



UNI-ROYAL
厚聲集團

DATA SHEET

Product Name Anti- Electro Static Discharge Thick Film Chip Resistors

Part Name ES Series

File No. SMD-SP-011

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1. Scope

- 1.1 This datasheet is the characteristics of Anti- Electro Static Discharge Thick Film Chip Resistors manufactured by UNI-ROYAL.
- 1.2 High voltage
- 1.3 Suitable for reflow & wave soldering
- 1.4 Application Medical Devices, Industrial Controls, AV adapter, Flash lamp of camera Automotive Industry, Outdoor Equipments.
- 1.5 AEC-Q200 qualified.

2. Part No. System

Part No. includes 14 codes shown as below:

2.1 1st~4th codes: Part name. E.g.: ES01、ES02、ES03、ES05、ES06、ES07

2.2 5th~6th codes: Power rating.

| E.g.: W=Normal Size | “1~G” = “1~16” | | | | | |
|---------------------|----------------|-----|------|------|-----|-----|
| Wattage | 1/2 | 1/4 | 1/16 | 1/20 | 2/3 | 2/5 |
| Normal Size | W2 | W4 | WG | WM | WK | 04 |

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

E.g.: WM=1/20W W4=1/4W

2.3 7th code: Tolerance. E.g.: F=±1% J=±5%

2.4 8th~11th codes: Resistance Value.

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

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

2.4.3 11th codes listed as following:

0=10⁰ 1=10¹ 2=10² 3=10³ 4=10⁴ 5=10⁵ 6=10⁶ J=10⁻¹ K=10⁻² L=10⁻³ M=10⁻⁴

2.5 12th~14th codes.

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

2.5.2 13th code: Standard Packing Quantity.

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

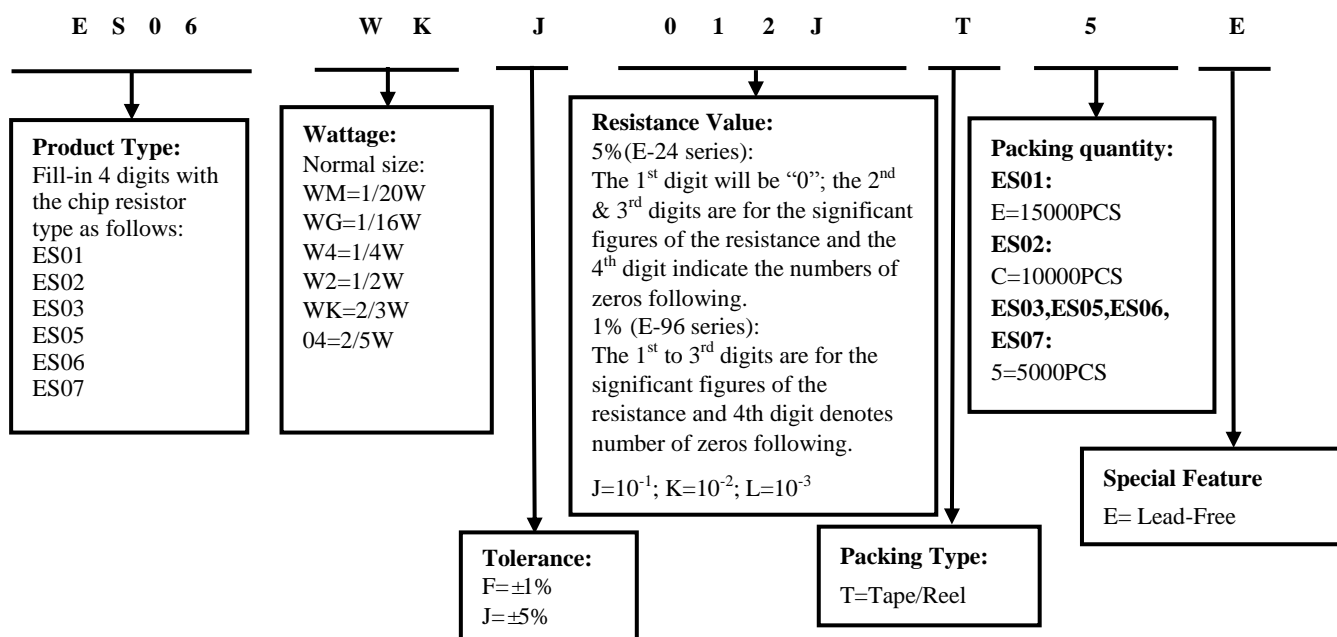
Chip Product: BD=B/B-20000pcs TC=T/R-10000pcs

2.5.3 14th code: Special features.

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

3. Ordering Procedure

(Example: ES06 2/3W ±5% 1.2Ω T/R-5000)



4. Marking

4.1 For ES01 and ES02 size. Due to the very ES01、ES02 small size of the resistor's body, there is no marking on the body.



4.2 $\pm 5\%$ tolerance products (E-24 series):

3 codes.

1st~2nd codes are the significant figures of resistance value, and the rest code is the power of ten.



333 \rightarrow 33K Ω

4.3 $\pm 1\%$ tolerance products (E-96 series):

4 codes.

1st~3rd 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 Ω

4.4 Standard E-96 series values of 0603 $\leq 1\%$: 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 0603 $\leq \pm 1\%$ 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 0603 $\leq \pm 1\%$ 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 Ω = $196 \times 10^1 \Omega$ = 29B



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

4.5 Standard E-24 and not belong to E-96 series values ($\leq \pm 1\%$) of 0603 size: the marking is the same as 5% tolerance but marking as underline.



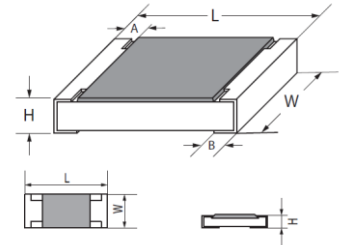
333=33K Ω



680=68 Ω

5. Dimension

| Type | Dimension(mm) | | | | |
|------------|---------------|-----------------|-----------|-----------|-----------|
| | L | W | H | A | B |
| ES01(0201) | 0.60±0.03 | 0.30±0.03 | 0.23±0.03 | 0.10±0.05 | 0.15±0.05 |
| ES02(0402) | 1.00±0.10 | 0.50±0.05 | 0.35±0.05 | 0.20±0.10 | 0.25±0.10 |
| ES03(0603) | 1.60±0.10 | 0.80±0.10 | 0.45±0.10 | 0.30±0.20 | 0.30±0.20 |
| ES05(0805) | 2.00±0.15 | 1.25+0.15/-0.10 | 0.55±0.10 | 0.40±0.20 | 0.40±0.20 |
| ES06(1206) | 3.10±0.15 | 1.55+0.15/-0.10 | 0.55±0.10 | 0.45±0.20 | 0.45±0.20 |
| ES07(1210) | 3.10±0.10 | 2.60±0.20 | 0.55±0.10 | 0.50±0.25 | 0.50±0.20 |

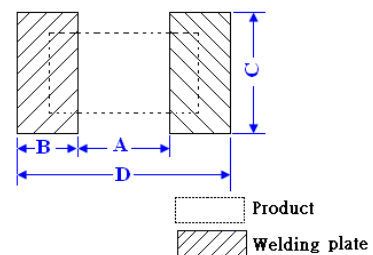


6. Resistance Range

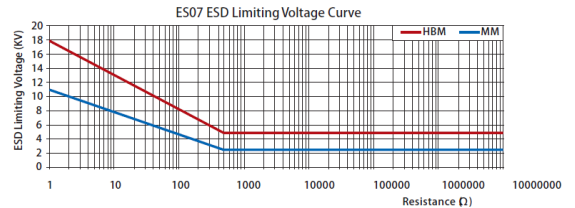
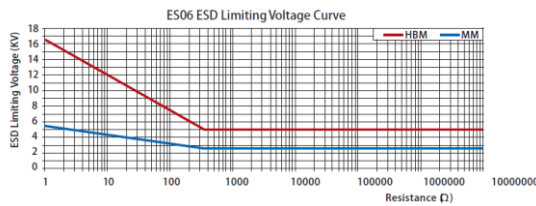
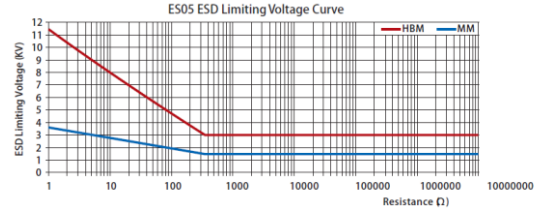
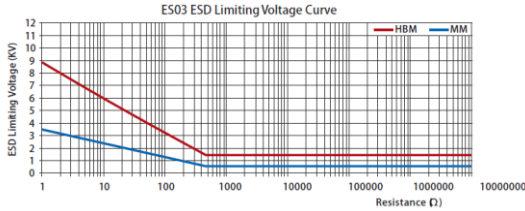
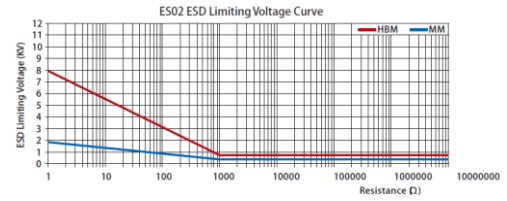
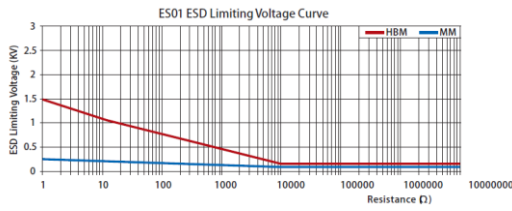
| Type | Power Rating | Max. Working Voltage | Max. Overload Voltage | Dielectric withstanding Voltage | Resistance Range $\pm 1\% & \pm 5\%$ | Operating Temperature |
|------|--------------|----------------------|-----------------------|---------------------------------|---|-------------------------|
| ES01 | 1/20W | 25V | 50V | -- | 1 Ω ~10M Ω | -55 ~ +155 $^{\circ}$ C |
| ES02 | 1/16W | 50V | 100V | 100V | | |
| ES03 | 1/4W | 150V | 200V | 300V | | |
| ES05 | 2/5W | 200V | 400V | 500V | | |
| ES06 | 2/3W | 500V | 1000V | 500V | | |
| ES07 | 1/2W | 800V | 1500V | 500V | | |

7. Soldering pad size recommended

| Type | Dimension(mm) | | | |
|------|---------------|-----------|----------|----------|
| | A | B | C | D |
| ES01 | 0.3±0.05 | 0.35±0.05 | 0.4±0.05 | 1.0±0.05 |
| ES02 | 0.5±0.05 | 0.5±0.05 | 0.6±0.05 | 1.5±0.05 |
| ES03 | 0.8±0.05 | 0.8±0.05 | 0.9±0.05 | 2.4±0.05 |
| ES05 | 1.0±0.1 | 1±0.1 | 1.4±0.1 | 3±0.1 |
| ES06 | 2.0±0.1 | 1.1±0.1 | 1.8±0.1 | 4.2±0.1 |
| ES07 | 2.0±0.1 | 1.1±0.1 | 2.9±0.1 | 4.2±0.1 |



8. ESD Limiting Voltage Curve



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:

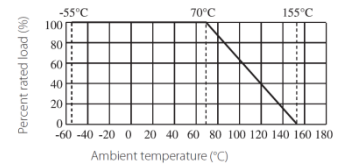
Resistors shall have a rated direct-current (DC) continuous working voltage or an approximate sine-wave root-mean-square (RMS) alternating-current (AC) continuous working voltage at commercial-line frequency and waveform corresponding to the power rating, as determined from the following formula:

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

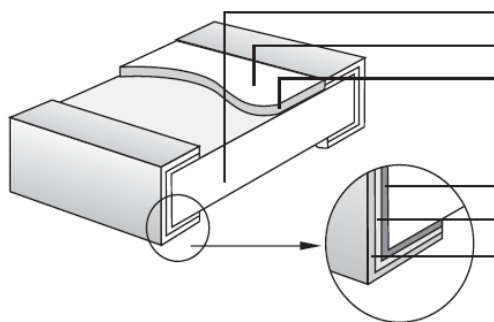
Remark: RCWV: Rating Continuous Working Voltage (Volt) P: power rating (Watt) R: nominal resistance (Ω)

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



1. High purity Alumina substrate
2. Protective coating
3. Resistance element
4. Termination (Inner) Ni / Cr
5. Termination (Between) Ni Barrier
6. Termination (Outer) Sn

11. Performance Specification

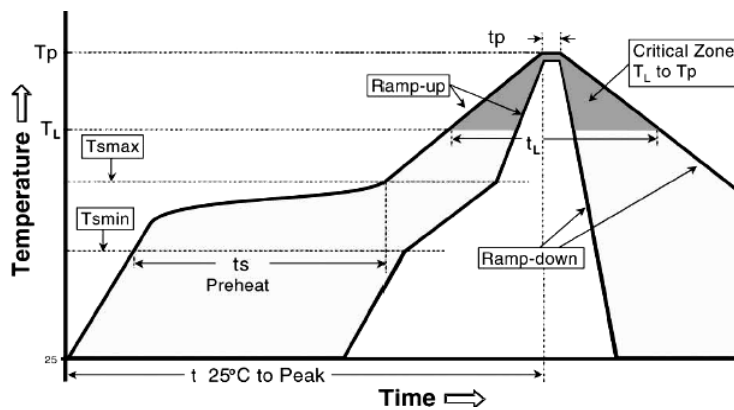
| Characteristic | Limits | Ref. Standards | Test Methods |
|-------------------------------------|--|--|--|
| Operational life | ±1%: ±(1.0%+0.1Ω) ±5%: ±(3.0%+0.1Ω) | MIL-STD-202 | 125°C, at 36% of operating power, 1000H(1.5 hours “ON”, 0.5 hour “OFF”). |
| Electrical Characterization | ES01: 1Ω≤R≤10Ω: ±400PPM/°C 10Ω<R≤10MΩ: ±200PPM/°C ES02、ES03、ES05、ES06、ES07: 1Ω≤R≤10Ω: ±200PPM/°C 10Ω<R≤10MΩ: ±100PPM/°C | GB/T 5729 4.8 JIS-C-5201 4.8 IEC60115-1 4.8 | Natural resistance changes per temp. Degree centigrade $\frac{R_2-R_1}{R_1(t_2-t_1)} \times 10^6$ (PPM/°C) R ₁ : Resistance Value at room temperature (t ₁) ; R ₂ : Resistance at test temperature (t ₂) t ₁ : +25 °C or specified room temperature t ₂ : Test temperature (-55°C or 125°C) |
| Short-time overload | ±1%: ±(1.0%+0.1Ω) ±5%: ±(2.0%+0.1Ω) | GB/T 5729 4.13 JIS-C-5201 4.13 IEC60115-1 4.13 | 4.13 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 | 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. Note: User(s) and Suppliers spec. Electrical test not required. |
| Resistance to Solvent | Marking Unsmearred | MIL-STD-202 Method 215 | Note: Add Aqueous wash chemical – OKEM Clean or equivalent. Do not use banned solvents. |
| Terminal Strength | Not broken | JIS-C-6429 | ES01、ES02:5N; others:17.7N, 60±1 seconds. |
| High Temperature Exposure (Storage) | ±1%: ±(1.0%+0.1Ω) ±5%: ±(3.0%+0.1Ω) | MIL-STD-202 Method 108 | 1000hrs. @T=155°C. Unpowered. Measurement at 24±2 hours after test conclusion. |
| Temperature Cycling | ±1%: ±(0.5%+0.05Ω) ±5%: ±(1.0%+0.05Ω) | JESD22 Method JA-104 | 1000 Cycles (-55°C to +155°C). Measurement at 24±2 hours after test conclusion. |
| Biased Humidity | ±1%: ±(1.0%+0.1Ω) ±5%: ±(3.0%+0.1Ω) | MIL-STD-202 Method 103 | 1000 hours 85°C, 85%RH. Note: Specified conditions: 10% of operating power. Measurement at 24±2 hours after test conclusion. |
| Mechanical Shock | ±1%: ±(1.0%+0.1Ω) ±5%: ±(2.0%+0.1Ω) | MIL-STD-202 Method 213 | Wave Form: Tolerance for half sine shock pulse. Peak value is 100g's. Normal duration (D) is 6. |
| Vibration | ±1%: ±(1.0%+0.1Ω) ±5%: ±(2.0%+0.1Ω) | MIL-STD-202 Method 204 | 5g's for 20 min., 12cycle each of 3 orientations. 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 | ±(1.0%+0.05Ω) | AEC-Q200-002 | HBM:100PF 1K5 1Cycle MM: 200PF 0E 1Cycle Note: ESD Voltag Refer to 4.0 |
| Solderability | Coverage must be over 95%. | J-STD-002 | For both leaded & SMD. Electrical test not required. Magnification 50X. Conditions: a) Method B 4hrs at 155°C dry heat, the dip in bath with 245±3°C, 5±0.5s. b) Method D: at 260±3°C, 30±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 | $\pm(1.0\%+0.05\Omega)$ | JIS-C-6429 | 2mm (Min) |
| 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 Method 210 | Condition B No per-heat of samples. Dipping the resistor into a solder bath having a temperature of 260°C \pm 5°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)

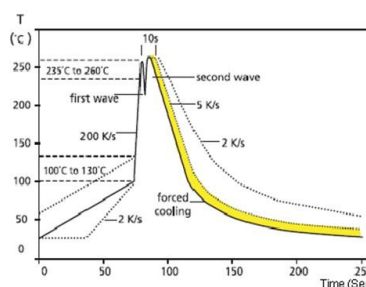


| Profile Feature | Lead (Pb)-Free solder |
|---|----------------------------------|
| Preheat: Temperature Min ($T_{s_{min}}$) Temperature Max ($T_{s_{max}}$) Time ($T_{s_{min}}$ to $T_{s_{max}}$) (t_s) | 150°C 200°C 60 -120seconds |
| Average ramp-up rate: (T_s max to T_p) | 3°C / second max. |
| Time maintained above : Temperature (T_l) Time (t_l) | 217°C 60-150 seconds |
| Peak Temperature (T_p) | 260°C |
| Time within $+0$ -5 °C of actual peak Temperature (t_p) ² | 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 N2 Re-flow furnace .

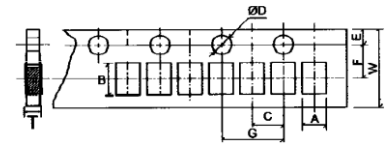
12.2 Recommend Wave Soldering Profile : (Apply to 0603 and above size)



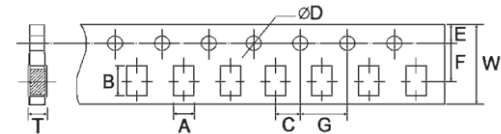
13. Packing

13.1 Dimension of Paper Taping :(Unit: mm)

| Type | A | B | C ±0.05 | $\Phi D_{-0}^{+0.1}$ | E ±0.1 | F ±0.05 | G ±0.1 | W ±0.2 | T |
|------|-----------|-----------|------------|----------------------|-----------|------------|-----------|-----------|-----------|
| ES01 | 0.40±0.05 | 0.70±0.05 | 2.00 | 1.50 | 1.75 | 3.50 | 4.00 | 8.00 | 0.42±0.1 |
| ES02 | 0.65±0.10 | 1.20±0.10 | 2.00 | 1.50 | 1.75 | 3.50 | 4.00 | 8.00 | 0.42±0.05 |

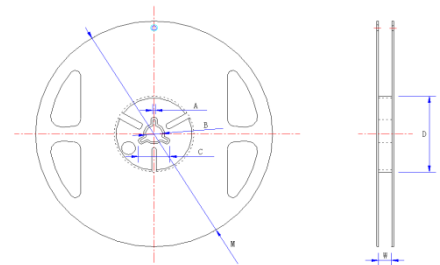


| Type | A ±0.2 | B ±0.2 | C ±0.05 | $\Phi D_{-0}^{+0.1}$ | E ±0.1 | F ±0.05 | G ±0.1 | W ±0.2 | T ±0.1 |
|------|-----------|-----------|------------|----------------------|-----------|------------|-----------|-----------|-----------|
| ES03 | 1.10 | 1.90 | 2.00 | 1.50 | 1.75 | 3.50 | 4.00 | 8.00 | 0.67 |
| ES05 | 1.65 | 2.40 | 2.00 | 1.50 | 1.75 | 3.50 | 4.00 | 8.00 | 0.81 |
| ES06 | 2.00 | 3.60 | 2.00 | 1.50 | 1.75 | 3.50 | 4.00 | 8.00 | 0.81 |
| ES07 | 2.80 | 3.50 | 2.00 | 1.50 | 1.75 | 3.50 | 4.00 | 8.00 | 0.75 |



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 |
|------|--------|-----------|-----------|-----------|-----------|---------|---------|---------|
| ES01 | Paper | 15,000pcs | 2.0 | 13.0 | 21.0 | 60.0 | 178.0 | 10.0 |
| ES02 | Paper | 10,000pcs | 2.0 | 13.0 | 21.0 | 60.0 | 178.0 | 10.0 |
| ES03 | Paper | 5,000pcs | 2.0 | 13.0 | 21.0 | 60.0 | 178.0 | 10.0 |
| ES05 | Paper | 5,000pcs | 2.0 | 13.0 | 21.0 | 60.0 | 178.0 | 10.0 |
| ES06 | Paper | 5,000pcs | 2.0 | 13.0 | 21.0 | 60.0 | 178.0 | 10.0 |
| ES07 | 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 Cl₂, H₂S, NH₃, SO₂, NO₂, Br etc.

15. Record

| Version | Description | Page | Date | Amended by | Checked by |
|---------|--|------|---------------|-------------|-------------|
| 1 | First version | 1~7 | Mar.20, 2018 | Haiyan Chen | Nana Chen |
| 2 | Modify ES01 packing quantity | 7 | Jun.06, 2018 | Haiyan Chen | Nana Chen |
| 3 | Modify characteristic | 5 | Feb.13, 2019 | Haiyan Chen | Yuhua Xu |
| 4 | Modify the High Temperature Exposure conditions | 7 | July.29, 2019 | Haiyan Chen | Yuhua Xu |
| 5 | Modify the reflow curve and add the wave soldering curve | 6 | Apr.29, 2020 | Haiyan Chen | Yuhua Xu |
| 6 | Add 0603 marking | 3~4 | Oct.08,2022 | Song Nie | Haiyan Chen |
| 7 | Modify the temperature coefficient test conditions | 6 | Oct.26, 2022 | Haiyan Chen | Yuhua Xu |
| 8 | Modify the performance meets AEC-Q200 qualified . | 6~7 | Oct.20, 2023 | Haiyan Chen | Yuhua Xu |