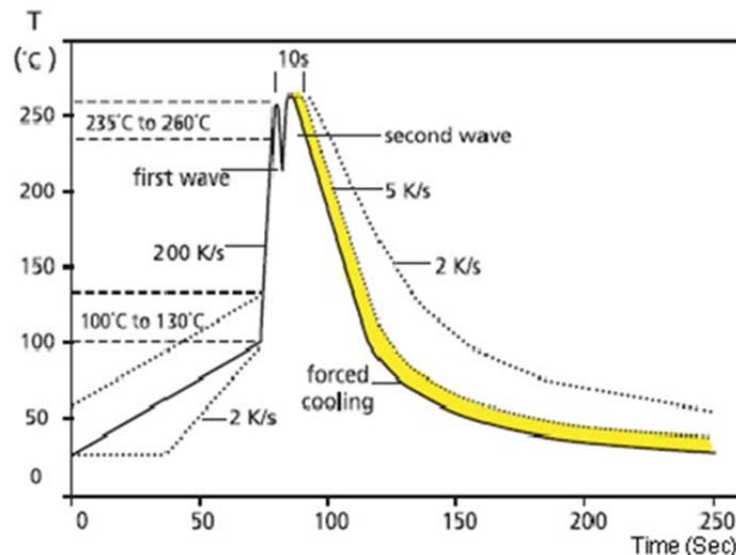


| Profile Feature   | Lead (Pb)-Free solder             |
|---|-----------------------------------|
| Preheat:<br>Temperature Min (T <sub>smin</sub> )<br>Temperature Max (T <sub>smax</sub> )<br>Time (T <sub>smin</sub> to T <sub>smax</sub> ) (ts) | 150°C<br>200°C<br>60 -120 seconds |
| Average ramp-up rate:<br>(T <sub>smax</sub> to T <sub>p</sub> )   | 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 (T <sub>p</sub> )  | 260°C                             |
| Time within $\begin{smallmatrix} +0^{\circ}\text{C} \\ -5^{\circ}\text{C} \end{smallmatrix}$ 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, we suggest use N2 Re-flow furnace .

12.2 Recommend Wave Soldering Profile : (Apply to 0603 and above size)

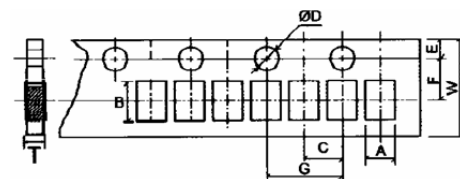




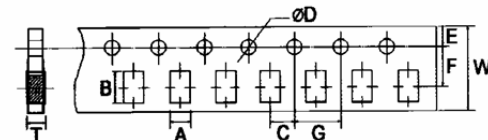
## 13. Packing of Surface Mount Resistors

### 13.1 Tapping Dimension : (Unit: mm)

| Type | A<br>±0.1 | B<br>±0.1 | C<br>±0.05 | $\Phi D^{+0.1}_{-0}$ | E<br>±0.1 | F<br>±0.05 | G<br>±0.1 | W<br>±0.2 | T<br>±0.05 |
|------|-----------|-----------|------------|----------------------|-----------|------------|-----------|-----------|------------|
| LT02 | 0.65      | 1.20      | 2.00       | 1.50                 | 1.75      | 3.50       | 4.00      | 8.00      | 0.42       |

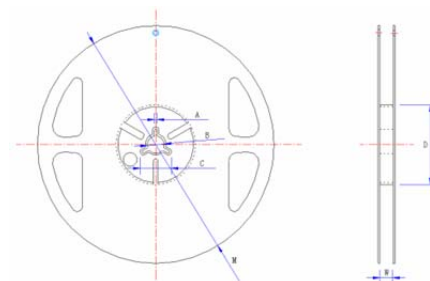


| Type | A<br>±0.2 | B<br>±0.2 | C<br>±0.05 | $\Phi D^{+0.1}_{-0}$ | E<br>±0.1 | F<br>±0.05 | G<br>±0.1 | W<br>±0.2 | T<br>±0.1 |
|------|-----------|-----------|------------|----------------------|-----------|------------|-----------|-----------|-----------|
| LT03 | 1.10      | 1.90      | 2.00       | 1.50                 | 1.75      | 3.50       | 4.00      | 8.00      | 0.67      |
| LT05 | 1.65      | 2.40      | 2.00       | 1.50                 | 1.75      | 3.50       | 4.00      | 8.00      | 0.81      |
| LT06 | 2.00      | 3.60      | 2.00       | 1.50                 | 1.75      | 3.50       | 4.00      | 8.00      | 0.81      |



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

| Type | Taping | Qty/Reel  | A±0.5 | B±0.5 | C±0.5 | D±1  | M±2   | W±1  |
|------|--------|-----------|-------|-------|-------|------|-------|------|
| LT02 | Paper  | 10,000pcs | 2.0   | 13.0  | 21.0  | 60.0 | 178.0 | 10.0 |
| LT03 | Paper  | 5,000pcs  | 2.0   | 13.0  | 21.0  | 60.0 | 178.0 | 10.0 |
| LT05 | Paper  | 5,000pcs  | 2.0   | 13.0  | 21.0  | 60.0 | 178.0 | 10.0 |
| LT06 | Paper  | 5,000pcs  | 2.0   | 13.0  | 21.0  | 60.0 | 178.0 | 10.0 |



## 14. Note

14.1. UNI-ROYAL recommend products store in warehouse with temperature between 15 to 35°C under humidity between 25 to 75%RH.

Even under storage conditions recommended above, solder ability of products will be degraded stored over 1 year old.

14.2. Cartons must be placed in correct direction which indicated on carton, otherwise the reel or wire will be deformed.

14.3. Storage conditions as below are inappropriate:

- Stored in high electrostatic environment
- Stored in direct sunshine, rain, snow or condensation.
- Exposed to sea wind or corrosive gases, such as Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, NO<sub>2</sub>, Br etc.

## 15. Record

| Version | Description     | Page | Date         | Amended by  | Checked by  |
|---------|-----------------|------|--------------|-------------|-------------|
| 1       | First version   | 1~8  | Dec.09, 2022 | Haiyan Chen | Yuhua Xu    |
| 2       | Modify ESD test | 6    | Feb.19, 2024 | Song Nie    | Haiyan Chen |

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