

## Type CRGH Series

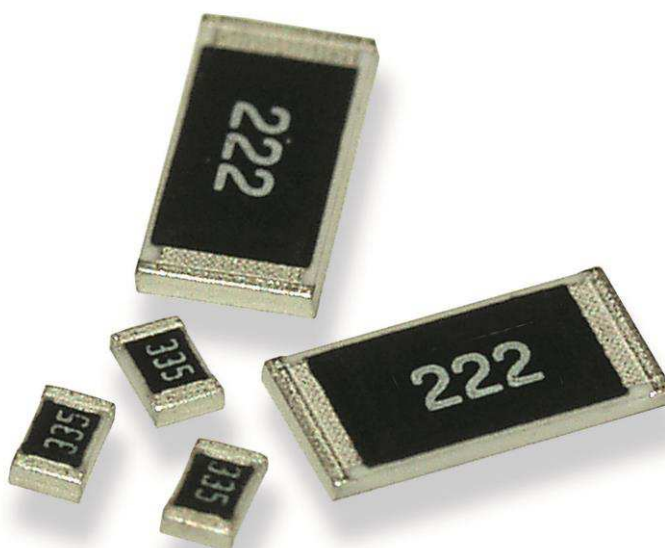
### Key Features

**Thick Film Resistors with high power to size ratio, ideally suited to industrial and general purpose use**

**Value range from 1Ω to 10MΩ**

**Seven package sizes**

**Terminal finish matte Sn over Ni**



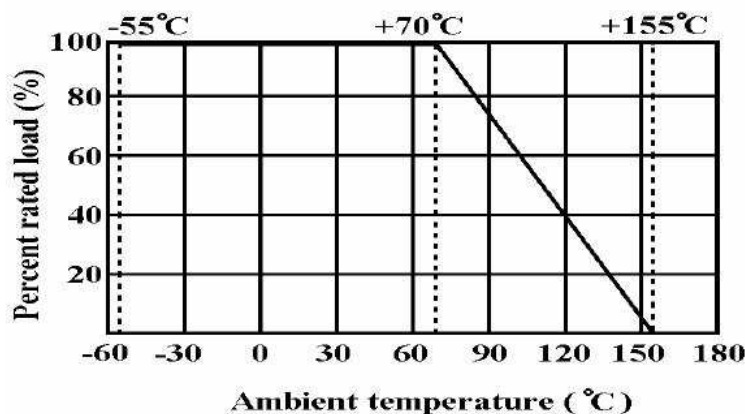
The resistive element is screen printed and fired, and a passivation layer added. Each resistor is trimmed to tolerance by laser. The pre-scribed tile is then broken into strips, the end plating fired on, and the strips broken into individual components. Final termination finish is electroplated matte Sn over a Ni barrier layer.

### Characteristics – Electrical

| Size                      | 0402          | 0603      | 0805      | 1206      | 1210      | 2010      | 2512      |
|---------------------------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Power Rating (W) @70°C    | 0.1           | 0.2       | 0.33      | 0.5       | 0.75      | 1         | 2         |
| Resistance Range          | 1R0 ~ 10M     | R10 ~ 10M | R10 ~ 10M | R10 ~ 10M | R10 ~ 10M | R10 ~ 10M | R10 ~ 10M |
| Tolerance                 | 1% 5%         |           |           |           |           |           |           |
| Max. Working Voltage (V)  | 50            | 50        | 150       | 200       | 200       | 200       | 250       |
| Max. Overload Voltage (V) | 100           | 100       | 300       | 400       | 500       | 500       | 500       |
| Dielectric strength       | 100           | 300       | 500       | 500       | 500       | 500       | 500       |
| Temperature Range         | -55°C ~ 155°C |           |           |           |           |           |           |

### Power Rating:

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 derated as shown below:



### 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:

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

Where:

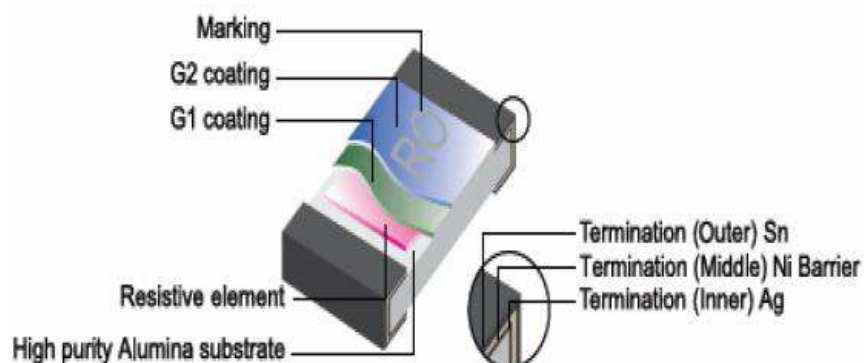
RCWV = Rated DC or RMS AC continuous working voltage at commercial-line frequency and waveform (volt)

P = Power Rating (watt)

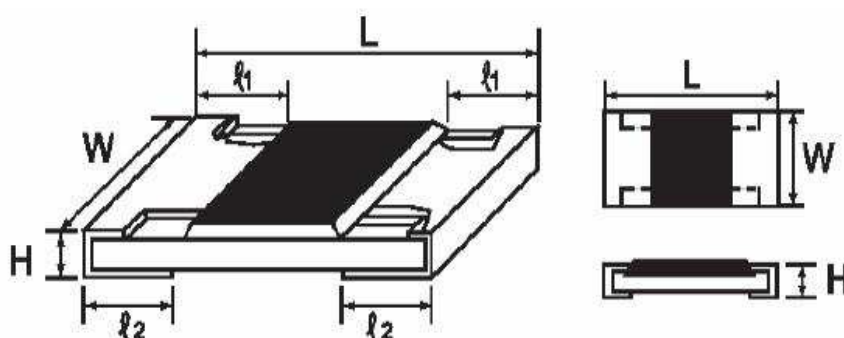
R = Nominal Resistance (ohm)

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

### Construction:

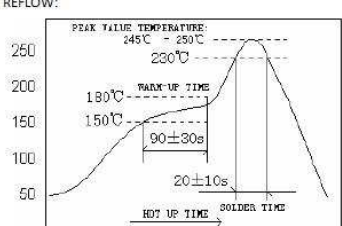


### Dimensions:



| Type     | Dimensions (mm) |                         |                 |                 |                 |
|----------|-----------------|-------------------------|-----------------|-----------------|-----------------|
|          | L               | W                       | H               | $\ell_1$        | $\ell_2$        |
| CRGH0402 | 1.00 $\pm$ 0.10 | 0.50 $\pm$ 0.05         | 0.35 $\pm$ 0.05 | 0.20 $\pm$ 0.10 | 0.25 $\pm$ 0.10 |
| CRGH0603 | 1.60 $\pm$ 0.10 | 0.80 $\pm$ 0.10         | 0.45 $\pm$ 0.10 | 0.30 $\pm$ 0.20 | 0.30 $\pm$ 0.20 |
| CRGH0805 | 2.00 $\pm$ 0.15 | 1.25 $^{+0.15}_{-0.10}$ | 0.55 $\pm$ 0.10 | 0.40 $\pm$ 0.20 | 0.40 $\pm$ 0.20 |
| CRGH1206 | 3.10 $\pm$ 0.15 | 1.55 $^{+0.15}_{-0.10}$ | 0.55 $\pm$ 0.10 | 0.45 $\pm$ 0.20 | 0.45 $\pm$ 0.20 |
| CRGH1210 | 3.10 $\pm$ 0.10 | 2.60 $\pm$ 0.20         | 0.55 $\pm$ 0.10 | 0.50 $\pm$ 0.20 | 0.50 $\pm$ 0.20 |
| CRGH2010 | 5.00 $\pm$ 0.10 | 2.50 $\pm$ 0.20         | 0.55 $\pm$ 0.10 | 0.60 $\pm$ 0.25 | 0.50 $\pm$ 0.20 |
| CRGH2512 | 6.35 $\pm$ 0.10 | 3.20 $\pm$ 0.20         | 0.55 $\pm$ 0.10 | 0.60 $\pm$ 0.25 | 0.50 $\pm$ 0.20 |

## Performance Specification

| Characteristic               | Limits                                                                                                                                                                                                                                                                                                                                                                                                                          | Test Methods<br>( JIS C 5201-1 )                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |      |             |      |   |                                         |         |   |            |            |   |                                          |         |   |            |            |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-------------|------|---|-----------------------------------------|---------|---|------------|------------|---|------------------------------------------|---------|---|------------|------------|
| Dielectric Withstand Voltage | No evidence of flashover mechanical damage, arcing or insulation break down                                                                                                                                                                                                                                                                                                                                                     | 4.7 Clamped in the trough of a 90°C metallic v-block and shall be tested at ac potential respectively specified in the type for 60-70 seconds                                                                                                                                                                                                                                                                                                                                                                                      |      |             |      |   |                                         |         |   |            |            |   |                                          |         |   |            |            |
| Temperature Coefficient      | $0.1\Omega \leq R \leq 0.976\Omega \pm 100$<br>(CRGH0603 = $\pm 200$ )<br>$1\Omega \sim 10\Omega$ : $\pm 200\text{PPM}/^\circ\text{C}$<br>$10.1\Omega \sim 10\text{M}\Omega$ : $\pm 100\text{PPM}/^\circ\text{C}$<br><b>CRGH0402</b> :<br>$1\Omega \sim 10\Omega$ : $\pm 400\text{PPM}/^\circ\text{C}$<br>$10.1\Omega \sim 100\Omega$ : $\pm 200\text{PPM}/^\circ\text{C}$<br>$>100\Omega$ : $\pm 100\text{PPM}/^\circ\text{C}$ | 4.8 Natural resistance change per temp. degree centigrade<br>$R2 - R1$<br>$\text{-----} \times 10^6 \text{ (PPM}/^\circ\text{C)}$<br>$R1(t2-t1)$<br>R1: Resistance value at room temperature (T1)<br>R2: Resistance value at room temp. plus 100 °C(T2)<br>Test pattern: room temp. (T1), room temp. +100°C(T2)                                                                                                                                                                                                                    |      |             |      |   |                                         |         |   |            |            |   |                                          |         |   |            |            |
| Short time overload          | Resistance change rate is<br>$\pm 5\%$ ( $2.0\% + 0.1\Omega$ ) Max.<br>$\pm 1\%$ ( $1.0\% + 0.1\Omega$ ) Max.                                                                                                                                                                                                                                                                                                                   | 4.13 Permanent resistance change after the application of a potential of 2.5 times RCWV for 5 seconds                                                                                                                                                                                                                                                                                                                                                                                                                              |      |             |      |   |                                         |         |   |            |            |   |                                          |         |   |            |            |
| Solderability                | 95 % coverage Min.                                                                                                                                                                                                                                                                                                                                                                                                              | Wave Solder:<br>Test temperature of solder: $245^\circ\text{C} \pm 3^\circ\text{C}$<br>dipping time in solder : 2-3 seconds.<br>REFLOW:<br>                                                                                                                                                                                                                                                                                                     |      |             |      |   |                                         |         |   |            |            |   |                                          |         |   |            |            |
| Soldering heat               | Resistance change rate is:<br>$\pm (1.0\% + 0.05\Omega)$ Max.                                                                                                                                                                                                                                                                                                                                                                   | 4.18 Dip the resistor into a solder bath having a temperature of $260^\circ\text{C} \pm 3^\circ\text{C}$ and hold it for $10 \pm 1$ seconds.                                                                                                                                                                                                                                                                                                                                                                                       |      |             |      |   |                                         |         |   |            |            |   |                                          |         |   |            |            |
| Temperature cycling          | Resistance change rate is<br>$\pm 5\%$ ( $1.0\% + 0.05\Omega$ ) Max.<br>$\pm 1\%$ ( $0.5\% + 0.05\Omega$ ) Max.                                                                                                                                                                                                                                                                                                                 | 4.19 Resistance change after continuous 5 cycles for duty cycle specified below :<br><table border="1"> <thead> <tr> <th>Step</th><th>Temperature</th><th>Time</th></tr> </thead> <tbody> <tr> <td>1</td><td><math>-55^\circ\text{C} \pm 3^\circ\text{C}</math></td><td>30 mins</td></tr> <tr> <td>2</td><td>Room temp.</td><td>10~15 mins</td></tr> <tr> <td>3</td><td><math>+155^\circ\text{C} \pm 2^\circ\text{C}</math></td><td>30 mins</td></tr> <tr> <td>4</td><td>Room temp.</td><td>10~15 mins</td></tr> </tbody> </table> | Step | Temperature | Time | 1 | $-55^\circ\text{C} \pm 3^\circ\text{C}$ | 30 mins | 2 | Room temp. | 10~15 mins | 3 | $+155^\circ\text{C} \pm 2^\circ\text{C}$ | 30 mins | 4 | Room temp. | 10~15 mins |
| Step                         | Temperature                                                                                                                                                                                                                                                                                                                                                                                                                     | Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |      |             |      |   |                                         |         |   |            |            |   |                                          |         |   |            |            |
| 1                            | $-55^\circ\text{C} \pm 3^\circ\text{C}$                                                                                                                                                                                                                                                                                                                                                                                         | 30 mins                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |             |      |   |                                         |         |   |            |            |   |                                          |         |   |            |            |
| 2                            | Room temp.                                                                                                                                                                                                                                                                                                                                                                                                                      | 10~15 mins                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      |             |      |   |                                         |         |   |            |            |   |                                          |         |   |            |            |
| 3                            | $+155^\circ\text{C} \pm 2^\circ\text{C}$                                                                                                                                                                                                                                                                                                                                                                                        | 30 mins                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |      |             |      |   |                                         |         |   |            |            |   |                                          |         |   |            |            |
| 4                            | Room temp.                                                                                                                                                                                                                                                                                                                                                                                                                      | 10~15 mins                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |      |             |      |   |                                         |         |   |            |            |   |                                          |         |   |            |            |
| Humidity                     | Resistance change rate is<br>$\pm 5\%$ ( $3.0\% + 0.1\Omega$ ) Max.<br>$\pm 1\%$ ( $0.5\% + 0.1\Omega$ ) Max.                                                                                                                                                                                                                                                                                                                   | 4.24 Temporary resistance change after 240 hours exposure in a humidity test chamber controlled at $40 \pm 2^\circ\text{C}$ and 90-95% relative humidity                                                                                                                                                                                                                                                                                                                                                                           |      |             |      |   |                                         |         |   |            |            |   |                                          |         |   |            |            |
| Load life in humidity        | Resistance change rate is<br>$\pm 5\%$ ( $3.0\% + 0.1\Omega$ ) Max.<br>$\pm 1\%$ ( $1.0\% + 0.1\Omega$ ) Max.                                                                                                                                                                                                                                                                                                                   | 7.9 Resistance change after 1,000 hours (1.5 hours "on", 0.5 hour "off" ) at RCWV in a humidity chamber controlled at $40^\circ\text{C} \pm 2^\circ\text{C}$ and 90 to 95 % relative humidity                                                                                                                                                                                                                                                                                                                                      |      |             |      |   |                                         |         |   |            |            |   |                                          |         |   |            |            |

**Performance Specification (continued)**

| Characteristic      | Limits                                                                                                        | Test Methods<br>( JIS C 5201-1 )                                                                                                                                                         |
|---------------------|---------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Load Life           | Resistance change rate is<br>$\pm 5\%$ ( $3.0\% + 0.1\Omega$ ) Max.<br>$\pm 1\%$ ( $1.0\% + 0.1\Omega$ ) Max. | 4.25.1 Permanent resistance change after<br>1,000 hours operating at RCWV, with duty<br>cycle of (1.5 hours"on", 0.5 hour"off") at<br>$70^{\circ}\text{C} \pm 2^{\circ}\text{C}$ ambient |
| Terminal<br>bending | Resistance change rate is<br>$\pm (1.0\% + 0.05\Omega)$ Max.                                                  | 4.33 Twist of Test Board:<br>Y/X = 3/90 mm for 60 seconds                                                                                                                                |

**Marking**

E24 series 0603 – 2512 3 Digits – first two digits denote significant figures of resistance and third digit denotes number of zeros thereafter. EG

|  |     |  |
|--|-----|--|
|  | 222 |  |
|--|-----|--|

=
2K2

Marking for E96 Series 0805 – 2512 4 digits – First three digits denote significant figures of resistance and fourth digit denotes number of zeros thereafter. EG.

|  |      |  |
|--|------|--|
|  | 1000 |  |
|--|------|--|

=
100R

For ohmic values below 100R letter "R" denotes decimal point. EG

|  |      |  |
|--|------|--|
|  | 1R80 |  |
|--|------|--|

=
1R8 /  $1.8\Omega$

0402 size chips are not marked

0603 E96 3 digit marking.

Resistance Code from table on next page, and Multiplier code from table below

**Multiplier Code**

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

|           |                 |         |      |   |     |   |           |   |     |
|-----------|-----------------|---------|------|---|-----|---|-----------|---|-----|
| Coding    | Formula         | Example | 10K2 | = | 102 | X | $10^2$    | = | 02C |
|           |                 |         |      |   | ↓   |   | ↓         |   |     |
|           |                 |         |      |   | 02  |   | C         |   |     |
| XX        | X               |         |      |   |     |   |           |   |     |
| Res. Code | Multiplier Code |         | 33R2 | = | 332 | X | $10^{-1}$ | = | 51X |
|           |                 |         |      |   | ↓   |   | ↓         |   |     |
|           |                 |         |      |   | 51  |   | X         |   |     |

## Resistance Code

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

## Label

Label shall be marked with the following item :

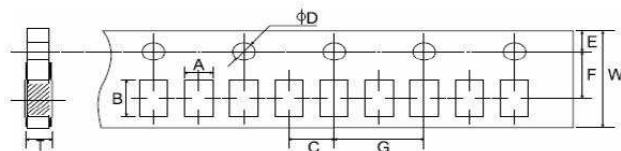
- A. Nominal Resistance and Resistance Tolerance
- B. Power Rating and Size
- C. Quantity and description
- D. Part No.
- E. Lot No.
- Ex.

|                           |                                                                                     |   |
|---------------------------|-------------------------------------------------------------------------------------|---|
| <b>RT008-04</b>           |  |   |
| 606150040052              | CHIP RESISTORS                                                                      | r |
| Resistance: 165R $\Omega$ | $\pm 5\%$                                                                           |   |
| Wattage: 1W               | Size: 2010                                                                          |   |
| Quantity: 4000 PCS        | CRGH 2010 5% 165R                                                                   |   |
| PART NO. 1-1879519-9      | RoHS 2011/65/EU                                                                     |   |
| LOT NO.                   | REF #                                                                               |   |
| Order Code (YYWW)         | 1623 Rev. BA                                                                        |   |

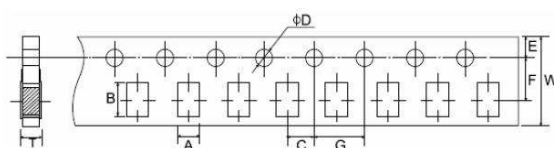
## Packing Specification:

### Tape dimensions (mm)

#### A. Paper Taping

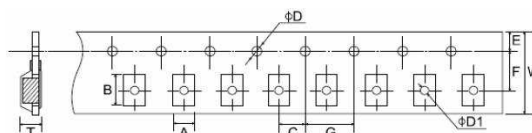


| Type | A±0.2 | B±0.2 | C±0.05 | ØD+0.1<br>-0 | E±0.1 | F±0.05 | G±0.1 | W±0.2 | T±0.1 |
|------|-------|-------|--------|--------------|-------|--------|-------|-------|-------|
| 0402 | 0.65  | 1.15  | 2.0    | 1.5          | 1.75  | 3.5    | 4.0   | 8.0   | 0.45  |



| Type | A±0.2 | B±0.2 | C±0.05 | ØD+0.1<br>-0 | E±0.1 | F±0.05 | G±0.1 | W±0.2 | T±0.1 |
|------|-------|-------|--------|--------------|-------|--------|-------|-------|-------|
| 0603 | 1.10  | 1.90  | 2.0    | 1.5          | 1.75  | 3.5    | 4.0   | 8.0   | 0.67  |
| 0805 | 1.65  | 2.40  | 2.0    | 1.5          | 1.75  | 3.5    | 4.0   | 8.0   | 0.81  |
| 1206 | 2.00  | 3.60  | 2.0    | 1.5          | 1.75  | 3.5    | 4.0   | 8.0   | 0.81  |
| 1210 | 2.80  | 3.50  | 2.0    | 1.5          | 1.75  | 3.5    | 4.0   | 8.0   | 0.75  |

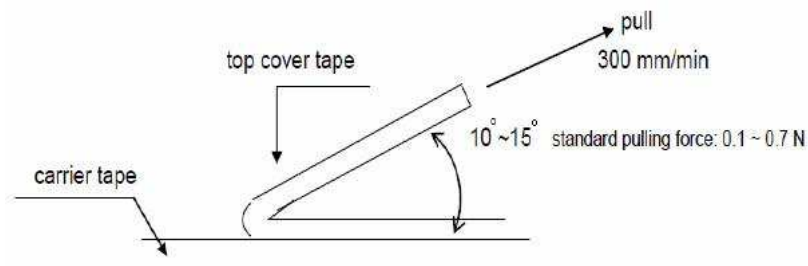
#### B. Embossed Taping



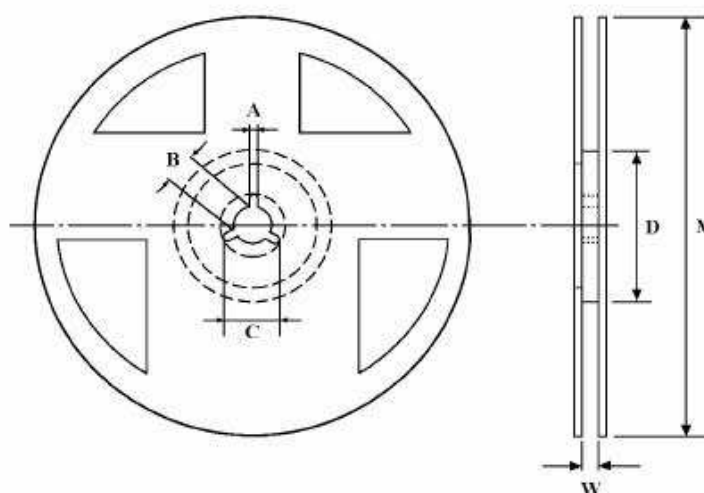
| Type | A<br>±0.2 | B<br>±0.2 | C<br>±0.05 | ØD+0.1<br>-0 | ØD1+0.1<br>-0 | E<br>±0.1 | F<br>±0.05 | G<br>±0.1 | W<br>±0.2 | T<br>±0.1 |
|------|-----------|-----------|------------|--------------|---------------|-----------|------------|-----------|-----------|-----------|
| 2010 | 2.90      | 5.60      | 2.0        | 1.5          | 1.5           | 1.75      | 5.5        | 4.0       | 12.0      | 1.0       |
| 2512 | 3.50      | 6.70      | 2.0        | 1.5          | 1.5           | 1.75      | 5.5        | 4.0       | 12.0      | 1.0       |

\* Peeling Strength of Top Cover Tape

Test Condition: 0.1 to 0.7 N at a peel-off speed of 300 mm / min.



## Reel Dimension (mm)



| Type | Taping   | Reel Quantity | A $\pm 0.5$ | B $\pm 0.5$ | C $\pm 0.5$ | D $\pm 1$ | M $\pm 1$ | W $\pm 1$ |
|------|----------|---------------|-------------|-------------|-------------|-----------|-----------|-----------|
| 0402 | Paper    | 10,000        | 2           | 13          | 21          | 60        | 178       | 10        |
| 0603 | Paper    | 5,000         | 2           | 13          | 21          | 60        | 178       | 10        |
| 0805 | Paper    | 5,000         | 2           | 13          | 21          | 60        | 178       | 10        |
| 1206 | Paper    | 5,000         | 2           | 13          | 21          | 60        | 178       | 10        |
| 1210 | Paper    | 5,000         | 2           | 13          | 21          | 60        | 178       | 10        |
| 2010 | Embossed | 4,000         | 2           | 13          | 21          | 60        | 178       | 13.8      |
| 2512 | Embossed | 4,000         | 2           | 13          | 21          | 60        | 178       | 13.8      |

## How To Order

| CRGH                                       | 0603 | J                              | 10K                              |
|--------------------------------------------|------|--------------------------------|----------------------------------|
| Common Part                                | Size | Tolerance                      | Resistance Value                 |
| CRGH - High Power Thick Film Chip Resistor | 0402 | F - $\pm 1\%$<br>J - $\pm 5\%$ | 1 ohm (1 $\Omega$ ) 1R0          |
|                                            | 0603 |                                | 1K ohm (1000 $\Omega$ ) 1K0      |
|                                            | 0805 |                                | 100K ohm (100000 $\Omega$ ) 100K |
|                                            | 1206 |                                |                                  |
|                                            | 1210 |                                |                                  |
|                                            | 2010 |                                |                                  |
|                                            | 2512 |                                | 1M ohm (1000000 $\Omega$ ) 1M0   |