

## 05D Series Data Sheet

### Features

- Wide operating voltage ( $V_{1mA}$ ) range from 18V to 750V
- Fast responding to transient over-voltage
- Large absorbing transient energy capability
- Low clamping ratio and no follow-on current
- Meets MSL level1, per J-STD-020
- Operating temperature:  $-40^{\circ}\text{C} \sim +85^{\circ}\text{C}$
- Storage Temperature:  $-40^{\circ}\text{C} \sim +125^{\circ}\text{C}$

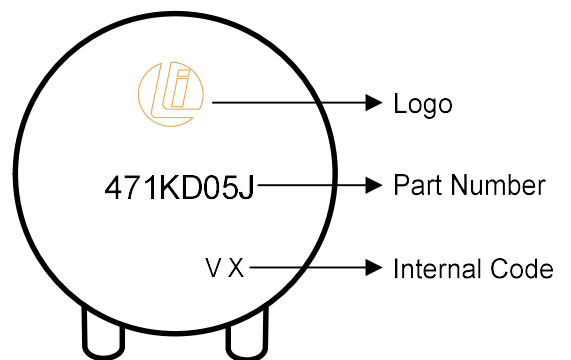
### Applications

- Transistor, diode, IC, SCR or SCR semiconductor protection
- Surge protection in consumer electronics
- Surge protection in industrial electronics
- Surge protection in electronic home appliances, gas and petroleum appliances
- Relay and electromagnetic valve surge absorption

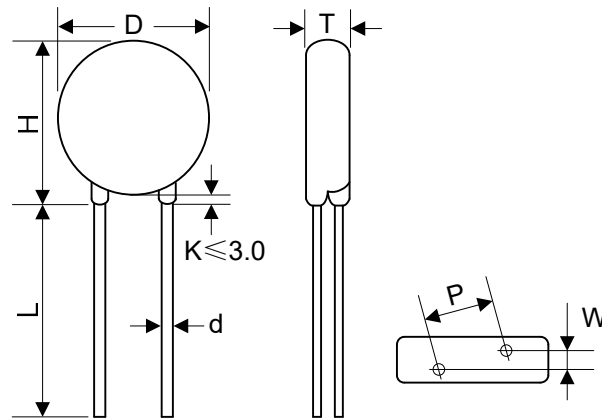
### Part Number Code and Marking Code

471 KD 05 J — TB

- TB: Tape & Box packing  
TR: Tape & Reel packing  
Blank: Bulk packing
- J: High surge type  
Blank: Standard surge type
- Element Diameter:  $\Phi 5\text{mm}$
- $\pm 10\%$  of  $V_{1mA}$ , Disk Type
- $V_{1mA} = 47 \times 10^1 \text{V} = 470\text{V}$



Dimensions



Straight leads

| Item           | D       | H        | L     | d        | P       | T                            | W |
|----------------|---------|----------|-------|----------|---------|------------------------------|---|
| Dimension (mm) | 5.0~7.5 | 5.5~10.0 | ≥20.0 | 0.6±0.05 | 5.0±0.8 | Refer to the following table |   |

| Model | T       | W       | Model | T       | W       | Model | T       | W       |
|-------|---------|---------|-------|---------|---------|-------|---------|---------|
| 180K  | 1.5~4.5 | 1.3±0.8 | 121K  | 1.9~4.5 | 2.0±0.8 | 391K  | 2.5~5.4 | 2.6±0.8 |
| 220K  | 1.6~4.6 | 1.4±0.8 | 151K  | 1.7~4.8 | 1.6±0.8 | 431K  | 2.7~5.7 | 2.8±0.8 |
| 270K  | 1.6~4.7 | 1.6±0.8 | 181K  | 1.8~4.3 | 1.7±0.8 | 471K  | 2.8~6.0 | 3.0±0.8 |
| 330K  | 1.7~4.9 | 1.5±0.8 | 201K  | 1.9~4.4 | 1.8±0.8 | 511K  | 2.9~6.2 | 3.2±0.8 |
| 390K  | 1.6~4.8 | 1.6±0.8 | 221K  | 2.0~4.5 | 1.9±0.8 | 561K  | 3.1~6.5 | 3.4±0.8 |
| 470K  | 1.7~4.9 | 1.7±0.8 | 241K  | 2.1~4.6 | 2.0±0.8 | 621K  | 3.3~6.5 | 3.7±0.8 |
| 560K  | 1.8~5.0 | 1.9±0.8 | 271K  | 2.1~4.9 | 2.2±0.8 | 681K  | 3.5~6.8 | 4.0±0.8 |
| 680K  | 1.9~5.2 | 2.2±0.8 | 301K  | 2.2~5.0 | 2.3±0.8 | 751K  | 3.8~6.9 | 4.1±0.8 |
| 820K  | 1.6~4.1 | 1.6±0.8 | 331K  | 2.2~5.1 | 2.3±0.8 |       |         |         |
| 101K  | 1.9~4.3 | 1.8±0.8 | 361K  | 2.4~5.2 | 2.5±0.8 |       |         |         |

### Electrical Characteristics

| Model    | Varistor Voltage | Maximum Allowable Voltage |              | Maximum Clamping Voltage |           | Surge Current | Maximum Energy (10/1000 $\mu$ s) | Maximum Leakage Current @83% of $V_{1mA}$ | Rated Power | Typical Capacitance (Reference) |
|----------|------------------|---------------------------|--------------|--------------------------|-----------|---------------|----------------------------------|---|-------------|---------------------------------|
|          | $V_{1mA}$ (V)    | $V_{AC}$ (V)              | $V_{DC}$ (V) | $I_P$ (A)                | $V_C$ (V) | I (A)         | E (J)                            | $I_R$ ( $\mu$ A)                          | P (W)       | @1KHz (pF)                      |
| 180KD05  | 18(15~21.6)      | 11                        | 14           | 1                        | 40        | 100           | 0.4                              | 50  | 0.01        | 1400                            |
| 180KD05J | 18(15~21.6)      | 11                        | 14           | 1                        | 40        | 250           | 0.6                              | 50  | 0.01        | 1400                            |
| 220KD05  | 22(19.5~26)      | 14                        | 18           | 1                        | 48        | 100           | 0.5                              | 50  | 0.01        | 1150                            |
| 220KD05J | 22(19.5~26)      | 14                        | 18           | 1                        | 48        | 250           | 0.7                              | 50  | 0.01        | 1150                            |
| 270KD05  | 27(24~31)        | 17                        | 22           | 1                        | 60        | 100           | 0.6                              | 50  | 0.01        | 930                             |
| 270KD05J | 27(24~31)        | 17                        | 22           | 1                        | 60        | 250           | 0.9                              | 50  | 0.01        | 930                             |
| 330KD05  | 33(29.5~36.5)    | 20                        | 26           | 1                        | 73        | 100           | 0.8                              | 50  | 0.01        | 760                             |
| 330KD05J | 33(29.5~36.5)    | 20                        | 26           | 1                        | 73        | 250           | 1.1                              | 50  | 0.01        | 760                             |
| 390KD05  | 39(35~43)        | 25                        | 31           | 1                        | 80        | 100           | 0.9                              | 50  | 0.01        | 640                             |
| 390KD05J | 39(35~43)        | 25                        | 31           | 1                        | 80        | 250           | 1.2                              | 50  | 0.01        | 640                             |
| 470KD05  | 47(42~52)        | 30                        | 38           | 1                        | 104       | 100           | 1.1                              | 50  | 0.01        | 530                             |
| 470KD05J | 47(42~52)        | 30                        | 38           | 1                        | 104       | 250           | 1.5                              | 50  | 0.01        | 530                             |
| 560KD05  | 56(50~62)        | 35                        | 45           | 1                        | 123       | 100           | 1.3                              | 50  | 0.01        | 450                             |
| 560KD05J | 56(50~62)        | 35                        | 45           | 1                        | 123       | 250           | 1.8                              | 50  | 0.01        | 450                             |
| 680KD05  | 68(61~75)        | 40                        | 56           | 1                        | 145       | 100           | 1.6                              | 50  | 0.01        | 370                             |
| 680KD05J | 68(61~75)        | 40                        | 56           | 1                        | 145       | 250           | 2.2                              | 50  | 0.01        | 370                             |
| 820KD05  | 82(74~90)        | 50                        | 65           | 5                        | 150       | 400           | 2.5                              | 25  | 0.1         | 300                             |
| 820KD05J | 82(74~90)        | 50                        | 65           | 5                        | 150       | 800           | 4.0                              | 25  | 0.1         | 300                             |
| 101KD05  | 100(90~110)      | 60                        | 85           | 5                        | 177       | 400           | 3.0                              | 25  | 0.1         | 250                             |
| 101KD05J | 100(90~110)      | 60                        | 85           | 5                        | 177       | 800           | 4.1                              | 25  | 0.1         | 250                             |
| 121KD05  | 120(108~132)     | 75                        | 100          | 5                        | 210       | 400           | 4.0                              | 25  | 0.1         | 210                             |
| 121KD05J | 120(108~132)     | 75                        | 100          | 5                        | 210       | 800           | 4.9                              | 25  | 0.1         | 210                             |
| 151KD05  | 150(135~165)     | 95                        | 125          | 5                        | 260       | 400           | 4.1                              | 25  | 0.1         | 165                             |
| 151KD05J | 150(135~165)     | 95                        | 125          | 5                        | 260       | 800           | 6.5                              | 25  | 0.1         | 165                             |
| 181KD05  | 180(162~198)     | 115                       | 150          | 5                        | 320       | 400           | 4.9                              | 25  | 0.1         | 140                             |
| 181KD05J | 180(162~198)     | 115                       | 150          | 5                        | 320       | 800           | 7.5                              | 25  | 0.1         | 140                             |
| 201KD05  | 200(180~220)     | 130                       | 170          | 5                        | 355       | 400           | 6.5                              | 25  | 0.1         | 125                             |
| 201KD05J | 200(180~220)     | 130                       | 170          | 5                        | 355       | 800           | 8.5                              | 25  | 0.1         | 125                             |

### Electrical Characteristics

| Model    | Varistor Voltage | Maximum Allowable Voltage |              | Maximum Clamping Voltage |           | Surge Current | Maximum Energy (10/1000 $\mu$ s) | Maximum Leakage Current @83% of $V_{1mA}$ | Rated Power | Typical Capacitance (Reference) |
|----------|------------------|---------------------------|--------------|--------------------------|-----------|---------------|----------------------------------|---|-------------|---------------------------------|
|          | $V_{1mA}$ (V)    | $V_{AC}$ (V)              | $V_{DC}$ (V) | $I_P$ (A)                | $V_C$ (V) | I (A)         | E (J)                            | $I_R$ ( $\mu$ A)                          | P (W)       | @1KHz (pF)                      |
| 221KD05  | 220(198~242)     | 140                       | 180          | 5                        | 380       | 400           | 7.5                              | 25  | 0.1         | 110                             |
| 221KD05J | 220(198~242)     | 140                       | 180          | 5                        | 380       | 800           | 9.0                              | 25  | 0.1         | 110                             |
| 241KD05  | 240(216~264)     | 150                       | 200          | 5                        | 415       | 400           | 8.0                              | 25  | 0.1         | 100                             |
| 241KD05J | 240(216~264)     | 150                       | 200          | 5                        | 415       | 800           | 10.5                             | 25  | 0.1         | 100                             |
| 271KD05  | 270(243~297)     | 175                       | 225          | 5                        | 475       | 400           | 8.5                              | 25  | 0.1         | 95                              |
| 271KD05J | 270(243~297)     | 175                       | 225          | 5                        | 475       | 800           | 11.0                             | 25  | 0.1         | 95                              |
| 301KD05  | 300(270~330)     | 190                       | 250          | 5                        | 520       | 400           | 9.0                              | 25  | 0.1         | 85                              |
| 301KD05J | 300(270~330)     | 190                       | 250          | 5                        | 520       | 800           | 12.0                             | 25  | 0.1         | 85                              |
| 331KD05  | 330(297~363)     | 210                       | 275          | 5                        | 570       | 400           | 9.5                              | 25  | 0.1         | 75                              |
| 331KD05J | 330(297~363)     | 210                       | 275          | 5                        | 570       | 800           | 13.0                             | 25  | 0.1         | 75                              |
| 361KD05  | 360(324~396)     | 230                       | 300          | 5                        | 620       | 400           | 10.0                             | 25  | 0.1         | 70                              |
| 361KD05J | 360(324~396)     | 230                       | 300          | 5                        | 620       | 800           | 16.0                             | 25  | 0.1         | 70                              |
| 391KD05  | 390(351~429)     | 250                       | 320          | 5                        | 675       | 400           | 12.0                             | 25  | 0.1         | 65                              |
| 391KD05J | 390(351~429)     | 250                       | 320          | 5                        | 675       | 800           | 17.0                             | 25  | 0.1         | 65                              |
| 431KD05  | 430(387~473)     | 275                       | 350          | 5                        | 745       | 400           | 13.0                             | 25  | 0.1         | 60                              |
| 431KD05J | 430(387~473)     | 275                       | 350          | 5                        | 745       | 800           | 20.0                             | 25  | 0.1         | 60                              |
| 471KD05  | 470(423~517)     | 300                       | 385          | 5                        | 810       | 400           | 15.0                             | 25  | 0.1         | 55                              |
| 471KD05J | 470(423~517)     | 300                       | 385          | 5                        | 810       | 800           | 21.0                             | 25  | 0.1         | 55                              |
| 511KD05  | 510(459~561)     | 320                       | 415          | 5                        | 845       | 400           | 16.0                             | 25  | 0.1         | 50                              |
| 511KD05J | 510(459~561)     | 320                       | 415          | 5                        | 845       | 800           | 22.5                             | 25  | 0.1         | 50                              |
| 561KD05  | 560(504~616)     | 350                       | 460          | 5                        | 920       | 400           | 16.8                             | 25  | 0.1         | 45                              |
| 561KD05J | 560(504~616)     | 350                       | 460          | 5                        | 920       | 800           | 24.0                             | 25  | 0.1         | 45                              |
| 621KD05  | 620(558~682)     | 385                       | 505          | 5                        | 1025      | 400           | 17.7                             | 25  | 0.1         | 40                              |
| 621KD05J | 620(558~682)     | 385                       | 505          | 5                        | 1025      | 800           | 25.0                             | 25  | 0.1         | 40                              |
| 681KD05  | 680(612~748)     | 420                       | 560          | 5                        | 1120      | 400           | 21.0                             | 25  | 0.1         | 35                              |
| 681KD05J | 680(612~748)     | 420                       | 560          | 5                        | 1120      | 800           | 29.0                             | 25  | 0.1         | 35                              |
| 751KD05  | 750(675~825)     | 460                       | 615          | 5                        | 1240      | 400           | 22.4                             | 25  | 0.1         | 30                              |
| 751KD05J | 750(675~825)     | 460                       | 615          | 5                        | 1240      | 800           | 32.0                             | 25  | 0.1         | 30                              |

### Electrical Ratings

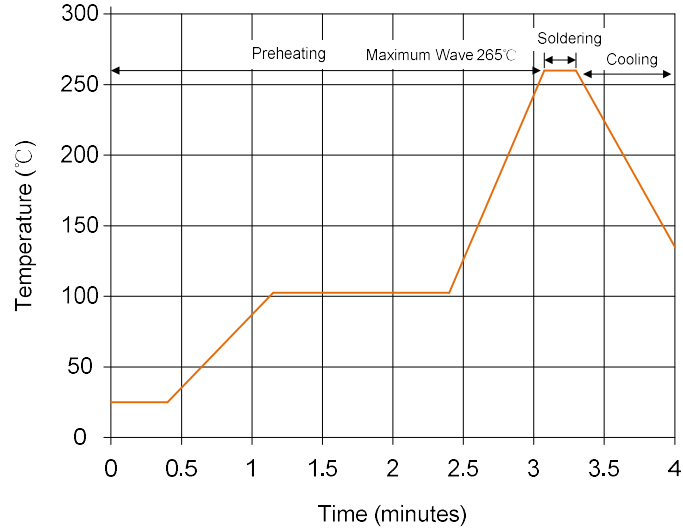
| Items                              | Test Condition/Description   |              | Requirement                                |              |
|------------------------------------|--|--------------|--|--------------|
| Varistor Voltage                   | The voltage between two terminals with the specified measuring current 1mA.DC applied is called Vb.  |              | To meet the Specified value                |              |
| Maximum Allowable Voltage          | The recommended maximum sine wave voltage (RMS) or the Maximum DC voltage can be applied continuously.   |              |  |              |
| Maximum Clamping Voltage           | The maximum voltage between two terminals with the specification standard impulse current.<br>Applied waveform: 8/20μs   |              |  |              |
| Surge Current                      | The maximum current within the varistor voltage change of ±10% with the standard impulse current (8/20μs) applied one time.  |              |  |              |
| Energy                             | The maximum energy within the varistor voltage change of ±10% when one impulse of 10/1000μs is applied.  |              |  |              |
| Leakage Current                    | The current through the varistor when 0.83V <sub>1mA</sub> is applied to both end.   |              |  |              |
| Rated Power                        | The maximum average power that can be applied within the specified ambient temperature.  |              |  |              |
| Varistor Voltage Temp. Coefficient | $\left  \frac{V_{1mA@85^{\circ}C} - V_{1mA@25^{\circ}C}}{V_{1mA@25^{\circ}C}} \times \frac{1}{60} \times 100\% (\%/^{\circ}C) \right $   |              | ≤0.05%/°C                                  |              |
|                                    | $\left  \frac{V_{1mA@-40^{\circ}C} - V_{1mA@25^{\circ}C}}{V_{1mA@25^{\circ}C}} \times \frac{1}{65} \times 100\% (\%/^{\circ}C) \right $  |              |  |              |
| Surge Life                         | The change of V <sub>1mA</sub> shall be measured after the impulse listed below which is applied 10,000 times continuously with the interval of ten seconds at room temperature. |              | ΔV <sub>1mA</sub> /V <sub>1mA</sub>   ≤10% |              |
|                                    | 05D series   | 180K to 680K |  | 10A (8/20μs) |
|                                    |  | 820K to 751K |  | 20A (8/20μs) |

Mechanical Characteristics and Reliability

| Items                         | Test conditions / Methods   |                  | Specifications  |  |
|-------------------------------|---|------------------|---|--|
| Tensile Strength of Terminals | Gradually applying the force specified and keeping the unit fixed for 10±1 sec.   |                  | No visible damage<br>$ \Delta V_{1mA}/V_{1mA}  \leq 5\%$    |  |
|                               | Terminal diameter (mm)  | Force (kg)       |   |  |
|                               | 0.5<d≤0.8   | 1.0              |   |  |
|                               | 0.8<d≤1.25  | 2.0              |   |  |
| Bending Strength of Terminals | Hold specimen and apply the force specified below to each lead. Bend the specimen to 90°, then return to the original position. Repeat the procedure in the opposite direction. |                  | No visible damage<br>$ \Delta V_{1mA}/V_{1mA}  \leq 5\%$    |  |
|                               | Terminal diameter (mm)  | Force (kg)       |   |  |
|                               | 0.5<d≤0.8   | 0.5              |   |  |
|                               | 0.8<d≤1.25  | 1.0              |   |  |
| Vibration                     | Frequency range: 10~55 Hz<br>Amplitude: 0.75mm or 98m/s <sup>2</sup><br>Direction: 3 mutually perpendicular directions, 2hrs each.  |                  | No visible damage<br>$ \Delta V_{1mA}/V_{1mA}  \leq 5\%$    |  |
|                               | Solder Temp: 245±5°C<br>Dipping Time: 2±0.5 sec   |                  |   |  |
| Solder ability                | Solder Temp: 245±5°C<br>Dipping Time: 2±0.5 sec   |                  | At least 95% of terminal electrode is covered by new solder |  |
| Resistance to Soldering Heat  | Solder Temp: 260±5°C<br>Dipping Time: 10±1 sec  |                  | No visible damage<br>$ \Delta V_{1mA}/V_{1mA}  \leq 10\%$   |  |
| High Temperature Storage      | Ambient Temp: 125±2°C<br>Duration: 1000hrs  |                  | $ \Delta V_{1mA}/V_{1mA}  \leq 5\%$                         |  |
| Low Temperature Storage       | Ambient Temp: -40±2°C<br>Duration: 1000hrs  |                  | $ \Delta V_{1mA}/V_{1mA}  \leq 5\%$                         |  |
| Humidity                      | Ambient Temp: 40±2°C, 90~95% R.H.<br>Duration: 1000hrs  |                  | $ \Delta V_{1mA}/V_{1mA}  \leq 5\%$                         |  |
| Temperature Cycle             | The conditions shown below shall be repeated 5 cycles   |                  |   | No visible damage<br>$ \Delta V_{1mA}/V_{1mA}  \leq 5\%$ |
|                               | Step  | Temperature (°C) | Period (minutes)  |  |
|                               | 1   | -40±3            | 30±3  |  |
|                               | 2   | Room temperature | 15±3  |  |
|                               | 3   | 125±3            | 30±3  |  |
| High Temperature Load         | Ambient Temp: 85±2°C      Duration: 1000hrs<br>Load: Max. Allowable Voltage In AC eara.   |                  | $ \Delta V_{1mA}/V_{1mA}  \leq 10\%$                        |  |
|                               | Ambient Temp: 40±2°C, 90~95% R.H.<br>Duration: 1000hrs      Load: Max. Allowable Voltage  |                  |   |  |
| Damp Heat Load                | Ambient Temp: 40±2°C, 90~95% R.H.<br>Duration: 1000hrs      Load: Max. Allowable Voltage  |                  | No visible damage<br>$ \Delta V_{1mA}/V_{1mA}  \leq 10\%$   |  |
| Voltage Proof                 | Metal balls method, 2500Vac 1 min.  |                  | No visible damage   |  |

**Soldering Recommendation**

**Wave Lead Free Soldering Recommendation**

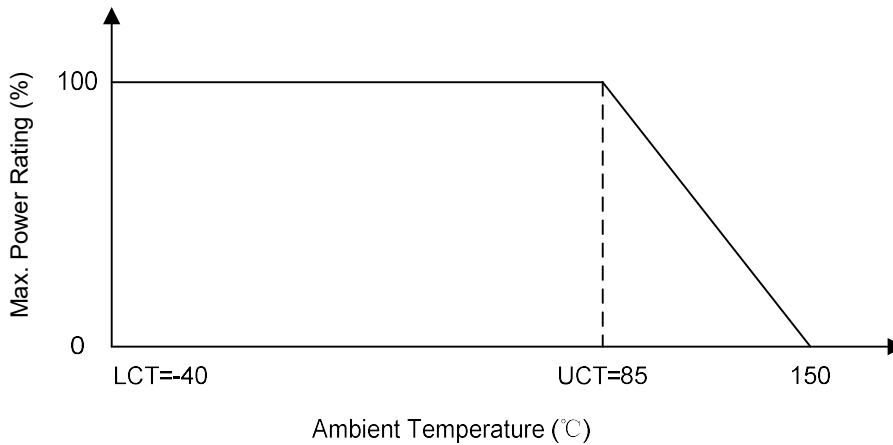


Peak Temperature: 265°C  
 Dipping Time: 10 seconds (max.)  
 Soldering: 1 time

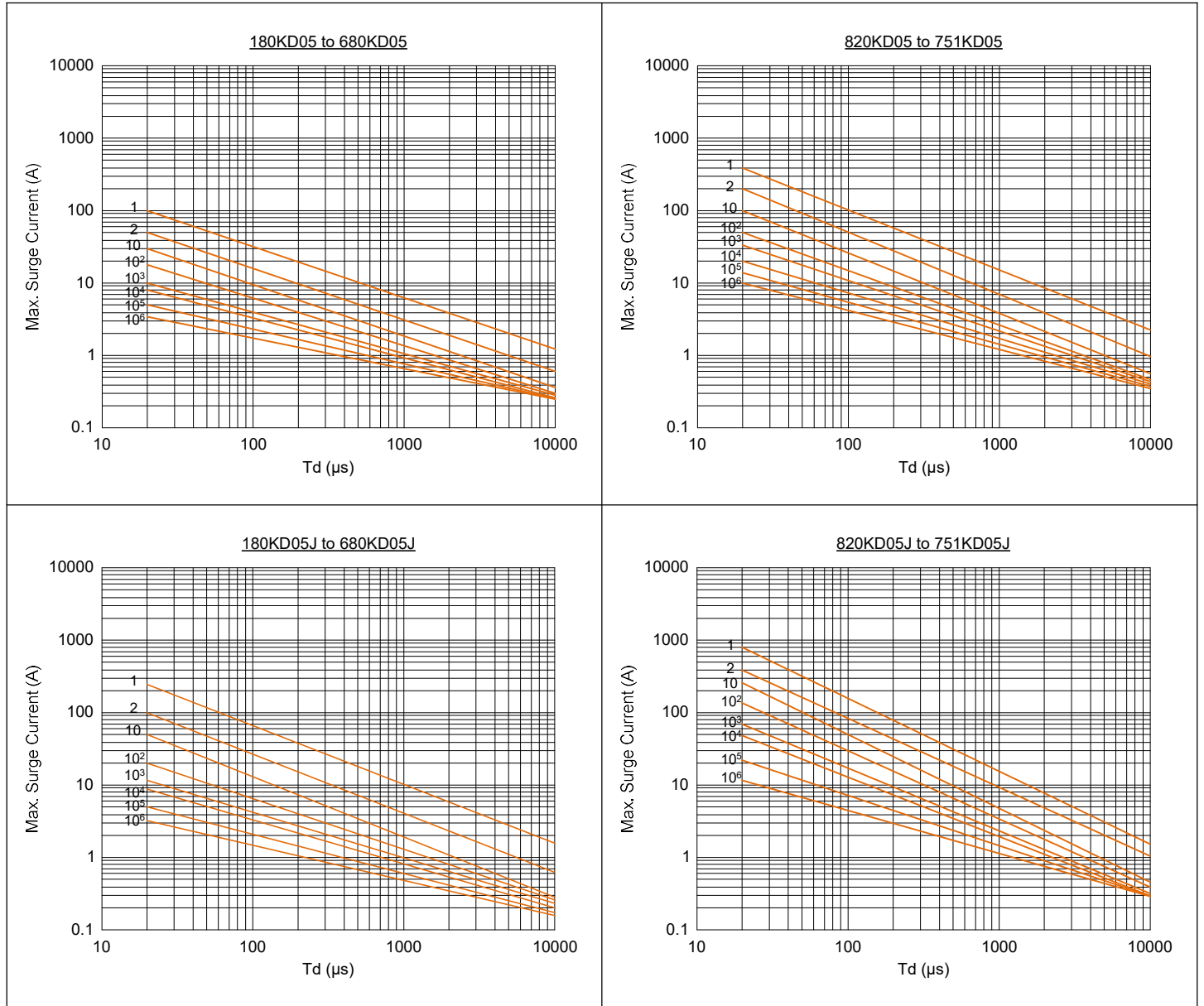
**Recommendation Reworking Conditions with Soldering Iron**

Temperature of Soldering Iron-tip: 360°C (max.)  
 Soldering Time: 3 seconds (max.)  
 Distance from Varistor: 2mm (min.)

**Power Derating Curve**

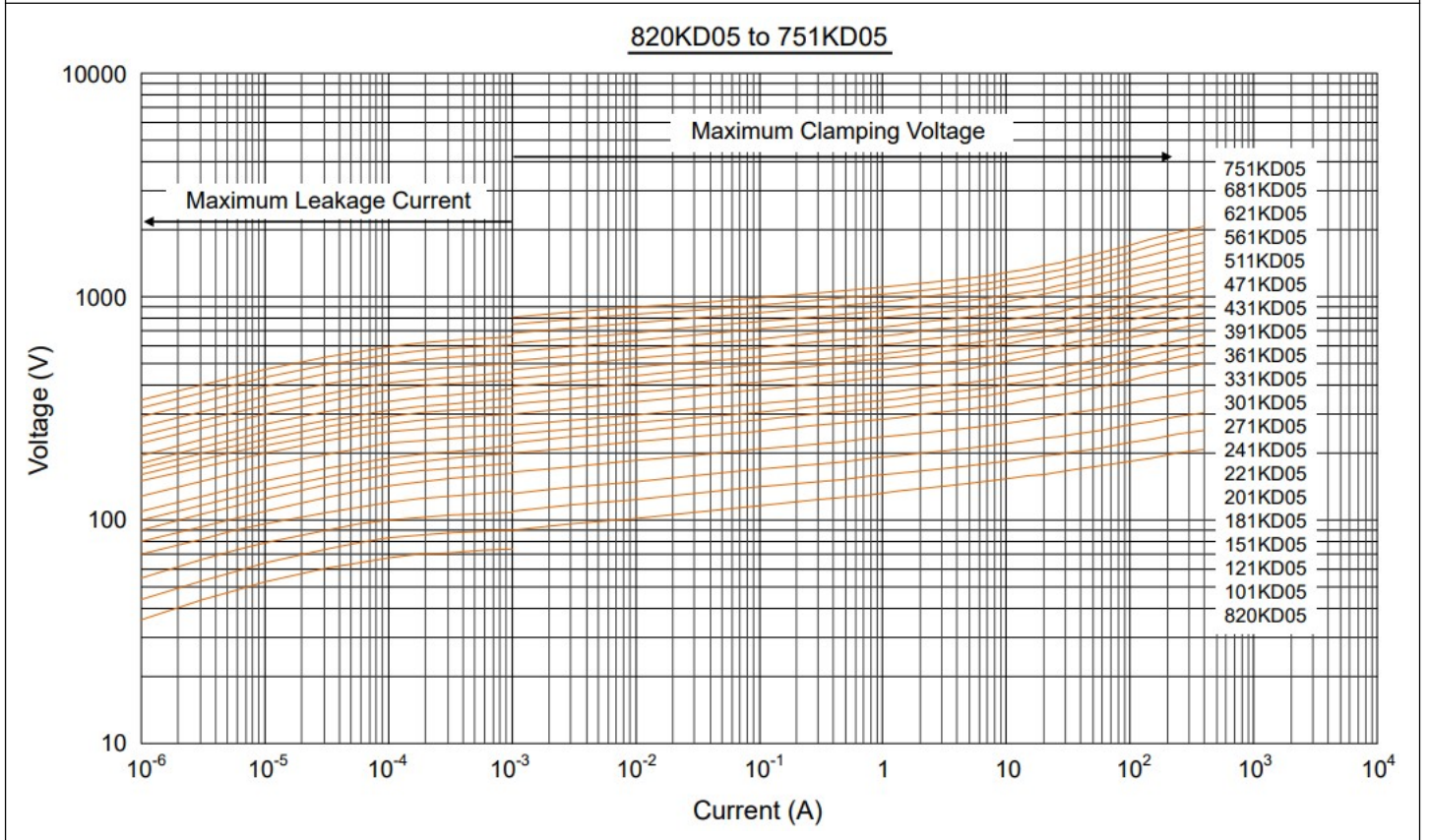
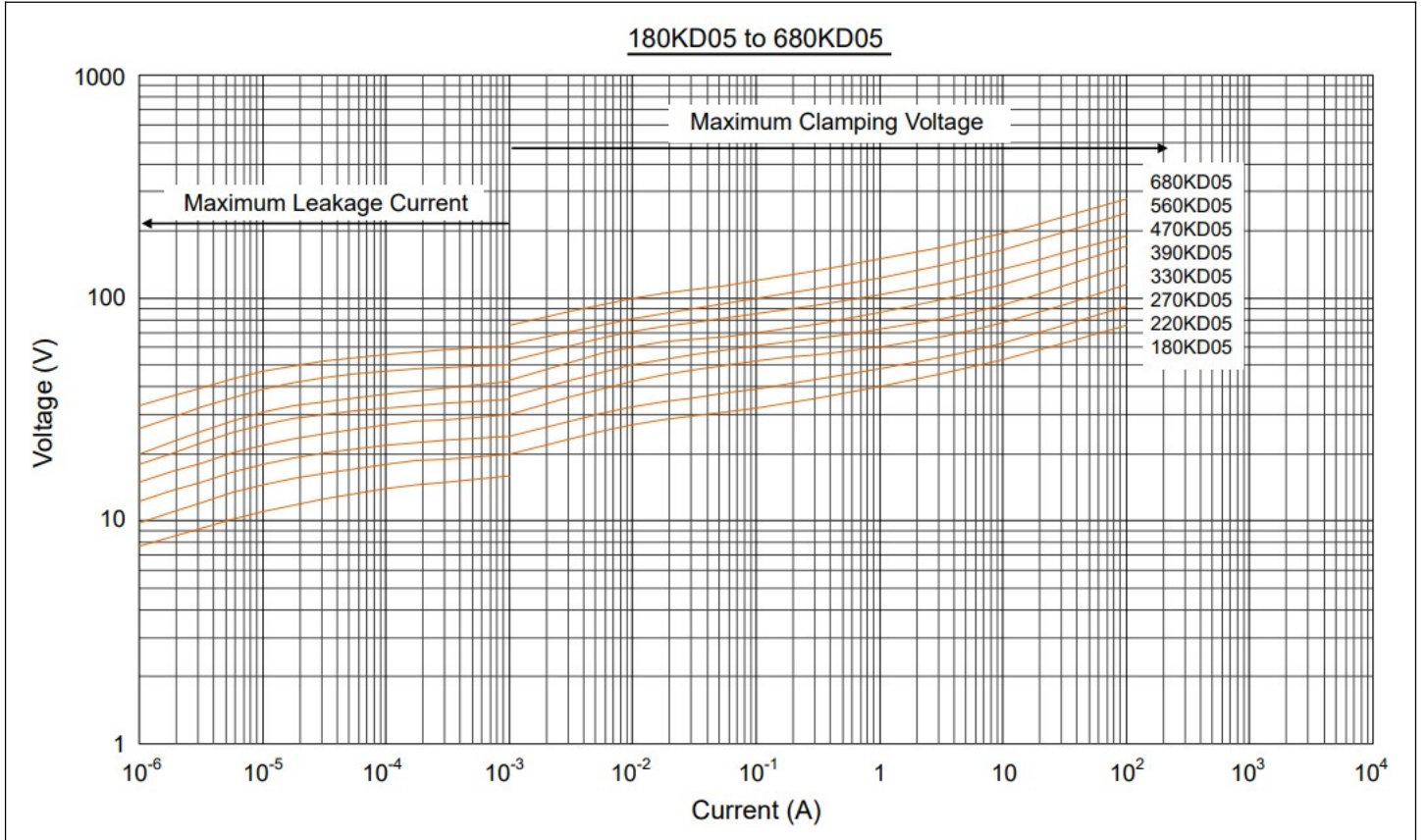


**Maximum Surge Current Derating Curve**

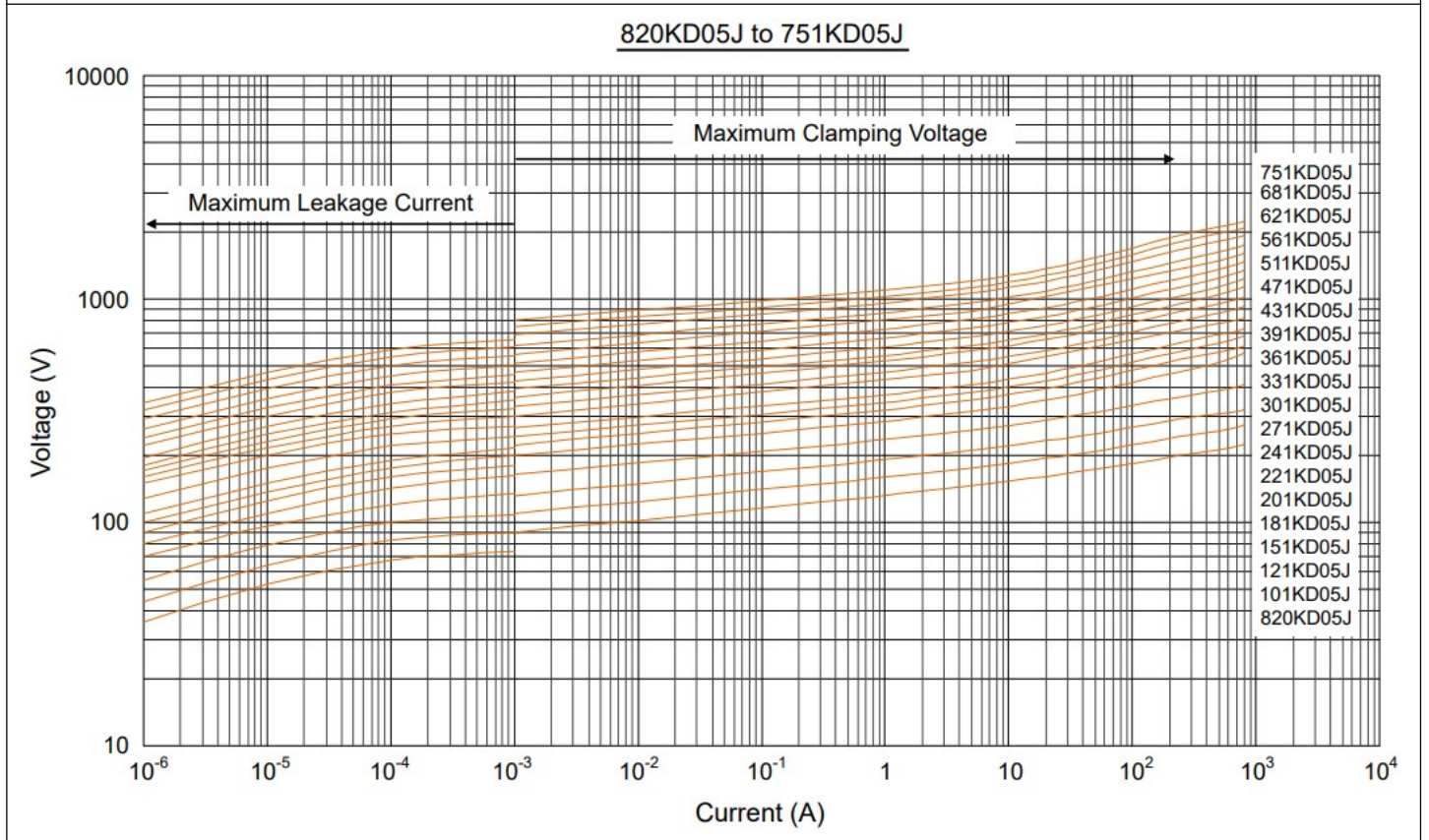
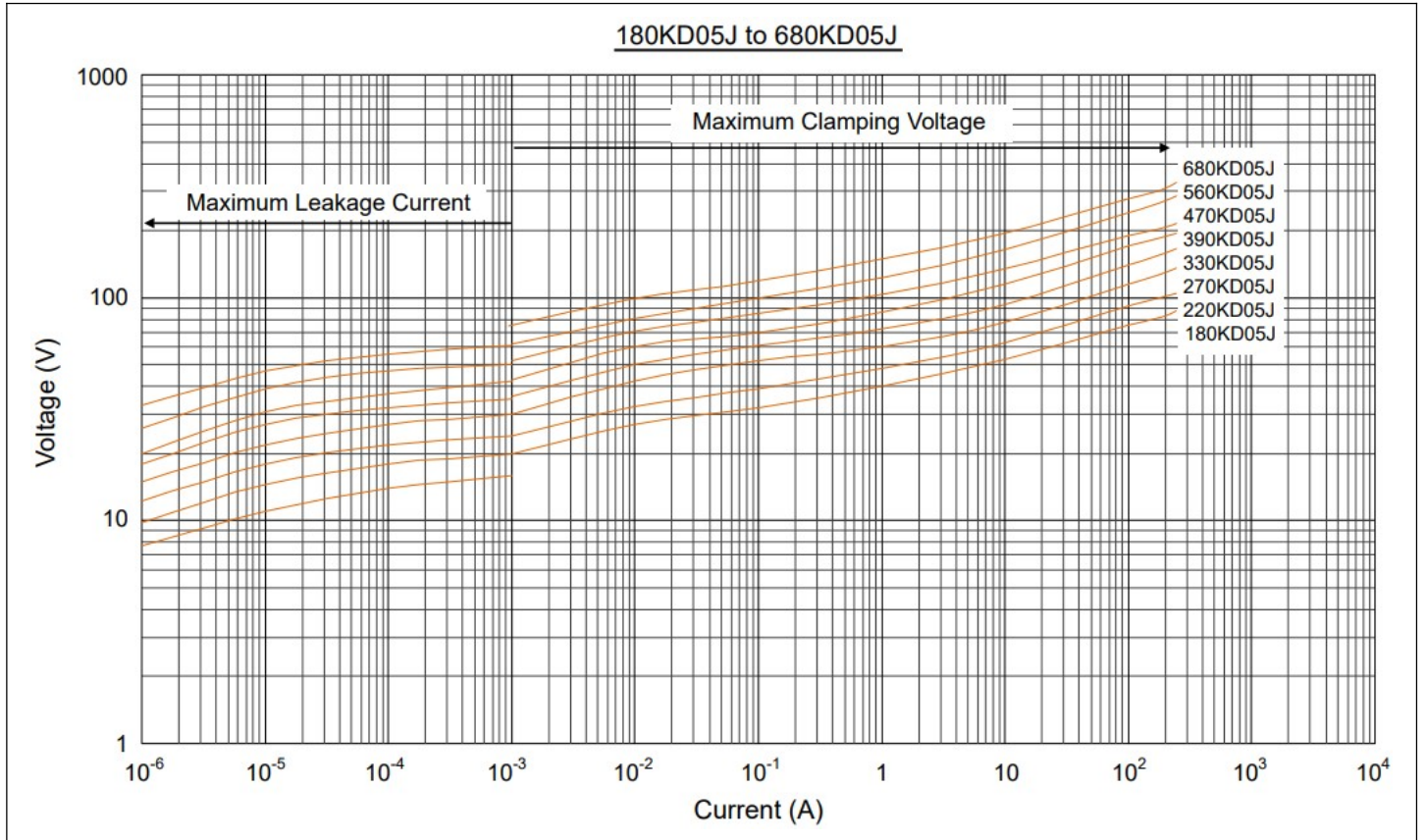




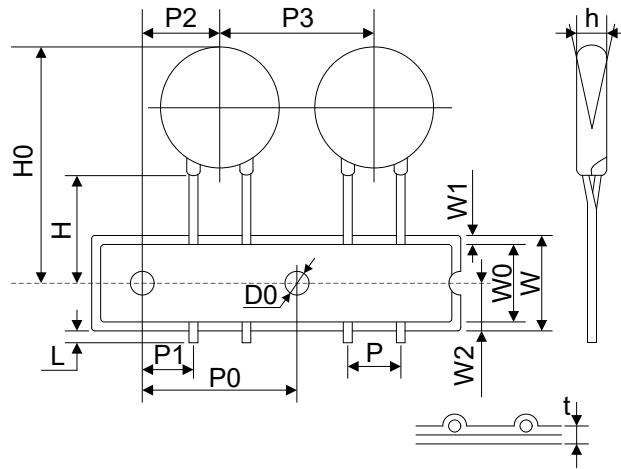
**Maximum Leakage Current and Maximum Clamping Voltage Curve**



**Maximum Leakage Current and Maximum Clamping Voltage Curve**

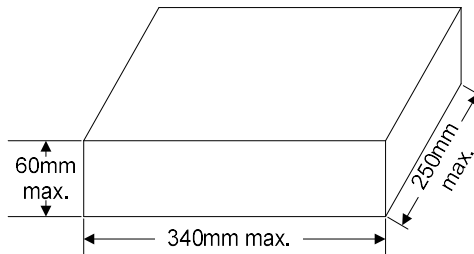


Taping Packaging

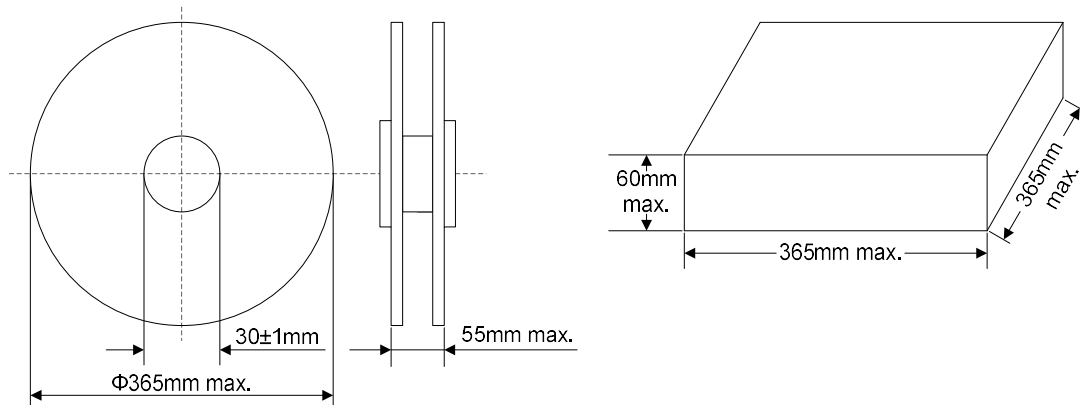


|                |         |          |          |          |          |          |          |         |
|----------------|---------|----------|----------|----------|----------|----------|----------|---------|
| Item           | P       | P0       | P1       | P2       | P3       | W        | W0       | W1      |
| Dimensions(mm) | 5.0±0.8 | 12.7±0.3 | 3.85±0.7 | 6.35±1.3 | 12.7±1.0 | 18.0±1.0 | 12.0±1.0 | 3.0max. |
| Item           | W2      | H        | H0       | D0       | L        | h        | t        |         |
| Dimensions(mm) | 9.0±0.5 | 20.0±2.0 | 32max.   | 4.0±0.2  | 1.0max.  | 0±2      | 0.6±0.3  |         |

Tape & Box



Tape & Reel



**Quantity**

| Packaging   | Model     | Quantity     |            |
|-------------|-----------|--------------|------------|
| Bulk        | 180K~751K | 1000pcs/bag  | 2 bags/box |
| Tape & Box  | 180K~391K | 1500pcs/box  | /          |
|             | 431K~751K | 1000pcs/box  | /          |
| Tape & Reel | 180K~391K | 2000pcs/reel | 1 reel/box |
|             | 431K~751K | 1500pcs/reel | 1 reel/box |

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