

# Notice for TAIYO YUDEN products

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# LW REVERSAL DECOUPLING CAPACITORS (LWDC™)



REFLOW

## FEATURES

- Low equivalent series resistance (ESR).
- Low equivalent series inductor (ESL).
- The effect of noise removal in the high frequency.
- Decreased ripple voltage.
- Small size with high capacitance.

## APPLICATIONS

- Decoupling capacitors
- Filtering capacitors

## PART NUMBER

J | W | K | 2 | 1 | 2 | △ | B | J | 1 | 0 | 6 | M | D | - | T | △

**1** Rated voltage (VDC)

|   |     |
|---|-----|
| A | 4   |
| J | 6.3 |
| L | 10  |
| E | 16  |
| T | 25  |

**2** Series name

|   |                 |
|---|-----------------|
| W | LW Reverse Type |
|---|-----------------|

**3** End termination

|   |        |
|---|--------|
| K | Plated |
|---|--------|

**4** Dimension

| Type | (inch) | L×W (mm) |
|------|--------|----------|
| 105  | (0204) | 0.52×1.0 |
| 107  | (0306) | 0.8×1.6  |
| 212  | (0508) | 1.25×2.0 |

**5** Dimension tolerance

|   |          |
|---|----------|
| △ | Standard |
|---|----------|

△=Blank space

**6** Temperature characteristics code

|    |     |
|----|-----|
| BJ | B   |
|    | X5R |
| C6 | X6S |
| C7 | X7S |
| B7 | X7R |

**7** Nominal capacitance (μF)

| example |      |
|---------|------|
| 105     | 1.0  |
| 106     | 10.0 |

**8** Capacitance tolerance

|   |      |
|---|------|
| K | ±10% |
| M | ±20% |

**9** Thickness (mm)

|   |      |
|---|------|
| P | 0.3  |
| V | 0.5  |
| D | 0.85 |

**10** Special code

|   |          |
|---|----------|
| - | Standard |
|---|----------|

**11** Packaging

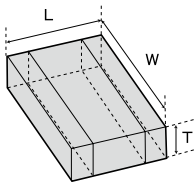
|   |   |
|---|---|
| F | φ178mm Taping (2mm pitch) 0204 Type       |
| T | φ178mm Taping (4mm pitch) 0306, 0508 Type |

**12** Internal code

|   |          |
|---|----------|
| △ | Standard |
|---|----------|

△=Blank space

## STANDARD EXTERNAL DIMENSIONS/STANDARD QUANTITY



| Type               | Dimension [mm] |           |           |   | Standard quantity [pcs] |               |
|--------------------|----------------|-----------|-----------|---|-------------------------|---------------|
|                    | L              | W         | T         |   | Paper tape              | Embossed tape |
| □WK105 (0204 inch) | 0.52±0.05      | 1.00±0.05 | 0.30±0.05 | P | 10000                   | -             |
| □WK107 (0306 inch) | 0.80±0.10      | 1.60±0.10 | 0.50±0.05 | V | -                       | 4000          |
| □WK212 (0508 inch) | 1.25±0.15      | 2.00±0.15 | 0.85±0.10 | D | 4000                    | -             |

## AVAILABLE CAPACITANCE RANGE

| Cap [μF] | Type | 105 |    |     |     |    |    |     |   |    |     |    |     | 107 |     |    |     |   |     |    |     | 212 |     |     |   |    |     |
|----------|------|-----|----|-----|-----|----|----|-----|---|----|-----|----|-----|-----|-----|----|-----|---|-----|----|-----|-----|-----|-----|---|----|-----|
|          |      | X7S |    |     | X6S |    |    | X5R |   |    | X7R |    | X7S |     | X6S |    | X5R |   | X6S |    | X5R |     |     |     |   |    |     |
|          |      | VDC | 10 | 6.3 | 4   | 16 | 10 | 6.3 | 4 | 25 | 16  | 10 | 6.3 | 4   | 25  | 16 | 6.3 | 4 | 4   | 25 | 16  | 10  | 6.3 | 6.3 | 4 | 10 | 6.3 |
| 0.10     | 104  | P   | P  |     | P   |    |    |     | P |    |     |    |     | V   |     |    |     |   | V   |    |     |     |     |     |   |    |     |
| 0.22     | 224  |     | P  | P   |     | P  |    |     |   | P  |     |    | P   |     | V   |    |     |   |     | V  |     |     |     |     |   |    |     |
| 0.47     | 474  |     |    |     |     |    | P  | P   |   |    | P   | P  |     |     | V   |    |     |   |     | V  |     |     |     |     |   |    |     |
| 1.0      | 105  |     |    |     |     |    |    | P   |   |    |     | P  |     |     |     | V  |     |   |     |    | V   | V   |     |     |   |    |     |
| 2.2      | 225  |     |    |     |     |    |    |     |   |    |     |    |     |     |     |    | V   |   |     |    |     | V   | V   |     |   |    |     |
| 4.7      | 475  |     |    |     |     |    |    |     |   |    |     |    |     |     |     |    |     |   |     |    | V   | V   |     | D   |   | D  |     |
| 10       | 106  |     |    |     |     |    |    |     |   |    |     |    |     |     |     |    |     |   |     |    |     |     |     | D   |   | D  |     |
| 22       | 226  |     |    |     |     |    |    |     |   |    |     |    |     |     |     |    |     |   |     |    |     |     |     |     | D |    | D   |

※Letters in the table indicate thickness.

| Temp.char.Code | Temperature characteristics |                        |                 |                        |     | Capacitance tolerance [%] |
|----------------|-----------------------------|------------------------|-----------------|------------------------|-----|---------------------------|
|                | Applicable standard         | Temperature range [°C] | Ref. Temp. [°C] | Capacitance change [%] |     |                           |
| BJ             | JIS                         | B                      | -25~+85         | 20                     | ±10 | ±10(K)<br>±20(M)          |
|                | EIA                         | X5R                    | -55~+85         | 25                     | ±15 |                           |
| C6             | EIA                         | X6S                    | -55~+105        | 25                     | ±22 |                           |
| C7             | EIA                         | X7S                    | -55~+125        | 25                     | ±22 |                           |
| B7             | EIA                         | X7R                    | -55~+125        | 25                     | ±15 |                           |

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## REPRESENTATIVE PART NUMBERS

### ● 105TYPE (0204 case size)

[Temperature Characteristic BJ:X5R]

·0.3mm thickness(P)

| Rated voltage | Part number 1  | Part number 2 | Temp. char.       | Capacitance (μF) | Capacitance tolerance | tan δ (%) | Thickness (mm) | Soldering R:Reflow W:Wave | HALT            | Internal code (P/N 1) | Note |
|---------------|----------------|---------------|-------------------|------------------|-----------------------|-----------|----------------|---------------------------|-----------------|-----------------------|------|
|               |                |               |                   |                  |                       |           |                |                           | % Rated voltage |                       |      |
| 25V           | TWK105 BJ104MP |               | X5R               | 0.1              | ±20                   | 5         | 0.3±0.05       | R                         | 150%            |                       |      |
| 16V           | EWK105 BJ224MP |               | X5R               | 0.22             | ±20                   | 10        | 0.3±0.05       | R                         | 150%            |                       |      |
| 10V           | LWK105 BJ474MP |               | X5R               | 0.47             | ±20                   | 10        | 0.3±0.05       | R                         | 150%            |                       |      |
| 6.3V          | JWK105 BJ104MP |               | X5R <sup>*1</sup> | 0.1              | ±20                   | 5         | 0.3±0.05       | R                         | 150%            |                       |      |
|               | JWK105 BJ474MP |               | X5R <sup>*1</sup> | 0.47             | ±20                   | 10        | 0.3±0.05       | R                         | 150%            |                       |      |
|               | JWK105 BJ105MP |               | X5R               | 1                | ±20                   | 10        | 0.3±0.05       | R                         | 150%            |                       |      |
| 4V            | AWK105 BJ224MP |               | X5R <sup>*1</sup> | 0.22             | ±20                   | 10        | 0.3±0.05       | R                         | 150%            |                       |      |

\*1 We may provide X6S/X7S for some items according to the individual specification.

[Temperature Characteristic C6:X6S C7:X7S]

·0.3mm thickness(P)

| Rated voltage | Part number 1  | Part number 2 | Temp. char. | Capacitance (μF) | Capacitance tolerance | tan δ (%) | Thickness (mm) | Soldering R:Reflow W:Wave | HALT            | Internal code (P/N 1) | Note |
|---------------|----------------|---------------|-------------|------------------|-----------------------|-----------|----------------|---------------------------|-----------------|-----------------------|------|
|               |                |               |             |                  |                       |           |                |                           | % Rated voltage |                       |      |
| 16V           | EWK105 C6104MP |               | X6S         | 0.1              | ±20                   | 5         | 0.3±0.05       | R                         | 150%            |                       |      |
| 10V           | LWK105 C7104MP |               | X7S         | 0.1              | ±20                   | 10        | 0.3±0.05       | R                         | 150%            |                       |      |
|               | LWK105 C6224MP |               | X6S         | 0.22             | ±20                   | 10        | 0.3±0.05       | R                         | 150%            |                       |      |
| 6.3V          | JWK105 C7104MP |               | X7S         | 0.1              | ±20                   | 5         | 0.3±0.05       | R                         | 150%            |                       |      |
|               | JWK105 C7224MP |               | X7S         | 0.22             | ±20                   | 10        | 0.3±0.05       | R                         | 150%            |                       |      |
|               | JWK105 C6474MP |               | X6S         | 0.47             | ±20                   | 10        | 0.3±0.05       | R                         | 150%            |                       |      |
| 4V            | AWK105 C6224MP |               | X6S         | 0.22             | ±20                   | 10        | 0.3±0.05       | R                         | 150%            |                       |      |
|               | AWK105 C6474MP |               | X6S         | 0.47             | ±20                   | 10        | 0.3±0.05       | R                         | 150%            |                       |      |
|               | AWK105 C6105MP |               | X6S         | 1                | ±20                   | 10        | 0.3±0.05       | R                         | 150%            |                       |      |

### ● 107TYPE (0306 case size)

[Temperature Characteristic BJ:X5R]

| Rated voltage | Part number 1  | Part number 2 | Temp. char.       | Capacitance (μF) | Capacitance tolerance | tan δ (%) | Thickness (mm) | Soldering R:Reflow W:Wave | HALT            | Internal code (P/N 1) | Note |
|---------------|----------------|---------------|-------------------|------------------|-----------------------|-----------|----------------|---------------------------|-----------------|-----------------------|------|
|               |                |               |                   |                  |                       |           |                |                           | % Rated voltage |                       |      |
| 25V           | TWK107 BJ104MV |               | X5R               | 0.1              | ±20                   | 5         | 0.5±0.05       | R                         | 150%            |                       |      |
| 16V           | EWK107 BJ224MV |               | X5R               | 0.22             | ±20                   | 5         | 0.5±0.05       | R                         | 150%            |                       |      |
|               | EWK107 BJ474MV |               | X5R               | 0.47             | ±20                   | 5         | 0.5±0.05       | R                         | 150%            |                       |      |
| 10V           | LWK107 BJ105MV |               | X5R               | 1                | ±20                   | 10        | 0.5±0.05       | R                         | 150%            |                       |      |
|               | LWK107 BJ225MV |               | X5R               | 2.2              | ±20                   | 10        | 0.5±0.05       | R                         | 150%            |                       |      |
| 6.3V          | JWK107 BJ105MV |               | X5R <sup>*1</sup> | 1                | ±20                   | 10        | 0.5±0.05       | R                         | 150%            |                       |      |
|               | JWK107 BJ225MV |               | X5R               | 2.2              | ±20                   | 10        | 0.5±0.05       | R                         | 150%            |                       |      |
|               | JWK107 BJ475MV |               | X5R               | 4.7              | ±20                   | 10        | 0.5±0.05       | R                         | 150%            |                       |      |

\*1 We may provide X7R/X7S for some items according to the individual specification.

[Temperature Characteristic B7:X7R C7:X7S C6:X6S]

| Rated voltage | Part number 1  | Part number 2 | Temp. char. | Capacitance (μF) | Capacitance tolerance | tan δ (%) | Thickness (mm) | Soldering R:Reflow W:Wave | HALT            | Internal code (P/N 1) | Note |
|---------------|----------------|---------------|-------------|------------------|-----------------------|-----------|----------------|---------------------------|-----------------|-----------------------|------|
|               |                |               |             |                  |                       |           |                |                           | % Rated voltage |                       |      |
| 25V           | TWK107 B7104MV |               | X7R         | 0.1              | ±20                   | 5         | 0.5±0.05       | R                         | 150%            |                       |      |
| 16V           | EWK107 B7224MV |               | X7R         | 0.22             | ±20                   | 5         | 0.5±0.05       | R                         | 150%            |                       |      |
|               | EWK107 B7474MV |               | X7R         | 0.47             | ±20                   | 5         | 0.5±0.05       | R                         | 150%            |                       |      |
| 6.3V          | JWK107 C7105MV |               | X7S         | 1                | ±20                   | 10        | 0.5±0.05       | R                         | 150%            |                       |      |
| 4V            | AWK107 C7225MV |               | X7S         | 2.2              | ±20                   | 10        | 0.5±0.05       | R                         | 150%            |                       |      |
|               | AWK107 C6475MV |               | X6S         | 4.7              | ±20                   | 10        | 0.5±0.05       | R                         | 150%            |                       |      |

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## REPRESENTATIVE PART NUMBERS

### 212TYPE (0508 case size)

[Temperature Characteristic BJ:X5R]

| Rated voltage | Part number 1  | Part number 2 | Temp. char. | Capacitance [ $\mu$ F] | Capacitance tolerance | $\tan \delta$ [%] | Thickness [mm] | Soldering R:Reflow W:Wave | HALT            | Internal code (P/N 1) | Note |
|---------------|----------------|---------------|-------------|------------------------|-----------------------|-------------------|----------------|---------------------------|-----------------|-----------------------|------|
|               |                |               |             |                        |                       |                   |                |                           | % Rated voltage |                       |      |
| 10V           | LWK212 BJ475□D |               | X5R         | 4.7                    | $\pm 10, \pm 20$      | 10                | $0.85 \pm 0.1$ | R                         | 150%            |                       |      |
|               | LWK212 BJ106MD |               | X5R         | 10                     | $\pm 20$              | 10                | $0.85 \pm 0.1$ | R                         | 150%            |                       |      |
| 6.3V          | JWK212 BJ226MD |               | X5R         | 22                     | $\pm 20$              | 10                | $0.85 \pm 0.1$ | R                         | 150%            |                       |      |

Capacitance tolerance code is applied to □ of part number.

[Temperature Characteristic C6:X6S]

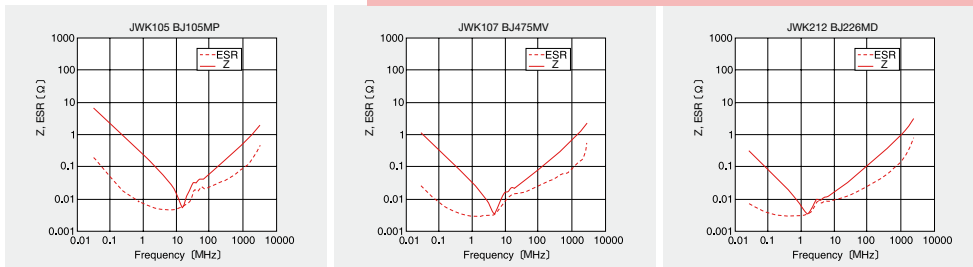
| Rated voltage | Part number 1  | Part number 2 | Temp. char. | Capacitance [ $\mu$ F] | Capacitance tolerance | $\tan \delta$ [%] | Thickness [mm] | Soldering R:Reflow W:Wave | HALT            | Internal code (P/N 1) | Note |
|---------------|----------------|---------------|-------------|------------------------|-----------------------|-------------------|----------------|---------------------------|-----------------|-----------------------|------|
|               |                |               |             |                        |                       |                   |                |                           | % Rated voltage |                       |      |
| 6.3V          | JWK212 C6475□D |               | X6S         | 4.7                    | $\pm 10, \pm 20$      | 10                | $0.85 \pm 0.1$ | R                         | 150%            |                       |      |
|               | JWK212 C6106MD |               | X6S         | 10                     | $\pm 20$              | 10                | $0.85 \pm 0.1$ | R                         | 150%            |                       |      |
| 4V            | AWK212 C6226MD |               | X6S         | 22                     | $\pm 20$              | 10                | $0.85 \pm 0.1$ | R                         | 150%            |                       |      |

Capacitance tolerance code is applied to □ of part number.

## ELECTRICAL CHARACTERISTICS

### Example of Impedance ESR vs. Frequency characteristics

#### Taiyo Yuden multilayer ceramic capacitor



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# PACKAGING

## ① Minimum Quantity

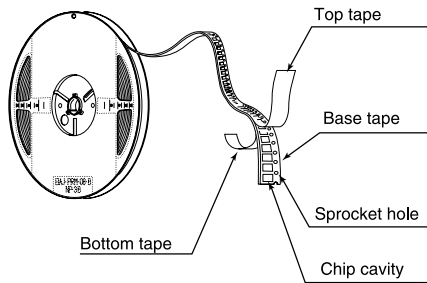
### ● Taped package

| Type   | Thickness |      | Standard quantity [pcs] |                 |
|--------|-----------|------|-------------------------|-----------------|
|        | mm        | code | Paper tape              | Embossed tape   |
| □MK042 | 0.2       | C, D | —                       | 40000           |
| □MK063 | 0.3       | P, T | 15000                   | —               |
| □2K096 | 0.3       | P    | 10000                   |                 |
| □WK105 | 0.45      | K    |                         |                 |
| □WK105 | 0.3       | P    |                         |                 |
| □MK105 | 0.2       | C    | 20000                   |                 |
|        | 0.3       | P    | 15000                   |                 |
| □VK105 | 0.5       | V, W | 10000                   |                 |
|        | 0.5       | W    |                         |                 |
| □MK107 | 0.45      | K    | 4000                    |                 |
| □WK107 | 0.5       | V    | —                       |                 |
| □2K110 | 0.8       | A    | 4000                    | —               |
|        | 0.5       | V    |                         |                 |
|        | 0.6       | B    |                         |                 |
| □MK212 | 0.6       | B    | 4000                    | —               |
|        | 0.8       | A    |                         |                 |
| □WK212 | 0.45      | K    | —                       | 3000            |
|        | 0.85      | D    |                         |                 |
| □4K212 | 1.25      | G    | —                       | 3000            |
|        | 0.85      | D    |                         |                 |
| □2K212 | 0.85      | D    | 4000                    | —               |
|        | 0.85      | D    |                         |                 |
|        | 0.85      | D    |                         |                 |
| □MK316 | 1.15      | F    | —                       | 3000            |
|        | 1.25      | G    |                         |                 |
|        | 1.6       | L    |                         |                 |
| □MK325 | 0.85      | D    | —                       | 2000            |
|        | 1.15      | F    |                         |                 |
|        | 1.9       | N    |                         |                 |
|        | 2.0max    | Y    |                         |                 |
|        | 2.5       | M    |                         |                 |
| □MK432 | 2.5       | M    | —                       | 500(T), 1000(P) |
| □MK432 | 2.5       | M    | —                       | 500             |

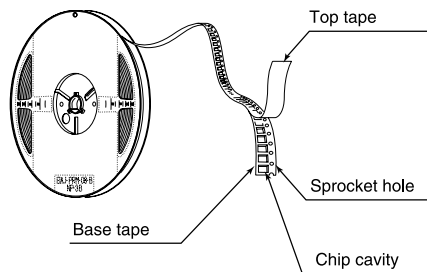
## ② Taping material

※ No bottom tape for pressed carrier tape

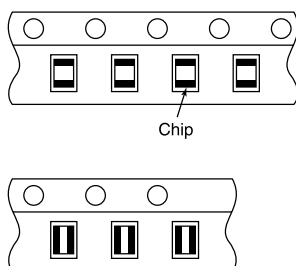
### ● Paper tape



### ● Embossed tape



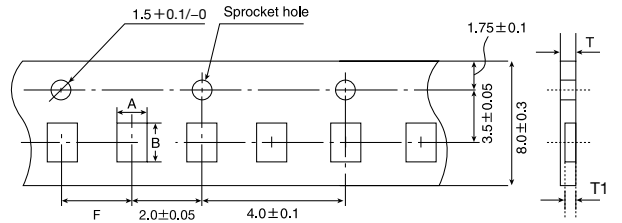
### ● Chip filled



## ③ Representative taping dimensions

### ● Paper Tape (8mm wide)

### ● Pressed carrier tape (2mm pitch)

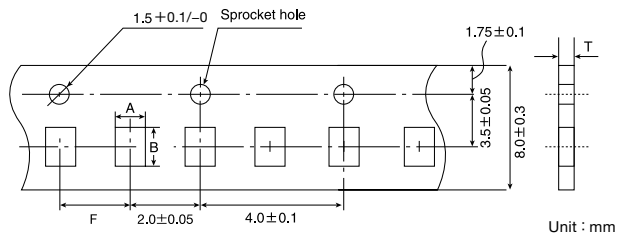


Unit : mm

| Type      | Chip Cavity |      | Insertion Pitch | Tape Thickness |          |
|-----------|-------------|------|-----------------|----------------|----------|
|           | A           | B    |                 | T              | T1       |
| □MK063    | 0.37        | 0.67 | 2.0±0.05        | 0.45max.       | 0.42max. |
| □2K096    | 0.65        | 1.02 |                 |                |          |
| □WK105    | 0.65        | 1.15 |                 | 0.4max.        | 0.3max.  |
| MK105(+C) |             |      | 0.45max.        | 0.42max.       |          |
| MK105(+P) |             |      |                 |                |          |

\* Thickness, C : 0.2mm, P : 0.3mm

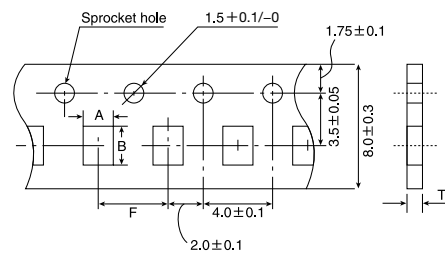
### ● Punched carrier tape (2mm pitch)



Unit : mm

| Type   | Chip Cavity |      | Insertion Pitch | Tape Thickness |
|--------|-------------|------|-----------------|----------------|
|        | A           | B    |                 | T              |
| □2K096 | 0.72        | 1.02 | 2.0±0.05        | 0.6max.        |
| □MK105 | 0.65        | 1.15 |                 | 0.8max.        |
| □VK105 |             |      |                 |                |

### ● Punched carrier tape (4mm pitch)



Unit : mm

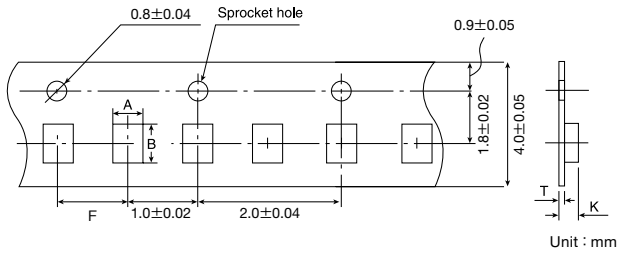
| Type   | Chip Cavity |      | Insertion Pitch | Tape Thickness |
|--------|-------------|------|-----------------|----------------|
|        | A           | B    |                 | T              |
| □MK107 | 1.0         | 1.8  | 4.0±0.1         | 1.1max.        |
| □WK107 |             |      |                 |                |
| □2K110 | 1.15        | 1.55 |                 | 1.0max.        |
| □MK212 | 1.65        | 2.4  |                 | 1.1max.        |
| □WK212 |             |      |                 |                |
| □4K212 | 2.0         | 3.6  |                 |                |

Note : Taping size might be different depending on the size of the product.

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## PACKAGING

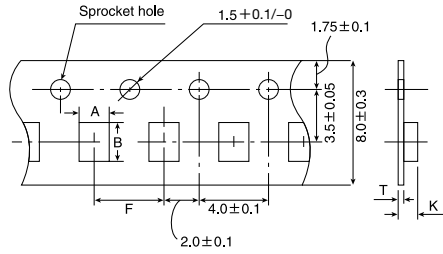
### ● Embossed tape (4mm wide)



Unit : mm

| Type   | Chip Cavity |      | Insertion Pitch<br>F | Tape Thickness |          |
|--------|-------------|------|----------------------|----------------|----------|
|        | A           | B    |                      | K              | T        |
| □MK042 | 0.23        | 0.43 | 1.0±0.02             | 0.5max.        | 0.25max. |

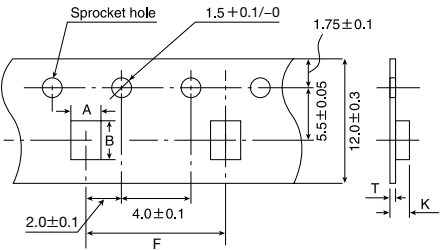
### ● Embossed tape (8mm wide)



Unit : mm

| Type   | Chip Cavity |     | Insertion Pitch<br>F | Tape Thickness |          |
|--------|-------------|-----|----------------------|----------------|----------|
|        | A           | B   |                      | K              | T        |
| □WK107 | 1.0         | 1.8 | 4.0±0.1              | 1.3max         | 0.25±0.1 |
| □MK212 | 1.65        | 2.4 |                      | 3.4max.        | 0.6max.  |
| □MK316 | 2.0         | 3.6 |                      |                |          |
| □MK325 | 2.8         | 3.6 |                      |                |          |

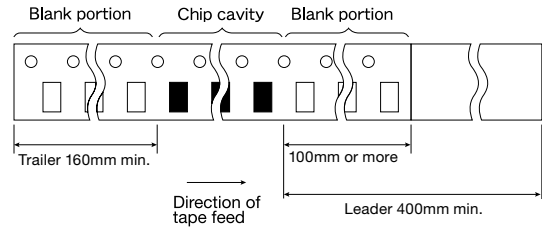
### ● Embossed tape (12mm wide)



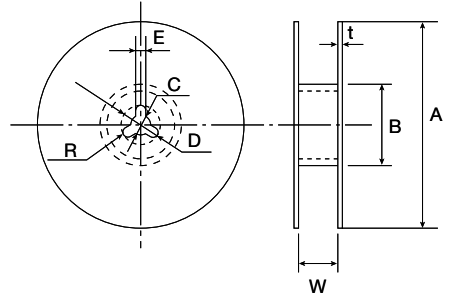
Unit : mm

| Type   | Chip Cavity |     | Insertion Pitch<br>F | Tape Thickness |         |
|--------|-------------|-----|----------------------|----------------|---------|
|        | A           | B   |                      | K              | T       |
| □MK432 | 3.7         | 4.9 | 8.0±0.1              | 4.0max.        | 0.6max. |

### ④ Trailer and Leader



### ⑤ Reel size

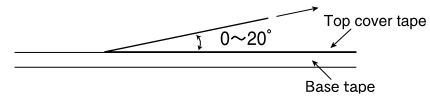


Unit : mm

|                |         |           |
|----------------|---------|-----------|
| A              | B       | C         |
| φ178±2.0       | φ50min. | φ13.0±0.2 |
| D              | E       | R         |
| φ21.0±0.8      | 2.0±0.5 | 1.0       |
|                | t       | W         |
| 4mm wide tape  | 1.5max. | 5±1.0     |
| 8mm wide tape  | 2.5max. | 10±1.5    |
| 12mm wide tape | 2.5max. | 14±1.5    |

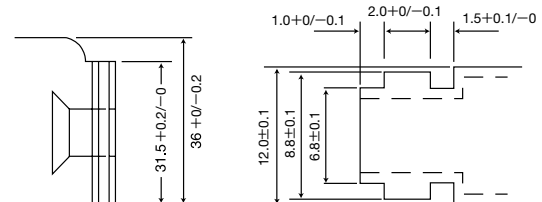
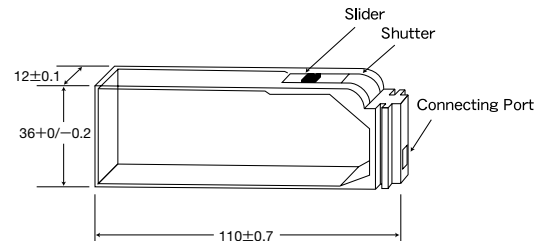
### ⑥ Top Tape Strength

The top tape requires a peel-off force of 0.1 to 0.7N in the direction of the arrow as illustrated below.



### ⑦ Bulk Cassette

The exchange of individual specification is necessary. Please contact Taiyo Yuden sales channels.



Unit : mm

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Super Low Distortion Multilayer Ceramic Capacitors and Medium-High Voltage Multilayer Ceramic Capacitors are noted separately.

Multilayer Ceramic Capacitors

| 1. Operating Temperature Range              |                                    |   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|---|------------------------------------|---|--|---|-----------------------|-------------|----------------------|----|-----------------------|----|-----------------------|--|--------------|----|-------------|--|
| Specified Value                             | Temperature Compensating (Class 1) | Standard  | -55 to +125°C  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | High Frequency Type   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| Specified Value                             | High Permittivity (Class 2)        |   | Specification  | Temperature Range                           |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | BJ  | B  | -25 to +85°C                                |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    |   | X5R  | -55 to +85°C                                |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | B7  | X7R  | -55 to +125°C                               |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | C6  | X6S  | -55 to +105°C                               |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | C7  | X7S  | -55 to +125°C                               |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | F   | F  | -25 to +85°C                                |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| Y5V   | -30 to +85°C                       |   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| 2. Storage Conditions                       |                                    |   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| Specified Value                             | Temperature Compensating (Class 1) | Standard  | -55 to +125°C  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | High Frequency Type   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| Specified Value                             | High Permittivity (Class 2)        |   | Specification  | Temperature Range                           |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | BJ  | B  | -25 to +85°C                                |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    |   | X5R  | -55 to +85°C                                |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | B7  | X7R  | -55 to +125°C                               |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | C6  | X6S  | -55 to +105°C                               |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | C7  | X7S  | -55 to +125°C                               |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | F   | F  | -25 to +85°C                                |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| Y5V   | -30 to +85°C                       |   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| 3. Rated Voltage                            |                                    |   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| Specified Value                             | Temperature Compensating (Class 1) | Standard  | 50VDC, 25VDC, 16VDC  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | High Frequency Type   | 50VDC, 16VDC   |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   | High Permittivity (Class 2)        |   | 50VDC, 35VDC, 25VDC, 16VDC, 10VDC, 6.3VDC, 4VDC  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| 4. Withstanding Voltage (Between terminals) |                                    |   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| Specified Value                             | Temperature Compensating (Class 1) | Standard  | No breakdown or damage   |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | High Frequency Type   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   | High Permittivity (Class 2)        |   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| [Test Methods and Remarks]                  |                                    |   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | Class 1   | Class 2  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| Applied voltage                             |                                    | Rated voltage×3   | Rated voltage×2.5  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| Duration                                    |                                    | 1 to 5 sec.   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| Charge/discharge current                    |                                    | 50mA max.   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| 5. Insulation Resistance                    |                                    |   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| Specified Value                             | Temperature Compensating (Class 1) | Standard  | 10000 MΩ min.  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | High Frequency Type   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   | High Permittivity (Class 2) Note 1 |   | C≤0.047μF : 10000 MΩ min.<br>C>0.047μF : 500MΩ·μF  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| [Test Methods and Remarks]                  |                                    |   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| Applied voltage: Rated voltage              |                                    |   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| Duration: 60±5 sec.                         |                                    |   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| Charge/discharge current: 50mA max.         |                                    |   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| 6. Capacitance (Tolerance)                  |                                    |   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| Specified Value                             | Temperature Compensating (Class 1) | Standard  | <table border="1"> <tr> <td>C△</td> <td>0.5pF≤C≤5pF : ±0.25pF</td> <td rowspan="3">RH</td> <td>0.5pF≤C≤2pF : ±0.1pF</td> </tr> <tr> <td>U△</td> <td>0.5pF&lt;C≤10pF : ±0.5pF</td> <td>S△</td> <td>0.5pF&lt;C≤10pF : ±0.5pF</td> </tr> <tr> <td></td> <td>C&gt;10pF : ±5%</td> <td>T△</td> <td>C&gt;2pF : ±5%</td> </tr> </table> | C△  | 0.5pF≤C≤5pF : ±0.25pF | RH          | 0.5pF≤C≤2pF : ±0.1pF | U△ | 0.5pF<C≤10pF : ±0.5pF | S△ | 0.5pF<C≤10pF : ±0.5pF |  | C>10pF : ±5% | T△ | C>2pF : ±5% |  |
|   |                                    | C△  | 0.5pF≤C≤5pF : ±0.25pF  | RH  | 0.5pF≤C≤2pF : ±0.1pF  |             |                      |    |                       |    |                       |  |              |    |             |  |
|   | U△                                 | 0.5pF<C≤10pF : ±0.5pF   | S△   |   | 0.5pF<C≤10pF : ±0.5pF |             |                      |    |                       |    |                       |  |              |    |             |  |
|   | C>10pF : ±5%                       | T△  | C>2pF : ±5%  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   | High Frequency Type                | <table border="1"> <tr> <td>CH</td> <td>0.5pF≤C≤2pF : ±0.1pF</td> </tr> <tr> <td>RH</td> <td>C&gt;2pF : ±5%</td> </tr> </table> | CH   | 0.5pF≤C≤2pF : ±0.1pF                        | RH                    | C>2pF : ±5% |                      |    |                       |    |                       |  |              |    |             |  |
| CH  | 0.5pF≤C≤2pF : ±0.1pF               |   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| RH  | C>2pF : ±5%                        |   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   | High Permittivity (Class 2)        |   | BJ, B7, C6,C7 : ±10% or ±20%, F : -20%/+80%  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| [Test Methods and Remarks]                  |                                    |   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | Class 1   | Class 2  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | Standard  | High Frequency Type  | C≤10μF                                      | C>10μF                |             |                      |    |                       |    |                       |  |              |    |             |  |
| Preconditioning                             |                                    | None  |  | Thermal treatment (at 150°C for 1hr) Note 2 |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| Measuring frequency                         |                                    | 1MHz±10%  |  | 1kHz±10%                                    | 120±10Hz              |             |                      |    |                       |    |                       |  |              |    |             |  |
| Measuring voltage Note 1                    |                                    | 0.5 to 5Vrms  |  | 1±0.2Vrms                                   | 0.5±0.1Vrms           |             |                      |    |                       |    |                       |  |              |    |             |  |
| Bias application                            |                                    | None  |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| 7. Q or Dissipation Factor                  |                                    |   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| Specified Value                             | Temperature Compensating (Class 1) | Standard  | C<30 pF : Q≥400+20C, C≥30 pF : Q≥1000 (C : Nominal capacitance)  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | High Frequency Type   | Refer to detailed specification  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   | High Permittivity (Class 2) Note 1 |   | BJ, B7, C6,C7 : 2.5% max., F : 7% max.   |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| [Test Methods and Remarks]                  |                                    |   |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | Class 1   | Class 2  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
|   |                                    | Standard  | High Frequency Type  | C≤10μF                                      | C>10μF                |             |                      |    |                       |    |                       |  |              |    |             |  |
| Preconditioning                             |                                    | None  |  | Thermal treatment (at 150°C for 1hr) Note 2 |                       |             |                      |    |                       |    |                       |  |              |    |             |  |
| Measuring frequency                         |                                    | 1MHz±10%  | 1GHz   | 1kHz±10%                                    | 120±10Hz              |             |                      |    |                       |    |                       |  |              |    |             |  |
| Measuring voltage Note 1                    |                                    | 0.5 to 5Vrms  |  | 1±0.2Vrms                                   | 0.5±0.1Vrms           |             |                      |    |                       |    |                       |  |              |    |             |  |
| Bias application                            |                                    | None  |  |   |                       |             |                      |    |                       |    |                       |  |              |    |             |  |

High Frequency Type  
Measuring equipment: HP4291A  
Measuring jig: HP16192A

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# RELIABILITY DATA

## 8. Temperature Characteristic (Without voltage application)

|                             |                                    |                     |                                     |            |                                     |
|-----------------------------|------------------------------------|---------------------|-------------------------------------|------------|-------------------------------------|
| Specified Value             | Temperature Compensating (Class 1) | Standard            | Temperature Characteristic [ppm/°C] |            | Tolerance<br>H±60<br>J±120<br>K±250 |
|                             |                                    | High Frequency Type | C□ : 0                              | CH, CJ, CK |                                     |
| High Permittivity (Class 2) |                                    |                     | R□ : -220                           | RH         |                                     |
|                             |                                    |                     | S□ : -330                           | SH, SJ, SK |                                     |
|                             |                                    |                     | T□ : -470                           | TJ, TK     |                                     |
|                             |                                    |                     | U□ : -750                           | UJ, UK     |                                     |
|                             |                                    |                     | SL : +350 to -1000                  |            |                                     |
|                             |                                    |                     |                                     |            |                                     |
|                             |                                    |                     |                                     |            |                                     |

| Specification | Capacitance change | Reference temperature | Temperature Range |               |
|---------------|--------------------|-----------------------|-------------------|---------------|
| BJ            | B                  | ±10%                  | 20°C              | -25 to +85°C  |
|               | X5R                | ±15%                  | 25°C              | -55 to +85°C  |
| B7            | X7R                | ±15%                  | 25°C              | -55 to +125°C |
| C6            | X6S                | ±22%                  | 25°C              | -55 to +105°C |
| C7            | X7S                | ±22%                  | 25°C              | -55 to +125°C |
| F             | F                  | +30/-80%              | 20°C              | -25 to +85°C  |
|               | Y5V                | +22/-82%              | 25°C              | -30 to +85°C  |

### [Test Methods and Remarks]

#### Class 1

Capacitance at 20°C and 85°C shall be measured in thermal equilibrium, and the temperature characteristic shall be calculated from the following equation.

$$\frac{(C_{85}-C_{20})}{C_{20} \times \Delta T} \times 10^6 \text{ (ppm/°C)} \quad \Delta T=65$$

#### Class 2

Capacitance at each step shall be measured in thermal equilibrium, and the temperature characteristic shall be calculated from the following equation.

| Step | B, F                          | X5R, X7R, X6S, X7S, Y5V | $\frac{(C-C_2)}{C_2} \times 100(\%)$ |
|------|-------------------------------|-------------------------|--------------------------------------|
| 1    | Minimum operating temperature |                         |                                      |
| 2    | 20°C                          | 25°C                    |                                      |
| 3    | Maximum operating temperature |                         |                                      |

C : Capacitance in Step 1 or Step 3  
C<sub>2</sub> : Capacitance in Step 2

## 9. Deflection

|                 |                                    |                     |   |
|-----------------|------------------------------------|---------------------|---|
| Specified Value | Temperature Compensating (Class 1) | Standard            | Appearance : No abnormality<br>Capacitance change : Within ±5% or ±0.5 pF, whichever is larger.     |
|                 |                                    | High Frequency Type | Appearance : No abnormality<br>Capacitance change : Within ±0.5 pF                                  |
|                 | High Permittivity (Class 2)        |                     | Appearance : No abnormality<br>Capacitance change : Within ±12.5% (BJ, B7, C6, C7), Within ±30% (F) |

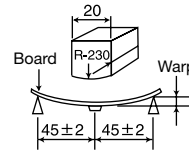
### [Test Methods and Remarks]

#### Multilayer Ceramic Capacitors

|                 | Board                       | Thickness | Warp | Duration |
|-----------------|-----------------------------|-----------|------|----------|
| 042, 063 Type   | glass epoxy-resin substrate | 0.8mm     | 1mm  | 10 sec.  |
| The other types |                             | 1.6mm     |      |          |

#### Array Type

|                    | Board                       | Thickness | Warp | Duration |
|--------------------|-----------------------------|-----------|------|----------|
| 096, 110, 212 Type | glass epoxy-resin substrate | 1.6mm     | 1mm  | 10 sec.  |



Capacitance measurement shall be conducted with the board bent (Unit: mm)

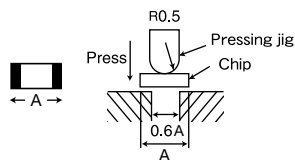
## 10. Body Strength

|                 |                                    |                     |                       |
|-----------------|------------------------------------|---------------------|-----------------------|
| Specified Value | Temperature Compensating (Class 1) | Standard            | —                     |
|                 |                                    | High Frequency Type | No mechanical damage. |
|                 | High Permittivity (Class 2)        |                     | —                     |

### [Test Methods and Remarks]

#### High Frequency Type

Applied force: 5N  
Duration: 10 sec.



## 11. Adhesive Strength of Terminal Electrodes

|                 |                                    |                     |   |
|-----------------|------------------------------------|---------------------|---|
| Specified Value | Temperature Compensating (Class 1) | Standard            | No terminal separation or its indication. |
|                 |                                    | High Frequency Type |   |
|                 | High Permittivity (Class 2)        |                     |   |

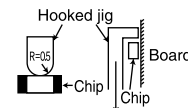
### [Test Methods and Remarks]

#### Multilayer Ceramic Capacitors

|                  | Applied force | Duration  |
|------------------|---------------|-----------|
| 042, 063 Type    | 2N            | 30±5 sec. |
| 105 Type or more | 5N            |           |

#### Array Type

|               | Applied force | Duration  |
|---------------|---------------|-----------|
| 096 Type      | 2N            | 30±5 sec. |
| 110, 212 Type | 5N            |           |



## 12. Solderability

|                 |                                    |                     |  |
|-----------------|------------------------------------|---------------------|--|
| Specified Value | Temperature Compensating (Class 1) | Standard            | At least 95% of terminal electrode is covered by new solder. |
|                 |                                    | High Frequency Type |  |
|                 | High Permittivity (Class 2)        |                     |  |

### [Test Methods and Remarks]

|                  | Solder type    | Solder temperature | Duration |
|------------------|----------------|--------------------|----------|
| Eutectic solder  | H60A or H63A   | 230±5°C            | 4±1 sec. |
| Lead-free solder | Sn-3.0Ag-0.5Cu | 245±3°C            |          |

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## RELIABILITY DATA

### 13. Resistance to Soldering

|                 |                                    |   |  |
|-----------------|------------------------------------|---|--|
| Specified Value | Temperature Compensating (Class 1) | Standard  | Appearance: No abnormality<br>Capacitance change: Within $\pm 2.5\%$ or $\pm 0.25\text{pF}$ , whichever is larger.<br>Q: Initial value<br>Insulation resistance: Initial value<br>Withstanding voltage (between terminals): No abnormality |
|                 |                                    | High Frequency Type   | Appearance: No abnormality<br>Capacitance change: Within $\pm 2.5\%$<br>Q: Initial value<br>Insulation resistance: Initial value<br>Withstanding voltage (between terminals): No abnormality   |
|                 | High Permittivity (Class 2) Note 1 | Appearance: No abnormality<br>Capacitance change: Within $\pm 7.5\%$ (BJ, B7, C6, C7)<br>Within $\pm 20\%$ (F)<br>Dissipation factor: Initial value<br>Insulation resistance: Initial value<br>Withstanding voltage (between terminals): No abnormality |  |

#### [Test Methods and Remarks]

##### Class 1

|                 |   |   |
|-----------------|---|---|
|                 | 042, 063 Type                           | 105 Type Array (096, 110 Type)                        |
| Preconditioning | None                                    |   |
| Preheating      | 150°C, 1 to 2 min.                      | 80 to 100°C, 2 to 5 min.<br>150 to 200°C, 2 to 5 min. |
| Solder temp.    | 270 $\pm$ 5°C                           |   |
| Duration        | 3 $\pm$ 0.5 sec.                        |   |
| Recovery        | 6 to 24 hrs (Standard condition) Note 5 |   |

##### Class 2

|                 |  |   |   |
|-----------------|--|---|---|
|                 | 042, 063 Type                                | 105, 107, 212 Type Array (096, 110, 212 Type)         | 316, 325 Type   |
| Preconditioning | Thermal treatment (at 150°C for 1 hr) Note 2 |   |   |
| Preheating      | 150°C, 1 to 2 min.                           | 80 to 100°C, 2 to 5 min.<br>150 to 200°C, 2 to 5 min. | 80 to 100°C, 5 to 10 min.<br>150 to 200°C, 5 to 10 min. |
| Solder temp.    | 270 $\pm$ 5°C                                |   |   |
| Duration        | 3 $\pm$ 0.5 sec.                             |   |   |
| Recovery        | 24 $\pm$ 2 hrs (Standard condition) Note 5   |   |   |

### 14. Temperature Cycle (Thermal Shock)

|                 |                                    |   |  |
|-----------------|------------------------------------|---|--|
| Specified Value | Temperature Compensating (Class 1) | Standard  | Appearance: No abnormality<br>Capacitance change: Within $\pm 2.5\%$ or $\pm 0.25\text{pF}$ , whichever is larger.<br>Q: Initial value<br>Insulation resistance: Initial value<br>Withstanding voltage (between terminals): No abnormality |
|                 |                                    | High Frequency Type   | Appearance: No abnormality<br>Capacitance change: Within $\pm 0.25\text{pF}$<br>Q: Initial value<br>Insulation resistance: Initial value<br>Withstanding voltage (between terminals): No abnormality                                       |
|                 | High Permittivity (Class 2) Note 1 | Appearance: No abnormality<br>Capacitance change: Within $\pm 7.5\%$ (BJ, B7, C6, C7)<br>Within $\pm 20\%$ (F)<br>Dissipation factor: Initial value<br>Insulation resistance: Initial value<br>Withstanding voltage (between terminals): No abnormality |  |

#### [Test Methods and Remarks]

|                  |   |                                     |  |             |
|------------------|---|-------------------------------------|--|-------------|
|                  | Class 1                                 |                                     | Class 2                                      |             |
| Preconditioning  | None                                    |                                     | Thermal treatment (at 150°C for 1 hr) Note 2 |             |
| 1 cycle          | Step                                    | Temperature (°C)                    |  | Time (min.) |
|                  | 1                                       | Lowest operating temperature +0/-3  |  | 30 $\pm$ 3  |
|                  | 2                                       | Normal temperature                  |  | 2 to 3      |
|                  | 3                                       | Highest operating temperature +0/-3 |  | 30 $\pm$ 3  |
|                  | 4                                       | Normal temperature                  |  | 2 to 3      |
| Number of cycles | 5 times                                 |                                     |  |             |
| Recovery         | 6 to 24 hrs (Standard condition) Note 5 |                                     | 24 $\pm$ 2 hrs (Standard condition) Note 5   |             |

### 15. Humidity (Steady State)

|                 |                                    |  |  |
|-----------------|------------------------------------|--|--|
| Specified Value | Temperature Compensating (Class 1) | Standard   | Appearance: No abnormality<br>Capacitance change: Within $\pm 5\%$ or $\pm 0.5\text{pF}$ , whichever is larger.<br>Q: C < 10pF : Q $\geq$ 200+10C<br>10 $\leq$ C < 30pF : Q $\geq$ 275+2.5C<br>C $\geq$ 30pF : Q $\geq$ 350 (C : Nominal capacitance)<br>Insulation resistance: 1000 M $\Omega$ min. |
|                 |                                    | High Frequency Type  | Appearance: No abnormality<br>Capacitance change: Within $\pm 0.5\text{pF}$<br>Insulation resistance: 1000 M $\Omega$ min.   |
|                 | High Permittivity (Class 2) Note 1 | Appearance: No abnormality<br>Capacitance change: Within $\pm 12.5\%$ (BJ, B7, C6, C7)<br>Within $\pm 30\%$ (F)<br>Dissipation factor : 5.0% max. (BJ, B7, C6, C7)<br>11.0% max. (F)<br>Insulation resistance: 50 M $\Omega\mu\text{F}$ or 1000 M $\Omega$ whichever is smaller. |  |

#### [Test Methods and Remarks]

##### Class 1

|                 |   |                     |
|-----------------|---|---------------------|
|                 | Standard                                | High Frequency Type |
| Preconditioning | None                                    |                     |
| Temperature     | 40 $\pm$ 2°C                            | 60 $\pm$ 2°C        |
| Humidity        | 90 to 95%RH                             |                     |
| Duration        | 500+24/-0 hrs                           |                     |
| Recovery        | 6 to 24 hrs (Standard condition) Note 5 |                     |

##### Class 2

|                 |  |  |
|-----------------|--|--|
|                 | All items                                    |  |
| Preconditioning | Thermal treatment (at 150°C for 1 hr) Note 2 |  |
| Temperature     | 40 $\pm$ 2°C                                 |  |
| Humidity        | 90 to 95%RH                                  |  |
| Duration        | 500+24/-0 hrs                                |  |
| Recovery        | 24 $\pm$ 2 hrs (Standard condition) Note 5   |  |

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**RELIABILITY DATA**

**16. Humidity Loading**

|                 |                                    |   |   |
|-----------------|------------------------------------|---|---|
| Specified Value | Temperature Compensating (Class 1) | Standard  | Appearance: No abnormality<br>Capacitance change: Within $\pm 7.5\%$ or $\pm 0.75\text{pF}$ , whichever is larger.<br>Q : $C < 30\text{pF} : Q \geq 100 + 10C/3$<br>$C \geq 30\text{pF} : Q \geq 200$ (C : Nominal capacitance)<br>Insulation resistance: 500 M $\Omega$ min. |
|                 |                                    | High Frequency Type   | Appearance: No abnormality<br>Capacitance change: $C \leq 2\text{pF} : \text{Within } \pm 0.4 \text{ pF}$<br>$C > 2\text{pF} : \text{Within } \pm 0.75 \text{ pF}$ (C : Nominal capacitance)<br>Insulation resistance: 500 M $\Omega$ min.                                    |
|                 | High Permittivity (Class 2) Note 1 | Appearance: No abnormality<br>Capacitance change: Within $\pm 12.5\%$ (BJ, B7, C6, C7)<br>Within $\pm 30\%$ (F)<br>Dissipation factor : 5.0% max. (BJ, B7, C6, C7)<br>11.0% max. (F)<br>Insulation resistance: 25 M $\Omega\mu\text{F}$ or 500 M $\Omega$ , whichever is smaller. |   |

**[Test Methods and Remarks]**

**Class 1**

|                          | Standard                                | High Frequency Type           |
|--------------------------|---|-------------------------------|
| Preconditioning          | None                                    |                               |
| Temperature              | 40 $\pm$ 2 $^{\circ}\text{C}$           | 60 $\pm$ 2 $^{\circ}\text{C}$ |
| Humidity                 | 90 to 95%RH                             |                               |
| Duration                 | 500+24/-0 hrs                           |                               |
| Applied voltage          | Rated voltage                           |                               |
| Charge/discharge current | 50mA max.                               |                               |
| Recovery                 | 6 to 24 hrs (Standard condition) Note 5 |                               |

**Class 2**

|                          | All items   |
|--------------------------|---|
| Preconditioning          | Voltage treatment (Rated voltage are applied for 1 hour at 40 $^{\circ}\text{C}$ ) Note 3 |
| Temperature              | 40 $\pm$ 2 $^{\circ}\text{C}$   |
| Humidity                 | 90 to 95%RH   |
| Duration                 | 500+24/-0 hrs   |
| Applied voltage          | Rated voltage   |
| Charge/discharge current | 50mA max.   |
| Recovery                 | 24 $\pm$ 2 hrs (Standard condition) Note 5  |

**17. High Temperature Loading**

|                 |                                    |  |  |
|-----------------|------------------------------------|--|--|
| Specified Value | Temperature Compensating (Class 1) | Standard   | Appearance: No abnormality<br>Capacitance change: Within $\pm 3\%$ or $\pm 0.3\text{pF}$ , whichever is larger.<br>Q : $C < 10\text{pF} : Q \geq 200 + 10C$<br>$10 \leq C < 30\text{pF} : Q \geq 275 + 2.5C$<br>$C \geq 30\text{pF} : Q \geq 350$ (C : Nominal capacitance)<br>Insulation resistance: 1000 M $\Omega$ min. |
|                 |                                    | High Frequency Type  | Appearance: No abnormality<br>Capacitance change: Within $\pm 3\%$ or $\pm 0.3\text{pF}$ , whichever is larger.<br>Insulation resistance: 1000 M $\Omega$ min.   |
|                 | High Permittivity (Class 2) Note 1 | Appearance: No abnormality<br>Capacitance change: Within $\pm 12.5\%$ (BJ, B7, C6, C7)<br>Within $\pm 30\%$ (F)<br>Dissipation factor : 5.0% max. (BJ, B7, C6, C7)<br>11.0% max. (F)<br>Insulation resistance: 50 M $\Omega\mu\text{F}$ or 1000 M $\Omega$ , whichever is smaller. |  |

**[Test Methods and Remarks]**

**Class 1**

|                          | Standard                              | High Frequency Type |
|--------------------------|---------------------------------------|---------------------|
| Preconditioning          | None                                  |                     |
| Temperature              | 125 $\pm$ 3 $^{\circ}\text{C}$        |                     |
| Duration                 | 1000+48/-0 hrs                        |                     |
| Applied voltage          | Rated voltage $\times$ 2              |                     |
| Charge/discharge current | 50mA max.                             |                     |
| Recovery                 | 6 to 24hr (Standard condition) Note 5 |                     |

**Class 2**

|                          | BJ, F  | C6                             | B7, C7                         |
|--------------------------|--|--------------------------------|--------------------------------|
| Preconditioning          | Voltage treatment (Twice the rated voltage shall be applied for 1 hour at 85 $^{\circ}\text{C}$ , 105 $^{\circ}\text{C}$ or 125 $^{\circ}\text{C}$ ) Note 3, 4 |                                |                                |
| Temperature              | 85 $\pm$ 2 $^{\circ}\text{C}$  | 105 $\pm$ 3 $^{\circ}\text{C}$ | 125 $\pm$ 3 $^{\circ}\text{C}$ |
| Duration                 | 1000+48/-0 hrs   |                                |                                |
| Applied voltage          | Rated voltage $\times$ 2 Note 4  |                                |                                |
| Charge/discharge current | 50mA max.  |                                |                                |
| Recovery                 | 24 $\pm$ 2 hrs (Standard condition) Note 5   |                                |                                |

Note 1 The figures indicate typical specifications. Please refer to individual specifications in detail.

Note 2 Thermal treatment : Initial value shall be measured after test sample is heat-treated at 150+0/-10 $^{\circ}\text{C}$  for an hour and kept at room temperature for 24 $\pm$ 2hours.

Note 3 Voltage treatment : Initial value shall be measured after test sample is voltage-treated for an hour at both the temperature and voltage specified in the test conditions, and kept at room temperature for 24 $\pm$ 2hours.

Note 4 150% of rated voltage is applicable to some items. Please refer to their specifications for further information.

Note 5 Standard condition: Temperature: 5 to 35 $^{\circ}\text{C}$ , Relative humidity: 45 to 85 % RH, Air pressure: 86 to 106kPa  
When there are questions concerning measurement results, in order to provide correlation data, the test shall be conducted under the following condition.

Temperature: 20 $\pm$ 2 $^{\circ}\text{C}$ , Relative humidity: 60 to 70 % RH, Air pressure: 86 to 106kPa  
Unless otherwise specified, all the tests are conducted under the "standard condition".

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# PRECAUTIONS

## Precautions on the use of Multilayer Ceramic Capacitors

### 1. Circuit Design

- ◆ Verification of operating environment, electrical rating and performance  
 1. A malfunction of equipment in fields such as medical, aerospace, nuclear control, etc. may cause serious harm to human life or have severe social ramifications. Therefore, any capacitors to be used in such equipment may require higher safety and reliability, and shall be clearly differentiated from them used in general purpose applications.
- ◆ Operating Voltage (Verification of Rated voltage)  
 1. The operating voltage for capacitors must always be their rated voltage or less.  
 If an AC voltage is loaded on a DC voltage, the sum of the two peak voltages shall be the rated voltage or less.  
 For a circuit where an AC or a pulse voltage may be used, the sum of their peak voltages shall also be the rated voltage or less.
2. Even if an applied voltage is the rated voltage or less reliability of capacitors may be deteriorated in case that either a high frequency AC voltage or a pulse voltage having rapid rise time is used in a circuit.

### 2. PCB Design

- ◆ Pattern configurations (Design of Land-patterns)  
 1. When capacitors are mounted on PCBs, the amount of solder used (size of fillet) can directly affect the capacitor performance. Therefore, the following items must be carefully considered in the design of land patterns:  
 (1) Excessive solder applied can cause mechanical stresses which lead to chip breaking or cracking. Therefore, please consider appropriate land-patterns for proper amount of solder.  
 (2) When more than one component are jointly soldered onto the same land, each component's soldering point shall be separated by solder-resist.
- ◆ Pattern configurations (Capacitor layout on PCBs)  
 After capacitors are mounted on boards, they can be subjected to mechanical stresses in subsequent manufacturing processes (PCB cutting, board inspection, mounting of additional parts, assembly into the chassis, wave soldering of the boards, etc.). For this reason, land pattern configurations and positions of capacitors shall be carefully considered to minimize stresses.

- ◆ Pattern configurations (Design of Land-patterns)  
 The following diagrams and tables show some examples of recommended land patterns to prevent excessive solder amounts.

(1) Recommended land dimensions for typical chip capacitors

- Multilayer Ceramic Capacitors : Recommended land dimensions (unit: mm)  
 Wave-soldering

| Type | 107        | 212        | 316        | 325        |
|------|------------|------------|------------|------------|
| Size | L          | 1.6        | 2.0        | 3.2        |
|      | W          | 0.8        | 1.25       | 1.6        |
| A    | 0.8 to 1.0 | 1.0 to 1.4 | 1.8 to 2.5 | 1.8 to 2.5 |
| B    | 0.5 to 0.8 | 0.8 to 1.5 | 0.8 to 1.7 | 0.8 to 1.7 |
| C    | 0.6 to 0.8 | 0.9 to 1.2 | 1.2 to 1.6 | 1.8 to 2.5 |

Reflow-soldering

| Type | 042          | 063          | 105          | 107        | 212        | 316        | 325        | 432        |
|------|--------------|--------------|--------------|------------|------------|------------|------------|------------|
| Size | L            | 0.4          | 0.6          | 1.0        | 1.6        | 2.0        | 3.2        | 4.5        |
|      | W            | 0.2          | 0.3          | 0.45       | 0.8        | 1.25       | 1.6        | 3.2        |
| A    | 0.15 to 0.25 | 0.20 to 0.30 | 0.45 to 0.55 | 0.8 to 1.0 | 0.8 to 1.2 | 1.8 to 2.5 | 1.8 to 2.5 | 2.5 to 3.5 |
| B    | 0.15 to 0.20 | 0.20 to 0.30 | 0.40 to 0.50 | 0.6 to 0.8 | 0.8 to 1.2 | 1.0 to 1.5 | 1.0 to 1.5 | 1.5 to 1.8 |
| C    | 0.15 to 0.30 | 0.25 to 0.40 | 0.45 to 0.55 | 0.6 to 0.8 | 0.9 to 1.6 | 1.2 to 2.0 | 1.8 to 3.2 | 2.3 to 3.5 |

Note : Recommended land size might be different according to the allowance of the size of the product.

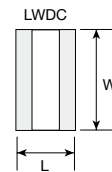
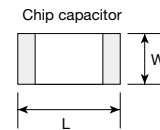
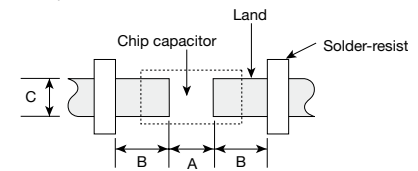
- LWDC: Recommended land dimensions for reflow-soldering (unit: mm)

| Type | 105          | 107         | 212        |
|------|--------------|-------------|------------|
| Size | L            | 0.52        | 0.8        |
|      | W            | 1.0         | 1.6        |
| A    | 0.18 to 0.22 | 0.25 to 0.3 | 0.5 to 0.7 |
| B    | 0.2 to 0.25  | 0.3 to 0.4  | 0.4 to 0.5 |
| C    | 0.9 to 1.1   | 1.5 to 1.7  | 1.9 to 2.1 |

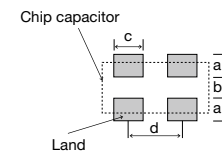
- Array type: Recommended land dimensions for reflow-soldering (unit: mm)

| Type | 096 (2 circuits) | 110 (2 circuits) | 212 (2 circuits) | 212 (4 circuits) |
|------|------------------|------------------|------------------|------------------|
| Size | L                | 0.9              | 1.37             | 2.0              |
|      | W                | 0.6              | 1.0              | 1.25             |
| a    | 0.25 to 0.35     | 0.35 to 0.45     | 0.5 to 0.6       | 0.5 to 0.6       |
| b    | 0.15 to 0.25     | 0.55 to 0.65     | 0.5 to 0.6       | 0.5 to 0.6       |
| c    | 0.15 to 0.25     | 0.3 to 0.4       | 0.5 to 0.6       | 0.2 to 0.3       |
| d    | 0.45             | 0.64             | 1.0              | 0.5              |

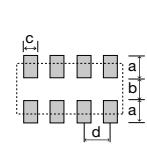
Land patterns for PCBs



2 circuits



4 circuits



(2) Examples of good and bad solder application

| Items   | Not recommended                          | Recommended   |
|---|--|---------------|
| Mixed mounting of SMD and leaded components                 | Lead wire of component                   | Solder-resist |
| Component placement close to the chassis                    | Chassis Solder (for grounding)<br>Land   | Solder-resist |
| Hand-soldering of leaded components near mounted components | Lead wire of component<br>Soldering iron | Solder-resist |
| Horizontal component placement                              |  | Solder-resist |

To next page

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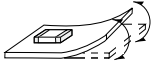
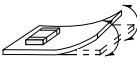
## PRECAUTIONS

### Precautions on the use of Multilayer Ceramic Capacitors

#### 2. PCB Design

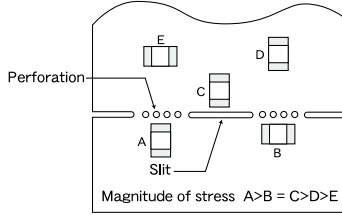
##### ◆Pattern configurations (Capacitor layout on PCBs)

1-1. The following is examples of good and bad capacitor layouts ; capacitors shall be located to minimize any possible mechanical stresses from board warp or deflection.

| Items               | Not recommended   | Recommended   |
|---------------------|---|---|
| Deflection of board |  |  Position the component at a right angle to the direction of the mechanical stresses that are anticipated. |

Technical considerations

1-2. The amount of mechanical stresses given will vary depending on capacitor layout. Please refer to diagram below.



1-3. When PCB is split, the amount of mechanical stress on the capacitors can vary according to the method used. The following methods are listed in order from least stressful to most stressful: push-back, slit, V-grooving, and perforation. Thus, please consider the PCB, split methods as well as chip location.

#### 3. Mounting

##### ◆Adjustment of mounting machine

- When capacitors are mounted on PCB, excessive impact load shall not be imposed on them.
- Maintenance and inspection of mounting machines shall be conducted periodically.

Precautions

##### ◆Selection of Adhesives

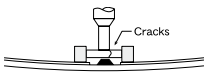
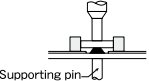
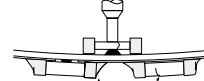
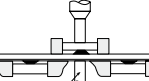
- When chips are attached on PCBs with adhesives prior to soldering, it may cause capacitor characteristics degradation unless the following factors are appropriately checked : size of land patterns, type of adhesive, amount applied, hardening temperature and hardening period. Therefore, please contact us for further information.

##### ◆Adjustment of mounting machine

1. When the bottom dead center of a pick-up nozzle is too low, excessive force is imposed on capacitors and causes damages. To avoid this, the following points shall be considerable.

- The bottom dead center of the pick-up nozzle shall be adjusted to the surface level of PCB without the board deflection.
- The pressure of nozzle shall be adjusted between 1 and 3 N static loads.

(3) To reduce the amount of deflection of the board caused by impact of the pick-up nozzle, supporting pins or back-up pins shall be used on the other side of the PCB. The following diagrams show some typical examples of good and bad pick-up nozzle placement:

| Items                 | Not recommended   | Recommended  |
|-----------------------|---|--|
| Single-sided mounting |  Cracks                |  Supporting pin |
| Double-sided mounting |  Solder peeling Cracks |  Supporting pin |

Technical considerations

2. As the alignment pin is worn out, adjustment of the nozzle height can cause chipping or cracking of capacitors because of mechanical impact on the capacitors. To avoid this, the monitoring of the width between the alignment pins in the stopped position, maintenance, check and replacement of the pin shall be conducted periodically.

##### ◆Selection of Adhesives

Some adhesives may cause IR deterioration. The different shrinkage percentage of between the adhesive and the capacitors may result in stresses on the capacitors and lead to cracking. Moreover, too little or too much adhesive applied to the board may adversely affect components. Therefore, the following precautions shall be noted in the application of adhesives.

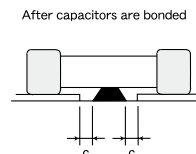
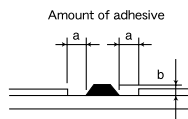
##### (1) Required adhesive characteristics

- The adhesive shall be strong enough to hold parts on the board during the mounting & solder process.
- The adhesive shall have sufficient strength at high temperatures.
- The adhesive shall have good coating and thickness consistency.
- The adhesive shall be used during its prescribed shelf life.
- The adhesive shall harden rapidly.
- The adhesive shall have corrosion resistance.
- The adhesive shall have excellent insulation characteristics.
- The adhesive shall have no emission of toxic gasses and no effect on the human body.

(2) The recommended amount of adhesives is as follows;

[Recommended condition]

| Figure | 212/316 case sizes as examples   |
|--------|----------------------------------|
| a      | 0.3mm min                        |
| b      | 100 to 120 $\mu$ m               |
| c      | Adhesives shall not contact land |



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**PRECAUTIONS**

Precautions on the use of Multilayer Ceramic Capacitors

4. Soldering

Precautions

◆ Selection of Flux

Since flux may have a significant effect on the performance of capacitors, it is necessary to verify the following conditions prior to use:  
 (1) Flux used shall be less than or equal to 0.1 wt% (in Cl equivalent) of halogenated content. Flux having a strong acidity content shall not be applied.  
 (2) When shall capacitors are soldered on boards, the amount of flux applied shall be controlled at the optimum level.  
 (3) When water-soluble flux is used, special care shall be taken to properly clean the boards.

◆ Soldering

Temperature, time, amount of solder, etc. shall be set in accordance with their recommended conditions.

Sn-Zn solder paste can adversely affect MLCC reliability.  
 Please contact us prior to usage of Sn-Zn solder.

◆ Selection of Flux

1-1. When too much halogenated substance (**Chlorine, etc.**) content is used to activate flux, or highly acidic flux is used, it may lead to corrosion of terminal electrodes or degradation of insulation resistance on the surfaces of the capacitors.

1-2. Flux is used to increase solderability in wave soldering. However if too much flux is applied, a large amount of flux gas may be emitted and may adversely affect the solderability. To minimize the amount of flux applied, it is recommended to use a flux-bubbling system.

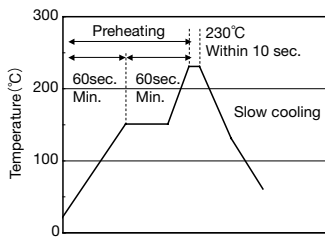
1-3. Since the residue of water-soluble flux is easily dissolved in moisture in the air, the residues on the surfaces of capacitors in high humidity conditions may cause a degradation of insulation resistance and reliability of the capacitors. Therefore, the cleaning methods and the capability of the machines used shall also be considered carefully when water-soluble flux is used.

◆ Soldering

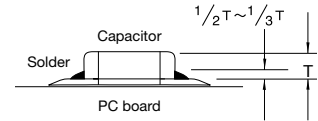
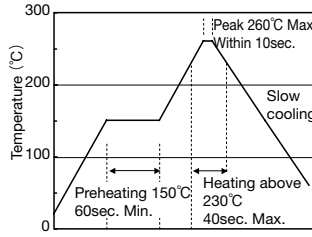
- Ceramic chip capacitors are susceptible to thermal shock when exposed to rapid or concentrated heating or rapid cooling.
- Therefore, the soldering must be conducted with great care so as to prevent malfunction of the components due to excessive thermal shock.
- Preheating : Capacitors shall be preheated sufficiently, and the temperature difference between the capacitors and solder shall be within 100 to 130°C.
- Cooling : The temperature difference between the capacitors and cleaning process shall not be greater than 100°C.

[Reflow soldering]

[Recommended conditions for eutectic soldering]



[Recommended condition for Pb-free soldering]



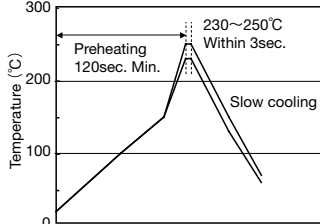
Caution

- ① The ideal condition is to have solder mass (fillet) controlled to 1/2 to 1/3 of the thickness of a capacitor.
- ② Because excessive dwell times can adversely affect solderability, soldering duration shall be kept as close to recommended times as possible.

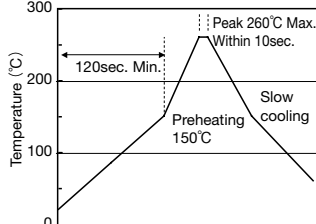
Technical considerations

[Wave soldering]

[Recommended conditions for eutectic soldering]



[Recommended condition for Pb-free soldering]

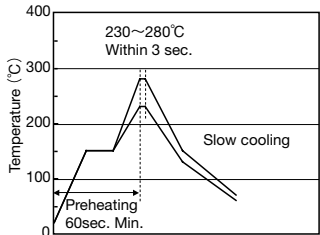


Caution

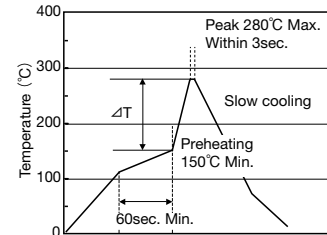
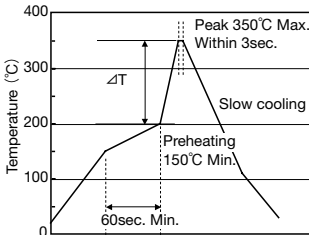
- ① Wave soldering must not be applied to capacitors designated as for reflow soldering only.

[Hand soldering]

[Recommended conditions for eutectic soldering]



[Recommended condition for Pb-free soldering]



Caution

- ① Use a 50W soldering iron with a maximum tip diameter of 1.0 mm.
- ② The soldering iron shall not directly touch capacitors.

\* This catalog contains the typical specification only due to the limitation of space. When you consider the purchase of our products, please check our specification. For details of each product (characteristics graph, reliability information, precautions for use, and so on), see our Web site (<http://www.ty-top.com/>) or CD catalogs.

## PRECAUTIONS

### Precautions on the use of Multilayer Ceramic Capacitors

| 5. Cleaning               |  |
|---------------------------|--|
| Precautions               | <ul style="list-style-type: none"><li>◆Cleaning conditions</li><li>1. When PCBs are cleaned after capacitors mounting, please select the appropriate cleaning solution in accordance with the intended use of the cleaning. (e.g. to remove soldering flux or other materials from the production process.)</li><li>2. Cleaning condition shall be determined after it is verified by using actual cleaning machine that the cleaning process does not affect capacitor's characteristics.</li></ul>   |
| Technical considerations  | <ul style="list-style-type: none"><li>1. The use of inappropriate cleaning solutions can cause foreign substances such as flux residue to adhere to capacitors or deteriorate their outer coating, resulting in a degradation of the capacitor's electrical properties (especially insulation resistance).</li><li>2. Inappropriate cleaning conditions (insufficient or excessive cleaning) may adversely affect the performance of the capacitors.<br/>In the case of ultrasonic cleaning, too much power output can cause excessive vibration of PCBs which may lead to the cracking of capacitors or the soldered portion, or decrease the terminal electrodes' strength. Therefore, the following conditions shall be carefully checked;<br/>Ultrasonic output : 20 W/l or less<br/>Ultrasonic frequency : 40 kHz or less<br/>Ultrasonic washing period : 5 min. or less</li></ul>  |
| 6. Resin coating and mold |  |
| Precautions               | <ul style="list-style-type: none"><li>1. With some type of resins, decomposition gas or chemical reaction vapor may remain inside the resin during the hardening period or while left under normal storage conditions resulting in the deterioration of the capacitor's performance.</li><li>2. When a resin's hardening temperature is higher than capacitor's operating temperature, the stresses generated by the excessive heat may lead to damage or destruction of capacitors.<br/>The use of such resins, molding materials etc. is not recommended.</li></ul>  |
| 7. Handling               |  |
| Precautions               | <ul style="list-style-type: none"><li>◆Splitting of PCB</li><li>1. When PCBs are split after components mounting, care shall be taken so as not to give any stresses of deflection or twisting to the board.</li><li>2. Board separation shall not be done manually, but by using the appropriate devices.</li><li>◆Mechanical considerations</li><li>Be careful not to subject capacitors to excessive mechanical shocks.<br/>(1) If ceramic capacitors are dropped onto a floor or a hard surface, they shall not be used.<br/>(2) Please be careful that the mounted components do not come in contact with or bump against other boards or components.</li></ul>   |
| 8. Storage conditions     |  |
| Precautions               | <ul style="list-style-type: none"><li>◆Storage</li><li>1. To maintain the solderability of terminal electrodes and to keep packaging materials in good condition, care must be taken to control temperature and humidity in the storage area. Humidity should especially be kept as low as possible.<ul style="list-style-type: none"><li>•Recommended conditions</li><li>Ambient temperature : Below 30°C</li><li>Humidity : Below 70% RH</li></ul>The ambient temperature must be kept below 40°C. Even under ideal storage conditions, solderability of capacitor is deteriorated as time passes, so capacitors shall be used within 6 months from the time of delivery.<ul style="list-style-type: none"><li>•Ceramic chip capacitors shall be kept where no chlorine or sulfur exists in the air.</li></ul></li><li>2. The capacitance values of high dielectric constant capacitors will gradually decrease with the passage of time, so care shall be taken to design circuits. Even if capacitance value decreases as time passes, it will get back to the initial value by a heat treatment at 150°C for 1hour.</li></ul> |
| Technical considerations  | If capacitors are stored in a high temperature and humidity environment, it might rapidly cause poor solderability due to terminal oxidation and quality loss of taping/packaging materials. For this reason, capacitors shall be used within 6 months from the time of delivery. If exceeding the above period, please check solderability before using the capacitors.   |

※RCR-2335B (Safety Application Guide for fixed ceramic capacitors for use in electronic equipment) is published by JEITA.  
Please check the guide regarding precautions for deflection test, soldering by spot heat, and so on.