



**UNI-ROYAL**  
厚聲集團

# DATA SHEET

**Product Name** Metal film low resistance chip resistor

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**Part Name** TL Series

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## 1. Scope

- 1.1. This datasheet is the characteristics of Metal film low resistance chip resistor manufactured by UNI-ROYAL.
- 1.2. Low Resistance / TCR / Inductance
- 1.3. Excellent long-term stability
- 1.4. High precision current sensing
- 1.5. High power capability
- 1.6. Halogen free and lead free
- 1.7. RoHS compliant

## 2. Part No. System

Part No. includes 14 codes shown as below:

2.1 1st~4th codes: Part name. E.g.: TL01, TL02, TL03, TL05, TL06, TL07, TL10, TL12

2.2 5th~6th codes: Power rating.

| E.g.: W=Normal Size |      | “1~G” = “1~16” |     |     |     |     |      |      |      |    |
|---------------------|------|----------------|-----|-----|-----|-----|------|------|------|----|
| Wattage             | 1/32 | 3/4            | 1/2 | 1/3 | 1/4 | 1/8 | 1/10 | 1/16 | 1/20 | 1  |
| Normal Size         | WH   | 07             | W2  | W3  | W4  | W8  | WA   | WG   | WM   | 1W |

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.: D=±0.5%              F=±1%              G=±2%              J=±5%              K= ±10%

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<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>

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=4,000pcs    5=5,000pcs              C=10,000pcs              D=20,000pcs              E=15,000pcs

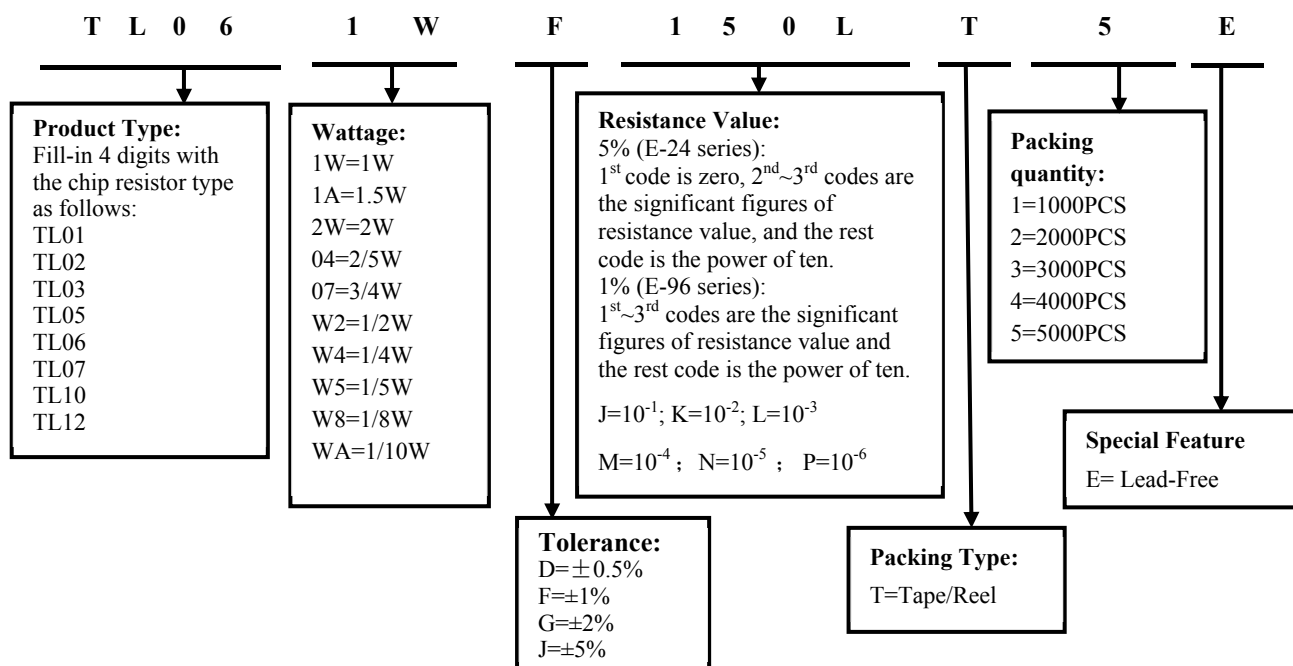
Chip Product: BD=B/B-20000pcs              TC=T/R-10000pcs

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

E = Environmental Protection, Lead Free, or Standard type.

## 3. Ordering Procedure

(Example: TL06 1W ±1% 0.15Ω T/R-5000)



## 4. Marking



0201~0402: no marking



0603: 3 digits



0805~2512: 4 digits

4.1 TL01 and TL02 : No marking

4.2 TL03: 3 digits

4.2.1 For E-24 values:

| Resistance value | Code | Example     |
|------------------|------|-------------|
| 50mΩ ~ 99mΩ      | 0XX  | 068 = 68mΩ  |
| 100mΩ ~ 990mΩ    | RXX  | R68 = 680mΩ |
| 1Ω ~ 9.9Ω        | XXR  | 6R8 = 6.8Ω  |
| 10Ω              | 10R  | 10R = 10Ω   |

|      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| E-24 | 10 | 11 | 12 | 13 | 15 | 16 | 18 | 20 | 22 | 24 | 27 | 30 | 33 | 36 | 39 | 43 | 47 | 51 | 56 | 62 | 68 | 75 | 82 | 91 |
|------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|

4.2.2 For E-96 values: excluding values 10/11/13/15/20/75 of E-24 series.

Standard E-96 Values and 0603 Resistance Codes

| 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   |

E-96 Multiplier Code

| Code       | A               | B               | C               | D               | E               | F               | G               | H               | X                | Y                | Z                |
|------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|------------------|
| Multiplier | 10 <sup>0</sup> | 10 <sup>1</sup> | 10 <sup>2</sup> | 10 <sup>3</sup> | 10 <sup>4</sup> | 10 <sup>5</sup> | 10 <sup>6</sup> | 10 <sup>7</sup> | 10 <sup>-1</sup> | 10 <sup>-2</sup> | 10 <sup>-3</sup> |

0603 3 digits coding formula for E-96 values as following:

Example: Example: 499 mΩ =  $499 \times 10^{-3} \Omega = 68Z$

68 Z

### 4.3 TL05 ~ TL12 : 4 digit marking

First 3 digits are the significant figures, the 4th digit is the multiplier. "R"= decimal point.

Examples:

| Resistance value                           | Code | Example      |
|--|------|--------------|
| 50mΩ ~ 99mΩ<br>(only for 0805, 1206, 1210) | R0XX | R068 = 68mΩ  |
| 100mΩ ~ 990mΩ                              | RXXX | R680 = 680mΩ |
| 1Ω ~ 9.9Ω                                  | XRXX | 6R80 = 6.8Ω  |
| 10Ω  | 10R0 | 10R0 = 10Ω   |

## 5. Standard Electrical Specifications

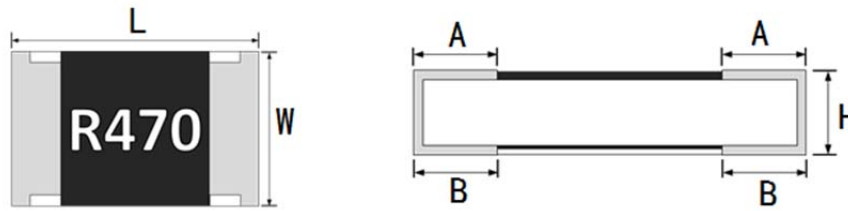
| Type           | Rating Power at 70°C | Max. Rating Current | Max. Overload Current | T.C.R (ppm/°C)                        | Resistance Range   |
|----------------|----------------------|---------------------|-----------------------|---------------------------------------|--|
|                |                      |                     |                       |                                       | 0.5% (D), 1.0% (F)<br>2.0% (G), 5.0% (J)                                 |
| TL01<br>(0201) | 1/10W                | 1.41A               | 3.16A                 | ±100<br>-----<br>±50                  | 50mΩ ≤ R < 100mΩ<br>-----<br>100mΩ ≤ R ≤ 10Ω                             |
| TL02<br>(0402) | 1/8W                 | 1.58A               | 3.54A                 |                                       |  |
|                | 1/4W                 | 2.24A               | 5.00A                 |                                       |  |
| TL03<br>(0603) | 1/5W                 | 2.00A               | 4.47A                 |                                       |  |
|                | 2/5W                 | 2.83A               | 6.32A                 |                                       |  |
| TL05<br>(0805) | 1/4W                 | 2.53A               | 5.66A                 | ±150<br>-----<br>±100<br>-----<br>±50 | 39mΩ ≤ R < 50mΩ<br>-----<br>50mΩ ≤ R < 100mΩ<br>-----<br>100mΩ ≤ R ≤ 10Ω |
|                | 1/2W                 | 3.58A               | 8.00A                 |                                       |  |
| TL06<br>(1206) | 1/2W                 | 3.58A               | 8.00A                 |                                       |  |
|                | 1W                   | 5.06A               | 11.32A                |                                       |  |
| TL07<br>(1210) | 1/2W                 | 3.58A               | 8.95A                 |                                       |  |
|                | 1W                   | 5.06A               | 11.32A                |                                       |  |
| TL10<br>(2010) | 3/4W                 | 2.74A               | 6.85A                 | ±50                                   | 100mΩ ≤ R ≤ 10Ω  |
|                | 1.5W                 | 3.87A               | 8.66A                 |                                       |  |
| TL12<br>(2512) | 2W                   | 4.47A               | 10.00A                |                                       |  |
|                | 3W                   | 5.48A               | 12.25A                |                                       |  |

| Type           | Rating Power at 70°C | Max. Rating Current | Max. Overload Current | T.C.R (ppm/°C) | Resistance Range               |
|----------------|----------------------|---------------------|-----------------------|----------------|--------------------------------|
|                |                      |                     |                       |                | 1.0% (F)<br>2.0% (G), 5.0% (J) |
| TL06<br>(1206) | 1/2W                 | 7.07A               | 15.81A                | ±200           | 10mΩ ≤ R < 39 mΩ               |

For non-standard parts, please contact our sales dept.

Operating Temperature Range : -55°C ~ +155°C.

**6. Dimension**



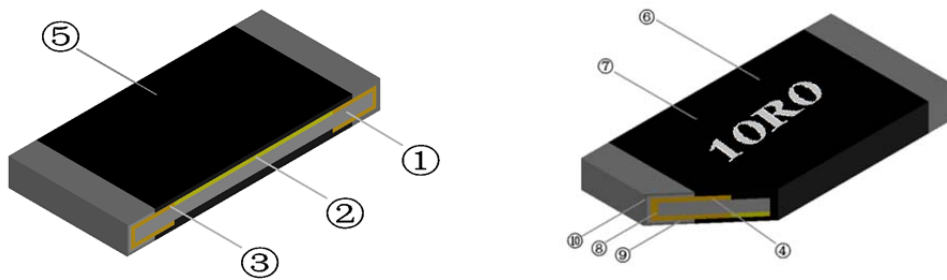
Unit: mm

| Type     | L         | W         | H         | A         | B         |
|----------|-----------|-----------|-----------|-----------|-----------|
| TL01     | 0.60±0.03 | 0.30±0.03 | 0.26±0.05 | 0.15±0.05 | 0.15±0.05 |
| TL02     | 1.00±0.10 | 0.50±0.05 | 0.35±0.05 | 0.20±0.10 | 0.25±0.10 |
| TL03     | 1.60±0.10 | 0.80±0.10 | 0.45±0.10 | 0.25±0.15 | 0.30±0.15 |
| TL05     | 2.00±0.10 | 1.25±0.10 | 0.55±0.10 | 0.35±0.20 | 0.40±0.20 |
| TL06     | 3.10±0.10 | 1.60±0.10 | 0.55±0.10 | 0.40±0.20 | 0.45±0.20 |
| TL07     | 3.10±0.10 | 2.50±0.15 | 0.55±0.10 | 0.50±0.20 | 0.50±0.20 |
| TL10     | 5.00±0.20 | 2.50±0.15 | 0.55±0.10 | 0.60±0.25 | 0.60±0.25 |
| TL12     | 6.30±0.20 | 3.20±0.20 | 0.55±0.10 | 0.65±0.25 | 0.65±0.25 |
| TL12(3W) | 6.30±0.20 | 3.20±0.20 | 0.70±0.15 | 0.65±0.25 | 0.65±0.25 |

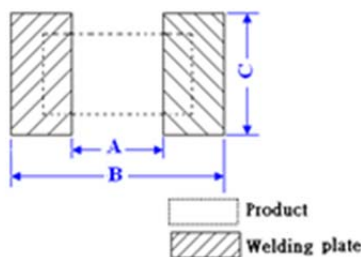
| Type                        | L         | W         | H        | A         | B         |
|-----------------------------|-----------|-----------|----------|-----------|-----------|
| TL06<br>(10 mΩ ≤ R < 39 mΩ) | 3.30±0.20 | 1.70±0.20 | 0.65±0.2 | 0.20±0.15 | 0.68±0.20 |

**7. Structure**



|   |  |   |                         |
|---|--|---|-------------------------|
| ① | Alumina Substrate  | ⑥ | Top Protective Overcoat |
| ② | Resistive Layer  | ⑦ | Marking                 |
| ③ | Bottom Inner Electrode (Cu)                                  | ⑧ | Side Inner Electrode    |
| ④ | Top Inner Electrode  | ⑨ | Barrier Layer (Ni)      |
| ⑤ | Bottom Protective Overcoat<br>White(≥ 39mR)<br>Green(< 39mR) | ⑩ | Solder coating (Sn)     |

8. Soldering pad size recommended



| Type                        | Dimension(mm) |      |      |
|-----------------------------|---------------|------|------|
|                             | A             | B    | C    |
| TL01                        | 0.25          | 0.85 | 0.35 |
| TL02                        | 0.50          | 1.60 | 0.70 |
| TL03                        | 0.80          | 2.40 | 1.00 |
| TL05                        | 1.30          | 2.90 | 1.45 |
| TL06                        | 2.20          | 4.20 | 1.80 |
| TL06<br>(10 mΩ ≤ R < 39 mΩ) | 1.20          | 4.80 | 1.84 |
| TL07                        | 2.00          | 4.40 | 2.70 |
| TL10                        | 3.80          | 6.60 | 2.70 |
| TL12                        | 4.90          | 8.10 | 3.40 |

9. Derating Curve

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

Voltage rating:

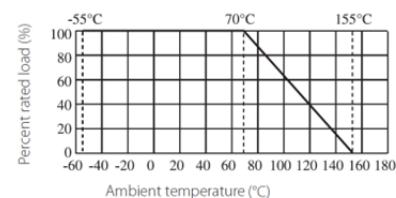
Rated Current: The resistor shall have a DC continuous working current or a AC (rms) continuous working current at commercial-line frequency and wave form corresponding to the power rating, as determined formula as following:

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

I = Rating current (A)

P= Rating Power (W)

R= Resistance(Ω)



10. Performance Specification

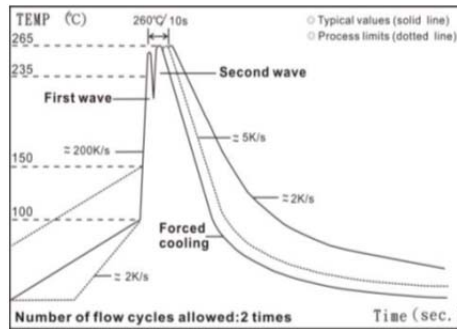
| Test Item                                     | Test Method              | Procedure   | Requirements                                |
|---|--------------------------|---|---|
| Temperature Coefficient of Resistance (T.C.R) | JIS C 5201-1 clause 4.8  | TCR +125 °C, 25 °C is the reference temperature   | Refer to Standard Electrical Specifications |
| Short Time Overload                           | JIS C 5201-1 clause 4.13 | Standard power : 6.25 times rated power whichever is less for 5 seconds.  | ±(1.0%+0.001Ω)                              |
|   |                          | High power (2X/4X) : 5 times rated power whichever is less for 5 seconds.   |   |
| Insulation Resistance                         | JIS C 5201-1 clause 4.6  | 100V for 1 minute.  | ≥ 10GΩ                                      |
| Dielectric Withstanding Voltage               | JIS-C5201-1 clause 4.7   | TL05、TL06、TL07、TL10、TL12 for 500 VAC 1min<br>TL01、TL02、TL03 for 300 VAC 1min  | No short or burned on the appearance.       |
| Core Body Strength                            | JIS-C5201-1 clause 4.15  | Central part pressurizing force : 10N , 10 seconds  | No broken                                   |
| Solderability                                 | JIS C 5201-1 clause 4.17 | 245±5°C for 3±0.5secs.  | >95% Coverage<br>No Visual damage           |
| Resistance to Soldering Heat                  | JIS-C5201-1 clause 4.18  | 1. Molten solder, 260±5 °C, 10±1 seconds immersion time<br>2. IR reflow, refer to solder reflow temperature condition | ±(1.0%+0.001Ω)<br>No Visual damage          |
| Leaching                                      | JIS-C5201-1 clause 4.18  | 260±5°C for 30 seconds.   | >95% Coverage<br>No Visual damage           |
| Temperature Cycling                           | JIS C 5201-1 clause 4.19 | -55°C to +155°C, 300 cycles   | ±(1.0%+0.001Ω)<br>No Visual damage          |

|                           |                          |   |                                    |
|---------------------------|--------------------------|---|------------------------------------|
| Load Life in Humidity     | JIS C 5201-1 clause 4.24 | 40±2°C, 90~95% R.H. , Rated power or Max. working current whichever is less for 1000 hrs with 1.5 hrs "ON" and 0.5 hr "OFF" .       | ±(1.0%+0.001Ω)                     |
| Load Life (Endurance)     | JIS C 5201-1 clause 4.25 | 70±2°C, Rated power, or Max. working current whichever is less for 1000 hrs with 1.5 hrs "ON" and 0.5 hr "OFF" .                    | ±(1.0%+0.001Ω)                     |
| High Temperature Exposure | JIS C 5201-1 clause 4.25 | 155±5°C for 1000 +48/-0 hours.  | ±(1.0%+0.001Ω)                     |
| Resistance to Solvent     | JIS C 5201-1 clause 4.29 | The tested resistor be immersed into isopropyl alcohol of 20~25°C for 60 secs.<br>Then the resistor is left in the room for 48 hrs. | ±(1.0%+0.001Ω)<br>No Visual damage |
| Terminal Strength         | JIS-C5201-1 clause 4.32  | Pressurizing force for 10 seconds<br>TL01 / TL02 / TL03 : 8N ; TL05 and above : 17.7N   | No broken                          |
| Terminal Bending Strength | JIS C 5201-1 clause 4.33 | Bending once for 5 seconds<br>D : TL01、TL02、TL03、TL05 = 5mm<br>TL06、TL07 = 3mm<br>TL10、TL12 = 2mm                                   | ±(1.0%+0.001Ω)<br>No Visual damage |

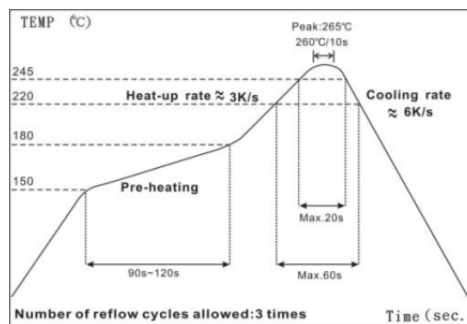
Temperature Coefficient of Resistance test to - 55 °C is available on request

**11. Recommended Customer Soldering Parameters**

11.1 Wave solder Temperature condition



11.2 Solder reflow Temperature condition



11.3 Rework temperature ( hot air equipment ) : 350°C, 3~5seconds

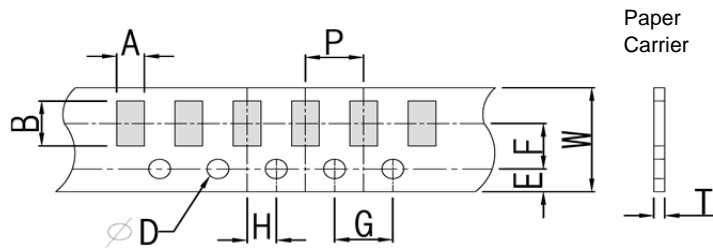
11.4 Recommended reflow methods

IR, vapor phase oven, hot air oven

If reflow temperatures exceed the recommended profile, devices may not meet the performance requirements.

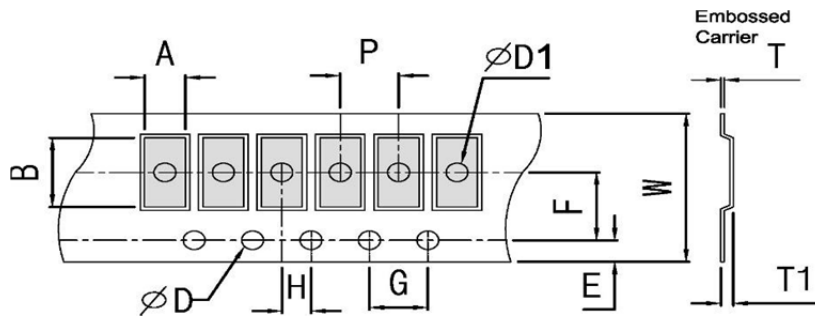
**12. Packing**

12.1 Tapping Specification:(Unit: mm)



| Packaging  | Type | A        | B        | W       | E        | F        | G       | H        | T        | $\psi D$                          | P       |
|------------|------|----------|----------|---------|----------|----------|---------|----------|----------|-----------------------------------|---------|
| Paper Type | TL01 | 0.45±0.1 | 0.75±0.1 | 8.0±0.2 | 1.75±0.1 | 3.5±0.05 | 4.0±0.1 | 2.0±0.05 | 0.35±0.1 | 1.50 <sup>+0.1</sup> <sub>0</sub> | 2.0±0.1 |
|            | TL02 | 0.7±0.1  | 1.20±0.1 | 8.0±0.2 | 1.75±0.1 | 3.5±0.05 | 4.0±0.1 | 2.0±0.05 | 0.45±0.1 |                                   | 2.0±0.1 |
|            | TL03 | 1.05±0.2 | 1.80±0.2 | 8.0±0.2 | 1.75±0.1 | 3.5±0.05 | 4.0±0.1 | 2.0±0.05 | 0.60±0.1 |                                   | 4.0±0.1 |
|            | TL05 | 1.55±0.2 | 2.30±0.2 | 8.0±0.2 | 1.75±0.1 | 3.5±0.05 | 4.0±0.1 | 2.0±0.05 | 0.75±0.1 |                                   | 4.0±0.1 |
|            | TL06 | 1.90±0.2 | 3.05±0.2 | 8.0±0.2 | 1.75±0.1 | 3.5±0.05 | 4.0±0.1 | 2.0±0.05 | 0.75±0.1 |                                   | 4.0±0.1 |
|            | TL07 | 2.85±0.2 | 3.05±0.2 | 8.0±0.2 | 1.75±0.1 | 3.5±0.05 | 4.0±0.1 | 2.0±0.05 | 0.75±0.1 |                                   | 4.0±0.1 |

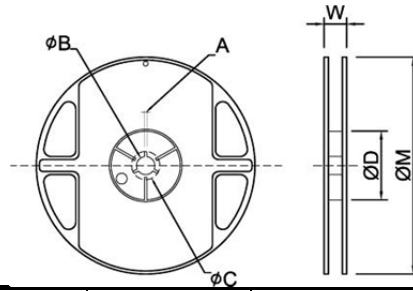
12.2 Embossed Dimension:(Unit: mm)



| Packaging     | Type | A        | B        | W      | E        | F        | G       | H        | T        | $\Phi D$                          | $\Phi D1$ | T1        | P       |
|---------------|------|----------|----------|--------|----------|----------|---------|----------|----------|-----------------------------------|-----------|-----------|---------|
| Embossed Type | TL10 | 2.80±0.2 | 5.60±0.2 | 12±0.1 | 1.75±0.1 | 5.5±0.05 | 4.0±0.1 | 2.0±0.05 | 0.23±0.1 | 1.50 <sup>+0.1</sup> <sub>0</sub> | 1.50±0.1  | 0.85±0.15 | 4.0±0.1 |
|               | TL12 | 3.40±0.2 | 6.70±0.2 | 12±0.1 | 1.75±0.1 | 5.5±0.05 | 4.0±0.1 | 2.0±0.05 | 0.23±0.1 |                                   | 1.50±0.1  | 0.85±0.15 | 4.0±0.1 |



12.3 Dimension of Reel : (Unit: mm)



| TYPE | SIZE |          | A       | ΦB       | ΦC     | ΦD     | W        | ΦM      |
|------|------|----------|---------|----------|--------|--------|----------|---------|
| TL01 | 7"   | 10K/Reel | 2.0±0.5 | 13.5±1.0 | 21±1.0 | 60±1.0 | 11.5±2.0 | 178±2.0 |
| TL02 | 7"   | 10K/Reel | 2.0±0.5 | 13.5±1.0 | 21±1.0 | 60±1.0 | 11.5±2.0 | 178±2.0 |
| TL03 | 7"   | 5K/Reel  | 2.0±0.5 | 13.5±1.0 | 21±1.0 | 60±1.0 | 11.5±2.0 | 178±2.0 |
| TL05 | 7"   | 5K/Reel  | 2.0±0.5 | 13.5±1.0 | 21±1.0 | 60±1.0 | 11.5±2.0 | 178±2.0 |
| TL06 | 7"   | 5K/Reel  | 2.0±0.5 | 13.5±1.0 | 21±1.0 | 60±1.0 | 11.5±2.0 | 178±2.0 |
| TL07 | 7"   | 5K/Reel  | 2.0±0.5 | 13.5±1.0 | 21±1.0 | 60±1.0 | 11.5±2.0 | 178±2.0 |
| TL10 | 7"   | 4K/Reel  | 2.0±0.5 | 13.5±1.0 | 21±1.0 | 60±1.0 | 11.5±2.0 | 178±2.0 |
| TL12 | 7"   | 4K/Reel  | 2.0±0.5 | 13.5±1.0 | 21±1.0 | 60±1.0 | 16.0±2.0 | 178±2.0 |

**13. Note**

- 13.1. UNI-ROYAL recommend products store in warehouse with temperature between  $25 \pm 5^{\circ}\text{C}$  under humidity between  $60 \pm 20\% \text{RH}$ .  
 Even under storage conditions recommended above, solder ability of products will be degraded stored over 1 year old.
- 13.2. Cartons must be placed in correct direction which indicated on carton, otherwise the reel or wire will be deformed.
- 13.3. Storage conditions as below are inappropriate:
  - a. Stored in high electrostatic environment
  - b. Stored in direct sunshine, rain, snow or condensation.
  - c. Exposed to sea wind or corrosive gases, such as  $\text{Cl}_2$ ,  $\text{H}_2\text{S}$ ,  $\text{NH}_3$ ,  $\text{SO}_2$ ,  $\text{NO}_2$ , etc.

**14. Record**

| Version | Description           | Page | Date         | Amended by  | Checked by |
|---------|-----------------------|------|--------------|-------------|------------|
| 1       | First version         | 1~9  | Nov.21, 2019 | Haiyan Chen | Yuhua Xu   |
| 2       | Add the TL12 3W power | 4~5  | Jun.06, 2019 | Haiyan Chen | Yuhua Xu   |
| 3       | Modify the power      | 4    | Sep.09, 2019 | Haiyan Chen | Yuhua Xu   |

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