

# Multilayer Ceramic Capacitors for Automotive Powertrain and Safety

REFLOW

AEC-Q200

## ■ PART NUMBER

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| M | A | A | S | J | 3 | 1 | L | A | B | 7 | 1 | 0 | 6 | K | T | N | A | 0 | 1 |
| ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | ⑩ |   |   |   |   |   |   |   |   |   |   |

### ① Series

| Code<br>(1)(2)(3)(4) |  |
|----------------------|--|
| MAAS                 | Multilayer Ceramic Capacitor (High dielectric type) for Automotive Powertrain and Safety |

### (1) Product Group

| Code |                              |
|------|------------------------------|
| M    | Multilayer Ceramic Capacitor |

### (3) Type

| Code |             |
|------|-------------|
| A    | 2 terminals |

### (2) Category

| Code | Recommended equipment                                   | Quality Grade |
|------|---|---------------|
| A    | Automotive Electronic Equipment<br>(Powertrain, Safety) | 1             |

### (4) Features, Characteristics

| Code |                  |
|------|------------------|
| S    | Standard/General |

### ② Rated voltage

| Code | Rated voltage [VDC] |
|------|---------------------|
| A    | 4                   |
| J    | 6.3                 |
| L    | 10                  |
| E    | 16                  |
| T    | 25                  |
| U    | 50                  |
| H    | 100                 |

### ④ Thickness

| Code | Thickness [mm] |
|------|----------------|
| 3    | 0.3            |
| 5    | 0.5            |
| 8    | 0.8            |
| Q    | 1.15           |
| G    | 1.25           |
| L    | 1.6            |
| N    | 1.9            |
| M    | 2.5            |

### ③ Dimension (L × W)

| Code | L × W [mm] | JIS(mm) | EIA(inch) |
|------|------------|---------|-----------|
| 06   | 0.6 × 0.3  | 0603    | 0201      |
| 10   | 1.0 × 0.5  | 1005    | 0402      |
| 16   | 1.6 × 0.8  | 1608    | 0603      |
| 21   | 2.0 × 1.25 | 2012    | 0805      |
| 31   | 3.2 × 1.6  | 3216    | 1206      |
| 32   | 3.2 × 2.5  | 3225    | 1210      |

### ⑤ Dimension tolerance

| Code | Dimension code | L [mm]         | W [mm]          | T [mm]               | Thickness code |
|------|----------------|----------------|-----------------|----------------------|----------------|
| A    | 10             | 1.0±0.10       | 0.5±0.10        | 0.5±0.10             | 5              |
|      | 16             | 1.6+0.15/-0.05 | 0.8+0.15/-0.05  | 0.8+0.15/-0.05       | 8              |
|      | 21             | 2.0+0.15/-0.05 | 1.25+0.15/-0.05 | 1.25+0.15/-0.05      | G              |
|      | 31             | 3.2±0.20       | 1.6±0.20        | 1.6±0.20             | L              |
|      | 32             | 3.2±0.30       | 2.5±0.30        | 2.5±0.30             | M              |
| B    | 21             | 2.0+0.20/-0    | 1.25+0.20/-0    | 1.25+0.20/-0         | G              |
|      | 31             | 3.2±0.30       | 1.6±0.30        | 1.6±0.30             | L              |
| C    | 10             | 1.0+0.20/-0    | 0.5+0.20/-0     | 0.5+0.20/-0          | 5              |
|      | 21             | 2.0+0.25/-0    | 1.25+0.25/-0    | 1.25+0.25/-0         | G              |
| H    | 31             | 3.2±0.15       | 1.6±0.15        | 1.15±0.10            | Q              |
| S    | 06             | 0.6±0.03       | 0.3±0.03        | 0.3±0.03             | 3              |
|      | 10             | 1.0±0.05       | 0.5±0.05        | 0.5±0.05             | 5              |
|      | 16             | 1.6±0.10       | 0.8±0.10        | 0.8±0.10             | 8              |
|      | 21             | 2.0±0.10       | 1.25±0.10       | 1.25±0.10            | G              |
|      | 31             | 3.2±0.15       | 1.6±0.15        | 1.6±0.20             | L              |
|      | 32             | 3.2±0.30       | 2.5±0.20        | 1.9±0.20<br>2.5±0.20 | N<br>M         |

## ⑥ Temperature characteristics code

## ■ High dielectric type

| Code | Applicable standard |     | Temperature range [°C] | Ref. Temp. [°C] | Capacitance change | Capacitance tolerance | Tolerance code |
|------|---------------------|-----|------------------------|-----------------|--------------------|-----------------------|----------------|
| B7   | EIA                 | X7R | -55 ~ +125             | 25              | ±15%               | ±10%                  | K              |
|      |                     |     |                        |                 |                    | ±20%                  | M              |
| C7   | EIA                 | X7S | -55 ~ +125             | 25              | ±22%               | ±10%                  | K              |
|      |                     |     |                        |                 |                    | ±20%                  | M              |
| D7   | EIA                 | X7T | -55 ~ +125             | 25              | +22% / -33%        | ±10%                  | K              |
|      |                     |     |                        |                 |                    | ±20%                  | M              |

## ⑦ Nominal capacitance

| Code (example) | Nominal capacitance |
|----------------|---------------------|
| 101            | 100pF               |
| 102            | 1,000pF             |
| 103            | 0.01μF              |
| 104            | 0.1μF               |
| 105            | 1μF                 |
| 106            | 10μF                |

## ⑨ Packaging

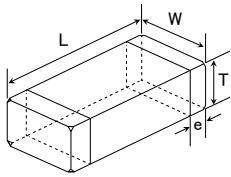
| Code | Packaging  |
|------|--|
| F    | φ178mm Taping (2mm pitch)  |
| T    | φ178mm Taping (4mm pitch)  |
| P    | φ178mm Taping (4mm pitch, 1000 pcs/reel)<br>3225 type (Thickness code M) |

## ⑩ Internal code

## ⑧ Capacitance tolerance

| Code | Capacitance tolerance |
|------|-----------------------|
| K    | ±10%                  |
| M    | ±20%                  |

## ■ STANDARD EXTERNAL DIMENSIONS



| Type    | JIS (mm) | EIA (inch) | Dimension [mm] (inch)     |                            |                            |    |  |
|---------|----------|------------|---------------------------|----------------------------|----------------------------|----|--|
|         |          |            | L                         | W                          | T                          | *1 | e                                      |
| MAAS□06 | 0603     | 0201       | 0.6±0.03<br>(0.024±0.001) | 0.3±0.03<br>(0.012±0.001)  | 0.3±0.03<br>(0.012±0.001)  | 3  | 0.15±0.05<br>(0.006±0.002)             |
| MAAS□10 | 1005     | 0402       | 1.0±0.05<br>(0.039±0.002) | 0.5±0.05<br>(0.020±0.002)  | 0.5±0.05<br>(0.020±0.002)  | 5  | 0.25±0.10<br>(0.010±0.004)             |
| MAAS□16 | 1608     | 0603       | 1.6±0.10<br>(0.063±0.004) | 0.8±0.10<br>(0.031±0.004)  | 0.8±0.10<br>(0.031±0.004)  | 8  | 0.35±0.25<br>(0.014±0.010)             |
| MAAS□21 | 2012     | 0805       | 2.0±0.10<br>(0.079±0.004) | 1.25±0.10<br>(0.049±0.004) | 1.25±0.10<br>(0.049±0.004) | G  | 0.5±0.25<br>(0.020±0.010)              |
| MAAS□31 | 3216     | 1206       | 3.2±0.15<br>(0.126±0.006) | 1.6±0.15<br>(0.063±0.006)  | 1.15±0.10<br>(0.045±0.004) | Q  | 0.5+0.35/-0.25<br>(0.020+0.014/-0.010) |
|         |          |            |                           |                            | 1.6±0.20<br>(0.063±0.008)  | L  |  |
| MAAS□32 | 3225     | 1210       | 3.2±0.30<br>(0.126±0.012) | 2.5±0.20<br>(0.098±0.008)  | 1.9±0.20<br>(0.075±0.008)  | N  | 0.6±0.3<br>(0.024±0.012)               |
|         |          |            |                           |                            | 2.5±0.20<br>(0.098±0.008)  | M  |  |

\*1.Thickness code

## ■ STANDARD QUANTITY

| Type |         |           | Thickness |      | Standard quantity [pcs] |                 |
|------|---------|-----------|-----------|------|-------------------------|-----------------|
| Code | JIS(mm) | EIA(inch) | [mm]      | Code | Paper tape              | Embossed tape   |
| 06   | 0603    | 0201      | 0.3       | 3    | 15000                   | —               |
| 10   | 1005    | 0402      | 0.5       | 5    | 10000                   | —               |
| 16   | 1608    | 0603      | 0.8       | 8    | 4000                    | —               |
| 21   | 2012    | 0805      | 1.25      | G    | —                       | 3000            |
| 31   | 3216    | 1206      | 1.15      | Q    | —                       | 3000            |
|      |         |           | 1.6       | L    | —                       | 2000            |
| 32   | 3225    | 1210      | 1.9       | N    | —                       | 2000            |
|      |         |           | 2.5       | M    | —                       | 500(T), 1000(P) |

## PART NUMBER

- All the Multilayer Ceramic Capacitors of the catalog lineup are RoHS compliant.
- Capacitance tolerance code is applied to □ of part number.
- All the Multilayer Ceramic Capacitors in the catalog lineup are applicable for reflow-soldering.

## Notes)

- The exchange of individual specifications is necessary depending on your application and/or circuit condition. Please contact TAIYO YUDEN's official sales channel.
- For Automotive (AEC-Q200 Qualified) products for POWERTRAIN and SAFETY. Please check "Automotive Application Guide" for further details before using the products.  
< AEC-Q200 :AEC-Q200 qualified >
- All the Multilayer Ceramic Capacitors for Automotive products are tested based on the test conditions and methods defined in AEC-Q200 by family item.  
125°C products: AEC-Q200 Grade1 (we conduct the evaluation at the test condition of Grade1.)  
Please consult with TAIYO YUDEN's official sales channel for the details of the product specifications and AEC-Q200 test results, etc.,  
and please review and approve the product specifications before ordering.
- \*1: For standard case size, please kindly refer to Dimension, Thickness, Dimension tolerance, and STANDARD EXTERNAL DIMENSIONS.

## Multilayer Ceramic Capacitors (High dielectric type) for Automotive Powertrain and Safety

## ● 0603TYPE

【Temperature Characteristic B7 : X7R (−55~+125°C), D7 : X7T (−55~+125°C)】 0.3mm Thickness

| New part number      | Old part number<br>(for reference) | Rated voltage<br>[V] | Temperature<br>characteristics | Capacitance<br>[F] | Capacitance tolerance [%] | tan δ<br>[%] | HTLT              | Thickness*1 [mm] | Note |
|----------------------|------------------------------------|----------------------|--------------------------------|--------------------|---------------------------|--------------|-------------------|------------------|------|
|                      |                                    |                      |                                |                    |                           |              | Rated voltage x % |                  |      |
| MAAST063SB7101□FCA01 | TMR063 B7101□P-F                   | 25                   | X7R                            | 100 p              | ±10, ±20                  | 3.5          | 200               | 0.3±0.03         |      |
| MAAST063SB7151□FCA01 | TMR063 B7151□P-F                   | 25                   | X7R                            | 150 p              | ±10, ±20                  | 3.5          | 200               | 0.3±0.03         |      |
| MAAST063SB7221□FCA01 | TMR063 B7221□P-F                   | 25                   | X7R                            | 220 p              | ±10, ±20                  | 3.5          | 200               | 0.3±0.03         |      |
| MAAST063SB7331□FCA01 | TMR063 B7331□P-F                   | 25                   | X7R                            | 330 p              | ±10, ±20                  | 3.5          | 200               | 0.3±0.03         |      |
| MAAST063SB7471□FCA01 | TMR063 B7471□P-F                   | 25                   | X7R                            | 470 p              | ±10, ±20                  | 3.5          | 200               | 0.3±0.03         |      |
| MAAST063SB7102□FCA01 | TMR063 B7102□P-F                   | 25                   | X7R                            | 1000 p             | ±10, ±20                  | 3.5          | 200               | 0.3±0.03         |      |
| MAAST063SB7152□FCA01 | TMR063 B7152□P-F                   | 25                   | X7R                            | 1500 p             | ±10, ±20                  | 5            | 200               | 0.3±0.03         |      |
| MAAST063SB7222□FCA01 | TMR063 B7222□P-F                   | 25                   | X7R                            | 2200 p             | ±10, ±20                  | 5            | 200               | 0.3±0.03         |      |
| MAAST063SB7332□FCA01 | TMR063 B7332□P-F                   | 25                   | X7R                            | 3300 p             | ±10, ±20                  | 5            | 200               | 0.3±0.03         |      |
| MAASE063SB7101□FCA01 | EMR063 B7101□P-F                   | 16                   | X7R                            | 100 p              | ±10, ±20                  | 3.5          | 200               | 0.3±0.03         |      |
| MAASE063SB7151□FCA01 | EMR063 B7151□P-F                   | 16                   | X7R                            | 150 p              | ±10, ±20                  | 3.5          | 200               | 0.3±0.03         |      |
| MAASE063SB7221□FCA01 | EMR063 B7221□P-F                   | 16                   | X7R                            | 220 p              | ±10, ±20                  | 3.5          | 200               | 0.3±0.03         |      |
| MAASE063SB7331□FCA01 | EMR063 B7331□P-F                   | 16                   | X7R                            | 330 p              | ±10, ±20                  | 3.5          | 200               | 0.3±0.03         |      |
| MAASE063SB7471□FCA01 | EMR063 B7471□P-F                   | 16                   | X7R                            | 470 p              | ±10, ±20                  | 3.5          | 200               | 0.3±0.03         |      |
| MAASE063SB7102□FCA01 | EMR063 B7102□P-F                   | 16                   | X7R                            | 1000 p             | ±10, ±20                  | 3.5          | 200               | 0.3±0.03         |      |
| MAASE063SB7152□FCA01 | EMR063 B7152□P-F                   | 16                   | X7R                            | 1500 p             | ±10, ±20                  | 5            | 200               | 0.3±0.03         |      |
| MAASE063SB7222□FCA01 | EMR063 B7222□P-F                   | 16                   | X7R                            | 2200 p             | ±10, ±20                  | 5            | 200               | 0.3±0.03         |      |
| MAASE063SB7332□FCA01 | EMR063 B7332□P-F                   | 16                   | X7R                            | 3300 p             | ±10, ±20                  | 5            | 200               | 0.3±0.03         |      |
| MAASL063SB7101□FCA01 | LMR063 B7101□P-F                   | 10                   | X7R                            | 100 p              | ±10, ±20                  | 3.5          | 200               | 0.3±0.03         |      |
| MAASL063SB7151□FCA01 | LMR063 B7151□P-F                   | 10                   | X7R                            | 150 p              | ±10, ±20                  | 3.5          | 200               | 0.3±0.03         |      |
| MAASL063SB7221□FCA01 | LMR063 B7221□P-F                   | 10                   | X7R                            | 220 p              | ±10, ±20                  | 3.5          | 200               | 0.3±0.03         |      |
| MAASL063SB7331□FCA01 | LMR063 B7331□P-F                   | 10                   | X7R                            | 330 p              | ±10, ±20                  | 3.5          | 200               | 0.3±0.03         |      |
| MAASL063SB7471□FCA01 | LMR063 B7471□P-F                   | 10                   | X7R                            | 470 p              | ±10, ±20                  | 3.5          | 200               | 0.3±0.03         |      |
| MAASL063SB7102□FCA01 | LMR063 B7102□P-F                   | 10                   | X7R                            | 1000 p             | ±10, ±20                  | 3.5          | 200               | 0.3±0.03         |      |
| MAASL063SB7152□FCA01 | LMR063 B7152□P-F                   | 10                   | X7R                            | 1500 p             | ±10, ±20                  | 5            | 200               | 0.3±0.03         |      |
| MAASL063SB7222□FCA01 | LMR063 B7222□P-F                   | 10                   | X7R                            | 2200 p             | ±10, ±20                  | 5            | 200               | 0.3±0.03         |      |
| MAASL063SB7332□FCA01 | LMR063 B7332□P-F                   | 10                   | X7R                            | 3300 p             | ±10, ±20                  | 5            | 200               | 0.3±0.03         |      |
| MAASL063SB7472□FCA01 | LMR063 B7472□P-F                   | 10                   | X7R                            | 4700 p             | ±10, ±20                  | 5            | 200               | 0.3±0.03         |      |
| MAASL063SB7682□FCA01 | LMR063 B7682□P-F                   | 10                   | X7R                            | 6800 p             | ±10, ±20                  | 5            | 200               | 0.3±0.03         |      |
| MAASL063SB7103□FCA01 | LMR063 B7103□P-F                   | 10                   | X7R                            | 0.01 μ             | ±10, ±20                  | 5            | 200               | 0.3±0.03         |      |
| MAASJ063SD7104□FCA01 | JMR063 D7104□P-F                   | 6.3                  | X7T                            | 0.1 μ              | ±10, ±20                  | 10           | 200               | 0.3±0.03         |      |

## PART NUMBER

## 1005TYPE

【Temperature Characteristic B7 : X7R (−55~+125°C), D7 : X7T (−55~+125°C)】 0.5mm Thickness

| New part number      | Old part number<br>(for reference) | Rated voltage<br>[V] | Temperature<br>characteristics | Capacitance<br>[F] | Capacitance tolerance [%] | tan δ<br>[%] | HTLT              | Thickness*1 [mm] | Note |
|----------------------|------------------------------------|----------------------|--------------------------------|--------------------|---------------------------|--------------|-------------------|------------------|------|
|                      |                                    |                      |                                |                    |                           |              | Rated voltage x % |                  |      |
| MAASH105SB7221[FCA01 | HMR105 B7221[V-F                   | 100                  | X7R                            | 220 p              | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASH105SB7331[FCA01 | HMR105 B7331[V-F                   | 100                  | X7R                            | 330 p              | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASH105SB7471[FCA01 | HMR105 B7471[V-F                   | 100                  | X7R                            | 470 p              | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASH105SB7681[FCA01 | HMR105 B7681[V-F                   | 100                  | X7R                            | 680 p              | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASH105SB7102[FCA01 | HMR105 B7102[V-F                   | 100                  | X7R                            | 1000 p             | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASH105SB7152[FCA01 | HMR105 B7152[V-F                   | 100                  | X7R                            | 1500 p             | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASH105SB7222[FCA01 | HMR105 B7222[V-F                   | 100                  | X7R                            | 2200 p             | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASH105SB7332[FCA01 | HMR105 B7332[V-F                   | 100                  | X7R                            | 3300 p             | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASH105SB7472[FCA01 | HMR105 B7472[V-F                   | 100                  | X7R                            | 4700 p             | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASH105SB7682[FCA01 | HMR105 B7682[V-F                   | 100                  | X7R                            | 6800 p             | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASH105SB7103[FCA01 | HMR105 B7103[V-F                   | 100                  | X7R                            | 0.01 μ             | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASU105SB7221[FCA01 | UMR105 B7221[V-F                   | 50                   | X7R                            | 220 p              | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASU105SB7331[FCA01 | UMR105 B7331[V-F                   | 50                   | X7R                            | 330 p              | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASU105SB7471[FCA01 | UMR105 B7471[V-F                   | 50                   | X7R                            | 470 p              | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASU105SB7681[FCA01 | UMR105 B7681[V-F                   | 50                   | X7R                            | 680 p              | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASU105SB7102[FNA01 | UMF105 B7102[VHF                   | 50                   | X7R                            | 1000 p             | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASU105SB7222[FNA01 | UMF105 B7222[VHF                   | 50                   | X7R                            | 2200 p             | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASU105SB7472[FNA01 | UMF105 B7472[VHF                   | 50                   | X7R                            | 4700 p             | ±10, ±20                  | 3.5          | 150               | 0.5±0.05         |      |
| MAASU105SB7103[FNA01 | UMF105 B7103[VHF                   | 50                   | X7R                            | 0.01 μ             | ±10, ±20                  | 3.5          | 150               | 0.5±0.05         |      |
| MAASU105SB7153[FCA01 | UMR105 B7153[V-F                   | 50                   | X7R                            | 0.015 μ            | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASU105SB7223[FCA01 | UMR105 B7223[V-F                   | 50                   | X7R                            | 0.022 μ            | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASU105SB7333[FCA01 | UMR105 B7333[V-F                   | 50                   | X7R                            | 0.033 μ            | ±10, ±20                  | 3.5          | 150               | 0.5±0.05         |      |
| MAASU105SB7473[FCA01 | UMR105 B7473[V-F                   | 50                   | X7R                            | 0.047 μ            | ±10, ±20                  | 3.5          | 150               | 0.5±0.05         |      |
| MAAST105SB7102[FNA01 | TMF105 B7102[VHF                   | 25                   | X7R                            | 1000 p             | ±10, ±20                  | 2.5          | 200               | 0.5±0.05         |      |
| MAAST105SB7223[FNA01 | TMF105 B7223[VHF                   | 25                   | X7R                            | 2200 p             | ±10, ±20                  | 2.5          | 200               | 0.5±0.05         |      |
| MAAST105SB7472[FNA01 | TMF105 B7472[VHF                   | 25                   | X7R                            | 4700 p             | ±10, ±20                  | 2.5          | 200               | 0.5±0.05         |      |
| MAAST105SB7103[FNA01 | TMF105 B7103[VHF                   | 25                   | X7R                            | 0.01 μ             | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAAST105SB7223[FNA01 | TMF105 B7223[VHF                   | 25                   | X7R                            | 0.022 μ            | ±10, ±20                  | 3.5          | 150               | 0.5±0.05         |      |
| MAAST105SB7473[FNA01 | TMF105 B7473[VHF                   | 25                   | X7R                            | 0.047 μ            | ±10, ±20                  | 3.5          | 150               | 0.5±0.05         |      |
| MAASE105SB7102[FNA01 | EMF105 B7102[VHF                   | 16                   | X7R                            | 1000 p             | ±10, ±20                  | 2.5          | 200               | 0.5±0.05         |      |
| MAASE105SB7222[FNA01 | EMF105 B7222[VHF                   | 16                   | X7R                            | 2200 p             | ±10, ±20                  | 2.5          | 200               | 0.5±0.05         |      |
| MAASE105SB7472[FNA01 | EMF105 B7472[VHF                   | 16                   | X7R                            | 4700 p             | ±10, ±20                  | 2.5          | 200               | 0.5±0.05         |      |
| MAASE105SB7103[FNA01 | EMF105 B7103[VHF                   | 16                   | X7R                            | 0.01 μ             | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASE105SB7223[FNA01 | EMF105 B7223[VHF                   | 16                   | X7R                            | 0.022 μ            | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASE105SB7473[FNA01 | EMF105 B7473[VHF                   | 16                   | X7R                            | 0.047 μ            | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASE105SB7104[FNA01 | EMF105 B7104[VHF                   | 16                   | X7R                            | 0.1 μ              | ±10, ±20                  | 5            | 150               | 0.5±0.05         |      |
| MAASE105SB7224[FCA01 | EMR105 B7224[V-F                   | 16                   | X7R                            | 0.22 μ             | ±10, ±20                  | 10           | 150               | 0.5±0.05         |      |
| MAASL105SB7102[FNA01 | LMF105 B7102[VHF                   | 10                   | X7R                            | 1000 p             | ±10, ±20                  | 2.5          | 200               | 0.5±0.05         |      |
| MAASL105SB7222[FNA01 | LMF105 B7222[VHF                   | 10                   | X7R                            | 2200 p             | ±10, ±20                  | 2.5          | 200               | 0.5±0.05         |      |
| MAASL105SB7472[FNA01 | LMF105 B7472[VHF                   | 10                   | X7R                            | 4700 p             | ±10, ±20                  | 2.5          | 200               | 0.5±0.05         |      |
| MAASL105SB7103[FNA01 | LMF105 B7103[VHF                   | 10                   | X7R                            | 0.01 μ             | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASL105SB7223[FNA01 | LMF105 B7223[VHF                   | 10                   | X7R                            | 0.022 μ            | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASL105SB7473[FNA01 | LMF105 B7473[VHF                   | 10                   | X7R                            | 0.047 μ            | ±10, ±20                  | 3.5          | 200               | 0.5±0.05         |      |
| MAASL105SB7104[FNA01 | LMF105 B7104[VHF                   | 10                   | X7R                            | 0.1 μ              | ±10, ±20                  | 5            | 200               | 0.5±0.05         |      |
| MAASL105SB7224[FCA01 | LMR105 B7224[V-F                   | 10                   | X7R                            | 0.22 μ             | ±10, ±20                  | 10           | 150               | 0.5±0.05         |      |
| MAASL105AD7474[FCA01 | LMR105AD7474[V-F                   | 10                   | X7T                            | 0.47 μ             | ±10, ±20                  | 10           | 150               | 0.5±0.1          |      |
| MAASJ105SB7224[FCA01 | JMR105 B7224[V-F                   | 6.3                  | X7R                            | 0.22 μ             | ±10, ±20                  | 10           | 150               | 0.5±0.05         |      |
| MAASJ105AD7474[FCA01 | JMR105AD7474[V-F                   | 6.3                  | X7T                            | 0.47 μ             | ±10, ±20                  | 10           | 150               | 0.5±0.1          |      |
| MAASJ105CD7105[FCA01 | JMR105CD7105[V-F                   | 6.3                  | X7T                            | 1 μ                | ±10, ±20                  | 10           | 150               | 0.5+0.2/-0       |      |
| MAASA105CD7105[FCA01 | AMR105CD7105[V-F                   | 4                    | X7T                            | 1 μ                | ±10, ±20                  | 10           | 200               | 0.5+0.2/-0       |      |

## PART NUMBER

## 1608TYPE

【Temperature Characteristic B7 : X7R(−55~+125°C), C7 : X7S(−55~+125°C)】 0.8mm Thickness

| New part number      | Old part number<br>(for reference) | Rated voltage<br>[V] | Temperature<br>characteristics | Capacitance<br>[F] | Capacitance tolerance [%] | tan δ<br>[%] | HRTL              |  | Thickness*1 [mm] | Note |
|----------------------|------------------------------------|----------------------|--------------------------------|--------------------|---------------------------|--------------|-------------------|--|------------------|------|
|                      |                                    |                      |                                |                    |                           |              | Rated voltage x % |  |                  |      |
| MAASH168SB7102□TCA01 | HMR107 B7102□A-T                   | 100                  | X7R                            | 1000 p             | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASH168SB7152□TCA01 | HMR107 B7152□A-T                   | 100                  | X7R                            | 1500 p             | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASH168SB7222□TCA01 | HMR107 B7222□A-T                   | 100                  | X7R                            | 2200 p             | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASH168SB7332□TCA01 | HMR107 B7332□A-T                   | 100                  | X7R                            | 3300 p             | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASH168SB7472□TCA01 | HMR107 B7472□A-T                   | 100                  | X7R                            | 4700 p             | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASH168SB7682□TCA01 | HMR107 B7682□A-T                   | 100                  | X7R                            | 6800 p             | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASH168SB7103□TCA01 | HMR107 B7103□A-T                   | 100                  | X7R                            | 0.01 μ             | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASH168SB7153□TCA01 | HMR107 B7153□A-T                   | 100                  | X7R                            | 0.015 μ            | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASH168SB7223□TCA01 | HMR107 B7223□A-T                   | 100                  | X7R                            | 0.022 μ            | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASH168SB7333□TCA01 | HMR107 B7333□A-T                   | 100                  | X7R                            | 0.033 μ            | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASH168SB7473□TCA01 | HMR107 B7473□A-T                   | 100                  | X7R                            | 0.047 μ            | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASH168AB7104□TCA01 | HMR107AB7104□A-T                   | 100                  | X7R                            | 0.1 μ              | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASU168SB7223□TNA01 | UMF107 B7223□AHT                   | 50                   | X7R                            | 0.022 μ            | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASU168SB7473□TNA01 | UMF107 B7473□AHT                   | 50                   | X7R                            | 0.047 μ            | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASU168SB7104□TNA01 | UMF107 B7104□AHT                   | 50                   | X7R                            | 0.1 μ              | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASU168AC7224□TCA01 | UMR107AC7224□A-T                   | 50                   | X7R                            | 0.22 μ             | ±10, ±20                  | 3.5          | 200               |  | 0.8+0.15/-0.05   |      |
| MAAST168SB7223□TNA01 | TMF107 B7223□AHT                   | 25                   | X7R                            | 0.022 μ            | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAAST168SB7473□TNA01 | TMF107 B7473□AHT                   | 25                   | X7R                            | 0.047 μ            | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAAST168SB7104□TNA01 | TMF107 B7104□AHT                   | 25                   | X7R                            | 0.1 μ              | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAAST168SB7224□TNA01 | TMF107 B7224□AHT                   | 25                   | X7R                            | 0.22 μ             | ±10, ±20                  | 10           | 150               |  | 0.8±0.10         |      |
| MAAST168SB7474□TNA01 | TMF107 B7474□AHT                   | 25                   | X7R                            | 0.47 μ             | ±10, ±20                  | 10           | 150               |  | 0.8±0.10         |      |
| MAAST168SB7105□TCA01 | TMR107 B7105□A-T                   | 25                   | X7R                            | 1 μ                | ±10, ±20                  | 10           | 150               |  | 0.8±0.10         |      |
| MAASE168SB7223□TNA01 | EMF107 B7223□AHT                   | 16                   | X7R                            | 0.022 μ            | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASE168SB7473□TNA01 | EMF107 B7473□AHT                   | 16                   | X7R                            | 0.047 μ            | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASE168SB7104□TNA01 | EMF107 B7104□AHT                   | 16                   | X7R                            | 0.1 μ              | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASE168SB7224□TNA01 | EMF107 B7224□AHT                   | 16                   | X7R                            | 0.22 μ             | ±10, ±20                  | 5            | 200               |  | 0.8±0.10         |      |
| MAASE168SB7474□TNA01 | EMF107 B7474□AHT                   | 16                   | X7R                            | 0.47 μ             | ±10, ±20                  | 10           | 150               |  | 0.8±0.10         |      |
| MAASE168SB7105□TNA01 | EMF107 B7105□AHT                   | 16                   | X7R                            | 1 μ                | ±10, ±20                  | 10           | 150               |  | 0.8±0.10         |      |
| MAASL168SB7223□TNA01 | LMF107 B7223□AHT                   | 10                   | X7R                            | 0.022 μ            | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASL168SB7473□TNA01 | LMF107 B7473□AHT                   | 10                   | X7R                            | 0.047 μ            | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASL168SB7104□TNA01 | LMF107 B7104□AHT                   | 10                   | X7R                            | 0.1 μ              | ±10, ±20                  | 3.5          | 200               |  | 0.8±0.10         |      |
| MAASL168SB7224□TNA01 | LMF107 B7224□AHT                   | 10                   | X7R                            | 0.22 μ             | ±10, ±20                  | 5            | 200               |  | 0.8±0.10         |      |
| MAASL168SB7474□TNA01 | LMF107 B7474□AHT                   | 10                   | X7R                            | 0.47 μ             | ±10, ±20                  | 10           | 150               |  | 0.8±0.10         |      |
| MAASL168SB7105□TNA01 | LMF107 B7105□AHT                   | 10                   | X7R                            | 1 μ                | ±10, ±20                  | 10           | 150               |  | 0.8±0.10         |      |

## 2012TYPE

【Temperature Characteristic B7 : X7R(−55~+125°C), C7 : X7S(−55~+125°C), D7 : X7T(−55~+125°C)】 1.25mm Thickness

| New part number      | Old part number<br>(for reference) | Rated voltage<br>[V] | Temperature<br>characteristics | Capacitance<br>[F] | Capacitance tolerance [%] | tan δ<br>[%] | HRTL              |  | Thickness*1 [mm] | Note |
|----------------------|------------------------------------|----------------------|--------------------------------|--------------------|---------------------------|--------------|-------------------|--|------------------|------|
|                      |                                    |                      |                                |                    |                           |              | Rated voltage x % |  |                  |      |
| MAASH21GSB7103□TNA01 | HMF212 B7103□GHT                   | 100                  | X7R                            | 0.01 μ             | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAASH21GSB7223□TNA01 | HMF212 B7223□GHT                   | 100                  | X7R                            | 0.022 μ            | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAASH21GSB7473□TNA01 | HMF212 B7473□GHT                   | 100                  | X7R                            | 0.047 μ            | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAASH21GSB7104□TNA01 | HMF212 B7104□GHT                   | 100                  | X7R                            | 0.1 μ              | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAASH21GSB7224□TNA01 | HMF212 B7224□GHT                   | 100                  | X7R                            | 0.22 μ             | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAASH21GAC7474□TCA01 | HMR212AC7474□G-T                   | 100                  | X7S                            | 0.47 μ             | ±10, ±20                  | 3.5          | 150               |  | 1.25+0.15/-0.05  |      |
| MAASH21GCC7105□TCA01 | HMR212CC7105□G-T                   | 100                  | X7S                            | 1 μ                | ±10, ±20                  | 3.5          | 150               |  | 1.25+0.25/-0     |      |
| MAASU21GSB7103□TNA01 | UMF212 B7103□GHT                   | 50                   | X7R                            | 0.01 μ             | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAASU21GSB7223□TNA01 | UMF212 B7223□GHT                   | 50                   | X7R                            | 0.022 μ            | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAASU21GSB7473□TNA01 | UMF212 B7473□GHT                   | 50                   | X7R                            | 0.047 μ            | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAASU21GSB7104□TNA01 | UMF212 B7104□GHT                   | 50                   | X7R                            | 0.1 μ              | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAASU21GSB7224□TNA01 | UMF212 B7224□GHT                   | 50                   | X7R                            | 0.22 μ             | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAASU21GSB7105□TNA01 | UMF212 B7105□GHT                   | 50                   | X7R                            | 1 μ                | ±10, ±20                  | 10           | 150               |  | 1.25±0.10        |      |
| MAAST21GSB7103□TNA01 | TMF212 B7103□GHT                   | 25                   | X7R                            | 0.01 μ             | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAAST21GSB7223□TNA01 | TMF212 B7223□GHT                   | 25                   | X7R                            | 0.022 μ            | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAAST21GSB7473□TNA01 | TMF212 B7473□GHT                   | 25                   | X7R                            | 0.047 μ            | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAAST21GSB7104□TNA01 | TMF212 B7104□GHT                   | 25                   | X7R                            | 0.1 μ              | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAAST21GSB7224□TNA01 | TMF212 B7224□GHT                   | 25                   | X7R                            | 0.22 μ             | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAAST21GSB7474□TNA01 | TMF212 B7474□GHT                   | 25                   | X7R                            | 0.47 μ             | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAAST21GSB7105□TNA01 | TMF212 B7105□GHT                   | 25                   | X7R                            | 1 μ                | ±10, ±20                  | 10           | 200               |  | 1.25±0.10        |      |
| MAAST21GSB7225□TNA01 | TMF212 B7225□GHT                   | 25                   | X7R                            | 2.2 μ              | ±10, ±20                  | 10           | 150               |  | 1.25±0.10        |      |
| MAASE21GSB7473□TNA01 | EMF212 B7473□GHT                   | 16                   | X7R                            | 0.047 μ            | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAASE21GSB7104□TNA01 | EMF212 B7104□GHT                   | 16                   | X7R                            | 0.1 μ              | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAASE21GSB7224□TNA01 | EMF212 B7224□GHT                   | 16                   | X7R                            | 0.22 μ             | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAASE21GSB7474□TNA01 | EMF212 B7474□GHT                   | 16                   | X7R                            | 0.47 μ             | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAASE21GSB7105□TNA01 | EMF212 B7105□GHT                   | 16                   | X7R                            | 1 μ                | ±10, ±20                  | 10           | 200               |  | 1.25±0.10        |      |
| MAASE21GSB7225□TNA01 | EMF212 B7225□GHT                   | 16                   | X7R                            | 2.2 μ              | ±10, ±20                  | 10           | 200               |  | 1.25±0.10        |      |
| MAASE21GAB7475□TNA01 | EMF212AB7475□GHT                   | 16                   | X7R                            | 4.7 μ              | ±10, ±20                  | 10           | 150               |  | 1.25+0.15/-0.05  |      |
| MAASL21GSB7473□TNA01 | LMF212 B7473□GHT                   | 10                   | X7R                            | 0.047 μ            | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAASL21GSB7104□TNA01 | LMF212 B7104□GHT                   | 10                   | X7R                            | 0.1 μ              | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAASL21GSB7224□TNA01 | LMF212 B7224□GHT                   | 10                   | X7R                            | 0.22 μ             | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAASL21GSB7474□TNA01 | LMF212 B7474□GHT                   | 10                   | X7R                            | 0.47 μ             | ±10, ±20                  | 3.5          | 200               |  | 1.25±0.10        |      |
| MAASL21GSB7105□TNA01 | LMF212 B7105□GHT                   | 10                   | X7R                            | 1 μ                | ±10, ±20                  | 10           | 200               |  | 1.25±0.10        |      |
| MAASL21GSB7225□TNA01 | LMF212 B7225□GHT                   | 10                   | X7R                            | 2.2 μ              | ±10, ±20                  | 10           | 200               |  | 1.25±0.10        |      |
| MAASL21GSB7475□TNA01 | LMF212 B7475□GHT                   | 10                   | X7R                            | 4.7 μ              | ±10, ±20                  | 10           | 150               |  | 1.25±0.10        |      |
| MAASL21GBD7106□TCA01 | LMR212BD7106□G-T                   | 10                   | X7T                            | 10 μ               | ±10, ±20                  | 10           | 150               |  | 1.25+0.2/-0      |      |
| MAASJ21GAB7106□TNA01 | JMF212AB7106□GHT                   | 6.3                  | X7R                            | 10 μ               | ±10, ±20                  | 10           | 150               |  | 1.25+0.15/-0.05  |      |

## PART NUMBER

## 3216TYPE

【Temperature Characteristic B7 : X7R(−55~+125°C)】 1.15mm Thickness

| New part number      | Old part number<br>(for reference) | Rated voltage<br>[V] | Temperature<br>characteristics | Capacitance<br>[F] | Capacitance tolerance [%] | tan δ<br>[%] | HTLT              | Thickness*1 [mm] | Note |
|----------------------|------------------------------------|----------------------|--------------------------------|--------------------|---------------------------|--------------|-------------------|------------------|------|
|                      |                                    |                      |                                |                    |                           |              | Rated voltage x % |                  |      |
| MAASH31QHB7102□TNA01 | HMF316 B7102□FHT                   | 100                  | X7R                            | 1000 p             | ±10, ±20                  | 2.5          | 200               | 1.15±0.10        |      |
| MAASH31QHB7222□TNA01 | HMF316 B7222□FHT                   | 100                  | X7R                            | 2200 p             | ±10, ±20                  | 2.5          | 200               | 1.15±0.10        |      |
| MAASH31QHB7472□TNA01 | HMF316 B7472□FHT                   | 100                  | X7R                            | 4700 p             | ±10, ±20                  | 2.5          | 200               | 1.15±0.10        |      |
| MAASH31QHB7103□TNA01 | HMF316 B7103□FHT                   | 100                  | X7R                            | 0.01 μ             | ±10, ±20                  | 2.5          | 200               | 1.15±0.10        |      |
| MAASU31QHB7102□TNA01 | UMF316 B7102□FHT                   | 50                   | X7R                            | 1000 p             | ±10, ±20                  | 2.5          | 200               | 1.15±0.10        |      |
| MAASU31QHB7222□TNA01 | UMF316 B7222□FHT                   | 50                   | X7R                            | 2200 p             | ±10, ±20                  | 2.5          | 200               | 1.15±0.10        |      |
| MAASU31QHB7472□TNA01 | UMF316 B7472□FHT                   | 50                   | X7R                            | 4700 p             | ±10, ±20                  | 2.5          | 200               | 1.15±0.10        |      |
| MAASU31QHB7103□TNA01 | UMF316 B7103□FHT                   | 50                   | X7R                            | 0.01 μ             | ±10, ±20                  | 2.5          | 200               | 1.15±0.10        |      |

【Temperature Characteristic B7 : X7R(−55~+125°C), C7 : X7S(−55~+125°C)】 1.6mm Thickness

| New part number      | Old part number<br>(for reference) | Rated voltage<br>[V] | Temperature<br>characteristics | Capacitance<br>[F] | Capacitance tolerance [%] | tan δ<br>[%] | HTLT              | Thickness*1 [mm] | Note |
|----------------------|------------------------------------|----------------------|--------------------------------|--------------------|---------------------------|--------------|-------------------|------------------|------|
|                      |                                    |                      |                                |                    |                           |              | Rated voltage x % |                  |      |
| MAASH31LSB7104□TNA01 | HMF316 B7104□LHT                   | 100                  | X7R                            | 0.1 μ              | ±10, ±20                  | 3.5          | 200               | 1.6±0.20         |      |
| MAASH31LSB7224□TNA01 | HMF316 B7224□LHT                   | 100                  | X7R                            | 0.22 μ             | ±10, ±20                  | 3.5          | 150               | 1.6±0.20         |      |
| MAASH31LSB7474□TNA01 | HMF316 B7474□LHT                   | 100                  | X7R                            | 0.47 μ             | ±10, ±20                  | 3.5          | 150               | 1.6±0.20         |      |
| MAASH31LBC7225□TCA01 | HMR316BC7225□L-T                   | 100                  | X7S                            | 2.2 μ              | ±10, ±20                  | 3.5          | 150               | 1.6±0.30         |      |
| MAASU31LSB7104□TNA01 | UMF316 B7104□LHT                   | 50                   | X7R                            | 0.1 μ              | ±10, ±20                  | 3.5          | 200               | 1.6±0.20         |      |
| MAASU31LSB7224□TNA01 | UMF316 B7224□LHT                   | 50                   | X7R                            | 0.22 μ             | ±10, ±20                  | 3.5          | 200               | 1.6±0.20         |      |
| MAASU31LSB7474□TNA01 | UMF316 B7474□LHT                   | 50                   | X7R                            | 0.47 μ             | ±10, ±20                  | 3.5          | 200               | 1.6±0.20         |      |
| MAASU31LSB7105□TNA01 | UMF316 B7105□LHT                   | 50                   | X7R                            | 1 μ                | ±10, ±20                  | 3.5          | 150               | 1.6±0.20         |      |
| MAASU31LBC7225□TCA01 | UMR316BC7225□L-T                   | 50                   | X7S                            | 2.2 μ              | ±10, ±20                  | 3.5          | 150               | 1.6±0.30         |      |
| MAASU31LBC7475□TCA01 | UMR316BC7475□L-T                   | 50                   | X7S                            | 4.7 μ              | ±10, ±20                  | 3.5          | 150               | 1.6±0.30         |      |
| MAAST31LSB7104□TNA01 | TMF316 B7104□LHT                   | 25                   | X7R                            | 0.1 μ              | ±10, ±20                  | 3.5          | 200               | 1.6±0.20         |      |
| MAAST31LSB7224□TNA01 | TMF316 B7224□LHT                   | 25                   | X7R                            | 0.22 μ             | ±10, ±20                  | 3.5          | 200               | 1.6±0.20         |      |
| MAAST31LSB7474□TNA01 | TMF316 B7474□LHT                   | 25                   | X7R                            | 0.47 μ             | ±10, ±20                  | 3.5          | 200               | 1.6±0.20         |      |
| MAAST31LSB7105□TNA01 | TMF316 B7105□LHT                   | 25                   | X7R                            | 1 μ                | ±10, ±20                  | 3.5          | 200               | 1.6±0.20         |      |
| MAAST31LSB7225□TNA01 | TMF316 B7225□LHT                   | 25                   | X7R                            | 2.2 μ              | ±10, ±20                  | 3.5          | 200               | 1.6±0.20         |      |
| MAAST31LAB7475□TNA01 | TMF316AB7475□LHT                   | 25                   | X7R                            | 4.7 μ              | ±10, ±20                  | 10           | 150               | 1.6±0.20         |      |
| MAASE31LSB7224□TNA01 | EMF316 B7224□LHT                   | 16                   | X7R                            | 0.22 μ             | ±10, ±20                  | 3.5          | 200               | 1.6±0.20         |      |
| MAASE31LSB7474□TNA01 | EMF316 B7474□LHT                   | 16                   | X7R                            | 0.47 μ             | ±10, ±20                  | 3.5          | 200               | 1.6±0.20         |      |
| MAASE31LSB7105□TNA01 | EMF316 B7105□LHT                   | 16                   | X7R                            | 1 μ                | ±10, ±20                  | 3.5          | 200               | 1.6±0.20         |      |
| MAASE31LSB7225□TNA01 | EMF316 B7225□LHT                   | 16                   | X7R                            | 2.2 μ              | ±10, ±20                  | 3.5          | 200               | 1.6±0.20         |      |
| MAASE31LAB7475□TNA01 | EMF316AB7475□LHT                   | 16                   | X7R                            | 4.7 μ              | ±10, ±20                  | 10           | 200               | 1.6±0.20         |      |
| MAASE31LAB7106□TNA01 | EMF316AB7106□LHT                   | 16                   | X7R                            | 10 μ               | ±10, ±20                  | 10           | 150               | 1.6±0.20         |      |
| MAASL31LSB7224□TNA01 | LMF316 B7224□LHT                   | 10                   | X7R                            | 0.22 μ             | ±10, ±20                  | 3.5          | 200               | 1.6±0.20         |      |
| MAASL31LSB7474□TNA01 | LMF316 B7474□LHT                   | 10                   | X7R                            | 0.47 μ             | ±10, ±20                  | 3.5          | 200               | 1.6±0.20         |      |
| MAASL31LSB7105□TNA01 | LMF316 B7105□LHT                   | 10                   | X7R                            | 1 μ                | ±10, ±20                  | 3.5          | 200               | 1.6±0.20         |      |
| MAASL31LSB7225□TNA01 | LMF316 B7225□LHT                   | 10                   | X7R                            | 2.2 μ              | ±10, ±20                  | 3.5          | 200               | 1.6±0.20         |      |
| MAASL31LAB7475□TNA01 | LMF316AB7475□LHT                   | 10                   | X7R                            | 4.7 μ              | ±10, ±20                  | 10           | 200               | 1.6±0.20         |      |
| MAASL31LAB7106□TNA01 | LMF316AB7106□LHT                   | 10                   | X7R                            | 10 μ               | ±10, ±20                  | 10           | 150               | 1.6±0.20         |      |
| MAASJ31LAB7106□TNA01 | JMF316AB7106□LHT                   | 6.3                  | X7R                            | 10 μ               | ±10, ±20                  | 10           | 200               | 1.6±0.20         |      |

## 3225TYPE

【Temperature Characteristic B7 : X7R(−55~+125°C), C7 : X7S(−55~+125°C)】 2.5mm Thickness

| New part number      | Old part number<br>(for reference) | Rated voltage<br>[V] | Temperature<br>characteristics | Capacitance<br>[F] | Capacitance tolerance [%] | tan δ<br>[%] | HTLT              | Thickness*1 [mm] | Note |
|----------------------|------------------------------------|----------------------|--------------------------------|--------------------|---------------------------|--------------|-------------------|------------------|------|
|                      |                                    |                      |                                |                    |                           |              | Rated voltage x % |                  |      |
| MAASH32MSB7225□PNA01 | HMF325 B7225□MHP                   | 100                  | X7R                            | 2.2 μ              | ±10, ±20                  | 3.5          | 150               | 2.5±0.20         |      |
| MAASH32MAC7475□PCA01 | HMR325AC7475□M-P                   | 100                  | X7S                            | 4.7 μ              | ±10, ±20                  | 3.5          | 150               | 2.5±0.30         |      |
| MAASU32MSB7225□PNA01 | UMF325 B7225□MHP                   | 50                   | X7R                            | 2.2 μ              | ±10, ±20                  | 3.5          | 200               | 2.5±0.20         |      |
| MAASU32MSB7475□PNA01 | UMF325 B7475□MHP                   | 50                   | X7R                            | 4.7 μ              | ±10, ±20                  | 5            | 150               | 2.5±0.20         |      |
| MAASU32MAC7106□PCA01 | UMR325AC7106□M-P                   | 50                   | X7S                            | 10 μ               | ±10, ±20                  | 3.5          | 150               | 2.5±0.30         |      |
| MAAST32MSB7225□PNA01 | TMF325 B7225□MHP                   | 25                   | X7R                            | 2.2 μ              | ±10, ±20                  | 3.5          | 200               | 2.5±0.20         |      |
| MAAST32MSB7475□PNA01 | TMF325 B7475□MHP                   | 25                   | X7R                            | 4.7 μ              | ±10, ±20                  | 5            | 200               | 2.5±0.20         |      |
| MAAST32MSB7106□PNA01 | TMF325 B7106□MHP                   | 25                   | X7R                            | 10 μ               | ±10, ±20                  | 10           | 150               | 2.5±0.20         |      |
| MAASE32MSB7225□PNA01 | EMF325 B7225□MHP                   | 16                   | X7R                            | 2.2 μ              | ±10, ±20                  | 3.5          | 200               | 2.5±0.20         |      |
| MAASE32MSB7475□PNA01 | EMF325 B7475□MHP                   | 16                   | X7R                            | 4.7 μ              | ±10, ±20                  | 5            | 200               | 2.5±0.20         |      |
| MAASE32MSB7106□PNA01 | EMF325 B7106□MHP                   | 16                   | X7R                            | 10 μ               | ±10, ±20                  | 10           | 200               | 2.5±0.20         |      |
| MAASL32MSB7225□PNA01 | LMF325 B7225□MHP                   | 10                   | X7R                            | 2.2 μ              | ±10, ±20                  | 3.5          | 200               | 2.5±0.20         |      |
| MAASL32MSB7475□PNA01 | LMF325 B7475□MHP                   | 10                   | X7R                            | 4.7 μ              | ±10, ±20                  | 5            | 200               | 2.5±0.20         |      |
| MAASL32MSB7106□PNA01 | LMF325 B7106□MHP                   | 10                   | X7R                            | 10 μ               | ±10, ±20                  | 10           | 200               | 2.5±0.20         |      |

## PART NUMBER

## 【Temperature Characteristic B7 : X7R(−55~+125°C)】 1.9mm Thickness

| New part number      | Old part number<br>(for reference) | Rated voltage<br>[V] | Temperature<br>characteristics | Capacitance<br>[F] | Capacitance tolerance [%] | tan δ<br>[%] | HTLT              | Thickness*1 [mm] | Note |
|----------------------|------------------------------------|----------------------|--------------------------------|--------------------|---------------------------|--------------|-------------------|------------------|------|
|                      |                                    |                      |                                |                    |                           |              | Rated voltage x % |                  |      |
| MAASH32NSB7223□TNA01 | HMF325 B7223□NHT                   | 100                  | X7R                            | 0.022 μ            | ±10, ±20                  | 2.5          | 200               | 1.9±0.20         |      |
| MAASH32NSB7473□TNA01 | HMF325 B7473□NHT                   | 100                  | X7R                            | 0.047 μ            | ±10, ±20                  | 2.5          | 200               | 1.9±0.20         |      |
| MAASH32NSB7104□TNA01 | HMF325 B7104□NHT                   | 100                  | X7R                            | 0.1 μ              | ±10, ±20                  | 3.5          | 200               | 1.9±0.20         |      |
| MAASH32NSB7224□TNA01 | HMF325 B7224□NHT                   | 100                  | X7R                            | 0.22 μ             | ±10, ±20                  | 3.5          | 200               | 1.9±0.20         |      |
| MAASU32NSB7223□TNA01 | UMF325 B7223□NHT                   | 50                   | X7R                            | 0.022 μ            | ±10, ±20                  | 2.5          | 200               | 1.9±0.20         |      |
| MAASU32NSB7473□TNA01 | UMF325 B7473□NHT                   | 50                   | X7R                            | 0.047 μ            | ±10, ±20                  | 2.5          | 200               | 1.9±0.20         |      |
| MAASU32NSB7104□TNA01 | UMF325 B7104□NHT                   | 50                   | X7R                            | 0.1 μ              | ±10, ±20                  | 3.5          | 200               | 1.9±0.20         |      |
| MAASU32NSB7224□TNA01 | UMF325 B7224□NHT                   | 50                   | X7R                            | 0.22 μ             | ±10, ±20                  | 3.5          | 200               | 1.9±0.20         |      |
| MAASU32NSB7474□TNA01 | UMF325 B7474□NHT                   | 50                   | X7R                            | 0.47 μ             | ±10, ±20                  | 3.5          | 200               | 1.9±0.20         |      |
| MAASU32NSB7105□TNA01 | UMF325 B7105□NHT                   | 50                   | X7R                            | 1 μ                | ±10, ±20                  | 3.5          | 200               | 1.9±0.20         |      |
| MAAST32NSB7224□TNA01 | TMF325 B7224□NHT                   | 25                   | X7R                            | 0.22 μ             | ±10, ±20                  | 3.5          | 200               | 1.9±0.20         |      |
| MAAST32NSB7474□TNA01 | TMF325 B7474□NHT                   | 25                   | X7R                            | 0.47 μ             | ±10, ±20                  | 3.5          | 200               | 1.9±0.20         |      |
| MAAST32NSB7105□TNA01 | TMF325 B7105□NHT                   | 25                   | X7R                            | 1 μ                | ±10, ±20                  | 3.5          | 200               | 1.9±0.20         |      |
| MAASE32NSB7224□TNA01 | EMF325 B7224□NHT                   | 16                   | X7R                            | 0.22 μ             | ±10, ±20                  | 3.5          | 200               | 1.9±0.20         |      |
| MAASE32NSB7474□TNA01 | EMF325 B7474□NHT                   | 16                   | X7R                            | 0.47 μ             | ±10, ±20                  | 3.5          | 200               | 1.9±0.20         |      |
| MAASE32NSB7105□TNA01 | EMF325 B7105□NHT                   | 16                   | X7R                            | 1 μ                | ±10, ±20                  | 3.5          | 200               | 1.9±0.20         |      |
| MAASL32NSB7224□TNA01 | LMF325 B7224□NHT                   | 10                   | X7R                            | 0.22 μ             | ±10, ±20                  | 3.5          | 200               | 1.9±0.20         |      |
| MAASL32NSB7474□TNA01 | LMF325 B7474□NHT                   | 10                   | X7R                            | 0.47 μ             | ±10, ±20                  | 3.5          | 200               | 1.9±0.20         |      |
| MAASL32NSB7105□TNA01 | LMF325 B7105□NHT                   | 10                   | X7R                            | 1 μ                | ±10, ±20                  | 3.5          | 200               | 1.9±0.20         |      |

# Multilayer Ceramic Capacitors

## PACKAGING

### ① Minimum Quantity

#### ● Taped package

| Type |         |           | Thickness |      | Standard Quantity [pcs]    |                            |
|------|---------|-----------|-----------|------|----------------------------|----------------------------|
| Code | JIS(mm) | EIA(inch) | [mm]      | Code | Paper tape                 | Embossed tape              |
| 02   | 0201    | 008004    | 0.125     | 1    | —                          | 50000                      |
| 04   | 0402    | 01005     | 0.2       | 2    | —                          | 40000                      |
| 06   | 0603    | 0201      | 0.3       | 3    | 15000                      | —                          |
| 1L   | 1005    | 0402      | 0.13      | H    | —                          | 20000                      |
|      |         |           | 0.18      | E    | —                          | 15000                      |
|      |         |           | 0.2       | 2    | 20000                      | —                          |
|      |         |           | 0.3       | 3    | 15000                      | —                          |
| 10   | 1005    | 0402      | 0.5       | 5    | 10000                      | —                          |
|      | 0510 ※  | 0204      | 0.3       | 3    | 10000                      | —                          |
| 16   | 1608    | 0603      | 0.45      | K    | 4000                       | —                          |
|      |         |           | 0.7       | 7    |                            |                            |
|      |         |           | 0.8       | 8    |                            |                            |
|      |         |           | 0.8       | 8    | 3000<br>(Soft Termination) | 3000<br>(Soft Termination) |
|      | 0816 ※  | 0306      | 0.5       | 5    | —                          | 4000                       |
| 21   | 2012    | 0805      | 0.85      | 9    | 4000                       | —                          |
|      |         |           | 1.25      | G    | —                          | 3000                       |
|      |         |           | 1.25      | G    | —                          | 2000<br>(Soft Termination) |
|      | 1220 ※  | 0508      | 0.85      | 9    | 4000                       | —                          |
| 31   | 3216    | 1206      | 0.85      | 9    | 4000                       | —                          |
|      |         |           | 1.15      | Q    | —                          | 3000                       |
|      |         |           | 1.6       | L    | —                          | 2000                       |
| 32   | 3225    | 1210      | 0.85      | 9    | —                          | 2000                       |
|      |         |           | 1.15      | Q    |                            |                            |
|      |         |           | 1.9       | N    |                            |                            |
|      |         |           | 2.0 max   | Y    |                            |                            |
|      |         |           | 2.5       | M    | —                          | 500(T), 1000(P)            |
| 45   | 4532    | 1812      | 2.0 max   | Y    | —                          | 1000                       |
|      |         |           | 2.5       | M    | —                          | 500                        |

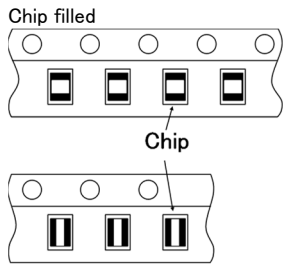
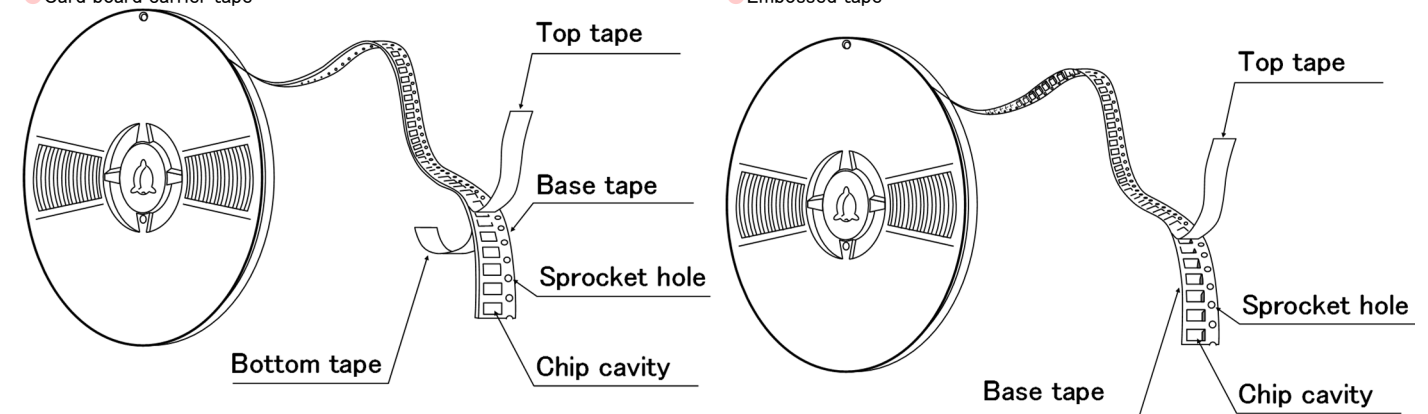
注: ※LW Reverse type (MSRL, MCRL, MBRL, MLRL, MMRL)



## ② Taping material

※ No bottom tape for pressed carrier tape

- Card board carrier tape
- Embossed tape

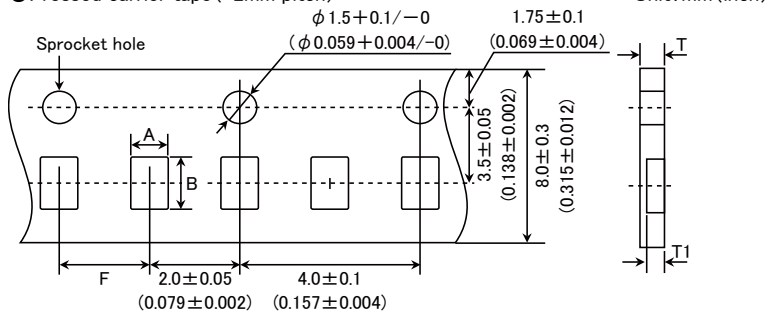


※ LW Reverse type.

## ③ Representative taping dimensions

● Paper Tape (8mm wide)

● Pressed carrier tape ( 2mm pitch)

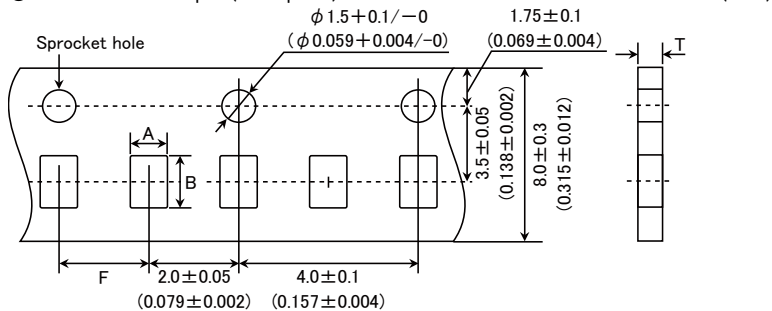


| Type(EIA)          | Chip Cavity |      | Insertion Pitch<br>F | Tape Thickness |          |
|--------------------|-------------|------|----------------------|----------------|----------|
|                    | A           | B    |                      | T              | T1       |
| 0603 (0201)        | 0.37        | 0.67 | 2.0±0.05             | 0.45max.       | 0.42max. |
| 0510 (0204) ※      | 0.65        | 1.15 |                      | 0.4max.        | 0.3max.  |
| 1005 (0402) (*1 2) |             |      |                      | 0.45max.       | 0.42max. |
| 1005 (0402) (*1 3) |             |      |                      |                |          |

Note \*1 Thickness, 2:0.2mm, 3:0.3mm. ※ LW Reverse type.

Unit: mm

● Punched carrier tape (2mm pitch)

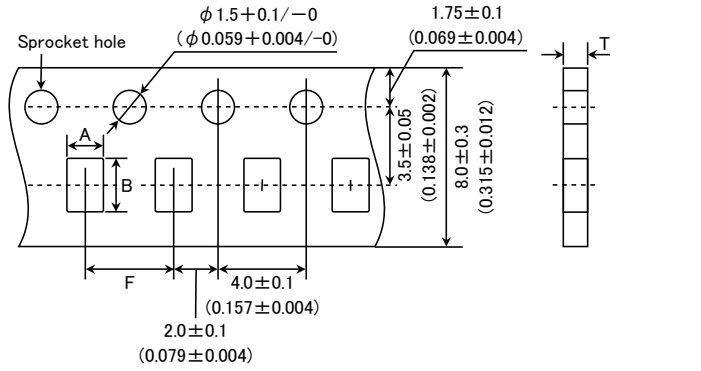


| Type(EIA)   | Chip Cavity |      | Insertion Pitch<br>F | Tape Thickness |
|-------------|-------------|------|----------------------|----------------|
|             | A           | B    |                      | T              |
| 1005 (0402) | 0.65        | 1.15 | 2.0±0.05             | 0.8max.        |

Unit: mm

► 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/>).

● Punched carrier tape (4mm pitch)

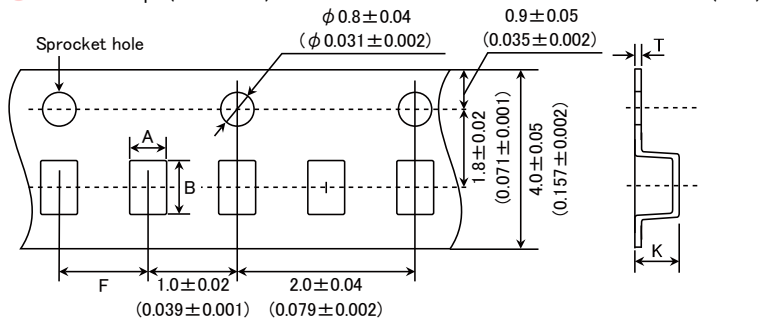


| Type(EIA)     | Chip Cavity |     | Insertion Pitch<br>F | Tape Thickness |         |
|---------------|-------------|-----|----------------------|----------------|---------|
|               | A           | B   |                      | K              | T       |
| 1608 (0603)   | 1.0         | 1.8 | 4.0 ± 0.1            | 1.1max.        | 1.1max. |
| 0816 (0306) ※ |             |     |                      |                |         |
| 2012 (0805)   |             |     |                      |                |         |
| 1220 (0508) ※ | 1.65        | 2.4 | 4.0 ± 0.1            | 1.1max.        | 1.1max. |
| 3216 (1206)   | 2.0         | 3.6 |                      |                |         |

Note: Taping size might be different depending on the size of the product. ※ LW Reverse type.

Unit: mm

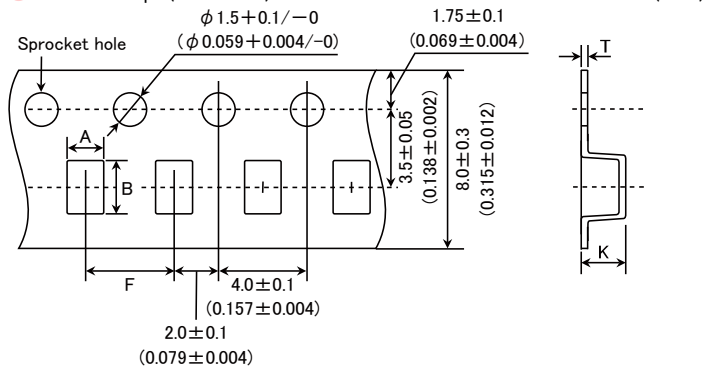
● Embossed tape (4mm wide)



| Type(EIA)     | Chip Cavity |      | Insertion Pitch<br>F | Tape Thickness |          |
|---------------|-------------|------|----------------------|----------------|----------|
|               | A           | B    |                      | K              | T        |
| 0201 (008004) | 0.135       | 0.27 | 1.0 ± 0.02           | 0.5max.        | 0.25max. |
| 0402 (01005)  |             |      |                      |                |          |

Unit: mm

● Embossed tape (8mm wide)



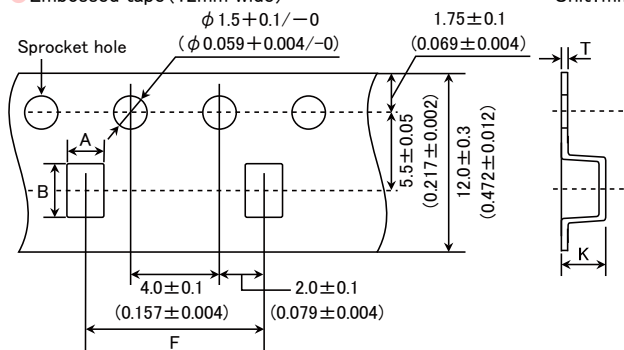
| Type(EIA)     | Chip Cavity |     | Insertion Pitch<br>F | Tape Thickness |            |
|---------------|-------------|-----|----------------------|----------------|------------|
|               | A           | B   |                      | K              | T          |
| 1005 (0402)   | 1.0         | 1.8 | 2.0 ± 0.1            | 0.6max         | 0.2 ± 0.1  |
| 0816 (0306) ※ |             |     |                      |                |            |
| 2012 (0805)   |             |     | 4.0 ± 0.1            | 1.3max.        | 0.25 ± 0.1 |
| 3216 (1206)   |             |     |                      |                |            |
| 3225 (1210)   |             |     |                      |                |            |
| 0816 (0306) ※ | 1.0         | 1.8 | 4.0 ± 0.1            | 3.4max.        | 0.6max.    |
| 2012 (0805)   | 1.65        | 2.4 |                      |                |            |
| 3216 (1206)   | 2.0         | 3.6 |                      |                |            |

Note: ※ LW Reverse type.

Unit: mm

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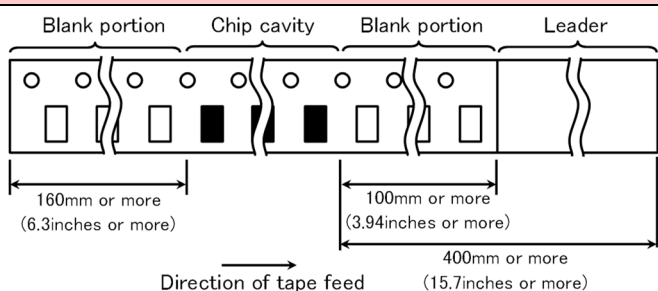
● Embossed tape (12mm wide) Unit: mm (inch)



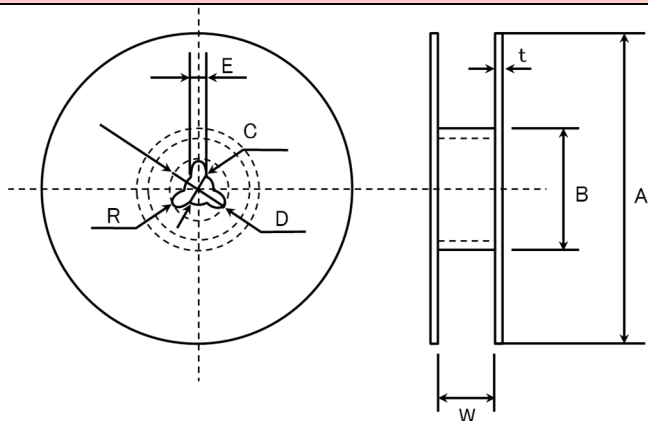
| Type(EIA)   | Chip Cavity |     | Insertion Pitch | Tape Thickness |         |
|-------------|-------------|-----|-----------------|----------------|---------|
|             | A           | B   |                 | K              | T       |
| 3225 (1210) | 3.1         | 4.0 | $8.0 \pm 0.1$   | 4.0max.        | 0.6max. |
| 4532 (1812) | 3.7         | 4.9 | $8.0 \pm 0.1$   | 4.0max.        | 0.6max. |

Unit: mm

④ Trailer and Leader



⑤ Reel size



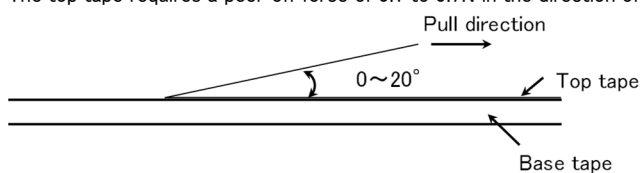
| A                  | B              | C                   | D                   | E             | R   |
|--------------------|----------------|---------------------|---------------------|---------------|-----|
| $\phi 178 \pm 2.0$ | $\phi 50$ min. | $\phi 13.0 \pm 0.2$ | $\phi 21.0 \pm 0.8$ | $2.0 \pm 0.5$ | 1.0 |

|                | T       | W            |
|----------------|---------|--------------|
| 4mm wide tape  | 1.5max. | $5 \pm 1.0$  |
| 8mm wide tape  | 2.5max. | $10 \pm 1.5$ |
| 12mm wide tape | 2.5max. | $14 \pm 1.5$ |

Unit: mm

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.



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# Multilayer Ceramic Capacitors for Automotive Powertrain and Safety

## ■ RELIABILITY DATA

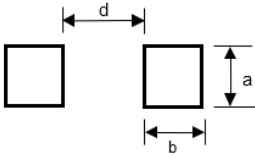
| 1. Operating Temperature Range                         |   |
|--|---|
| Specified Value  | X7R, X7S, X7T (−55°C to +125°C)   |
| Test Methods and Remarks                               | Continuous use is available in this range. (reference temperature : 25°C)   |
| 2. Highest Operating temperature Range                 |   |
| Specified Value  | X7R, X7S, X7T (−55°C to +125°C)   |
| Test Methods and Remarks                               | Maximum operating temperature at which capacitors can be continuously used with rated voltage applied.  |
| 3. Rated Voltage                                       |   |
| Specified Value  | Please refer to the page of the "PART NUMBERS".   |
| Test Methods and Remarks                               | Continuous maximum applied voltage. If an AC voltage is loaded on a DC voltage, the sum of the two peak voltages should be lower than the rated voltage of the capacitor. |
| 4. Shape and Dimensions                                |   |
| Specified Value  | Please refer to the page of the "EXTERNAL DIMENSIONS".  |
| 5. Heat Treatment                                      |   |
| Test Methods and Remarks                               | Initial value shall be measured after test sample is heat-treated at 150+0/−10°C for an hour and kept at room temperature for 24 ± 2 hours.                               |
| 6. Dielectric Withstanding Voltage (between terminals) |   |
| Specified Value  | No abnormality.   |
| Test Methods and Remarks                               | Applied voltage : Rated voltage × 2.5<br>Duration : 1 to 5 seconds.<br>Charging and discharging current shall be 50mA max.  |
| 7. Insulation Resistance                               |   |
| Specified Value<br>Note 1                              | Larger than whichever smaller of 500 MΩ · μF or 10000 MΩ  |
| Test Methods and Remarks                               | Applied voltage : Rated voltage<br>Duration : 60 ± 5 seconds.<br>Charging and discharging current shall be 50mA max.  |
| 8. Capacitance and Tolerance                           |   |
| Specified Value  | ±10% or ±20%  |
| Test Methods and Remarks                               | Measurement frequency : 1kHz ± 10% (C ≤ 10 μF)<br>Measurement voltage : 1 ± 0.2Vrms (C ≤ 10 μF)<br>0.5 ± 0.1V (6.3V rated voltage) Note 1                                 |
| 9. Dissipation factor (tan δ)                          |   |
| Specified Value  | Please refer to the page of the "PART NUMBERS".   |
| Test Methods and Remarks                               | Measurement frequency : 1kHz ± 10% (C ≤ 10 μF)<br>Measurement voltage : 1 ± 0.2Vrms (C ≤ 10 μF)<br>0.5 ± 0.1V (6.3V rated voltage) Note 1                                 |

▶ 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/>).

### 10. Temperature Characteristic (without DC bias)

| Specified Value          | X7R( $\pm 15\%$ ), X7S( $\pm 22\%$ ), X7T(+ 22%/- 33%)   |                               |                 |   |     |   |                               |   |     |   |                               |   |     |
|--------------------------|--|-------------------------------|-----------------|---|-----|---|-------------------------------|---|-----|---|-------------------------------|---|-----|
| Test Methods and Remarks | Heat treatment specified in No.5 of the specification shall be conducted prior to test.<br>Change of the maximum capacitance deviation in step 1 to 5.   |                               |                 |   |     |   |                               |   |     |   |                               |   |     |
|                          | <table border="1"> <thead> <tr> <th>step</th> <th>Temperature(°C)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>+25</td> </tr> <tr> <td>2</td> <td>Minimum operating temperature</td> </tr> <tr> <td>3</td> <td>+25</td> </tr> <tr> <td>4</td> <td>Maximum operating temperature</td> </tr> <tr> <td>5</td> <td>+25</td> </tr> </tbody> </table> | step                          | Temperature(°C) | 1 | +25 | 2 | Minimum operating temperature | 3 | +25 | 4 | Maximum operating temperature | 5 | +25 |
|                          | step   | Temperature(°C)               |                 |   |     |   |                               |   |     |   |                               |   |     |
|                          | 1  | +25                           |                 |   |     |   |                               |   |     |   |                               |   |     |
|                          | 2  | Minimum operating temperature |                 |   |     |   |                               |   |     |   |                               |   |     |
|                          | 3  | +25                           |                 |   |     |   |                               |   |     |   |                               |   |     |
| 4                        | Maximum operating temperature  |                               |                 |   |     |   |                               |   |     |   |                               |   |     |
| 5                        | +25  |                               |                 |   |     |   |                               |   |     |   |                               |   |     |
|                          |  |                               |                 |   |     |   |                               |   |     |   |                               |   |     |
|                          |  |                               |                 |   |     |   |                               |   |     |   |                               |   |     |
|                          |  |                               |                 |   |     |   |                               |   |     |   |                               |   |     |

### 11. Adhesive Force of Terminal Electrodes

| Specified Value          | Appearance: Terminal electrodes shall be no exfoliation or a sign of exfoliation.   |   |           |                       |                       |      |                |    |    |       |      |          |                     |      |      |   |       |                             |     |      |     |     |   |     |      |     |     |     |     |   |     |     |     |     |     |     |  |  |  |
|--------------------------|---|---|-----------|-----------------------|-----------------------|------|----------------|----|----|-------|------|----------|---------------------|------|------|---|-------|-----------------------------|-----|------|-----|-----|---|-----|------|-----|-----|-----|-----|---|-----|-----|-----|-----|-----|-----|--|--|--|
| Test Methods and Remarks | <table border="1"> <thead> <tr> <th></th> <th>0603 size</th> <th>1005 size</th> <th colspan="2">larger than 1608 size</th> </tr> </thead> <tbody> <tr> <td>Applying force</td> <td>2N</td> <td>5N</td> <td colspan="2">17.7N</td> </tr> <tr> <td>Duration</td> <td colspan="4">60<math>\pm</math>1 seconds.</td> </tr> <tr> <td>Board</td> <td colspan="4">Glass epoxy-resin substrate</td> </tr> </tbody> </table> |   | 0603 size | 1005 size             | larger than 1608 size |      | Applying force | 2N | 5N | 17.7N |      | Duration | 60 $\pm$ 1 seconds. |      |      |   | Board | Glass epoxy-resin substrate |     |      |     |     |   |     |      |     |     |     |     |   |     |     |     |     |     |     |  |  |  |
|                          |   | 0603 size   | 1005 size | larger than 1608 size |                       |      |                |    |    |       |      |          |                     |      |      |   |       |                             |     |      |     |     |   |     |      |     |     |     |     |   |     |     |     |     |     |     |  |  |  |
|                          | Applying force  | 2N  | 5N        | 17.7N                 |                       |      |                |    |    |       |      |          |                     |      |      |   |       |                             |     |      |     |     |   |     |      |     |     |     |     |   |     |     |     |     |     |     |  |  |  |
|                          | Duration  | 60 $\pm$ 1 seconds.   |           |                       |                       |      |                |    |    |       |      |          |                     |      |      |   |       |                             |     |      |     |     |   |     |      |     |     |     |     |   |     |     |     |     |     |     |  |  |  |
|                          | Board   | Glass epoxy-resin substrate   |           |                       |                       |      |                |    |    |       |      |          |                     |      |      |   |       |                             |     |      |     |     |   |     |      |     |     |     |     |   |     |     |     |     |     |     |  |  |  |
|                          |   | Solder lands refer to fig.1.  |           |                       |                       |      |                |    |    |       |      |          |                     |      |      |   |       |                             |     |      |     |     |   |     |      |     |     |     |     |   |     |     |     |     |     |     |  |  |  |
|                          |    | <table border="1"> <thead> <tr> <th rowspan="2">Dimension</th> <th colspan="6">Case size</th> </tr> <tr> <th>0603</th> <th>1005</th> <th>1608</th> <th>2012</th> <th>3216</th> <th>3225</th> </tr> </thead> <tbody> <tr> <td>a</td> <td>0.4</td> <td>0.5</td> <td>1.2</td> <td>1.65</td> <td>2.0</td> <td>2.9</td> </tr> <tr> <td>b</td> <td>0.3</td> <td>0.55</td> <td>1.0</td> <td>1.4</td> <td>1.4</td> <td>1.4</td> </tr> <tr> <td>d</td> <td>0.3</td> <td>0.4</td> <td>1.0</td> <td>1.2</td> <td>2.2</td> <td>2.2</td> </tr> </tbody> </table> | Dimension | Case size             |                       |      |                |    |    | 0603  | 1005 | 1608     | 2012                | 3216 | 3225 | a | 0.4   | 0.5                         | 1.2 | 1.65 | 2.0 | 2.9 | b | 0.3 | 0.55 | 1.0 | 1.4 | 1.4 | 1.4 | d | 0.3 | 0.4 | 1.0 | 1.2 | 2.2 | 2.2 |  |  |  |
| Dimension                | Case size   |   |           |                       |                       |      |                |    |    |       |      |          |                     |      |      |   |       |                             |     |      |     |     |   |     |      |     |     |     |     |   |     |     |     |     |     |     |  |  |  |
|                          | 0603  | 1005  | 1608      | 2012                  | 3216                  | 3225 |                |    |    |       |      |          |                     |      |      |   |       |                             |     |      |     |     |   |     |      |     |     |     |     |   |     |     |     |     |     |     |  |  |  |
| a                        | 0.4   | 0.5   | 1.2       | 1.65                  | 2.0                   | 2.9  |                |    |    |       |      |          |                     |      |      |   |       |                             |     |      |     |     |   |     |      |     |     |     |     |   |     |     |     |     |     |     |  |  |  |
| b                        | 0.3   | 0.55  | 1.0       | 1.4                   | 1.4                   | 1.4  |                |    |    |       |      |          |                     |      |      |   |       |                             |     |      |     |     |   |     |      |     |     |     |     |   |     |     |     |     |     |     |  |  |  |
| d                        | 0.3   | 0.4   | 1.0       | 1.2                   | 2.2                   | 2.2  |                |    |    |       |      |          |                     |      |      |   |       |                             |     |      |     |     |   |     |      |     |     |     |     |   |     |     |     |     |     |     |  |  |  |
|                          | Fig.1   |   |           |                       |                       |      |                |    |    |       |      |          |                     |      |      |   |       |                             |     |      |     |     |   |     |      |     |     |     |     |   |     |     |     |     |     |     |  |  |  |

### 12. Vibration

|                          |   |
|--------------------------|---|
| Specified Value          | Appearance : No abnormality<br>Capacitance change : Initial value shall be satisfied.<br>Dissipation factor : Initial value shall be satisfied.<br>Insulation resistance : Initial value shall be satisfied.  |
| Test Methods and Remarks | Heat treatment specified in No.5 of the specification shall be conducted prior to test.<br>Solder lands refer to figure 1.<br>Direction of the vibration test : X, Y, Z each of 3 orientations for 12 times respectively (Total 36 times)<br>Vibration frequency : 10 to 2000 to 10Hz (20 minutes each)<br>Total amplitude : 1.5 mm<br>Measurement shall be performed after test sample following the test is heated at 150+0/-10°C for an hour and kept at room temperature for 24 $\pm$ 2 hrs. No.5 |

### 13. Solderability

|                          |  |
|--------------------------|--|
| Specified Value          | More than 95% of terminal electrode shall be covered with fresh solder.  |
| Test Methods and Remarks | Immerse test sample in an solder solution (Sn-3Ag-0.5Cu).<br>Soldering temperature : 245°C $\pm$ 3°C<br>Duration : 3 $\pm$ 1 seconds |

### 14. Resistance to Soldering Heat

|                          |  |
|--------------------------|--|
| Specified Value Note 1   | Appearance : No abnormality<br>Capacitance change : $\leq \pm 7.5\%$<br>Dissipation factor : Initial value shall be satisfied.<br>Insulation resistance : Initial value shall be satisfied.<br>Dielectric withstanding voltage (between terminals) : No abnormality  |
| Test Methods and Remarks | Heat treatment specified in No.5 of the specification shall be conducted prior to test.<br>Immerse test sample in an solder solution (Sn-3Ag-0.5Cu).<br>Soldering temperature : 260°C $\pm$ 5°C<br>Duration : 10 $\pm$ 1 seconds<br>Soaking position : Test sample is soaked until the terminal electrode is covered in solder solution.<br>Measurement shall be performed after test sample following the test is heated at 150+0/-10°C for an hour and kept at room temperature for 24 $\pm$ 2 hrs. No.5 |

### 15. Temperature Cycling

| Specified Value<br>Note 1   | Appearance : No abnormality<br>Capacitance change : $\leq \pm 7.5\%$<br>Dissipation factor : Initial value shall be satisfied.<br>Insulation resistance : Initial value shall be satisfied.  |             |                  |             |   |                           |      |   |     |        |   |                           |      |   |     |        |
|-----------------------------|--|-------------|------------------|-------------|---|---------------------------|------|---|-----|--------|---|---------------------------|------|---|-----|--------|
| Test Methods<br>and Remarks | Heat treatment specified in No.5 of the specification shall be conducted prior to test.<br>condition of the one cycle<br><table border="1"> <thead> <tr> <th>Step</th> <th>Temperature (°C)</th> <th>Time (min.)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Minimum usage temperature</td> <td>30±3</td> </tr> <tr> <td>2</td> <td>+25</td> <td>2 to 3</td> </tr> <tr> <td>3</td> <td>Maximum usage temperature</td> <td>30±3</td> </tr> <tr> <td>4</td> <td>+25</td> <td>2 to 3</td> </tr> </tbody> </table> <p>Test cycles: 1000 times<br/>Solder lands refer to fig. 2.<br/>Measurement shall be performed after test sample following the test is heated at 150+0/-10°C for an hour and kept at room temperature for 24±2 hrs. No.5</p> | Step        | Temperature (°C) | Time (min.) | 1 | Minimum usage temperature | 30±3 | 2 | +25 | 2 to 3 | 3 | Maximum usage temperature | 30±3 | 4 | +25 | 2 to 3 |
| Step                        | Temperature (°C)   | Time (min.) |                  |             |   |                           |      |   |     |        |   |                           |      |   |     |        |
| 1                           | Minimum usage temperature  | 30±3        |                  |             |   |                           |      |   |     |        |   |                           |      |   |     |        |
| 2                           | +25  | 2 to 3      |                  |             |   |                           |      |   |     |        |   |                           |      |   |     |        |
| 3                           | Maximum usage temperature  | 30±3        |                  |             |   |                           |      |   |     |        |   |                           |      |   |     |        |
| 4                           | +25  | 2 to 3      |                  |             |   |                           |      |   |     |        |   |                           |      |   |     |        |

### 16. High Temperature Loading

|                             |  |
|-----------------------------|--|
| Specified Value<br>Note1    | Appearance : No abnormality<br>Capacitance change : $\leq \pm 12.5\%$<br>Dissipation factor : 5.0%max.<br>Insulation resistance : Larger than whichever smaller of 50MΩ · μF or 1000MΩ   |
| Test Methods<br>and Remarks | Heat treatment specified in No.5 of the specification shall be conducted prior to test.<br>Temperature : Maximum usage temperature<br>Duration : 1000 +48/-0 hours.<br>Applied voltage : Applied rated voltage.<br>Charging and discharging current : 50mA max<br>Measurement shall be performed after test sample following the test is heated at 150+0/-10°C for an hour and kept at room temperature for 24±2 hrs. No.5 |

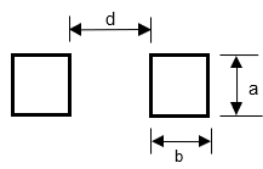
### 17. Humidity Loading

|                             |   |
|-----------------------------|---|
| Specified Value<br>Note1    | Appearance : No abnormality<br>Capacitance change : $\leq \pm 12.5\%$<br>Dissipation factor : 5.0%max.<br>Insulation resistance : Larger than whichever smaller of 25MΩ · μF or 500MΩ   |
| Test Methods<br>and Remarks | Heat treatment specified in No.5 of the specification shall be conducted prior to test.<br>Temperature : 85°C<br>Humidity : 85%RH<br>Duration : 1000 +48/-0 hours.<br>Applied voltage : Applied rated voltage. (Add 100kΩ resistor)<br>Measurement shall be performed after test sample following the test is heated at 150+0/-10°C for an hour and kept at room temperature for 24±2 hrs. No.5 |

**18. Resistance to Flexure of substrate**

|                           |                       |                                     |
|---------------------------|-----------------------|-------------------------------------|
| Specified Value<br>Note 1 | Appearance            | : No abnormality                    |
|                           | Capacitance change    | : $\leq \pm 7.5\%$                  |
|                           | Dissipation factor    | : Initial value shall be satisfied. |
|                           | Insulation resistance | : Initial value shall be satisfied. |

|                             |                             |                                 |
|-----------------------------|-----------------------------|---------------------------------|
| Test Methods<br>and Remarks | Warp                        | : 2mm for 60 seconds            |
|                             | Testing board               | : Grass epoxy - resin substrate |
|                             | Test board and solder lands | : Refer to fig. 2 and fig.3.    |



| Dimension | Case size |      |      |      |      |      |
|-----------|-----------|------|------|------|------|------|
|           | 0603      | 1005 | 1608 | 2012 | 3216 | 3225 |
| a         | 0.3       | 0.5  | 0.9  | 1.3  | 1.7  | 2.6  |
| b         | 0.3       | 0.55 | 0.8  | 1.1  | 1.2  | 1.2  |
| d         | 0.3       | 0.4  | 0.6  | 0.8  | 2.0  | 2.0  |
| t         | 0.8       | 1.6  |      |      |      |      |

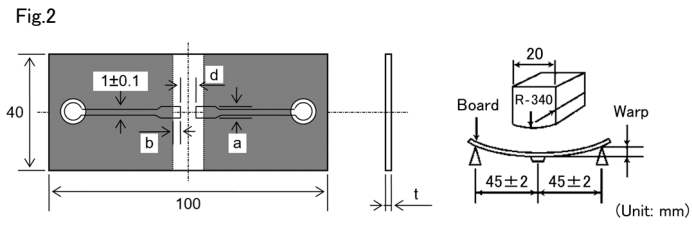


Fig.3 Capacitance measurement shall be conducted with the board bent.

**19. High Temperature Exposure**

|                          |                       |                                     |
|--------------------------|-----------------------|-------------------------------------|
| Specified Value<br>Note1 | Appearance            | : No abnormality                    |
|                          | Capacitance change    | : $\leq \pm 7.5\%$                  |
|                          | Dissipation factor    | : Initial value shall be satisfied. |
|                          | Insulation resistance | : Initial value shall be satisfied. |

|                             |  |                             |
|-----------------------------|--|-----------------------------|
| Test Methods<br>and Remarks | Heat treatment specified in No.5 of the specification shall be conducted prior to test.  |                             |
|                             | Temperature  | : Maximum usage temperature |
|                             | Duration   | : 1000+48/-0 hours.         |
|                             | Measurement shall be performed after test sample following the test is heated at 150+0/-10°C for an hour and kept at room temperature for 24±2 hrs. No.5 |                             |

**20. Resistance to Solvents**

|                          |                       |                                    |
|--------------------------|-----------------------|------------------------------------|
| Specified Value<br>Note1 | Appearance            | : No abnormality                   |
|                          | Capacitance change    | : $\leq \pm 7.5\%$                 |
|                          | Dissipation factor    | : Initial value shall be satisfied |
|                          | Insulation resistance | : Initial value shall be satisfied |

|                             |  |  |
|-----------------------------|--|--|
| Test Methods<br>and Remarks | Heat treatment specified in No.5 of the specification shall be conducted prior to test.  |  |
|                             | Add Aqueous wash chemical OKEMCLEAN (A 6% concentrated Oakite cleaner) or equivalent.  |  |
|                             | Measurement shall be performed after test sample following the test is heated at 150+0/-10°C for an hour and kept at room temperature for 24±2 hrs. No.5 |  |

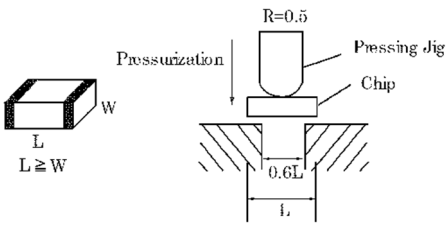
**21. Mechanical Shock**

|                           |                       |                                    |
|---------------------------|-----------------------|------------------------------------|
| Specified Value<br>Note 1 | Appearance            | : No abnormality                   |
|                           | Capacitance change    | : $\leq \pm 7.5\%$                 |
|                           | Dissipation factor    | : Initial value shall be satisfied |
|                           | Insulation resistance | : Initial value shall be satisfied |

|  |  |  |
|--|--|--|
| Test Methods<br>and Remarks  | Heat treatment specified in No5 of the specification shall be conducted prior to test.                                 |  |
|  | Three shocks in each direction should be applied along 3 mutually perpendicular axes of the test specimen (18 shocks). |  |
|  | Peak value: 1500g  |  |
|  | Duration: 0.5ms  |  |
|  | Test pulse: Half-sine  |  |
|  | Velocity change: 4.7m/s.   |  |
| Measurement shall be performed after test sample following the test is heated at 150+0/-10°C for an hour and kept at room temperature for 24±2 hrs. No.5 |  |  |

► 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/>).

| 22. ESD                     |   |
|-----------------------------|---|
| Specified Value<br>Note 1   | Appearance: No abnormality<br>Insulation resistance: Initial value shall be satisfied   |
| Test Methods and<br>Remarks | Heat treatment specified in No.5 of the specification shall be conducted prior to test.<br>Per AEC-Q200-002<br>Measurement shall be performed after test sample following the test is heated at 150+0/-10°C for an hour and kept at room temperature for 24±2 hrs. No.5 |

| 23. Beam Load Test          |   |
|-----------------------------|---|
| Specified Value             | 2N min (0603 size)<br>8N min (1005 size min)  |
| Test Methods and<br>Remarks | Per AEC-Q200-003<br> |

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



# Multilayer Ceramic Capacitors

## PRECAUTIONS

### 1. Circuit Design

- Precautions**
- ◆ 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

- Precautions**
- ◆ 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.

**Technical considerations**

- ◆ Pattern configurations (Design of Land-patterns)
 

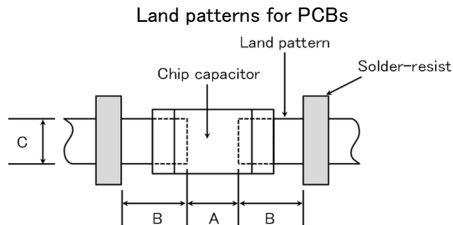
The following diagrams and tables show some examples of recommended land patterns to prevent excessive solder amounts.

(1) Recommended land dimensions for typical chip capacitors

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

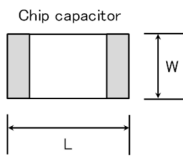
**Wave-soldering**

| Type | 1608       | 2012       | 3216       | 3225       |     |
|------|------------|------------|------------|------------|-----|
| Size | L          | 1.6        | 2.0        | 3.2        | 3.2 |
|      | W          | 0.8        | 1.25       | 1.6        | 2.5 |
| 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**

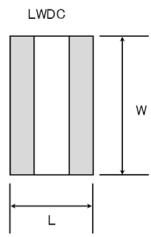
| Type | 0201        | 0402      | 0603      | 1005      | 1608    | 2012    | 3216    | 3225    | 4532    |
|------|-------------|-----------|-----------|-----------|---------|---------|---------|---------|---------|
| Size | L           | 0.25      | 0.4       | 0.6       | 1.0     | 1.6     | 2.0     | 3.2     | 4.5     |
|      | W           | 0.125     | 0.2       | 0.3       | 0.5     | 0.8     | 1.25    | 1.6     | 3.2     |
| A    | 0.095~0.135 | 0.15~0.25 | 0.20~0.30 | 0.45~0.55 | 0.6~0.8 | 0.8~1.2 | 1.8~2.5 | 1.8~2.5 | 2.5~3.5 |
| B    | 0.085~0.125 | 0.10~0.20 | 0.20~0.30 | 0.40~0.50 | 0.6~0.8 | 0.8~1.2 | 1.0~1.5 | 1.0~1.5 | 1.5~1.8 |
| C    | 0.110~0.150 | 0.15~0.30 | 0.25~0.40 | 0.45~0.55 | 0.6~0.8 | 0.9~1.6 | 1.2~2.0 | 1.8~3.2 | 2.3~3.5 |



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

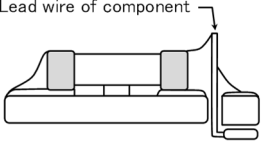
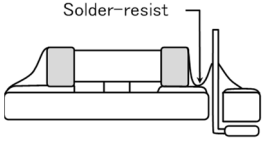
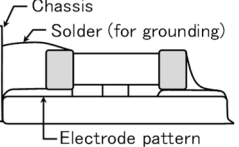
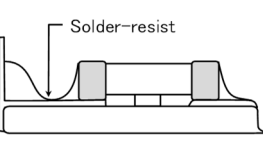
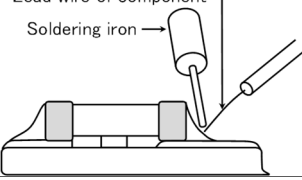
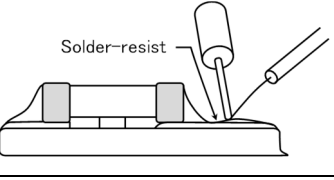
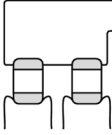
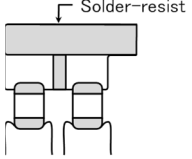
  - LWDC: Recommended land dimensions for reflow-soldering (unit: mm)

| Type | 0510      | 0816     | 1220    |      |
|------|-----------|----------|---------|------|
| Size | L         | 0.52     | 0.8     | 1.25 |
|      | W         | 1.0      | 1.6     | 2.0  |
| A    | 0.18~0.22 | 0.25~0.3 | 0.5~0.7 |      |
| B    | 0.2~0.25  | 0.3~0.4  | 0.4~0.5 |      |
| C    | 0.9~1.1   | 1.5~1.7  | 1.9~2.1 |      |



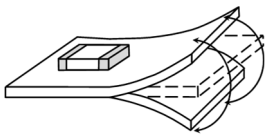
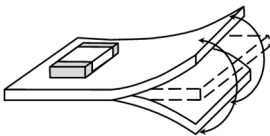
\* This catalog contains the typical specification only due to the limitation of space. When you consider the purchase of our products, please check our specification. For details of each product (characteristics graph, reliability information, precautions for use, and so on), see our Web site (<http://www.ty-top.com/>).

(2) Examples of good and bad solder application

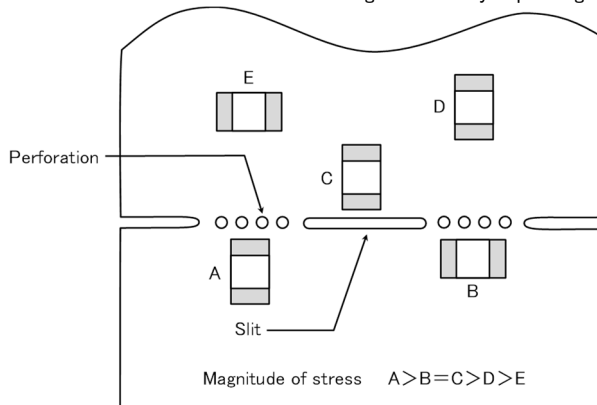
| Item  | Not recommended   | Recommended   |
|---|---|---|
| Mixed mounting of SMD and leaded components                 |  |  |
| Component placement close to the chassis                    |  |  |
| Hand-soldering of leaded components near mounted components |  |  |
| Horizontal component placement                              |  |  |

◆ 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 |  |  Place the product at a right angle to the direction of the anticipated mechanical stress. |

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

Precautions

◆ Adjustment of mounting machine

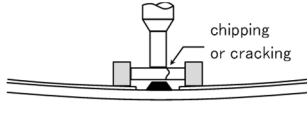
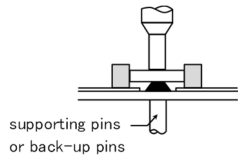
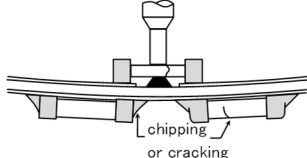
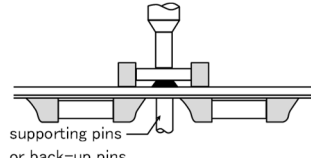
- When capacitors are mounted on PCB, excessive impact load shall not be imposed on them.
- Maintenance and inspection of mounting machines shall be conducted periodically.

◆ 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.
  - (1) The bottom dead center of the pick-up nozzle shall be adjusted to the surface level of PCB without the board deflection.
  - (2) 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:

| Item                  | Improper method   | Proper method   |
|-----------------------|---|---|
| Single-sided mounting |  |  |
| Double-sided mounting |  |  |

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.

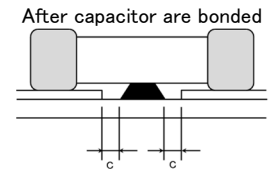
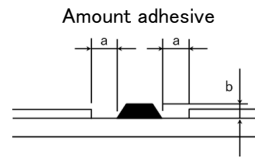
◆ Selection of Adhesives

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
  - a. The adhesive shall be strong enough to hold parts on the board during the mounting & solder process.
  - b. The adhesive shall have sufficient strength at high temperatures.
  - c. The adhesive shall have good coating and thickness consistency.
  - d. The adhesive shall be used during its prescribed shelf life.
  - e. The adhesive shall harden rapidly.
  - f. The adhesive shall have corrosion resistance.
  - g. The adhesive shall have excellent insulation characteristics.
  - h. 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 | 2012/3216 case sizes as examples |
|--------|----------------------------------|
| a      | 0.3mm min                        |
| b      | 100 to 120 μm                    |
| c      | Adhesives shall not contact land |



4. Soldering

◆ 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.

Precautions

◆ 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

Technical considerations

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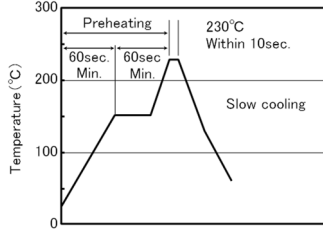
and the capability of the machines used shall also be considered carefully when water-soluble flux is used.

◆Soldering

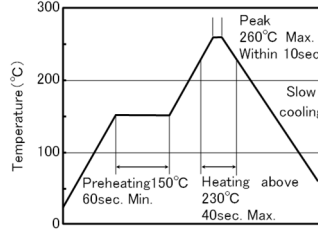
- Ceramic chip capacitors are susceptible to thermal shock when exposed to rapid or concentrated heating or rapid cooling.
- Therefore, the soldering must be conducted with great care so as to prevent malfunction of the components due to excessive thermal shock.
- Preheating : Capacitors shall be preheated sufficiently, and the temperature difference between the capacitors and solder shall be within 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】

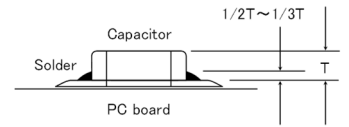


【Recommended condition for Pb-free soldering】



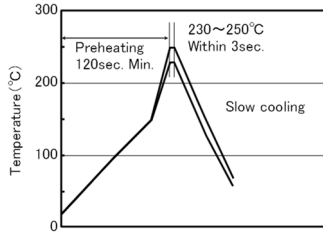
Caution

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

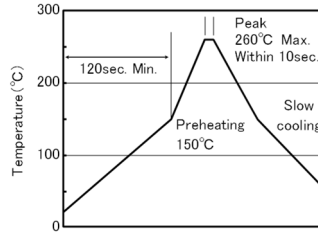


[Wave soldering]

【Recommended conditions for eutectic soldering】



【Recommended condition for Pb-free soldering】

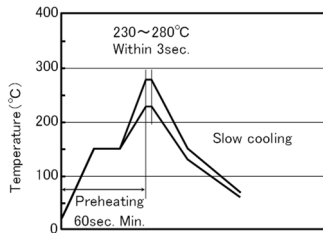


Caution

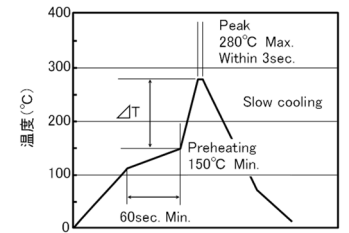
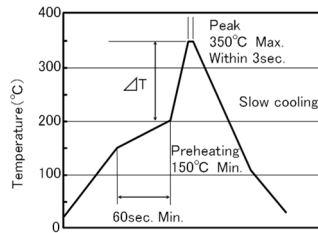
- ①Wave soldering must not be applied to capacitors designated as for reflow soldering only. soldering for 1 times.

[Hand soldering]

【Recommended conditions for eutectic soldering】



【Recommended condition for Pb-free soldering】



|                  |                                     |
|------------------|-------------------------------------|
|                  | $\Delta T$                          |
| 3216type or less | $\Delta T \leq 150^{\circ}\text{C}$ |

|                  |                                     |
|------------------|-------------------------------------|
|                  | $\Delta T$                          |
| 3225type or more | $\Delta T \leq 130^{\circ}\text{C}$ |

Caution

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

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| 5. Cleaning              |   |
|--------------------------|---|
| Precautions              | <p>◆Cleaning conditions</p> <ol style="list-style-type: none"> <li>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>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> </ol>  |
| Technical considerations | <ol style="list-style-type: none"> <li>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>Inappropriate cleaning conditions (insufficient or excessive cleaning) may adversely affect the performance of the capacitors. 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      Ultrasonic frequency : 40 kHz or less<br/>           Ultrasonic washing period : 5 min. or less</li> </ol> |

| 6. Resin coating and mold |  |
|---------------------------|--|
| Precautions               | <ol style="list-style-type: none"> <li>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>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> </ol> |

| 7. Handling |   |
|-------------|---|
| Precautions | <p>◆Splitting of PCB</p> <ol style="list-style-type: none"> <li>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>Board separation shall not be done manually, but by using the appropriate devices.</li> </ol> <p>◆Mechanical considerations</p> <p>Be careful not to subject capacitors to excessive mechanical shocks.</p> <ol style="list-style-type: none"> <li>If ceramic capacitors are dropped onto a floor or a hard surface, they shall not be used.</li> <li>Please be careful that the mounted components do not come in contact with or bump against other boards or components.</li> </ol> |

| 8. Storage conditions    |  |
|--------------------------|--|
| Precautions              | <p>◆Storage</p> <ol style="list-style-type: none"> <li>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<br/>               Ambient temperature : Below 30°C      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>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> </ol> |
| Technical considerations | <p>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.</p>  |

※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.